Conference proceedings of the Design Management Academy
Research Perspectives on Creative Intersections

edited by
Erik Bohemia
Cees de Bont
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Volume 1

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The conference general theme \textit{Research Perspectives on Creative Intersections} captured the overall conference spirit. It also reflects the conference planning and organisational processes which involved the community of international scholars located in different institutions, faculties, schools and departments.

The interdisciplinary nature of the conference enabled active intersections of scholars from the fields of design, social sciences and business studies. The mingling of researchers from diverse disciplines reflects the need for interdisciplinary approaches to research complex issues related to innovation.

The intersection between emerging and established researchers was an intended aspect of the conference. The reason was that today’s PhD candidates will drive the future research. The conference succeeded by attracting significant number of PhD candidates who represented a third of the conference delegates. This provides a good indication for the future growth research related to design innovation.

Altogether, 295 authors have submitted: 140 full papers and 31 workshop proposals. These numbers indicate that a single authored research is no longer the norm. The intersection which stems from collaboration amongst researchers to undertake and disseminate research is now becoming the established practice within the design innovation research.

The 19 conference tracks, for which the papers were submitted, were organised within 7 overarching themes (see Table 1). The track facilitators ultimately shaped the overall conference scope and direction. The tracks’ topics acted as the focal points for the overall Call for Papers. Thus, our thanks you go to all the 69 tracks’ facilitators. It was them who collectively were responsible for the conference programme and we would like to thank them for their valuable services on the International Scientific Programme Committee.
We would like to also thank the over 150 expert reviewers who provided their valuable time to provide critical peer feedback. Their service on the International Board of Reviewers was invaluable as the good quality peer reviews provided a vital contribution to this international conference. Each reviewer scored papers on a scale of 0 to 10 and provided critical review comments.

Most papers were reviewed by two people, though some had three or even four reviewers, and in a very small number of cases only one review was submitted. Total number of submitted full papers was 140. After the blind peer review process 66 papers (47%) were accepted and 49 (35%) papers were provisionally accepted as these needed major revisions, and 25 (19%) papers were rejected.

In making the final decisions about papers, the Review Committee first looked at all papers where the difference of opinion between reviewers was 4 points or greater and moderated the scores if necessary. The Review Committee then discussed all papers that were just under the general level of acceptance to determine outcomes, before finally looking at any exceptions.
At the end of the review process 103 (73%) paper submissions were accepted for presentations of which 95 (68%) were included in the proceedings and 38 (27%) papers were rejected. Seven accepted papers were presented at the conference as research in progress and they were not included in the proceedings.

The workshops provided another intersection on how delegates and workshop facilitators interacted. Altogether, 31 workshop proposals were submitted and 17 (54%) workshops were accepted by the International Workshop Organising Committee. We would like to thank the International Workshop Organising Committee members: Katinka Bergema, Nuša Fain, Oriana Haselwanter, Sylvia Xihui Liu, Ida Telalbasic and Sharon Prendeville for providing their expertise.

We would like to thank both keynote speakers, Professor Jeanne Liedtka and Mr Richard Kelly, who generously gave their time to share their insights with the conference delegates. Their generosity allowed us to offer bursaries to five emerging researchers to attend the conference. The bursar recipients were selected from close to 40 applicants. The number of applicants indicates the need to setup funding schemes to allow emerging researchers to attend international events such as this conference.

The PhD Seminar event which took place a day prior to the conference was attended by over 100 delegates. The PhD Seminar was chaired by Dr Sylvia Xihui Liu and Professor Jun Cai. Initially 40 submissions were received of which 36 were presented at the event. The event culminated with a debate organised by the PhD students who were inspired by the “Open Letter to the Design Community: Stand Up for Democracy” by Manzini and Margolin (2017). We are grateful to the debate organisers.

The location of the conference in the Jockey Club Innovation Tower designed by Zaha Hadid at the Hong Kong Polytechnic University has also provided delegates with visible cultural intersections of a rapidly transitioning major interconnected global city from one political sphere of influence into another. The conference would not have happened without the solid work provided by the local organising team which was led by Professor Cees de Bont and consisted of: Ms Rennie Kan who took up the role of the fixer; Mr Pierre Tam who in his role as the Conference Secretary tirelessly worked on satisfying at many times conflicting requirement; Ms Flora Chang who checked and checked again all delegates registrations; Mr Rio Chan wizard of IT and Mr Jason Liu who provided the visual direction for the conference.

The Design Management Academy’s international research conference was organised under the auspices of the Design Society’s Design Management Special Interest Group (DeMSIG) and Design Research Society’s Design Innovation Management Special Interest Group (DIMSIG) in collaboration with: The Hong Kong Polytechnic University, Loughborough University, Tsinghua University, University of Strathclyde, Politecnico di Milano and Delft University of Technology. The conference was a culmination of two years of planning and the 2019 conference planning commenced well before the 2017 conference programme schedule was finalised. It is a hope that the conference will act as a platform to build a diverse community of scholars who are interested to explore and discuss design innovation practices.
Reference

About the Editors

Cees de Bont is dean of School of Design, Hong Kong Polytechnic University. His research interests are in the areas of early concept testing of consumer acceptance, branding, networked innovation and design education.

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Keynote: Beyond Better Solutions: Design Thinking as a Social Technology

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The value delivered by design thinking is almost always seen to be improvements in the creativity and usefulness of the solutions produced. This paper takes a broader view of the potential power of design thinking, highlighting its role as a social technology for enhancing the productivity of conversations for change across difference. Examined through this lens, design thinking can be observed to aid diverse sets of stakeholders’ abilities to work together to both produce higher order, more innovative solutions and to implement them more successfully. In this way, it acts as a facilitator of the processes of collectives, by enhancing their ability to learn, align and change together. This paper draws on both the author’s extensive field research on the use of design thinking in social sector organizations, as well as on the literature of complex social systems, to discuss implications for both practitioners and scholars interested in assessing the impact of design thinking on organizational performance.

Introduction
One of the central themes in both practitioner and scholarly conversations today, across disciplines, is the acceleration of the complexity and uncertainty that organizations face, and the premium this places on creativity and innovation. Across virtually all sectors of the economy, there is a sense that organizations need to change in fundamental ways if they are to successfully adapt. In design, we talk about “wicked” problems, biologists talk of complex adaptive systems, behavioural economists focus on evolutionary growth theory; behind all of these differences in nomenclature lies a widespread suspicion that the mechanisms that ensured survival and indeed prosperity in a stable and predictable world - ones based largely on hierarchical control - are likely to be ill-suited to an increasingly complex and uncertain new one.
Those of us working in the design thinking space have been major beneficiaries of this fear - as from time immemorial, when those toiling at the periphery of fields suddenly find themselves in demand as the inadequacies of mainstream approaches reveal themselves. In what seems to me to undo undoubtedly fortuitous timing from our career standpoints, design thinking is enjoying unpredicted popularity. We are suddenly seen as potential possessors of the latest Holy Grail - the famed “silver bullet” - capable of miraculous things. Though research on its impact on organizational performance is just getting underway, we find design thinking at work in nearly every sector of the global economy, in organizations as diverse as social innovation start-ups, global corporations, NGOs, national governments and elementary schools. It has been adopted by entrepreneurs, corporate executives, city managers, and kindergarten teachers alike. In just a small sample from our own research, we see it employed to address issues ranging from processing vendor invoices in Istanbul, to increasing blood donation in Peru, helping impoverished farmers adopt new practices in Mexico, keeping at risk California teenagers in high school, and reducing emergency room visits in Dallas, Texas and patient stays in Melbourne, Australia.

In cases like these, the value delivered by design thinking is almost always seen to be improvements in the creativity and usefulness of the solutions produced. My research suggests a much richer set of benefits, ones that link to the accelerating complexity and uncertainty noted earlier and, in this paper, I want to set out some hypotheses around a broader role for design thinking: as providing an enabling social technology that facilitates adaptation and effective problem-solving in complex social systems. By first improving the quality and productivity of conversations, design thinking not only does the job we expect it to do - identifying more creative solutions - it increases the likelihood of their implementation, by enhancing a collective’s ability to align, learn, and change together.

In this paper, I review the literature spanning a diverse set of disciplines at both macro and micro levels, on complex adaptive systems, innovation team performance and learning in action in order to explore the challenges to decision-making they highlight. From this review, a series of facilitators identified in previous research as critical to the performance of collaborative innovation is distilled. I then discuss examples from my research that illustrate how design thinking contributes to accomplishing these imperatives, and advance an argument that it provides more than a problem-solving process - it provides a social technology.

What is a social technology?
Though today we associate the term “technology” with digital or physical ways of accomplishing activities, technology has a much broader meaning. Derived from the Greek, meaning “science of craft,” it refers to a collection of techniques, skills and processes used to transform knowledge into practical outcomes (Wikipedia, 2017). Thinking about “social” technologies (in contrast to physical ones) has somewhat surprising roots in the field of economics: leading evolutionary economist Richard Nelson first drew the differentiation between “social” and “physical” technologies in a discussion of the limits to productivity improvements made by the introduction of new physical technology that ignored the accompanying social dimension (Nelson & Sampat, 2000). He tied the two through the notion of the centrality of “routines” (ways of doing things, courses of action) which he and Sidney Winter (1982) made famous as the basis of
evolutionary growth theory. Successful behavioural change, Nelson argued, requires attention to social mechanisms in order to succeed, bringing a human-centred aspect to economics. He argued that institutions themselves were forms of social technology, and that routines were the basic way that they accomplished change. This argument spawned a growing literature on the social aspects of physical technology introduction (linked to a corollary literature on the management of change that had been developing for decades). Others have tied the idea of “social technology” to innovation more broadly. Otto Scharmar (2007), in his work on “Theory U” called for a new “social leadership technology” that would allow organizations to “presence” the new future that already lay within. In the context of design thinking specifically, Charles Pezeshki (2014) first used the term to describe design thinking’s contribution, focusing on how it impacted organizational information flows in ways that facilitated higher quality problem solving. Coupling this perspective with research done relating to complex adaptive systems theory yields insights into the mechanisms through which design thinking can contribute significant value well beyond providing better outcomes.

Dealing with Complex Social Systems
Managing within complex social systems is a challenge to traditional approaches - recent research illustrates clearly that the complex reality of social systems is not consistent with convenient simplifying assumptions of the traditional “rational actor” model (Colander and Kupers, 2014) and illustrates two critical outcomes: (1) the failure of hierarchical control as a governing mechanism and (2) the urgency of the need for continuous adaptation through innovation. The failure of control drives the need for de-centralization of decision-making; the need for continuous adaptation drives towards diversity of input. Complex systems have a set of identifiable characteristics, most notably their rich connectivity which leads to difficulties in centralized control and prediction of cause and effect, driving the need to localize decision-making where possible. The possibility of finding a single system-wide “optimal” solution is low; much of the information and implementation challenges are local, necessitating a de-centralized approach. Network effects play an important role, as well, with how people form and behave in groups tending to overshadow individual behaviour. Efficiency, the dominant criteria in stable, simple systems, must be balanced against the importance of the capacity for resilience and adaptability in complex, unstable systems. Diversity plays an increasingly critical role: though simple, stable systems favour homogeneity and view diversity of input as problematic; in complex social systems, heterogeneity is more valuable because it increases the range of both current information and the breadth of solutions generated. The introduction of new voices helps an organization see more opportunities—ones not necessarily path dependent on previous choices. Thus, local decisions made by a diverse set of actors working together are theoretically likely to be most successful. And, though the larger system is itself complex and difficult to predict, its subunits less so. These components tend to operate on what researchers call “replicator dynamics.” As in a fractal pattern (in which each subunit is a smaller-scale picture of the whole), simple central rules—established globally but applied locally—are the most promising method for bringing order and accomplishing change.
Uhl-Bien and Arena (2017) describe as “one of the great ironies of complexity” that the natural response to increasing complexity is almost always to attempt to impose more order, which often results in making things worse rather than better (they use the 2016 US Presidential election as a sobering example). Instead, facilitating a new order in which agents in a networked system work together to create something that is emergent is key - “richly connected interactions that allow diverse people, ideas and pressures to collide and combine in ways that generate the emergence of novelty” are required (p.11). Such emergence must be enabled rather than managed, they argue.

Because the bureaucratic systems of large organizations, aimed at imposing standardization and control, are so critical to successful operation of ongoing operations, and simultaneously resistant to change, strong informal systems must be established to accomplish this localization. The creation of what Uhl-Bien and Arena term “adaptive spaces” are necessary and are aimed at two objectives: (1) to facilitate the brokerage of information across diverse groups that is needed to deal with the complexity of challenges and (2) to build the group cohesion that enables these networked interactions (outside of the formal organizational systems) to work together successfully. These kinds of brokering activity (Hargadon & Sutton, 1997) and psychological safety (Edmondson, 1999) have consistently emerged as critical to innovation. New structures and routines that centre on developing collective performance norms and coordinating learning and performance enhancement become critical as Gibb, Sune and Albers (2017) demonstrate in their research into how the diverse network of players in the New Zealand Dairy industry worked together to improve their competitive position. Human-centred design approaches have much to offer in this environment, a topic to which we will turn after reviewing related findings from a more micro literature focused on innovation team success.

The Challenge of Innovation and the Paradox of Difference

Working at a more micro level, research on successful research and development teams also contributes to this discussion of the challenges facing organizations as they decentralize decision-making and attempt to tap into a more diverse capability set. Accessing local knowledge and incorporating a more diverse set of perspectives emphasizes working successfully across difference - whether these be differences in functional expertise, in hierarchical levels, across geography or stakeholder groups with different perspectives, or among members of an ecosystem. Leveraging such differences offers the potential to produce better solutions - more systemic, more valuable, and more easily implemented. Yet significant research also suggests that such difference can (and in fact frequently does) drive disagreement and dysfunction. For instance, the extent of a team’s functional diversity was demonstrated by Lovelace, Shapiro, and Weingart (2001) to be a determinant of the amount of disagreement within a team. Similarly, Bettenhausen (1991) concluded, after a comprehensive review of the literature, that diversity generally had a negative rather than a positive effect on team performance, especially in times of rapid change: the additional time it took diverse teams to reach consensus offset the positive effect of diverse perspectives. Brown and Eisenhardt (1995) also reviewed a long tradition in product development research that centred on communication within teams and
networks, and highlighted the role of disconnects caused by different interpretive schemes of members.

Carlile (2004) argued that the challenges diverse teams face exist because knowledge creation occurs across domains, and working successfully across domains is difficult. These domain boundaries are both interpretive (as team members accord personal meaning to information and events), and political (as different interests clash and impede knowledge sharing). Innovation requires the development of a shared perspective and is difficult because it occurs at the intersection of the 3 types of boundaries that must be crossed that Carlile identified: difference due to the need to cross various kinds of specialized expertise; the reality of the dependence upon each other that relies on navigating specialized knowledge; and the need for a transcendent novelty, or the creation of new, higher order solutions. Thus, in order to work together, diverse team members must successfully transfer information, translate across interpretive differences, and transform to rise above political differences - a challenging set of activities.

Dougherty and Tolboom (2008) studied this challenge and echoed similar themes, suggesting that departmentalized “thought worlds” interfered with the integration of diverse perspectives in cross functional teams which must collaborate. “Departments,” Dougherty (1992) argued, “not only know different things, they know things differently” and have differing “systems of meaning” which lead to different interpretations. Such differences in “ways of knowing” have long been recognized in the psychology literature (Belenkey, Clinchy, Goldberger & Tarule, 1986). Dougherty warned that standard approaches to structure and process inhibit success: prescribed roles on teams inhibit cross-fertilization and mutual learning, and pre-determined definitions of issues reduce the search for new possibilities.

Learning theorists have also contributed to the discussion, from a different perspective, because teams cross boundaries not only to coordinate, but to learn as well. In the evolution of their understanding of the phenomena of learning, theorists have moved beyond early views of learning as information processing to a view that knowledge is both personal and context-specific (Nonaka, von Krogh, & Voepel, 2006). Organizational learning has long been acknowledged to be a social phenomenon (Nonaka & Takeuchi, 1995). The creation of new knowledge leading to innovation requires both perspective taking - making one’s own perspective visible and reconcilable to others - and perspective making - the creation of a coherent belief system (Boland and Tenkasi, 1995). Creating a shared perspective requires surfacing and reconciling differences in knowledge and cognitive frames of reference. Seemingly expedient decision processes like voting that attempt to circumvent the often challenging activities of perspective taking and making fail to create new knowledge, they assert.

Another challenge to the learning that is key to innovation relates to psychological safety and discomfort with ambiguity and uncertainty. Choices are often driven primarily by a fear of making mistakes; many decision-makers have a preference for inaction over action when at risk of failure (Dweck, 2006; Higgins, 2006). Psychological safety is essential to encouraging an action bias, and team psychological safety and learning behavior are closely linked (Edmondson, 1999).
Bruns (2013) studied collaboration across domains of expertise in the field of systems biology, and argued that when complexity and novelty are linked, routines often fail and coordination needs to be on-going. He also noted that arriving at novel constructions in the face of such complexity does more than add an additional layer of coordination - it changes the nature of the work within the individual domains. Members of successful teams, Bruns finds, re-design their work plans to make their contributions more compatible with others and consistently consider the consequences of their work for other domains.

Taken together, these diverse literatures suggest a clear (if challenging) set of imperatives that define what the “adaptive spaces” created within organizations will need to accomplish if they are to help the people within them navigate greater complexity and uncertainty successfully:

1. Avoid centralized hierarchical control in favour of de-centralizing decision-making
2. Broker information across a set of diverse local actors
3. Develop shared meaning and interests and collective performance norms
4. Manage on-going coordination of learning and performance enhancement
5. Create cohesive groups of diverse local actors that provide psychological safety for risk-taking and accommodate diverse ways of knowing that allow both interpretive and political differences to be overcome

**Prescriptions for Success**

Fortunately, these same literatures that we have reviewed to lay out the formidable challenges involved in working locally across difference in complex systems, also offer specific actionable insights into how to accomplish this. Their prescriptions are summarized in Table 1.

In the team literature, for instance, Brown and Eisenhardt (1995) note that success in their study was achieved by alignment via concrete tasks, and speed was associated with iteration and testing. Carlile (2004) asserted that boundary crossing required the creation of a common lexicon, shared meanings, and common interests. Successful innovation teams, Dougherty (1992) found learned from each other, mutually adapting through interactions; their definitions were emergent as the work unfolded; and they grounded activities in actual use. Put the product in user’s hands, Dougherty argued, and build a common and comprehensive view from action from these particulars, not abstract goals. Tsai and Ghoshal (1998) looked at value creation from the perspective of social capital, asserting that the cognitive dimension of shared social capital is shared vision. Because new value is created by novel use of resources, mainly through exchanging and recombining, such shared vision is a “bonding mechanism” that increases resource sharing and ability to see potential value and decrease misunderstanding.

Boland and Tenkasi (1995) argued that the creation of new knowledge leading to innovation is often “communities of knowing” questioning and revising routines and, in doing so, creating new processes and relationships. Edmondson (1999) noted, “Learning behaviour in social settings is risky but can be mitigated by a team’s tolerance of imperfection and error.” Edmondson operationalized team learning behaviour as consisting of 5 activities: asking questions, seeking feedback, experimenting, reflecting on
results, and discussing errors and unexpected outcomes. Majchrzak, Move and Faraj (2012), however, found that those who succeeded in working across specialities did not necessarily need to transverse (that is, identify, elaborate and explicitly confront) their differences, but instead could adopt a set of practices that allowed them to transcend their differences. They identified practices that included sustained engagement through sharing, summarizing, shifting emphasis to stakeholder criteria and co-creating visual representations and dialoguing around them to re-frame around creative tension. Successful teams were willing to test their representations with external stakeholders and were willing to abandon them when they failed to meet their needs. Rather than debating, he argued, such successful groups were able to “go with the energy and let go of the idea of one true optimal solution.”

Shin, Picken and Dess (2017) focused specifically on the problems attendant to information sharing and stressed the need to empower employees at all levels, encourage experimentation, challenge the status quo and create a sense of shared purpose.

In the complexity literature, we see an often similar set of interesting prescriptions for action, with writers advocating for “simple rules,” attention to building connections, and providing a safe environment in which to build trust (Uhl-Bien & Arena, 2017). Norman & Stappers (2015) stress the need to shape both cognition and behaviour: social sense-making is critical and co-creation with rather than for key stakeholders is essential.

Taken together, these prescriptions offer a number of related but discrete bundles of advice for helping diverse sets of actors achieve collaborative innovation:
- provide a framework that offers a common lexicon and simple rules
- focus on concrete tasks and ground the work in tangible actions, rather than abstract goals.
- allow for the emergence of new problem definitions and solutions during the process
- take an experimental approach, seeking outside feedback, tolerating error and imperfection
- seek shared meaning and perspectives
- organize around stakeholder criteria
- emphasize co-creation with stakeholders

Though few of the scholars reviewed here work in the field of design, those who do will note the strong resonance of their prescriptions with the tenets of design thinking. This will be the focus of our final discussion. Having now reviewed a diverse set of literatures to set out then the challenges faced by organizations, as well as prescriptions for successfully surmounting them, we can now return to our initial objective – to examine the linkage between these challenges and prescriptions and the design thinking methodology, in order to test our hypothesis that it does, indeed, provide an enabling “social technology.”

**How Does Design Thinking Enable?**

In this final section, I will explore, first at a theoretical level and then with specific examples from my research, the way in which design thinking’s methodology and toolkit satisfies the prescriptions reviewed above and is therefore likely to meet the five challenges around de-centralization, brokering, shared perspectives, coordination of
learning and group cohesion that we reviewed earlier. This is the heart of the “design thinking as enabling social technology” argument: because design thinking focuses on innovation as a collaborative social process, intimately tied to human emotions and reliant on inexact methodologies in which humans come together and solutions emerge, instead of being imposed, it offers a set of tools and processes capable of facilitating adaptive innovation in complex social systems.

It accomplishes this through numerous mechanisms. Design thinking, with its core emphasis on broad stakeholder engagement, empathy and co-creation, taps into diverse perspectives to find higher-order solutions, by first, assembling a diverse team and then giving them a conversational framework to use to leverage differences. During these conversations across difference, design thinking avoids reaching for early, often mediocre, compromises, seeking instead solutions that resolve unwanted trade-offs. The search for multiple possible solutions supports the emergence of ideas during the process, shaped by conversation among the players involved. Exploration of the problem during design’s discovery builds engagement that leads to alignment around the nature of the problems that need to be addressed and that naturally deepens dissatisfaction with the status quo, motivating ownership and energy for implementation. Ethnography that identifies pain points and unmet needs helps develop empathy and builds change agents’ resolve to make life better for those they serve. In the process, it works to shift the mindset of “experts” from one of evaluation (people aren’t using the system correctly) to one of empathy. Building new networks accelerates innovation. The testing process allows decentralization while minimizing risk and improving hypothesis-testing skills. Prototyping requires that innovators flesh out salient details of any new idea in detail. Experiments involving external stakeholders further enhance the tangibility and vividness of the new future.

**Convening Conversations for Change across Diverse Stakeholders**

By bringing these elements together, design thinking helps innovators in complex social systems convene conversations that create a “virtuous cycle” that encourages change. We see numerous instances of this in our research. In each case, we observe the activities previously discussed as critical to navigating complexity and uncertainty: de-centralization of decision-making, brokering of information across diverse groups, mechanisms for the creation of shared perspectives, collective performance norms, and coordinated learning within cohesive teams.
First, organizations in our research base reached out from headquarters to engage a diverse set of local stakeholders in the conversation, inviting new perspectives from employees who often previously had little voice in the innovation conversation. At the US Department of Health and Human Services (HHS), for example, their Ignite Accelerator program is bypassing the hierarchy of the HHS bureaucracy and democratizing innovation by inviting the 80,000 plus employees at the front lines of HHS throughout the country to tackle opportunities for innovation that they see in their own backyard, supporting their efforts with training and mentoring in design thinking and lean start-up, and building their creative confidence that they can succeed.

Next, the organizations in our research freed local teams to find their own generative problem space to work together in. One NGO, The Community Transportation Association of America (CTAA), focused on better meeting of the transportation needs of low wage earners, offers a case in point. At CTAA, we see the power of localized decision making that uses design thinking as a backbone to foster grassroots problem identification and solving to address the transportation difficulties faced by low-income workers. Rather than defining a major global problem centrally, and recommending implementation of broad transportation initiatives, the emphasis in CTAA’s application of design thinking was on selecting and empowering a diverse set of local partners to frame problem statements and form solution concepts grounded in the unique set of circumstances within each of their communities. CTAA taught the design thinking methodology to seven community-based teams from across the US, allowing each community team to define its target customer group and develop a customized local program to respond to that group’s challenge in getting to available jobs. CTAA’s approach put the tools and power into the local community’s hands and led to problem definitions that were both fine-tuned to local nuance and more easily adjusted as learning occurred.

Alignment emerged in our research case studies as team members transitioned from their own view of reality to a shared view. At the US Food and Drug Administration (FDA), for
example, years of observing the polarizing effect of the traditional “public-meeting” format approach that involved each stakeholder presenting their preferred solution sequentially in a large forum, that generally devolved into an entrenched opposition to each other suggestions, led them to design thinking. The FDA elected to try a design thinking approach to reach an accord on standards for emergency respiratory therapy devices, which had a history of conflict. They convened the stakeholders involved which included respiratory device manufacturers and fellow federal agencies and put together small groups, each with a diverse stakeholder representation. They then led a dialogue, using collaborative design tools like affinity clustering, visualization, and joint prioritization. Not only did they develop a new set of solutions together, they discovered that they had been arguing about the wrong problem: achieving standards would accomplish little in reality - the core challenge to emergency preparedness lay with variation in the capabilities of users, not manufacturing standards.

_Curation_ happened next, as the innovators drilled down to what really mattered and decided what to pay attention to. Deep immersion in stakeholders’ worlds, rather than imposing experts’ views, led to crucial insights in the organizations we studied. The medical staff at Monash Medical Centre brought together clinicians from across specialties and helped them align their differing views to achieve consensus on changes both small and large. After years of recognizing the need for change in their psychiatric walk-in department, but unable to reach consensus on how to respond, clinicians decided to try a design thinking approach and did the difficult work of learning more about patients’ actual treatment experiences from the patient’s perspective, rather than the Medical Centre’s. What they learned changed the nature of the solutions they sought and allowed them to reach consensus on a new design. What was missing, they realized, was not attention to medical details, it was a sense of care for a patient’s long-term problems that was being lost amid multiple points of clinical interaction. This new focus aligned the perspectives of the multiple specialists around the patient’s needs, rather than their own clinical perspectives, and allowed them to finally take action to improve the patient experience.

Finally, the innovators in our study iterated and experimented, using prototypes. Starting with a set of initial ideas, testing them, seeking feedback from outside stakeholders on ways to improve them (or, if needed, even discarding them) on the basis of their experimental results. This approach not only reduced the risk and cost of failure in a decentralized system, it created a vehicle for on-going brokering of information, the coordination of learning, and the development of cohesive groups that provided psychological safety in the face of change. As part of the process of experimentation, design thinking insists that we construct a clear and compelling case for an altered future as part of the process, not as an afterthought, and provides powerful tools, like prototyping, co-creation, and experimentation, to accomplish this. Another story from our research, MasAgro, illustrates this. MasAgro is a partnership between the Mexican government and agricultural groups that works with local farming communities to bridge the gap between farmers and research scientists and encourage the adoption of sustainable modern agricultural methods. But subsistence farmers’ entire livelihoods can rely on each year’s crop, and they are understandably loath to risk abandoning traditional tried-and-true methods for new ones, even ones aimed at raising their income. MasAgro uses respected community leaders and local hubs to create compelling prototypes and
experiments that demonstrate results. They even plant rows of crops side by side - one side using traditional methods and the other side using the sustainable modern methods - so that farmers can see the difference, providing the ultimate proof through prototyping and with it psychological safety, making the promise of modern farming techniques tangible to risk-averse farmers.

Another outcome we observed in our research from this virtuous cycle was the increased likelihood and speed of implementation. Engaged and committed people seized the opportunity to act, while those operating from a sense of compliance hesitated. Aligned members of larger systems transcended workplace politics to work together to reduce the frictions that might have slowed them down. Curated conversations helped innovators prioritize and focus on specifying essential design criteria— what was truly important to stakeholders— and avoid being distracted by a deluge of largely irrelevant data. Such engagement, alignment, and curation led to better implementation, with less inertia, hesitation, internal politics, and confusion to slow innovation down.

Taken together, these design tools and approaches provide the kind of enabling social technology that fosters democratizing design and brings diverse local voices into the innovation conversation to identify and solve their own problems, while fostering sharing across units. In doing this, it addresses one of the key challenges in governance in complex social systems—the tension between centralization and decentralization. Design thinking can begin to let us get at the best of both worlds, providing much more than just better solutions- enabling new kinds of conversations capable of catalysing change across difference.
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<td>Tsoukas (2009)</td>
<td>Knowledge through social networks</td>
<td>• Dialogue&lt;br&gt;• Emergence of joint frames&lt;br&gt;• Incremental emergence</td>
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<td>Majchrzak, Move &amp; Faraj (2012)</td>
<td>Transcending difference in complexity</td>
<td>• Shift in emphasis&lt;br&gt;• Shift to stakeholder criteria&lt;br&gt;• Co-create visuals&lt;br&gt;• Try them out with stakeholders&lt;br&gt;• Let go of single solution</td>
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<td>Norman &amp; Stappers (2015)</td>
<td>Social systems complexity</td>
<td>• Co-creation&lt;br&gt;• Shape cognition as well as behaviour&lt;br&gt;• Simple rules&lt;br&gt;• Provide safe environment&lt;br&gt;• Build connections</td>
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Theme 1. New Models of Innovation
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Section 1.a
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Introduction: The Interplay between Science, Technology and Design

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Politecnico di Milano, Italy

Introduction
Design has recently gained much attention among practitioners and scholars as a source of innovation (Dell’Era et al., 2017). Firms are increasingly investing in design and involving design firms in their innovation processes. Yet, the role of design in innovation and competition remains a rather young (preparadigmatic) area, with blurred boundaries and often unclear or contrasting perspectives. The track “The Interplay between Science, Technology and Design” aims at exploring the contribution provided by design in exploiting the potentialities embedded in new and emerging technologies (Chesbrough, 2003). Traditionally, especially in technology-intensive industries, design has been seen as playing a minor role: indeed, mainstream theories of innovation consider technology as a main driver of change, with design following up for creating a user friendly interface or as a source of differentiation through form, when feature differentiation created through technology has run its course (Lloyd and Snelders, 2003).

Recent developments however give design a more central role in models of innovation. The focus is in particular on how design can actually play a major role early on in the innovation cycle (Buganza et al., 2015). At a technology’s inception, especially when a breakthrough technology arises, design is a way to conceive breakthrough applications (Verganti, 2003). In fact, when a breakthrough technology emerges, it embeds many potential applications: some are immediate and promoted by those who have initially guided technological development, and are typically aimed at substituting old technologies to improve existing performances; but there are other applications require imagining new patterns of use, new needs, new experiences, which is a typical creative contribution of design (Verganti, 2009). Apple, is a typical example of a company that has combined design early on with breakthrough technologies to create unprecedented applications (Norman and Verganti, 2014). Design can even move upstream into R&D to
steer the development of technology and science towards applications with greater value and need (Klein, and Kleinman, 2002; Geels, 2004). Indeed, some pioneering experiments, promoted by the EU and other national governments (e.g. in the UK) promote the joint collaboration of designers with technologists, and even scientists, to foster the development of technologies that are more socially and economically more promising. Designers can therefore bring into R&D laboratories a more people-centric focus and new creative processes (MacKenzie and Wajcman, 1985). The purpose of the track is to discuss this and other perspectives at the interplay between science, technology and design. In particular, the six papers submitted for this track propose wide and different perspectives on the topic. In particular, they move from the definition of new approaches to the role that designers have in leading innovation. Hereafter a short description of each single paper is reported.

The paper, *Bio-inspired design: explicating the value of bio-inspiration*, proposes an innovative approach toward innovation driven by design. This approach is directly inspired by nature, given that it is nature that ultimately will suggest novel ways to conserve biodiversity and provide human beings with a sustainable lifestyle. In the article, the authors suggest to designers to communicate to the business community the value of bio-inspired products and services, the beneficial roles that designers and organizations can play in the value chain.

*Managing technology development: a two-steps process to discover new meanings* tackles a key issue that is how to identify meaningful application field for technologies in order to better explore and exploit them. Therefore, the article aims at investigating those managerial practices that can enhance the development of technologies. Through the investigation, the article identifies a process that can enrich managers’ knowledge regarding the technology development by proposing an innovative two-step process.

The paper entitled *Interdisciplinary view on design education* deal with the topic of innovation in education in particular by crossing and integrating different sources of knowledge, the paper further analyzes the “knowledge” of design education and then constructs the organic combination of “five-access tendency” of design education—technology access, management access, sustainability access, business thinking access and design innovation access that conform to an interdisciplinary perspective. The aim of the paper is to create a brand new interdisciplinary open mode of teaching that leverage on the interplay between technology and design in order to enhance the quality of modern education.

The article entitled *Influence of design to implement a thermographic device for preventing diabetic foot ulceration* aims at showing the role and the advantage of involving designers in developing and influencing the technology development. The investigation encourages the collaboration between researchers, engineers and designers due to the role that designers can have in adapting a technology in a specific medical device that prevents the formation of ulcers in patients with diabetic foot.

*The impact of collaborative design on new product development: an empirical study of B2B e-commerce project in Taiwan* is a research that study the impact of collaborative design on new product development. In particular, by investigating the B2B e-commerce market
in Taiwan the authors underscore the importance of recognizing collaborative design as one of the key practices for improving the new product development.

The article entitled, Dual nature of designer’s attitudes toward design-led innovation, investigates the contribution of the designer’s attitude relating to problem solving and to exploratory researches to the creation of new value. Through the investigation conducted the authors provide a conceptual framework that explain relations between dual nature of designer’s attitude and design-led innovation.

Concluding the contributions submitted enrich the knowledge regarding several different aspects related to the interplay between science, technology and design. Indeed, some of them tackle the issues connected to the roles played by designers in technological innovation projects while other propose new approaches to unlock the opportunities offered by technologies thanks to the adoption of design principles. Notwithstanding this, further researches in this field can be conducted in order to enlarge the knowledge regarding this relevant topic.

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Bio-inspired Design: Explicating the Value of Bio-Inspiration

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Policymakers and stakeholders are asking corporations to innovate and synchronize their practices with that of the natural environment. In this hopefully thought-provoking position paper, we use a comprehensive review of literature and industrial practice in gradually building strong arguments that bio-inspired design is a possible pathway to achieve this. This approach is directly inspired by nature, given that it is nature that ultimately will suggest novel ways to conserve biodiversity and provide human beings with a sustainable lifestyle. We strive to show the value of bio-inspired products and services, not only by virtue of being more environmentally sustainable, but, when consolidated in a concerted business model and value chain to lead to a sustainable competitive advantage for companies.

\textit{Keywords: bioinspired design, business model, analogies, strategy}

Introduction

In every industry across the globe, corporations are being asked to innovate their strategies and mind-sets to meet the rapidly evolving expectations of governments and stakeholders for environmentally conscious business practices.

However, companies tend to interpret sustainability with a patchwork of disjointed practices aimed simply at \textit{appearing} socially responsible (Howe and Kramer, 2006). Buildings and cities often adopt design features that focus on discrete problems, such as energy or waste reduction, to the neglect of an overarching strategy, due to their tendency to focus on working project by project (Kahneman & Lovallo, 1993). Yet,
excessive consumption, pollution, and overpopulation cannot be addressed with a series of individual solutions. With users and their needs remaining at the forefront of contemporary design, organizations are likely to continue to overlook the need for an overarching approach to social responsibility, unless overconsumption and similar issues become urgent user problems. The need for a more integrative approach to design is becoming increasingly obvious.

As we will show in this article, nature can provide tangible inspiration and analogies to help designers address some of the challenges of our century, in an approach that we call bio-inspired design. Designers can advocate this view to managers and management scholars alike, given that managers are responsible for the marketing of such bio-inspired products and that management and strategy are disciplines that are increasingly encouraged to employ designerly ways of thinking into their practices (e.g., Garbuio et al, 2015; Martin, 2009; Brown, 2009). To facilitate the spread of bio-inspired products and services, such solutions need to be cohesively integrated with an organization’s value chain and competitive business models.

In this paper, we build on an extensive literature in making our proposition that bio-inspired design (as an adjustment or expansion, respectively, to the mechanisms of user-centered design) may spearhead a pathway to addressing the larger challenges to modern society, or at least mitigating their severity. Throughout the paper, we complement these arguments with examples of industrial success in utilizing principles of bio-inspired design to also yield competitive advantages for companies. In the next section, we first discuss the concept of “user centricity” in design and highlight some its virtues and pitfalls when it comes to tackling some of today’s most pressing challenges. We then describe bio-inspired design, which involves looking at nature as inspiration and considering the entire ecosystem during the design process rather than the individual user. This entails a shift in the perspectives taken while designing products, services and strategies. We provide arguments, based on extant research, that this may very likely be cohesively connected with prominent approaches for user-centered design and innovation, such as design thinking. Finally, we illustrate how designers can facilitate the adoption of bio-inspired products and services by business leaders through their consolidation with/into sustainable business models. We strive to provide compelling arguments that bio-inspired design may help biologists, designers, and business leaders to address many of our most pressing environmental challenges.

PROBLEMS ASSOCIATED WITH USER CENTRICITY IN DESIGN THINKING

Defining User Centricity
One design principle that is widely accepted by designers and, more recently, business scholars is the importance of observing and understanding users. User-centered design represents a general approach that brings users or consumers into the design process (Norman and Draper 1986; Norman, 1998; Veryzer & Borja de Mozota, 2005; Vredenburg, Mao, Smith, & Carey, 2002). This approach involves getting to know users’ needs and wants, and sometimes also involves broadening their participation in the design process to more intimately identify their experience with products (Von Hippel, 1988; Bate and Robert, 2007). Thus, it moves design from a focus on the function of artefacts to the
actions of users as they experience these artefacts (Margolin, 1995; Margolin, 1997). Typically, user-centricty underpins a common process in which designers engage in an iterative cycle of investigation of customers’ perceptions of products, services, and needs. At times, designers may complement such activities directly focused on a particular user through broader, ethnographic research or persona\textsuperscript{1} creation (e.g., Miaskiewicz and Kozar, 2011; Mariampolski, 2005; Elliot and Jankel, 2003; Kelly, 2001; Squires and Byrne, 2002; Michlewski, 2008).

The user-centered approach was spearheaded in the professional design field several decades ago (compare Dorst, 2008; Visser, 2006) and has since dispersed to appendant fields, particularly management, where user understanding has become a key element of MBA education (Dunne and Martin, 2006). The approach is also popular among designers and managers of internationally recognized design-led organizations, such as the design consultancy IDEO and Philips Design (Brown, 2009; Kyffin and Gardien, 2009). In an interview study of attitudes toward design, senior designers and managers at these firms clearly identified how the user-perspective combined with a commercial viability perspective has become ingrained among them (Michewski, 2008). IDEO CEO Tim Brown assigns particular importance to design thinking as a human-centered endeavor (Brown, 2009). According to him, a successful design outcome exists at the intersection of three concerns: what is desirable from the user’s perspective, what is technically feasible, and what is commercially viable for the organization (Brown 2009). The approach is on the one hand a claim to support conception of visionary business strategies, on the other, envisions design to have the power to influence society (Badke-Schaub et al., 2010; Lockwood 2009, Martin 2009, Verganti 2009). Adoption of design thinking and its underlying user-centered approach to design, hence, have extremely valuable implications for management and business venturing. As we will discuss more thoroughly later in this article, here is where the connection can be drawn with building a larger, overarching vision through bio-inspired design and its orchestration into organizations’ business models.

2.2 Complications associated with user centricity in design thinking

Though scholars have at times voiced criticism (see, e.g., Norman, 2010; Badke-Schaub et al. 2010; Visser, 2009) pertaining to the scientific foundation of the design thinking approach, particularly in the proliferation in which it is promoted by Brown (2009), there is a large consensus on its efficacy for user-centered design and business strategy (Martin, 2009). If a deeper understanding of customers leads to products and services that better satisfy individual needs, problems can still arise when users’ desires conflict with what is ultimately good for them or others and the environment. From reviewing extant literature, it seems there are three main problems exacerbated by overreliance on user-centricty: overconsumption, product obsolescence and counter-intentional unsustainable behavior.

\textsuperscript{1} Personas are fictitious yet specific and concrete representations of target users. More specifically, personae represent an aggregate of target users who share common behavioral characteristics (i.e., is a hypothetical archetype of real users) (Pruitt and Adlin, 2006; Miaskiewicz and Kozar, 2011).
First, overconsumption is exacerbated by people’s preferences for immediate rather than delayed gratification (Crocker, 2013; Randers, 2012). Several decades of psychology and behavioral economics experiments have confirmed that individuals discount the future more heavily than the present time: they strongly prefer to consume today rather than tomorrow, even when future benefit is larger (Bulley et al., 2016; Peters and Büchel, 2009). Behavioral economics have identified many patterns that lead to poor long-term choices, such as under-investing in 401(k) plans (Madrian and Shea, 2001), failing to stick to personal savings plans (Laibson, 1997), and failing to take advantage of long-term oriented benefit programs (Della Vigna and Malmendier, 2006).

Secondly, overconsumption is exacerbated by obsolescence, which can be either directly built into products or is triggered through deliberate manipulation of consumers into frequent substitution of older-generation products for new ones. The term planned (or built-in) obsolescence dates at least to 1932 with Bernard London’s pamphlet “Ending the Depression Through Planned Obsolescence,” which advocated government imposition of something like an expiration date on consumer items in order to stimulate further consumption, and was popularized in 1954 by the American industrial designer Brooks Stevens. The first creator of large-scale planned obsolescence was the Phoebus cartel, a group of light-bulb manufacturers that has been accused of preventing technological advances that would have produced longer-lasting light bulbs to stir sales of their product (Wells, 2002; Dannoritzer, 2010). Today, many electronic gadgets as well as cars are victim of planned obsolescence, whether of function or style. Rather than decreasing in the face of heightened awareness about sustainability, research suggests that obsolescence is strategically used by more and more companies today (Abramson, 2012). Originally dictated by commercial logic, planned obsolescence is now largely accepted and, inadvertently, even expected by consumers.

By continually introducing new functions and retargeting or discontinuing others, a manufacturer can ride fashion cycles in product categories such as automobiles, which have a strict yearly schedule for new models, and mobile phones, which endure constant minor feature enhancements and restyling. Some of these companies also adopt strategies such as annual revisions about what features to include in each year’s new models – and exclude form previous years’ models, thus making older models less desirable for no technical reason (Bellezza et al., in press). Similarly, the clothing industry is cyclical and almost entirely style-driven. Americans buy 20 billion garments a year, an average of 64 garments a person (Cline, 2012). In the last decades, clothing stores started to break up the century-old biannual cycle of fashion; now several fashion companies produce four-to-six collections each year instead of two. This type of “fast fashion” has not changed the amount of labor needed to make an item or the waste created by its production, according to Masoud Golsorkhi, editor of the London culture and fashion magazine Tank. “Sometimes it’s actually cheaper to throw away clothes than to wash them,” he noted, “that has got to be wrong” (Hansen, 2012).

Thirdly, most of the increasing demand for sustainable products appears to be an expression of a status-conscious mind-set rather than a truly environmentally conscious mind-set. The number one reason Toyota Prius owners gave for purchasing the low-emissions vehicle was that it “makes a statement about me,” namely showing the world that they care about the environment (Maynard, 2007). By contrast, environmental
conservation only ranked number five on this list. Prius sales are concentrated in geographic areas where being green is likely to be a status symbol; similarly, people are more likely to install solar panels where they will be visible to others rather than in direct sunlight (Sexton and Sexton, 2011). These studies confirm the fact that consumers are willing to pay higher prices for sustainable products that enhance their status (Griskevicius et al., 2010). Given that the design of sustainable products may not be driven entirely by sustainability concerns, user-centric design may have a limited capacity to truly improve the well-being of users. By extension, the sustainability of popularly “green” products and technologies becomes questionable due to known effects connected with behavioral consumer patterns like the rebound effect (Herring and Sorrell, 2009), which paradoxically then leads to less sustainable consumption overall. As illustration, users may end up driving their fuel-efficient cars further and more often than their gas guzzlers. Thus, solutions to environmental challenges might not require new, more efficient technologies, but rather behavioral changes in how we use the technology and reductions in our consumption of goods and services (Waltersdorfer et al., 2015; Herring and Sorrell, 2009; Owen, 2012).

A final, maybe less obvious deficit is that user-centricity is not always the best source of innovation. Famous leaders in innovation, such as the late Steve Jobs, have recognized that users often do not know or cannot articulate what they want from a product (see Isaacson, 2011, for examples of Job’s hesitation to rely on user and market research to generate new-product ideas; see also Leonard and Rayport, 1997). In addition, researchers have begun to theorize that paying too much attention to current customers, especially large, influential ones, leads companies to provide only incremental, rather than radical, innovation and fall behind new entrants that are not blindsided by these customers (Christensen, 1997). Similarly, a truly needed, overarching vision towards sustainability may become more and more distant. Distance from customers could spur leaders to search for innovation that goes deeper than mere technological or stylistic innovation (Norman and Verganti, 2012; Verganti, 2008; Bennett and Cooper, 1979).

For all these reasons, the world’s environmental issues are unlikely to be solved with current practices. The fact that user-centricity and design thinking are nowadays permeating into the business environment may accelerate this effect further. We suggest that what is needed is a more radical re-evaluation of the relationship between energy and consumption by human beings and companies alike. Our search of extant literature suggests that designers are maybe best equipped to address these problems given their tools, talents, and drive to solve challenging and often ill-defined problems (Simon 1973). Hence, in the next section we propose compelling arguments from a review of literature and practice to highlight the benefit in merging design thinking endeavors with a different, more inherently environment-oriented component, i.e. bio-inspired design.
BIO-INSPIRED DESIGN

Given the challenges of the 21st century, bio-inspired design may provide an interesting approach in a transition from a user-centered approach to one rooted in the natural world. More specifically, we propose that bio-inspiration reacts to nature in two ways:

i) Nature as inspiration: Bio-inspired design is inspired by a systematic examination of ecological processes.

ii) Nature as a design constraint: As compared to traditional design, bio-inspired design gives equal weight to all organisms rather than being anthropocentric.

Design and bio-inspired design are of course about design for human needs and wants. However, the definition of bio-inspired design goes a step further and explicates the role of nature in design. As a source of inspiration, elements of the natural environment play an active role in design, enriching the designer’s inspirations. But nature also provides constraints to designers, requiring them to consider all organisms that might be impacted by the design process during all its phases. In this sense, bio-inspired design is not based exclusively on human needs and wants – i.e. user-centricity – but rather places the design object in the context of a larger ecosystem of resources, objects, and actions that limits and alleviates the environmental stress currently imposed on our planet. Using nature as both inspiration and constraint in the design process, bio-inspired design recognizes that resources are finite, nature is vulnerable, and other organisms are as important as humans are. Arguably, this is a fairly radical change in mind-set, that some people may find somewhat confronting at first and we will use the next sections to explicate how this is to be interpreted.

Nature as inspiration

The first defining characteristic of bio-inspired design is its use of natural processes, structures and fundamental effectual relations as a source of inspiration and innovation. It distinguishes itself from bionic or biomimetic design, which directly try to mimic extraordinary design solutions found in nature into products (Nachigall, 2002). Bio-inspired design promotes a novel, more overarching perspective, using the idea of natural equilibria as vantage point and making considerations about the orchestration of disturbances to these, e.g. through novel products and services, salient.

In general, bringing a fresh perspective to an old problem has been proven to lead to innovative solutions (Garbuio et al, forthcoming). Neuroscientific research has found that our perception of the external environment is not a product of eyes or ears, but rather of the brain (Berns, 2008). In fact, our perceptions are heavily influenced by past experiences (Jiang et al, 2007; Purves and Lotto, 2003). Commonplace perceptions feel comfortable and cost little energy to process. Conversely, uncommon perceptions force the brain into a different, more challenging mode of processing. Innovators see the world differently from others because their brains avoid many of the cognitive traps that affect most people (Berns, 2008).

2 Of course, there are other characteristics of design thinking that contribute to bio-inspired design, such as abduction, framing (e.g., Dorst, 2011), prototyping, and experimentation (e.g., Brown, 2009; Liedtka and Olgivie, 2011).
Ultimately, the ability to identify novel insights depends on the ability to view both the familiar and the unfamiliar from a new perspective. In an experimental study, Chan et al. (2011) found that senior engineering students generated more novel and higher-quality solutions during the ideation process when considering far-flung (from a different problem domain) and less-common examples than when considering more familiar ones (see also Arntz et al. forthcoming; Goldschmidt and Sever, 2011). The potential for creative insights strengthens when the two domains being compared are very different on their surface characteristics — that is, on their appearance and attributes — rather than their structural characteristics, that is, on their working relationships (Gentner and Markman, 1997; Tseng et al., 2008). Moreover, Casakin and Goldschmidt (1999) found that visual analogies can improve design problem solving by both novice and expert architects (see also Ball et al. 2004; Helms, Vattam, and Goel, 2009; and Mazzoleni, 2013).

Radical innovations often happen at the intersections of disciplines. Applying established methods from one’s own field to a novel problem, attacking problems as a beginner, and letting go of preconceptions and fear of failure are all keys to creativity (Berns, 2008; Lakhani and Jeppesen, 2010). People are predisposed to link problems that are distant from their fields with solutions they have encountered in their own work. In a study of the company InnoCentive, which posts tough R&D problems online for anyone to solve, Lakhani and Jeppesen (2010) found that problem solvers were most effective at the margins of their own fields. For example, one molecular biology problem was solved by an aerospace physicist and a small agriculture business owner. These individuals were close enough to understand the challenge, but not so close that their knowledge led them to the same stumbling blocks that held back their more expert peers. In fact, 30 per cent of posted challenges that confounded experienced corporate researchers were solved by non-employees (Lakhani and Jeppesen, 2010). When we deeply understand how organisms function in a different field, we bypass the restrictive, simplifying frameworks of our own field and see more broadly.

Looking at creativity and innovation from a psychological point of view, we see that differences in the ability to think creatively can be linked to variations in personally traits and cognitive faculties (Batey & Furnham, 2006). Cognitive strategies applied by highly creative people are related to abstraction of knowledge and semantic relation (Gilhooly et al., 2007). This entails abstraction and recombination of remotely related concepts across domains by use of analogies. Such solution finding strategies have been linked with higher originality and innovation than direct retrieval from memory (Nusbaum & Silvia, 2011; Kauman, 2009; Silvia, 2008; Runco, 2007). The idea of reconnecting concepts across domains is very similar to the process of abductive reasoning, which, in combination with analogical reasoning, is considered the lifeblood for the successful application of design thinking (see, e.g., Dong et al., 2016; Dorst, 2011; Kolko, 2010). An expansion of design thinking towards bio-inspired design, hence, not only seems inherently possible, but a seamless pathway for innovation.

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3 By using analogies far from their field, the opposite is also true. That is, people are predisposed to link solutions that are distant from their fields with problems they have encountered in their own work.
One early example of nature as a source of inspiration and innovation is the study of birds in the quest for human flight. In his fruitless attempt to design a “flying machine,” Leonardo da Vinci (1452–1519) meticulously studied the anatomy and flight of birds. More recently, the seminal work of the designer Janine Benyus (1997) exemplifies biomimicry. Biomimicry considers the natural environment as an element worthy of imitation in the form, function, and process of design. Through the observation and analysis of natural processes, it is possible to learn lessons that generate new forms of integrated design in addition to creating artefacts that show respect for nature. Our definition of bio-inspired design attempts to capture the essence of Janine’s work by focusing on inspiration rather than imitation. In neighboring disciplines, such as engineering and science, approaches like bionics a biomimetics mentioned earlier have been vital in the development of new innovative technologies and solutions (Bar-Cohen, 2011).

As Benyus (1997) and Ternaux et al. (2011) suggest, there are numerous reasons that the biological world serves as a useful analogy for design. Nature is efficient: it relies on one primary source of energy—solar—and uses only as much as it needs and creates the rest. Nature is sufficient, recycling everything. Like the best designers, it matches form to function, bets on diversity, works with local expertise, and uses constraints as a source of creativity. In addition, many optimal structures in nature resemble each other (i.e., water droplets and jellyfish, trees and blood vessels), inspiring us to borrow from them. Finally, the elaborate behavior of many plant and animal species allows the resolution of complex problems and maintains the survival of the species.

Procter & Gamble (P&G) is one company that has transitioned from user-centric design to a deeper design that finds inspiration for new products in nature, as championed by Vice President of Design Innovation and Strategy Claudia Kotcha and CEO A.G. Lafley in the 2000s. When Pete Foley, the associate director of P&G’s cognitive science group, was looking for an inspired solution to the challenges of one of P&G’s business unit, he took his R&D staff to the San Diego Zoo. The San Diego Zoo, in fact, is developing a program in bio-inspiration to help companies innovate by looking at the natural world. Coca-Cola, Colgate-Palmolive, General Electric, Boeing, Herman Miller, and Nike have all experimented with using nature as inspiration for product design. But similarity of form and processes between a natural object and a manmade object is only one aspect of inspiration. The use of natural forms and processes in design can be a stepping stone for a corporation to become more sensitive to bio-inspiration in a broader sense.

The presented research and case examples clearly suggest vital benefits of consolidating design thinking and related approaches aimed at fostering innovation and creativity with bio-inspired design as a fundamental principle. It is in fact inherently rooted in innovation to recombine analogical principles into novel solutions and nature is a paramount source of inspiration for this. However, to fully address the challenges of our century, this would be insufficient if bio-inspiration did not explicitly consider nature as a constraint in the design process. 

**Nature as a constraint**

Bio-inspired design marks a deep transition from user-centered design to system-driven bio-design – a move away from an anthropocentric focus to placing equal value on all organisms. For design to be respectful of nature, nature itself rather than potential
customers must be the driver of the design process. Thus, a broad section of the environment rather than a single element – such as an animal or a plant – should play an active role in the design. This approach enriches the designer’s inspirations while also lessening the environmental impact of the final product, simply because the impact on all these other organisms is explicitly considered in the design process. We foresee design moving toward this type of co-evolutionary process, where multiple environmental factors intervene in the making of a product and its placement in the marketplace.

A proactive observation of natural processes and ecosystems can allow both designers and managers to learn lessons that inspire design solutions and strategies that are not only “constrained” by the natural environment but also better integrated with it. As a result of this new approach, bio-inspired design considers the object being designed in the context of a large ecosystem of resources, objects, and actions, each of which limits and alleviates the environmental stress currently imposed on our planet. Natural systems are interconnected, and natural cycles give each other feedback in a balanced way. But the increased pace and scale of human activities has unknown consequences for the balance of systems that allow all species, including our own, to thrive. In bio-inspired design, designers aim for interconnectedness in design—that is, the integration of nature’s solutions with innovative problem solving for manmade environments.

Nature as both an inspiration and constraint in the design process is indeed a difficult yet attainable goal. Companies such as Patagonia and Iittala, for example, pay attention to the environment, explicitly promoting durability and asking their customers to avoid overconsumption. Since its inception, but especially after filing for bankruptcy in 1991, Patagonia has put environmental values at the forefront of its mission. In founder Yvon Chouinard’s words, “The reasons we hadn’t sold out and retired was that were pessimistic about the fate of the world and felt responsibility to use our resources to do something about it” (Chouinard, 2005). The near-death experience of bankruptcy was followed by a stringent environmental impact assessment of the company’s products as well as efforts to reduce waste. The former led Patagonia to use only organically grown cotton; the latter to changes in packaging and a request to customers to send back old Patagonia products to be recycled into fabrics. More recently, Patagonia has asked its customers to buy only what they truly need.\(^4\) Of course, these practices are reflected in higher prices, which customers have proven willing to pay, as witnessed by the company’s financial recovery and recent profitability.

Iittala’s approach to durability and overconsumption is stated on its mission statement:

We believe that in today’s increasingly disposable world people value things that are well-designed and made to outlive changing times and trends. Our strategy is to build on superior consumer understanding, customer satisfaction, strong brands, an efficient supply chain, and growth in both individual product segments and geographically.”\(^5\)

In using nature as a source for analogy and as constraint, designers may be able generate solutions that alleviate the potential pitfalls associated with excessive focus on user-centricity discussed earlier. This approach explicitly views consumption of products and

\(^4\) See http://www.patagonia.com/us/common-threads/
\(^5\) See https://www.iittala.com/about-us-meet-the-company
services as part of a large ecosystem, as purchasing, usage, and disposal decisions explicitly consider the impact on the environment. Given, however, that implementation of novel solutions imperatively requires backing from management typically focused on economic growth, this automatically begs the question how bio-inspired design solutions may feasibly and cohesively be integrated into lucrative businesses.

THE ROLE OF THE DESIGNER: REFLECTION QUESTIONS FOR IMPLEMENTING BIO-INSPIRED DESIGN

Efforts to employ bio-inspired design will fail unless business leaders can be persuaded of its benefits. Brown (2009) conceived design thinking to have the capability to not only lead to novel product or service solutions but provide a pathway to improve society. We strongly concur that focus on individual product or service innovations will lead to a neglect of an overarching strategy. Moreover, while launching novel and commercially successful products and services remains imperative to business venturing, history has taught us repeatedly that product innovations are typically picked up and replicated quickly by competitors (Massa and Tucci, 2013; Casprini, 2015). This poses stark challenges to companies to repeat the innovation cycle quickly after a novel product has been launched leading to shorter cycles between product generations, which is eventually detrimental to sustainability (as discussed earlier). Extant literature informs us that changes of business models are much more likely to lead to a much longer sustainable competitive advantage (Achtenhagen et al., 2013), as they are distinctly harder to replicate. What is more, research has shown the vast opportunity for value creation and monetization that a change towards more sustainable business models carry (Kiron, et al., 2013; Kramer & Porter, 2011). Examples can be found in diverse sectors, such as the high-tech companies Google and IBM, but also Johnson & Johnson, Unilever, Nestle, in private equity and the clothing industry (Bocken, 2015; Short et al., 2014; Bocken et al., 2014). Arguably, such endeavors are still far from the norm, but their potential is undeniable.

To frame their arguments for maximum appeal to business leaders (Teece, 2010), designers need to understand the concept of business models, which describe simultaneously how a company creates, delivers, and captures value (e.g., Teece, 2010; Sinfield, Calder, McConnell and Colson, 2011). On the basis of our research, we have identified three areas that designers and companies need to consider in order to successfully bring bio-inspired products and services to market and anchor it in a concerted business model. Like Teece (2010) and Markides and Oyon (2010), we do not provide a recipe for how to design a business model for bio-inspired products and services, but rather raise questions to be considered. New business models provide provisional solutions to customers’ needs and wants. Through discovery, learning, and adaptation, these models are likely to be replaced by improved models that take advantage of further innovations. As noted by Teece (2010), designing good business models is in part an “art.” In fact, the right business model is rarely apparent early on, but a strong template can help designers and managers learn and adjust.

In this spirit, we address these three key elements of business models that will help designers and companies alike create, deliver, and capture value from bio-inspired products and services: the value proposition offered to customers, the role of the business in the value chain, and how the business makes a profit. To achieve buy-in, designers can
leverage the opportunity to communicate the benefits of bio-inspired products and services in terms of these three elements. Table 1 below summarized our proposed template for the creation, deliver, and capture of value through bio-inspired products and services.

Table 1: Template for the creation, deliver, and capture of value through bio-inspired products and services

<table>
<thead>
<tr>
<th>Value</th>
<th>Bio-inspired products and services: Key questions</th>
</tr>
</thead>
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| Value creation – users’ value | How does your product or service create immediate and delayed value to users?  
How does your product or service create value direct value to the (direct) users and indirect value because of a better environment due to the way material is sourced, the product is produced, used and finally disposed?  
How does your product or service consider direct benefits to the environment? |
| Value delivery – new distribution of value across actors in the value chain | How do you (or the company you work for) deliver efficient and adaptive value to the users in a bio-inspired value chain?  
How does your product or service take advantage of cheaper and more sophisticated additive manufacturing?  
How will co-location of design and manufacturing facilitate bio-inspired value chains?  
How does your role as a designer expand in bio-inspired value chains? |
| Value capturing - Competitive advantage | How does a company use bio-inspired design thinking as a source of competitive advantage?  
How can these sources of competitive advantage be protected over time, as bio-inspired design is more broadly embraced?  
How is bio-inspired products and services’ value captured through innovative price systems?  
How can traditional companies capture value while designers’ role in the value chain expands? |

Redefining value creation: Value created by bio-inspired design products and services
The first element of business models that designers need to think about when using a bio-inspired design approach is the value they create for users. Unlike traditional approaches, which focus on a specific user, a bio-inspired design approach considers how each organism is impacted by the product or service during its entire life cycle. By doing so, and by explicitly considering all stakeholders, designers create value that goes beyond the
As discussed earlier, there are barriers to communicating these benefits. Namely, consumers or direct users may not perceive these goals as important due to a short-term focus. A bias toward the present causes people to place more weight on consumption today rather than tomorrow, next year, or 50 years from now. In addition, there is currently a trend toward buying products that “look” green rather than actually being green.

How can designers communicate the immediate and delayed benefits of bio-inspired products and services to facilitate their adoption and reduce overconsumption? To address these challenges, designers could consider distinguishing between two types of value generated by bio-inspired products: value that directly benefits the user of a good or service (e.g., the car takes me to work) and value that comes indirectly from living in a better environment (e.g., the quality of air in a clean town versus an overpopulated one).

That is, questions arise as to how take into consideration benefits that accrue directly to individuals and benefits that are come indirectly from the fact that bio-inspired design will generate products and services that will improve our environment. This exercise directly considers the value created for the broader environment in which the material is sourced and products are made, used, and disposed.

Redefining value delivering: The role of designers and companies
Companies operate not in isolation but as part of industry value chains that proceed from the extraction of materials to production, delivery of products and services to users, usage and maintenance, and final product disposal (Porter, 1980). Traditionally, the value chain is focused on the industry level and consists of actors ranging from suppliers to customers. By contrast, bio-inspired design extends this notion to encompass a lifecycle value chain that considers any organism that comes into contact with the company or its products during the product or service lifecycle. Given the complexity of bio-inspired product design, companies that follow this model will be embedded in a large, strong network of collaborators that starts with biologists. A value chain inspired by nature is energy efficient, as actors work in the same environment and keep intermediaries to a minimum.

Designers and companies will have to redefine their understanding of the value chain, for two primary reasons. First, with the advent of new technological tools for the manufacture and marketing of products and services, from additive manufacturing processes to 3D printing to the Internet, designers can directly connect with customers. As

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6 In particular, from a practical point of view, we could explicitly distinguish between two types of users. Direct users are those who ultimately use an artifact or benefit from a service. Indirect users are those who do not directly use the artifacts but are impacted by them in some ways. These can be organisms that come in contact with the artifact, the extraction of resources for its production and its disposals. But this group also includes all the future generations that inevitably will be affected by a poorer and more polluted environment. In fact, we ourselves are already the “future” generation that has been affected by a poorer, more polluted, and in many ways damaged environment.
a result, designers have the ability to produce and distribute the final product anywhere in the world, a change that affects how we think about the value chain.

Second, there has been a growing recognition of the importance of physically co-locating design, manufacturing, and management for the sake of innovation. In their work, Pisano and Shih (2009) show that keeping industrial and design capabilities close to company headquarters is the key to long-term competitive advantage and innovation, as the manufacturing process is a source of innovation for most high-tech companies. They also note that keeping industrial capabilities within a country creates a virtuous circle around shared know-how, competences, and infrastructures for specific industries and thus stimulates innovation. Co-location of design and manufacturing also resembles the type of energy-efficient value chains found in nature.

**Re-defining value capturing: Competitive advantage through selling and profiting from bio-inspired design**

Bio-design may lead to products and services that offer new value for customers as well as a new value chain, but what competitive advantage does bio-inspired design offer companies? An examination of the fundamental definition of competitive advantage can bring us to a deeper understanding of how bio-inspired design may provide differentiation from competitors and financial rewards.

A firm is said to have achieved a competitive advantage over its rivals when it has driven a wide wedge between the willingness to pay it generates among buyers and the costs it incurs (Ghemawat, 2009)—specifically, a wider wedge than its competitors have achieved. Products and services inspired by bio-design thinking offer sources of value that, if correctly communicated, will be greater than those of non-bio-inspired products and services. As a result of the greater value generated, the prices of bio-inspired products can be higher than those of other products, at least in the short run. In turn, higher prices translate into relatively higher revenues for bio-inspired products.

As others have claimed before us, we believe that prices need to reflect the environmental impact, such as pollution generated, of man-made products and services (Chouinard et al., 2011). In addition, changes in pricing mechanisms may induce behavioral changes by corporations. For example, as pointed out by Owen (2012), if customers must rent electronic gadgets from manufacturers rather than buying them, manufacturers would have sufficient incentives to make products that last beyond the mandatory warranty period rather than frequently enticing consumers with incremental, paid upgrades.

Innovating through bio-inspired design is not cheap. Innovation requires R&D spending; however, given that bio-inspiration calls for companies to use as many resources as are required and no more, cost savings are likely achievable in novel ways. Ultimately, the cost of designing and producing bio-inspired products is perhaps the greatest challenge to leveraging bio-inspiration. Fortunately, designers thrive on constraints and challenges.

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7 3D printing services companies such as Shapeways, Kraftwurx, i.materialise, and Freedom Of Creation will facilitate this process. Also, Thingiverse of MakerBot Industries allows the sharing of 3D printing files and serves as a community resource. Finally, these services are now moving to smartphones, such as the applications Sculptr3D.
Moreover, analytics can assist in monitoring demand and production can be democratized, as it is with 3D printing. Bio-inspired products and services can be developed that save costs to the benefit of the environment at large.

**DISCUSSION AND CONCLUSION**

Design has unequivocally peaked as a source of value creation for individuals, companies, and society at large (e.g., Norman, 2004, Dell’Era and Verganti, 2007). Notably, in 2011, the European Commission launched the European Design Innovation Initiative (EDII) to exploit the full potential of design for innovation and to reinforce the link between design, innovation, and competitiveness." In this somewhat provocative piece, we have used a comprehensive review of literature and examples from practice to gradually construe and underpin our proposition that, by embracing a bio-inspired perspective in design and business venturing, we can try to approach the 21st century with a stronger vision of the environment at large. When focusing on the bigger picture, designers are aspired to be able to satisfy user needs and desires while also sustaining the planet’s resources. To achieve these goals, intervening in the design-to-consumption lifecycle becomes critical. We propose doing so using an eco-system-inspired approach that requires designers to regain contact with nature and humbly observe the living world for sources of information and inspiration.

At its most radical, bio-inspired design will not be limited to the creative actions of designers but includes the entire production process (from idea generation to marketability to production, to use and final disposal) and all players involved, including the environment (which provides resources), designers (who interpret problems and design solutions), and business actors (who champion new ideas and solutions and successfully take them to the market). An ecological, system-like mind-set drives the design process rather than the final customer. Collaboration among multidisciplinary individuals is perhaps the first step in building awareness of interdependencies and cyclicality and better integrating artificial and natural cycles.

In fact, it is crucial that bio-inspiration stay not only with designers but extend to managers and management scholars as well. Luckily, these recently started to embrace design thinking as a way to innovate and form company strategy (Garbuio et al, 2015; Garbuio et al, forthcoming; Mintzberg et al. 1998; Liedtka and Mintzberg, 2006; Brown, 2009; Martin, 2009; Carlopio, 2010; Liedtka and Olgivie, 2011). Designers may become the catalysts advancing this transformation in management and strategy scholarship and practice. The shift needs to deeply modify corporate behaviors and dramatically reduce the use of scarce natural resources.

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Managing technology development: A two-steps process to discover new meanings

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In the past few decades, several researchers have tried to understand how technology development can be influenced to reduce development expenditures. Moreover, the growing attention to idea generation from both practitioners and academics has given rise to several different veins of inquiry. Considering this, in the literature several studies have attempted to cluster the existing methods to select the technology to be developed (i.e. technology future analysis), but few have tried to medialize how technology development can be influenced in the following stages of evolution. In addition, the increasing attention that enterprises pay to design can be of help in understanding the role that a design mindset can play in technology development. Therefore, this article aims to investigate those managerial practices that can enhance the development of technologies. The methodology used is the single-case study, and the company analysed is Fullpower. Through the investigation, the article identifies a process that can enrich managers’ knowledge regarding technology development by proposing a two-step process.

Keywords: Technology Management; Technology Epiphany; Technology Development; Technology Steering

Introduction

In recent years increasing attention has been paid to analysing the effectiveness of R&D expenditures (Baghana & Mohnen, 2009; Bianchi, Croce, Dell’Era, Benedetto, & Frattini, 2016; Lee, Son, & Lee, 1996; Schwartz, Miller, Plummer, & Fusfeld, 2011). Indeed, investing in several new technologies is not easy for today’s companies, but they do so to select the most promising one among all the possibilities. To overcome this limitation,
several companies have recently adopted different strategies to select and to develop technology. Under one approach some companies have involved other investors (foreigners or externals) in their research and development processes as co-financing entities. Alternatively, other companies have acquired technology and know-how from outside their company. The first approach is clearly described in the open innovation literature (Chesbrough, 2006), whereas the second refers to the growing phenomenon of the acquisition of innovative start-ups by large companies (Cassiman, Colombo, Garrone, & Veugelers, 2005). This is a largely diffused trend in the digital environment, but is also manifest in other sectors. Thus, Facebook’s 2014 acquisition of Oculus is a typical acquisition made by a large firm to enhance its knowledge of other potential and interesting technology and to explore the opportunities offered by the virtual reality technology. The acquisition of a company is a way to explore the technology, but not all companies are willing to risk the acquisition failing, so other approaches can be evaluated by managers. Indeed, the process of exploring new opportunities is a risky one in which the potential spillovers are greater than in other processes. This is one of the main reasons why several developers have decided to develop the technology internally (Mu, Peng, & MacLachlan, 2009). When a technology is developed internally, new perspectives and insights are needed; moreover, if the development purpose is guided by a desire of the company to create an innovation in the reason why people should buy the new product (Verganti, 2009), this necessity is even stronger. In this case a new perspective on how to develop a technology effectively and profitably is needed. Indeed, it is unclear to these companies how they can find more meaningful (i.e., more profitable and more valuable) applications for the technologies that they develop. This question appears to be even more relevant if we consider the words of the semiologist Giampaolo Proni, who in 2007 stressed the concept according to which each technology has a greater number of opportunities than are really exploited by companies. Therefore, the aim of this study is to understand how companies can steer technology development to identify the more meaningful opportunities within it. In other words, through this investigation we try to understand the process and the guidelines that companies can follow to unveil quiescent meanings.

To achieve this aim, the paper is grounded in the concept of a technology epiphany, which was defined by Verganti (2009, 2011) as the discovery of a hidden and often more powerful meaning inside a particular technology. Considering this approach makes it clear that it is not a matter of being the first but of being the first to identify the real market potential of an analysed technology (Verganti, 2011), which is what has occurred in several companies, such as Kuka with the Robocoster (Verganti & Öberg, 2013). Thus, as previously expressed, the real challenge that we want to investigate is how companies can identify the most potential applications and envision new meanings within technologies. Consequently, the focus is more on the technology business unit inside firms than on the companies that deliver the final products. The paper aims to provide a structured process that can help R&D departments and innovation business units in influencing technology development. Considering the scope of the research, the main literature streams on which the reasoning is built include marginally technology management but in more detail the technology epiphany stream.
To cope with the scope of the research, a brief review of the most important literature is reported and then the methodology adopted is presented. The empirical result follows, and the link between it and the theoretical underpinning is reported. The final section contains the managerial practices, limitations, and potential follow-ups.

**Literature review**

To achieve the aim of the research, as previously reported, a structured methodology was adopted to survey the existing literature. In particular, the first step was the identification of articles relevant to the technology management topic. Then a deeper focus was directed to a peculiar moment of technology development.

**Technology management**

What emerges from the literature search is that technology management research is mainly divided into three streams: technology selection, technology development, and technology integration (Brode-Jepsen, Dell’Era, & Verganti, 2014; Cassiman & Veugelers, 2006; Iansiti, 2000; Soukhoroukova, Spann, & Skiera, 2012). In particular, the three streams of research mirror the crucial phases of technology management itself. Indeed, the first phase of the evolution of the technology is the period of selection, during which the technology is chosen among different alternatives developed within the R&D department. The most important work in this area is that of Porter et al. (2004), which proposes a framework, under the name of technology future analysis (TFA), that embraces different techniques and methodologies that help companies in selecting technology.

After the selection, there is the technology development stream and phase, which match the phases in which the technology opportunities are explored. Part of this field of study is the social construction of technology (SCOT) (Pinch & Bijker, 1987) or the research undertaken by Verganti (2009) regarding how to develop a new vision inside companies leveraging both on technologies and on strategies. The last phase of technology management refers to technology integration (Iansiti, 2000). In other words, it refers to all the studies conducted around the idea that, at the end of the process, the main goal of every company is to launch onto the market a new product that exploits the selected and developed technology.

Given the aim of the research, the most important stream is technology development. Indeed, to identify more meaningful application fields starting from the technology, the way in which decisions are taken during the phase of technology development is quite important. It is clear that, among the three phases of selection, development, and integration, development is the most exploratory one. Indeed, as Porter framed the TFA, in that period the decision is based more on the forecasting that researchers can carry out than on the exploration of opportunities in the application fields. Considering integration, the focus is vice versa on the exploitation and the implementation in a particular application field and not in a complementary or adjacent application field. Thus, the relevance of technology development is demonstrated in this study. Indeed, in this phase of technology management, the more exploratory search around the potential applications of the technology in the market is managed. In addition to that and in line with the aim of the research, a focus on the technology epiphany phenomenon seems to
be relevant. The study aims to identify a process to find meaningful application fields; therefore, clarification of what meaningful means in a technology context is needed.

**Technology epiphany**

Addressing the innovation of meaning, it emerges that there are two types of strategies, user-driven and design-driven strategies. User-driven design has been popular over the last decade and has been in the spotlight thanks to the successes of major design firms such as IDEO (Kelley, 2001) and Continuum (Lojacono & Zaccai, 2004). This approach implies that product development should begin with a deep analysis of user needs (Chayutsahakij & Poggenpohl, 2002; Dell’Era & Landoni, 2014; Leonard & Rayport, 1997; Stein & Iansiti, 1995; Thomke & Von Hippel, 2002). By using ethnographic methods and observation—and therefore becoming closer to users—firms may understand those meanings better and, through creative problem-solving sessions, may be able to address any mismatch between the existing meanings and the existing products (Dell’Era & Bellini, 2009; Dell’Era & Verganti, 2007; Dell’Era et al., 2008a; Verganti and Dell’Era, 2014). Importantly, radical innovation of meaning clearly requires a different process. Indeed, customers can barely help but anticipate possible radical changes in product meanings. The contemporary socio-cultural context in which customers are immersed makes them inclined to make interpretations that are consistent with what is occurring today. However, radical changes in meanings instead ask for wholly new interpretations of what a product is meant for, which might be understood (and affected) only by looking at things from a broader perspective (Dell’Era & Verganti, 2009; Dell’Era et al., 2008b; Verganti & Dell’Era, 2014; Verganti & Öberg, 2013). On some occasions a particular type of design-driven innovation might be generated by deeply analysing the possibilities offered by technologies. Indeed, when the innovation comes from the revelation of quiescent meanings hidden in technologies, a technology epiphany occurs (Verganti, 2009). In particular, in Verganti’s view technology epiphanies emerge from the interplay of two different radical innovation approaches: technology-push, on one hand, and design-push, on the other; see figure 1 for more details. Technology-push is an innovation attitude based on the discovery of new technologies that foster the emergence of revolutionary products on the market (Norman & Verganti, 2014). The technology is typically embedded in new objects and gives rise to new usage of the latter. However, the design-push approach focuses on radical changes in meanings. The recent stream of technology epiphany literature provides additional insights into the strategies that companies can adopt to extract value from applications based on new technologies (Buganza, Dell’Era, Pellizzoni, Trabucchi, & Verganti, 2015; Dell’Era et al., 2009 Verganti, 2009). In this vein both KUKA and Swatch are examples of radical innovation based on technological development that was guided by the idea of proposing new meanings to the market (Verganti, 2008). Especially if we consider Swatch, we can understand that the same quartz technology was explored in greater depth by researchers to identify new opportunities, and in doing so they were able to produce an innovation and the reason for its influence on the market. Indeed, the company sold 1.1 million Swatches in 1983, 4 million in 1984, and 8 million in 1985; it has sold an increasing number of watches ever since. Considering that no clear guidelines on how to foster this type of innovation have already been shared and that the vast majority of the studies in this field are more focused on identifying cases of technology epiphanies, a study that investigates the
decisions that lead companies to develop such innovations is particularly interesting and powerful.

Figure 1 Technologies and Meanings as Dimensions of Innovation (Source: Verganti, 2009)

Considering the streams of literature and the previously discussed objective of the paper, our investigation aims to enhance the knowledge regarding both managers' and practitioners' perspectives. Indeed, the main goal is, on one hand, to identify a few practices that can help R&D departments in identifying meaningful application fields to steer their technology development and, on the other hand, to enrich the theoretical knowledge regarding the technology development field of research.

Research design
To fulfil the objectives, the company selected for this study is a high-tech firm in which the technology development is undertaken in the R&D department. In fact, the objective of this investigation is to enhance the existing theory on technology development and especially on the technology epiphany phenomenon. Thus, as opposed to previous research (i.e. Dell’Era, Altuna, Magistretti, & Verganti, 2017), the perspective adopted by the present study is that of upstream firms in technology development and not that of the
companies that market products. For this reason this study investigates Fullpower, a leading American company in the production and development of smart technologies. In particular, we refer to a specific technology developed by Fullpower for a product that is known all over the world, that is, Jawbone. The selection of a single-case study analysis is both empirical and theoretical to try to enrich the knowledge around the technology development phenomenon (Dubois & Gadde, 2002; Easton, 1995; Eisenhardt, 1989; Halinen & Törnroos, 2005; Siggelkow, 2007). In particular, the selection of the case followed a particular process. Having identified an innovation of meaning that is rooted in the Jawbone technology, a qualitative research methodology to investigate it was defined (Yin, 2003). Thus, we built an explorative case study. In doing so we utilized both primary and secondary resources, collecting reports available online, institutional web pages, articles, and insights gathered during direct contact with the managers of the company. All this information was collected to create the genealogy of the technology. In particular, having identified the epiphany, this study focused on the different application fields in which the technology was applied before the unveiling of the quiescent meaning in the Jawbone bracelet to define the path followed during the technology development with the intention of understanding the development and the decisions undertaken by the company. After the mapping phase, the interpretation of the results took place with the aim of highlighting a few managerial practices that can help R&D-centric companies in unveiling the potentiality offered by technology.

Empirical results
This section will describe longitudinally the process through which the company under investigation generated an epiphany. In particular, the description will start by explaining why we consider this technology to be an enabler of an epiphany and then try to express the decisions taken by the company to develop it.

Fullpower
To cope with the aim of the research, a technology-based company was needed, especially a company that was able, through different developments of the technology, to identify different application fields. Consequently, by screening the digital market, a few tech suppliers were identified. In particular, the focus was on the supplier, because in that field are the real companies that develop and bring the technology to the market. In addition, to be consistent with the investigation, it was not enough for the company to develop a technology internally; it should have developed technology epiphanies through that technology. This limited the available companies considerably, so our final decision was to study Fullpower.

Fullpower is a US company founded in 2003 that deals with several digital technologies, but it is famous worldwide for the sensors that it develops and in particular for a

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1 Fullpower was founded in 2003 by Philippe Kahn. Thanks to his passion, the company has been a leader in the sensor manufacturing industry since its foundation. The company’s particular mission is to integrate motion sensors into mobile devices. To achieve that, Fullpower developed a peculiar accelerometer and an IT platform called MotionX.
technology called MotionX. MotionX is basically a platform on which an accelerometer, especially a three-axis one, interacts with a very sophisticated and accurate algorithm. In today’s world accelerometers are widely used for several different purposes, from entertainment, such as the Nintendo Wii control system, to safety features, for example air bag activation. They are sensors that recognize the acceleration experienced by an object. In particular, by studying this technology longitudinally, we were able to understand that the company was capable of launching onto the market several different products that were introduced into different application fields. In detail, it first launched a mobile application to test the software part of the solution, which was a dice game, then, relying on its data analysis expertise, it started to identify potential markets in which the combination of it and the sensor could create a more meaningful application, unveiling a quiescent meaning of the technology. Thus, the company came up with the Jawbone bracelet. This can be considered as an epiphany, because, exploiting the same technology as several different fitness bracelets, it was able to monitor in detail the sleeping action and change the meaning of tracking. Indeed, it moves from pure fitness tracking, the number of steps taken, kilometres run, and so on, to 360° fitness in which sleeping is also crucial for the recovery of the body. The wake-up feature is one of the most important features added, and it was first introduced by the company. Analysing the movements and data from the sensor, the algorithm is able to understand whether the person who is wearing the bracelet is in REM or non-REM sleep, allowing it to wake up the person in the smoothest and most appropriate way by considering the sleep moment. This allows the company to change the reason why people should buy the product, moving from the concept of feeling good is fitness to that of feeling good is living well. Thus, we can conclude that the MotionX technology is a technology epiphany and that studying the history of the development further can give us insights into how the company moved from a mobile application to a well-being bracelet.
Looking at the history of the development of the technology and ultimately the technology epiphany, the first application field identified was the mobile application one. Launching the MotionX-Poker application, based on a 3-D rendered die, the company was able to develop the software and the technology of interaction more between the sensor, the accelerometer present inside the smartphones, and the algorithm.

The second step of development was the identification of an opportunity to develop its own sensor to exploit the potentiality of the technology better, so the accelerometer was developed by Fullpower. This decision gave birth to the Nike+ activity tracker in 2010. This tracker allows users to monitor the distance walked and run.

The third application of this technology, which required further development, was the Jawbone ERA. This product is a headset that recognizes the movements of the headset that the user can make to enable different actions, such as call answering or rejection. This product was the first to come from Fullpower with the aim of integrating both the sensor and the software.

The final application and the one that enabled the epiphany is the Jawbone UP. This product emerged at the end of the development of the technology, and it was mainly driven by the willingness of the company to address a new application field. Indeed, the technology development was boosted in the motion recognition not only when people are
in real movement, such as running, but also when they are resting in bed. This further development of the accelerometer was guided by the foresight of the owner of the company in identifying new application fields.

**Discussion**

This section is mainly dedicated to the critical analysis of the case to understand the decisions taken by the company to identify different application fields.

Analysing the case, we understood that a little information about why and how the technology was developed emerged. Indeed, what emerged immediately from the empirical results reported previously is that, to identify a meaningful application field and give rise to an epiphany, a company should explore the technology through different application fields. This is mainly due to the necessity of understanding the opportunity offered by the technology, because this enables the company to steer the development to gain a competitive advantage from the implementation of the technology in products. Thus, it is clear that the first phase of the technology development followed by Fullpower is the *exploration* one. Indeed, in this phase, through the identification of several application fields, like the mobile application, the activity tracker, and the headset, Fullpower was able to understand the MotionX technology a little more. The outcomes gathered during the explorative phase turn into inputs for the second phase of the innovation process, which can allow the company to identify a more meaningful application field. In particular, the explorative phase concerns a creative and divergent process to generate solutions that is shared among practitioners; during this phase a heterogeneous team of experts and the presence of both designers and material scientists can bring useful and valuable insights to the technology development.

The second phase is the *selection* phase and aims to transform the opportunities identified into the identification of the new application field in which the technology can embrace potential new meanings, allowing an epiphany to occur. The application in which so-called quiescent meaning can be unveiled can allow the company to achieve a significant competitive advantage in the market or to create a new market.

**Explorative phase**

From the case study conducted, certain insights emerge regarding how to explore the opportunities offered by a technology. In particular, the figure reported below shows different approaches to the exploration phase.
Looking at Figure 3, we can see that three different approaches are envisaged. The first, most common, way to exploit the technology appears to be the *technology substitution* approach, in which the new invention is used in a straightforward application. In other words, an older technology is replaced by a new technology that typically performs better. With this approach no new meanings are brought to end users. This approach does not lead to an epiphany, because no quiescent meaning is unveiled. An example of this methodology is the first usage of MotionX in the Nike+ product. In this case the technology was used to substitute the previous pedometer technology, but the meanings remained untouched.

The second approach involves the exploration of the *straightforward activity chain*. By this denomination, we refer to all the types of activities that are strictly related to the previously addressed application field. Indeed, identifying closer activities to the one currently addressed by the solutions allows managers and researchers to understand the need and the information that they can leverage to offer a new product that can be based on the same technology slightly developed. With respect to MotionX, this approach allowed the company to move from an application that was made to play poker to the creation of an external sensor for fitness tracking. Indeed, the activity chain is the same—smartphone infotainment—but the service provided is quite different. In addition, if we consider the exact point in the activity chain, we can outline the difference, because it is in the end product, the mobile app, whereas the other exact point is in the sensor that populates the mobile app.

The third approach is referred to as *experience exploration*. In this case the exploration is even enlarged; indeed, this approach suggests that the company should focus on the overall experience in which the current technology is used. If we consider Fullpower and MotionX, this approach can be seen in the development of the Jawbone UP starting from the Nike+ product. Both of the solutions are in the overall experience of motion tracking, but the experiences to which they refer are completely different. In a sense the company was able to jump to another activity chain that involved the tracking experience but was different from fitness and running monitoring, which was sleeping recognition and
analysis. Thus, what emerges from the case is that the probability of creating a technology epiphany in this case was larger, because the company opened up the technology’s boundaries and tried to identify several different application fields in which the value and the meanings were greater. Table 1 summarizes the findings in term of the probability of realizing a technology epiphany.

<table>
<thead>
<tr>
<th>Technology epiphany approach</th>
<th>What should I study?</th>
<th>When is the adoption of each approach preferable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity chain exploration</td>
<td>The output of the technology application</td>
<td>When the applications are well known</td>
</tr>
<tr>
<td>Experience exploration</td>
<td>The overall experience provided by the technology application</td>
<td>When many applications have previously been disclosed</td>
</tr>
</tbody>
</table>

**Selection phase**

Having described how the explorative phase works by digging into the case, we were able to understand that a second moment took place after it. In particular, the output of the exploratory phase is the input of the selection phase, and what emerges from the analysis is that these two phases are iterative and not subsequent. The deep study of the case outlines that there are some drivers that can lead to the selection phase. In particular, having created a heterogeneous long list of possible new applications, the selection of the more promising studies is based on the following four criteria.

1. **Value for users** (will people love it?): This criterion is based on the appeal that the product has to final users;
2. **Differentiation** (will it make a difference in the competition/current path?): This criterion represents the capability of generating a competitive advantage;
3. **Appropriability** (can we ‘own’ the meaning? Branding, technology, distribution): This criterion represents the ability of the company to retain the profits generated by its research activities and limit imitation by competitors;
4. **Feasibility** (is there any interesting product/service idea already?): This criterion represents the investigation of whether there are previous ideas and/or prototypes of the technology that have been studied in the market.

These four criteria emerge from the analysis conducted on the shift between different application fields explored by Fullpower during the development of the MotionX technology. Indeed, choosing to steer the MotionX technology to foster the realization of the Jawbone UP forced Fullpower to take into account different aspects of the technology. After evaluating the potential value for the user, the company decided to add a new feature to the fitness tracker, sleep monitoring, following the insights of the founder, Philippe Kahn, because every design-driven innovation employed these emotional aspects of the purchasing process. Moreover, it was a differentiation choice, because it opened the market of tracking bracelets to a new and different segment of users. Indeed, it allowed the company to focus also on people who want to feel good and not only people...
who are addicted to running. In addition, in terms of appropriability, this choice is interesting thanks to the brand awareness created through the communications of the sleeping recognition and the wake-up modality. There were no other solutions on the market for the feasibility concerns at the time of development.

**Conclusion**

Considering that competitiveness is increasing and the costs of technology development and investments are rising in today’s market, a deeper knowledge about how to foster radical innovation is relevant to both practitioners and scholars. In line with the foregoing conclusion, this paper has enhanced the knowledge around the concept of technology epiphanies. In particular, it has provided some insights regarding how managers can approach technological development to unveil quiescent meanings. Revealing the processes and the sub-criteria embodied in the two phases is useful for both practitioners and researchers to comprehend better how to create and approach technology epiphanies. This step is particularly important with respect to exploration and gathering opportunities. In other words, companies and managers can truly exploit technological development through exploration. Considering the costs and efforts that a new technology development process requires, companies should be interested in being able to enhance the potentiality of the impact of technological development. In particular, the exploration in this instance is not casual but guided, and the basic assumption is that the exploration can occur in two directions: either following a previously addressed activity chain or within the experience in which the first application was launched. It is especially important that, after the first explorative application, the firm can enlarge its horizons by creating a list of different application fields in which the newly developed technology can be applied. All these opportunities are then evaluated with a structured approach during the selection phase and converge in the selection of a single application field. This convergence process helps to leverage the four criteria and assists managers in choosing one application field at a given time. Understanding the technology and exploring the opportunities offered are just two of the important areas to examine when developing a new technology. The investigation also revealed the idea that managers should create a multidisciplinary team to address the development of the technology. Indeed, adding different perspectives in both the explorative and the selection phase can lead to real insights into the progress of the technology.

Bearing in mind that this is an exploratory study, the evidence and the clues outlined are not generalizable, which is one of the most relevant limitations to this investigation. Nevertheless, this growing attention to R&D effectiveness is an important factor in creating knowledge and consciousness around the technology epiphany concept, because it can help companies to create both new markets and more meaningful applications and—as a result—radical innovations. Thus, this area represents one of the most significant follow-ups for further research in the field. Technology epiphanies are an under-researched topic that is relevant to several sectors—not just the digital technology sector—and several nations. Finally, a more quantitative and structured approach can be used to enhance the knowledge around the two-step process identified in this paper.
References


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Interdisciplinary View on Design Education

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With rapid change of the connotation and denotation of discipline development, design is infiltrating deeply into the human society and transforming extensively our design education. However, in order to produce more significant influence to the real world, design is seeking new knowledge and practice at the junctions of different disciplines, which forces us to rethink the cross-culture and cross-discipline directions of disciplines.

With crossing and integration of interdisciplinary knowledge, the paper further analyzes the “knowledge” of design education and then constructs the organic combination of “five-access tendency” of design education—technology access, management access, sustainability access, business thinking access and design innovation access that conform to an interdisciplinary perspective. It is expected to break the barrier among the disciplines of technology, design, economy, environment and sociology. The aim is to create a brand new interdisciplinary open mode of teaching and enhance the quality of modern design education.

keywords: interdisciplinary; innovation tendency; design education knowledge, design education thinking.

I. Historical background of the interdisciplinary development of design education

From the different perspectives, such as discipline, culture, technology and economy, design fell into crisis once more in the 21st century (Bremner and Rodgers, 2013). The crisis of design also gets design education caught in confusion. How to cultivate the designers that the society needs? What kinds of design are required to serve China’s economic transition and satisfy the development demand for knowledge reconstruction? This is the
question that all related teachers in universities and colleges, all related institutions and enterprises have been discussing.

With the great transition that information technology brings to human life, design and multi-discipline blending is permeating to enterprises, society, culture, economy, zoology, business and other aspects with irresistible influence. The society has an enormous demand for the professionals in design that can handle all kinds of problems under this background. Under such pressure, on the one hand, the current challenge has exceeded existing designing personnel’s coping capacity, and institutions of higher learning have to think about the mode of designing personnel training. An indisputable fact is current designing graduates’ ability cannot meet the actual demands of the society and lots of graduates change their profession, causing severe loss of educational resources; however, the society, especially enterprises have been troubled with the difficulty in recruiting appropriate personnel (Zhang and Zhao, 2013). Against such background, the transition of design education, compared with other disciplines, is better to combine the result of current technology, society, economy and industry changes.

On the other hand, the driving force for innovation has turned from technology and market to society and culture. The rapid development of interdisciplinary innovation education creates a new communication site, and also constructs an interdisciplinary platform that spans time and space and is able to encourage co-creation and co-share (Fu, 2014). As an important component of society and culture, art design itself contains the core value necessary for information cognition, dissemination, and artistic expression. Therefore, promoting the integration and blending development of design industry is the inevitable choice of the global knowledge era and the transformation in design education field.

In conclusion, how to promote and guide interdisciplinary knowledge intersection and how to cultivate interdisciplinary open innovative designing personnel in order to drive the development of design discipline has become a pressing topic for discussion of current design education.

II. The fracture in the boundary of design disciplines and multi-disciplinary blending

The orientation of social demand finally drives the multi-disciplinary blending of design discipline education. How to comprehend discipline crossing design in the new age and search for wisdom behind education system is the brand new challenge facing current design education.

As shown in Figure 1, first, the difference of design education objects in different fields results in the different forms of design processes, design tools and expert knowledge. The designers to be cultivated in the future in fact relate closely with social practice development. The design education in the traditional time of design is merely the single technical expertise impartment; however, up to now, in order to meet the demand of mass market, its knowledge construction is increasingly tending to the crossing construction mode in social responsibility, commercial platform mode, system innovation and other directions rather than in a single or multiple disciplines. The development of new social media and new technology makes designers play more roles in the industry in this
transformation period, such as designer, artistic, consultant, strategist, corporate planner, conceptual designer, executor, media workers, information personnel, designer managers...

Second, there is also intersection and crossing between design and many other disciplines. Now, the boundaries of the closed systems of the design disciplines that are previously considered to be independent, such as ergonomics, engineering science and management science, have been broken and continue to dissolve (Bremner and Rodgers, 2013). As shown in Table 1, the key points of the changes in discipline boundary lie in that people have realized there is uncertainty in current occupation boundary, and the mobile employment mode among traditional design disciplines have become a normal state.

In addition, the infiltration and change by interdisciplinary education to our world is underway. Many appeals of modern design are just nascent in many social fields but haven’t reached a mature mode. The project designs, such as those in business, management, environment, interaction and data visualization requires designers’ close participation as the core of the projects; at the same time, the supports from different professional knowledge fields are also needed in this process.

![Boundary of design disciplines and core component of knowledge blending construction](image)

*Figure 1  Boundary of design disciplines and core component of knowledge blending construction.*
Table 1  Features of designer and discipline under different discipline boundary.

<table>
<thead>
<tr>
<th>Discipline boundary</th>
<th>Designers’ features</th>
<th>Discipline features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-discipline</td>
<td>Individuals are able to understand one group of concepts or a kind of methodology. They can raise questions of knowledge within single discipline scope and make single technical contributions within this field.</td>
<td>It is possible to comprehend the single concepts and methodology that come from practice. It is possible to tolerate problems and only contribute design in this field.</td>
</tr>
<tr>
<td>Technical Expertise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple-discipline</td>
<td>Individuals manifest discipline ability and understand that their efforts must link with the efforts of those from other disciplines. Therefore, they set about to comprehend and apply some of the concepts used in these fields.</td>
<td>It is possible to comprehend differences of disciplines and demonstrate the ability to learn from other disciplines.</td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interdisciplinary Knowledge</td>
<td>This problem solving mode synthesizes relevant cross-disciplines, for example, design science and engineering science. Some designs include many different fields. Some of the fields are related to integrated disciplines.</td>
<td>It is possible to comprehend the blending and integration of different disciplines, which have been interconnected in different fields of design itself.</td>
</tr>
</tbody>
</table>

III. The design thinking orientation of interdisciplinary design education

The mission and significance of interdisciplinary design education just lie in breaking discipline boundary and integrating the application of multiple-discipline knowledge with design thinking; cultivating excellent talents who have multiple cultural perspectives and interdisciplinary team working ability and who have the courage to solve actual problems and embrace actual challenges; and training versatile talents to serve the demand of service industry (College of Design and Innovation, 2016). What this mission embodies is the discipline construction within the system. This mission emphasizes the result of innovation development more. The demands of design education, design practice and design researches are recognized once more extensively.

As shown in Figure 2, the fundamental objective of interdisciplinary design education is to make students seek new knowledge and practice at the junction of different fields. Namely, it is to improve various complex systems through “knowledge integration” and “knowledge blending” to provide unique knowledge experience for students; to make knowledge blend with the constantly changing environment so as to increase the difficulty for students to solve problems and communicate with others and to enhance students’ design practice, problem solving, teamwork, communication and other abilities and employment competiveness; to develop passageway to contact with enterprises from multiple fields for students through interdisciplinary knowledge integration and design practice courses and
allow them to get the opportunity to know about enterprise integration operation mode before they join the society; meanwhile, to join relevant innovation contents and provide entrepreneurship cultivation, entrepreneurial knowledge reservation and the entrepreneurial application opportunity at school for students.

![Diagram of Thinking orientation of interdisciplinary design education](image)

*Figure 2 Thinking orientation of interdisciplinary design education.*

The knowledge crossing mode of design research is undergoing new changes along with social and technical transformation. To see this clearly, we must consider the emerging situation—open source and point-to-point working method make new education transformation possible (Manzini, 2016). The application of internet and other high-tech technologies will form a system to involve more and more students. In fact, inspired by the point-to-point and open source spirit, various design teams may develop design projects and studies in accordance with their resources and opportunities; meanwhile, it composes design study activities on the grand network together with other similar teams. This is an open design study plan, through which, students may handle some complex issues, and obtain explicit, discussable, passable knowledge integration that can be accumulated (Manzini, 2016).

On the other hand, the sharing of this design research information is free, for example, design trend, business studies and sustainable studies, etc.; the most important aspect of
all is it is possible to put forward some valuable untraditional and critical points of view and thus facilitate achievement transformation; in turn, it can promote open research program of courses and the progress in innovation and entrepreneurship. Therefore, the roles schools play shall be guiding traditional design to sustainable development of creative design.

The application in design practice provides design thinking tools and methodology for the open education of students, thus cultivating interdisciplinary creativity and research. It encourages that students’ practice shall lay emphasis on “open style interdisciplinary cooperation mode” and it is dedicated to bridging the gap between design research and the change in real world, thus turning existing design practices into a better practice system. In practicing field, experts in and out schools and commercial resources are brought together. Aiming at the innovation works formed during teaching, it is necessary to carry out further development and create socialized and industrialized opportunities for design achievements, striving to hatch and produce independently innovative products that have industry-leading significance (Fu, 2014).

IV. Open innovation tendency under interdisciplinary design perspective

Open creative design and innovation blending are the intrinsic requirement of interdisciplinary design education. It is to construct the “five-access tendency” of interdisciplinary open innovation. The “five-access tendency” includes technology access, management access, sustainability access, business thinking access and design innovation access. The five components shall be integrated organically and thus it constructs the “five-values” of interdisciplinary design, namely: economic value, knowledge value, innovation value, client value and ecological value. (As shown in Figure 3)
1. **Advanced technology practice be introduced to the design education**

Rediscovering new technology is an important education method (Lou, 2015). With the development of knowledge-based economy, the high-tech innovation has not only promoted industrial transformation and upgrading, but changed the business models as well as improved the design education environment. The characteristics and application of science and technology have exerted profound and significant impacts on traditional forms of enterprises and human life styles. When the digital technology combines with daily life, rest and recreation or even education of common consumers, the technology innovation and application exhibit infinitive room for development, also leads to unlimited business opportunities for various kinds of creative industries (Lin et al., 2009). As a matter of fact, the successful commercial designs are in need of technology supports which enable the realization of diversification of dissemination forms and performance results for design information, thus meeting the requirements under Social Orientation, Service Orientation and Experience Orientation.

How to apply the technology into relevant design education and whole society, we should focus on the cultivation sector for digital strategy innovation ability (as shown in Fig. 4), digital culture creativity contact, digital experience media strategy, digital virtual experience
of future in order to facilitate students to study and practice multi-dimensional designs in theory as well as in practice level. Following the aforesaid rule, one experience practice system based on “strategy and experience” has been established in accordance with characteristics of different design professionals as well as students' background knowledge for the purpose of optimizing scientific and commercial development. Within such system, students could understand and experience the whole business models from the analysis of entrepreneurial environment to determination of business forms, even to refined products service modes and product marketing concepts through the combination of technology and actual practice. This trend could be applied to every sector of education and society accordingly. The Virtual Environment concept mentioned herein: do you have the awfully experience standing in supermarket check line, or waiting in line for fruit weighting? Then the Virtual Environment technology could help you to solve such problems. During the teaching course, the combination of digital virtual experience of future with visual design would enable students to understand and experience the whole procedure of technology-based entrepreneurial, and thus complying with the dynamic trend and education orientation of social development.

![Figure 4: Design + Technology: Interdisciplinary knowledge creates values.](image)

2. **Advanced management innovation be introduced to the design education**
Rediscovering the design management has great influence on economic value, which leads the students to realize their designs and careers in the future would affect economy (Lou, 2015).
The management is used to guide design development. In current society, design interacts with society, environment and business inevitably. Being a significant matter for economy
and acting as the communication tool as well as business strategy, design management has promoted its status dramatically, and pushed the actual potential of design to enterprise’s agenda (Best, 2008). Furthermore, the basic goal of management is to improve the efficiency of product development in order to create competitive advantage (Galli, 2016). Enhancing the scientific design management, using the management to ensure optimal results from design; through meaningful change, the management not only drives innovation, but influences enterprise development programs. In terms of education, design management contributes to fostering the students’ awareness to be prepared for enterprises’ future development, which consequently shaping more comprehensive and strategic education models.

3. **Sustainable concepts be introduced to the design education**
   “Ecological Balance” will lead the green, intelligence and personality characterized by sustainable education. The sustainable design education requires considering the economic, environmental, moral and social problems in balance, pursuing the harmonious development of human and environment, which not only satisfy the needs of contemporary generations, but ensure the sustainable development of descendants; on the other hand, “Social Responsibility” facilitates the structure of interdisciplinary knowledge for sustainable design and education models, which promotes the shaping of sustainable education development models and life styles.

4. **Business model thinking be introduced to the design education**
The introduction of business model thinking into education is an innovative process, which focuses on the human nature and people-oriented concept in essence. Developing the creative industrial courses based on design thinking, fostering the creative design ability of team and combing the industrial needs to provide design methods in order to support the students to develop brand-new products and enhance their technical ability; during the term, observation, cooperation and quick learning are stressed. Meantime, being a new design education model and teaching method, visualizing the ideas and modelling the quick concept as well as analyzing the business models could promote students to discover the unsatisfied needs and opportunities, thus creating new solutions. Adopting such education method and combining the problems during the courses for analysis is helpful to learn and practice the spiral progressive thinking and working methods.

5. **Design innovation be introduced to the design education**
Design could not only drive the innovation, but promotes the changes of social life style and new economic transformation (Lou, 2015). When starting innovation through design, and using design to intervene into the primary stage of integration education, we could bring the effects of design and multidisciplinary influence into people’s daily life which is utilizing the business thinking earlier (Xin, 2015). The promotion of creative products based on design background will becomes one part of the innovative system for design education.

V. **Design practice course experiment based on interdisciplinary education concept**
For the design courses based on the interdisciplinary concept, the overall objective of the experiment is to foster the idea of "design with the future", to make the designers the
program providers for future challenges, and to let students think on design in encouraging experiments of different projects. Based on this goal, the sustainable design practice curriculum under the background of interdisciplinary education has undergone subversive changes from design tools, design methods, design process and design research. Each student will play a different role in the design process.

First, according to the different subject choice, the course focuses on the "creative design" of the interdisciplinary education of knowledge, and faces the challenges with industrial value and social significance. Through the challenging curriculum, and with the help of cultural design experiment, media experiment, commercial sales experiments, student knowledge will be promoted to integrate and the potential of students will be released. The experimental results will be used to establish a good knowledge base. Cooperation with enterprises is made to increase experiments’ benefits and to attain a win-win situation. Besides, in the process of self-learning, students’ capacity for sustainability will be developed and new values will be reshaped.

Challenge Method 1: Encourage students to do small projects, give students unique design challenging topics.

These small-scale projects are to encourage students to find, and to focus on the achieving. Giving challenging tasks, is to encourage students to learn different skills with their personal strengths, so that they can make their design thinking out of the ordinary. The "knowledge economy" drive effect is used to promote interdisciplinary creative goals. It is the future development trend that students can achieve the growth of knowledge and cultivate unique business thinking. Through "personal interest" and "problem solving", the designers are bringing the traditional design to the "sustainable development". As shown in Figure 5, though for our undergraduates we have no jewellery courses, students with love of jewellery, are combining their base of aesthetics, technology and business model, and developed some creative custom projects of integrated materials jewellery.

![Figure 5](image)

**Figure 5** Students’ business design products from steps of "personal like", "solution" to "sustainable development".

Challenge Method 2: Integration of teaching practice by combining with the policy of entrepreneurship in Beijing universities.

Based on the Beijing High School Talent Cross-training Program on Entrepreneurship, we encourage students to take innovative discovery and new applications under the national
policy. We select and establish the design direction and objectives through the interdisciplinary policy resources research, and choose topics that are closely related with the course by combining with the content of course teaching. We enable students to experience the design of entrepreneurship education. We add value to design through cultural and creative thinking, and promote entrepreneurship through culture, creativity and design process. In this way, we achieve the goal of combination of technology, creativity, design and business knowledge economy (Lin 2009). In the practical operation, the entrepreneurship must pass the "curriculum" to "the entrepreneurial policy", then arrives at the mode of creative business product under guide of entrepreneurship policy. As shown in Figure 6, one work of 2016 graduates, combined with some related policies of the Beijing High School Talent Cross-training Program on Entrepreneurship, is a product of "paper word only" children's text toy. The main text which is designed with semi-enclosed structure, full structure, up-and-down structure, left-and-right structure, and graphics, can generate more than 1400 characters. Through the plug-in design, it can be used for both literacy education and games like three-dimensional intersection paper toy, word grouping games, integrated games, digital games, games of shape, games of colour and others.

Figure 6 Graduation Design products for the Beijing High School Talent Cross-training Program on Entrepreneurship

Challenge Method 3: Encourage product market feedback and patent application and protection
The course includes interdisciplinary research, creative design and user needs and feedback analysis, product strategy points searching, both business, value creation combining society, environment, and users. It’s achieved through a wide range of experience touch points like product experiments and patent protection. In the process, the methods of business model analysis and sustainability assessment are used. For example, before massive production in market, the "paper word only" text toys are tested and analyzed in the New Oriental Bubble Kindergarten for class of kindergarten-to-primary-school transition, and creative courses in Muxidi campus.
Challenge Method 4: Group cooperation and teamwork training and coaching
Students from different areas, e.g. from architecture, business, informatics and so on, are gathered to cooperate with each other. Individual working is changed into teamwork in the form teaching practice. The knowledge is divided into different optional modules: design thinking and technology preliminary, precise development and rapid prototyping, business models and products and services, integrated presentation and publication and promotion. The practical teaching is taken in the form of teamwork, and the corresponding teaching tools are designed according to each module. The students are expected to master a variety of knowledge in the process of module structuring. At the same time, consultants and experts in science and technology, media, business are invited, to provide an extension of the knowledge, so that students can build their own knowledge architecture with their own characteristics.

On the other hand, we encourage the integration of different disciplines of expertise into design and translated it into research results, and actively assist students to develop creative counselling in different disciplines, which finally lead to the potential inner intelligence of students. We are expecting that students have a lifetime learning enthusiasm and motivation.

Challenge Method 5: Actively promote enterprises to join the design teaching
With the media of design, we guide students’ business cooperation with enterprises and collaborative innovation work. Students should be able to face and undertake design work systematically and in an all-round perspective. We invited designers and R & D supervisors of related fields to give keynote speeches and to work as project instructor. Students can visit related workshops, understand the product design process, provide samples and prototype for the enterprises and provide technical support for the design. Ultimately, the good programs are chosen for prototype making. In this process, students’ creative interests are stimulated, and their sense of accomplishment is produced.

VI. Conclusion
The development, change and confusion that design discipline and design education face are global challenges of the time. Therefore, designers must absorb more knowledge, think more extensively and switch their roles in order to suit the need of social development. Only in this way, can an open, compatible and continuously developing design thinking logic and matching interdisciplinary knowledge system be formed in this age of knowledge economy.
Accordingly, the students are able to suit the demands of design works, researches and innovation in the future.

The change in the demand of design personnel by the society finally requires design education to make corresponding intersection and transformation so as to suit the steps of the development of times. Through the discussion of design thinking and innovation education during design education transformation under an interdisciplinary perspective, this paper realizes interdisciplinary knowledge integration and establishes a mechanism to cultivate the high-quality professionals boasting a wide range of knowledge; as it emphasizes the execution of crossing-design, it also stresses on the integration of students’ academic studies, researches and knowledge. It dedicates to fundamentally alter the traditional education mode centring on single knowledge and cultivate new force of designers which does not only comply with the demand of the time but also stay down to earth. Only if the barriers between disciplines are broken and different disciplines are combined together, can the excellent designers who are both professional (Zhu, 2012) and open-minded be cultivated. Further, only in this way, can the diversified demand of different markets be really satisfied so as to give specific benefits and contribution to national economic development.

References

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Influence of design to implement a thermographic device for preventing diabetic foot ulceration

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The term Design Thinking highlighted the importance of design as a creative tool in promoting effective innovation; its importance has been increasing in academia as in business. Thus, today design is a more recent area of investigation whose main requirements define the limits and perspectives according to theory. In practice, it is necessary to establish the differentiation of values and innovations that make the object of study desirable. This article aims to show that the Universidad Autónoma de Querétaro’s (UAQ) design-led thermal camera research and development, encourages collaboration between researchers, engineers and designers to implement this technology in a medical device whose goal is to prevent the formation of ulcers in patients with diabetic foot. The concepts applied to reach the goal are "Radical change of meaning" and "Interpreters" of the Design-Driven Innovation and the adoption of the method called “Asignification” developed in Germany by The Dark Horse design studio.

keywords: design; diabetic foot; innovation; thermography

Introduction

Design is inherent in any human development. Everything that surrounds us is a result of the creation and inventiveness of people and business force. The design process has led to research with the purpose of documenting how to apply creativity in the daily creation of competitive products or services. Among these aspects is the user-centred design of Don
Norman in 1993, then moving to Norman’s emotional design in the 2004, and Design Driven Innovation proposed by Roberto Verganti in 2003.

All the research proposals on the cognitive processes of design and social behaviour are classified within Design Thinking, a term popularized by its application in business development by the company IDEO founded by David M. Kelley in 1991. These design theorists converge towards the journey from form to function through three main variables: morphology, technology, and usability. However, Verganti and Norman agree on the link between message-emotions to engage users with meaning in everything they prefer to consume (Zampollo, 2015), linking experiences and intangible characteristics that broaden the way of innovation (Malaver, Pérez, & Rodríguez, 2016).

In linguistics, meaning is defined as the way of expressing or representing a concept (Royal Spanish Academy, 2016), then “Asignification” is the act of breaking with the representations of established concepts; Verganti claims that design discourse is the result of the interpretation of different cultural languages. "Interpreters" or agents of change share information that leads to the resignification of the meanings perceived by costumers. It is therefore possible to conceptualize objects or services that people desire as shown by Rampino (2011) in the “The innovation pyramid” (p. 13) in Figure 1 below.

![Figure 1 The Innovation Pyramid. Source: Adaptation from Rampino. L. (2011).](image-url)

Design then is not just about generating ideas, it is a thought structure to answer two simple questions What? And How? So where is there space to innovate or design? It becomes the intangible activities of the designer who will give the answer through new How’s? and What’s? through experiences and meanings (Dorst, 2015).

This feature of design is promoted as an alternative to solve complex problems in fields such as in sports to win more medals by mixing design thinking with training (Coyle, 2016); in the field of economics and administration, it is needed to break the paradigms of indices of innovation capability based on technological levels (Malaver et al., 2016); as a reform in the implementation and development of civil protection programs in urban areas affected by hurricanes (Ovink, 2015); and in the development of agriculture (Yagita and Shirasaka, 2015). In the field of research, design is an effective tool for technology adoption and promotion of new products, services, processes and systems (Matarranz,
This latest example is the objective of this research and demonstrates how Design influences the adoption and development of a device for preventing diabetic foot ulceration.

**Diabetic foot**

The design of a medical device to prevent the formation of ulcers in patients with diabetic foot was selected since the prevalence of type 2 diabetes mellitus (DM2) has 6.4 million cases in Mexico; one out of three deaths is due to this disease (World Health Organization, 2016). The absence of symptoms in the early phase is the main disadvantage in the timely detection of diabetic foot, which causes serious health complications such as amputation of the lower extremities (Ojeda et al., 2012). Twenty percent of patients diagnosed with T2DM will develop ulcers due to risk factors such as poor quality of diet, obesity, depression, and stress that accelerates the development of the disease (Pérez, Villalpando, Shamah, & Méndez, 2014).

Diabetic foot has among its main health implications, the formation of ulcers, which when not detected trigger as an infection in tissues which severely affects the bones, nerves and blood supply. If this ulceration is not detected at an early stage and the lesion is neglected, then limb amputations are the only option. In order to contribute to the solution of this problem, numerous investigations have been carried out to develop more advanced methods of diagnosis and control.

**Technology review for prevention and treatment of diabetic foot**

As a proposal for the study of the medical protocol for diagnosis of diabetic foot, we attempt to present a classification of the most important studies related to the following variables such as temperature, blood pressure, loss of sensitivity, as well as biomechanical points of support for the foot. For the analysis of these variables we use methods that are divided into invasive and non-invasive.

**Invasive diagnostic methods**

It applies to procedures and devices that involve chemicals called contrasts that are injected or tools to physically penetrate the patient's body (Cofepris, 2016). These methods are applied in cases of arterial calcification or to verify etiological factors that in most cases end in surgery due to the lack of timely diagnosis.

Among the invasive methods related to the pressure variable, we can mention arteriography, angiography (CT or MRI) and biopsy (Castro et al., 2009; Contreras, Ibañez, Roldán & Torres, 2014).

Invasive diagnostic methods were the only technologies in the market between from 1970 to 1980 (Banerjee, Beckmann, Busch, Buzzi, & Thomas, 2012; Comin, Nerín, Villarroya, Pérez & Marco, 1999), and have hardly changed to the present time.

**Non-invasive diagnostic methods**

Applies to procedures and devices where no tools are involved to break the skin or physically penetrate the patient's body (Cofepris, 2016). These methods are used in the early stages of diabetic foot, grade 0 and 1 according to Wagner scale.

**Blood pressure variable**
The most well-known non-invasive methods related to the blood pressure variable are: photoplethysmography, the ankle-brachial index (ABI), ergometry and Eco-Doppler. The aim of the Eco-Doppler is to develop an arterial map to decide whether amputation will be performed on the upper or lower leg section (Castro et al., 2009; Contreras et al., 2014; López, Dotor, Silveira, Giannetti, & Herrera, 2009).

**Loss of sensitivity variable**
Regarding these types of methods, those related to the loss of sensitivity variable are the 128 Hz tuning fork. The most current alternative to this type of tool is the Biotesiometer®, a device that emits electrical charges that are necessary to evaluate the sensitivity in the foot using algorithms; The Semmes-Weinstein monofilaments of 10 g are within this group, so are (Armstrong, Lavery, Vela, Quebedeaux, & Fleischli, 1998; Castro et al., 2009; Contreras et al., 2014).

**Biomechanical foot points**
The methods associated with biomechanical foot points are the following: simple podography, Tempstat® pedigree - the most viable technological proposal to date - and baropodometry, in two very common brands: F-scan® And Pedar-X® (Castro et al., 2009; Júbiz, Márquez, Márquez & Brugés, 2012).

**Temperature variable**
Finally, the variable of interest in this research is the temperature among the devices related to thermograms is the Podimetrics™ device a network of sensors shown in Figure 2, used to analyze the variations of temperature and pressure in the sole of the foot. This is an application of telemedicine that was the thesis subject of Eng. Robert Som in 2013. Among his advisors was Dr. Armstrong, a research pioneer in the correlation of temperature variations and diabetic foot conditions. Currently, this device is in the commercialization phase through a spin off from the University of Texas. Infrared thermometers such as the GlucoQuick® brand are also included in this classification (Hernandez, Peregrina, Rangel, Ramirez, & Renero, 2015; Peregrina et al., 2014; Vilcahuaman, 2013).
Role of design in disruptive technological development
The innovation of all these medical devices is incremental, which has been analysed in countless engineering documents in biomedical, computational or electronic areas. However, if design is allowed to direct technological development and research, representative products are conceptualized that break with the usual methods for diabetic foot prevention, as it is the example of Neuropath™ compared to the aforementioned Podimetrics™ device illustrated in Figure 2.

A patch of clear polyethylene adhesive, which protects against outside environmental humidity. This patch includes another patch inside impregnated with 11.56 mg of cobalt dichloride. Each molecule must react with at least 5 molecules of water to change its initial blue colour and turn pink. The change in colour of the dressing allows us to observe the disorder of the sudomotor function allowing us to diagnose peripheral autonomic neuropathy early. (Sánchez, de Planell, Moliné & Alvarez, 2016, p. 99)

UAQ’s Thermography proposal
This technology has the advantage of being a non-invasive method as well as not requiring a specialized technician to operate in Health Clinics and Medical Offices. This was tested in the thesis entitled "Therapeutic evaluation of the diabetic foot and its association with diabetic retinopathy" (Vásquez, 2013) of the Faculty of Engineering. Its scope was delimited to obtain an interface for software, and develop a blockage to avoid thermic noise, a prototype is shown in Figure 3. The analysis of the scientific literature was the
basis for establishing four important factors in the operation of the equipment (Kaabouch et al., 2010; Nagase et al., 2011; Sun et al., 2006):

- Temperature controlled at 24°C ± 1°C in the space for taking infrared pictures.
- Foot areas –angiosomes related- to be segmented by the algorithm for image processing.
- The patient’s position was established as supine position.
- Time of stabilization of the patient, with respect to the temperature are 15 minutes and 10 minutes for recovery of physical stimuli.

Figure 3. Prototype proposal with Flir A310™. Source: Vásquez. R (2013)

The configuration of this system has been summarized in the study of other tissues of the body as it is the case of investigation of temperature-breast cancer or temperature-emotions. The continuous improvement of the technology has miniaturized the software and optimized the algorithm, for instance in Figure 4, technological research established requirements such as patient hygiene. Patients are suggested to bathe with neutral soap, without lotion, creams or powders so as not to affect the photography. Another aspect to be mentioned in previous research is the interaction with a Board of doctors as advisors in the consulting protocol for patients and equipment used to assess the diagnosis, the technical knowledge of the disciplines involved has been considered again.

Figure 4. Hardware with Flir Lepton™ and Software Optimization. Source: Morales. H (2016)
The development of the prototype has been carried out in order to provide a doctor's tool for obtaining and analysing data, as well as to show the evolution and efficiency of the last device compared with the previous one, in which the design takes part only in the formal and functional aspect of the prototype. A commercial objective has not been visualized until they are registered in the Mexican Institute of Industrial Property (IMPI), this is to protect the knowledge developed so far. Once the design is released, it will be verified if the product is viable, considering technical specifications studied and the market requirements.

**Pushing new ideas forward Design. Pulling together Design elements**

Under the scheme proposed to solve contemporary problems by Kees Dorts in his book Frame Innovation: Create new thinking by design. Design is characterized by being open with no boundaries, complex because it is immersed in many relationships and elements, dynamic since they are changing with the passage of time and are networked across organizations. Therefore, the design method is nonlinear, it is iterative, and each stage is constantly nurtured with new activities generating knowledge of interest to the designer. They can no longer be solved with trusted routines. In twenty years the design disciplines have been developed considerably so their techniques have matured to offer an alternative to problem solving strategies and replace the trend of designers to "do aesthetically appealing things," although some in the guild are not interested in leaving it (Dorst, 2015).

**Latin America abandons innovation trend**

In 2010, the Community Innovation Survey (CIS) carried out by the European index Innovation reveals the limitation of verifying innovation in countries such as Latin America, excluding them from the high technology industry; the medium and low technology sectors are not considered, although these are the main sources for these countries. The perspective of the Oslo Manual (OECD, 2005) relegates design to formal aspects, tangibility, appearance or participation in product functionality, use and performance. Like CIS, there are conceptualizations and measurements of innovation in different countries, which do not adequately describe the design-innovation relationship that is the central factor in the humanization of technologies. However, the Design fulfils as a process to generate innovation in this geographical area (Arundel, Bordoy, & Kanerva, 2008; Salter and Tether, 2006). The ability to identify, assimilate and apply existing knowledge of innovation by Latin firms in their context has not been recognized, which demands to adapt with the intervention of design and engineering (Malaver et al., 2016). Since activities of design are absorbed by other activities such as R+D, in the technological field; in the academic field have emerged proposals such as using and interacting, doing and user-driven innovation as alternatives at technology push.

**Radical change of meaning**

This concept indicates the point where the design processes are unified, to generate infinite proposals after answering the questions, How to get to the solution that breaks with the established norms? How to generate new meanings? Projecting the object of study in a framework that links future trends to the present, and links emotions that generate new experiences. Every time we live unknown experiences, our perception
expands, generating new concepts. So to generate a radical or disruptive innovation it is necessary to release the User Centred Design, not to be incorrect, but in another phase of the design process; here at this point, the goal of Design Driven Innovation is interwoven with what is a research process to generate unknown experiences, obtaining the radical meanings that we seek to express, we apply the User-Centred Design to improve concepts and finally with the tools of industrial design we materialize these new meanings; These levels of research in the area of design are illustrated in Figure 5 below (Verganti, 2009).

**Interpreters**
The actors who interpreted the phenomena that we are interested in, through their different products their designs are called interpreters by Roberto Verganti. Because design is a product of culture, designers do not work alone all phenomena are always immersed in collective research. Scientist generate primary knowledge then technicians pick up research to be applied as products, but interpreters influence people’s point of view and behaviour as consumers, they asignificate objects and make them desirable. To choose the interpreters it is necessary to create a link based on the interest of the research phenomenon and the disruptive project instead of money our expertise of meaning may be offered, as well as technology know-how, testing tools such as books, papers, concept products and presentations. Interpreters are so important at design discourse because they know other different ways to persuade people to give new meanings to products (Sigolotto, 2010).

**The three stages of products development**
Design plays an active role in Malaver and Vargas’s three main stages to develop products:

1. Emergence of the idea and conceptualization
2. Materialization
3. Marketing and communication.

It is well known that value of the product is defined in the conceptualization stage, which is the major contribution of design when using the language to generate a new message before technology (Verganti, 2008).
The first challenge of this project is to actively participate during the first stage of identifying and translating the needs of consumers in the health sector into a medical tool which may be capable of coping with needs with technological advances generated by UAQ’s thermography. The second stage of the product development, called materialization, is the most recognized by the innovation sector due to its plan, models and prototypes. Finally, the third one is focused on marketing, apart from packaging or advertising. The design requires proposals for new interaction models, new consumer experiences with the product or brand (Creusen and Schoormans, 2005). Uber or Airbnb, Inc. are examples of a new way of commercialization. In this stage, the second challenge of this project is to validate the acceptance of the product.

The proposal for validating how design influences a technology implement is to develop a device trial through establishing what the value of the product is and the new consumer experience of the proposed idea. The conceptualization tools might be a presentation prototype, a user manual, maintenance instructions, input from suppliers, a brochure and promotional video.

**Methodology to be applied**

The methodology consists of two main points; the first is the interaction with technology which is the most important, since it requires different design approaches that allow the development of the proposed device. So the thermographic technology used in this project has two main technological elements: hardware consisting of an infrared (IR) camera and a software that is the image recognition algorithm, both require different approaches for their analysis. As to the second point, this refers to various users involved. The interaction with the device can be considered of two types: direct and indirect; that is, the equipment or device will be operated by medical personnel, who are considered the direct user, while the patient will be the indirect user, since it will be the one who provides the feet section required to generate the termogramas (Money et al., 2011). The first challenge of this research will be to determine and select the "Interpreters" (Verganti, 2008), without contaminating the information or avoiding small and unprofitable elections. Once these points and intentions have been clarified, the work of this disruptive research delimited (Hernández, Fernández & Baptista, 2014), with the application of this mixed methodology for the two technological elements and for the different levels of users, essential sources for the delimitation of both qualitative and quantitative variables, which will be correlated to characterize the project in order to explain, describe and evaluate the phenomenon of study, from the design field.

**Asignification Method**

Then, based on the designing process, five stages are presented in Figure 6 that constitute the main method to be used - proposed by the German study The Dark Horse, one of "Interpreters", who agreed to participate in the revision of the design process – method that specifies in each stage of the elements and actors mentioned above influence or are influenced during the investigation (Kumar, 2012).
INPUT

The information gathered from the research process (theoretical framework of the state of the art, etc.) will also be directed by the design, as well as the analysis of existing products, along with the interpretation of technology and the cultural context in which the research is carried out, this is the impetus for the vision of trends, and even contemplates the breakdown of paradigms in the development of auxiliary tools in medical diagnosis, all of which will allow to define the "Interpreters" to define insights for development of the prototype of the proposed medical device.

360 RESEARCH

This stage is an analytic challenge, because it will be the moment to be interpreter of all the languages involved in the hard data. It is useless to mix the technological and research information because, although the design will be the link to interpret the messages emitted by the different participants in the context of health (Verganti, 2009), it is necessary to reflect on this subject to try to solve the following question. How to reinterpret the information obtained? The pretension to answer such a question will be in a planned selection of "Interpreters", to form a trans-disciplinary team, chosen by their experience to observe through all the socio-cultural, technological and design perspectives and to identify the variables that will characterize the conceptualization of the design proposal, as to manufacture of a prototype. For the aforementioned selection, photographic studies and some videos showing control consultancies will be carried out to organize the information in representative charts for which the informed consent of the participants is integrated into the project. The interviews are semi-structured to all those involved in the cycle: the sample will be obtained with medical staff, with the aim of working mainly with general practitioners, Algologist, Chiropractors, Podiatrists, and Internists.

Doctors will be invited without discriminating as to their length of practice, whether beginners or experienced, since both youth and maturity can meet the qualities required by the project. To get the necessary insights it is required to work with physicians - specialists will be visited in OUTPUT -stage 5- to conclude the study. The patients involved during the validation of the equipment are over 6 years Type 2 diabetes -incidence age specified by medical specialist above- . It would be desirable to integrate some biomedical engineers, technicians and / or sellers of medical devices, with the aim of providing...
feedback to the needs of clients in the diagnosis as well as in the control of Type 2 Diabetes Mellitus.

SYNTHESIS

The variables needed to maintain and impact the reliability of the study will determine the design of the device, which in turn, through its insights, requirements and specifications, will generate innovation to promote a technological transfer in the market. The cultural, technological and morphological aspects should be unified, towards the use of this new product as an aid to medical diagnosis. To represent the aforementioned aspects related to diabetic foot monitoring, descriptive models, analytical models and info-graphics will be applied (Milton and Rodgers, 2013). It is also sought to confirm that with the use of thermography in the control consultation, it is possible to avoid the formation of ulcers, up to 30 days before they manifest themselves.

CONCEPTUALIZATION AND TANGIBLE EVIDENCE

This stage is fundamental, because it is a mixture between conceptualization and rapid prototyping, since it will mark the moment of involving the user - especially the expert user - in the validation of each rapid prototype, in order to achieve an effective design; the user feedback this validation with its qualification on effectiveness, ease of use, cleaning, etc., acceptance of materials, and thus collaboration in the practice of co-innovation in the proposal. Therefore, the users will be, doctors, patients, vendors and even medical equipment repairing technicians. From this stage will arise the development of the process of the Industrial Design profession that requires detailing processes, materials, assemblies and finishes for the final proposal and the production of an alpha prototype or presentation prototype.

OUTPUT

The achievement of this last stage of research will be a planning of the prototype of preproduction and a test of some visual elements of a model of technology transfer product package, which will culminate in a university project, by validation via a trial with Instituto Mexicano del Seguro Social (IMSS) to offer continuity to previous projects carried out by Campus San Juan del Río of the UAQ. Similar to Research 360, stage 2, five doctors will be invited with the characteristics mentioned in that stage. Each doctor who agrees to test the equipment requires directing patients considered fit to perform the thermographic follow-up for a month. It is aimed at a sample of people who present diabetic foot determined. Two groups will be formed: Experimental Group and Control Group A. The difference between these two tests will be that the first one will use the thermographic equipment to be designed, while the second will use the traditional equipment available at the clinic in Santa Bárbara. The designer must carry a feedback for a future redesign as the main actor of a continuous model of innovation executed in a real context with objective results, which will allow constant evaluation of user satisfaction, use and requirements of a team that evolves to meet market demand. In case the contact with IMSS is not achieved, the second option may be clinic Santa Bárbara.
Application of design, method and concepts

Interpreters’ selection
The first is Dark Horse, a design company established in Berlin, supported this research and allow the use of their method to implement and develop the thermographic device. As well they will share expertise applying the design tools to establish insights and the conceptualization process; this research will share the results of customer's behavior and the final proposal of the device.

Introduce Thermography to medical consultation
A general practitioner and Nutritionist in chronic diseases, is the first user accepted who knows and uses the UAQ’s thermographic device. She is a volunteer at Enfermería de Salud Integral (ENSAIN by its acronym in Spanish) in Campus San Juan del Rio. She worked with five patients invited by the head nurse of ENSAIN, all the actors signed a Consent of Participation, all personal information of patients is confidential that’s why it will refer to them only as patient 1, 2, 3, 4 and 5. At Consent It’s established too three different seasons to analyze context and behavior from all participants.

First Insights
Based on the test that was carried out at ENSAIN, the information obtained is the following which is the activities carry out by the patients to get medical advice and who are the actors enumerate in Table 1. It is also important to the emotions linked in all the process, all these variables are the manner to highlight where innovation opportunities are and why the radical change of meaning could improve ulceration prevention.

Table 1  Actors from Patient Journey

<table>
<thead>
<tr>
<th>Person</th>
<th>Role</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor</td>
<td>Professional that controls the degenerative disease of the patient with diagnosis and medication.</td>
<td>To guide the patient in the care required for his illness.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prescribe medicines.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inform the patient about required treatments and studies</td>
</tr>
<tr>
<td>Nurse</td>
<td>Professional that provides care and direct care to patients in the clinic.</td>
<td>Measure patient’s vital signs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Informs patients of the order in which they will be assisted.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supports the Doctor during consultation if required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remind patients appointment dates</td>
</tr>
<tr>
<td>Family and</td>
<td>They support patients and take care of them at home.</td>
<td>They carry, accompany or collect them for consultation.</td>
</tr>
<tr>
<td>friends</td>
<td></td>
<td>Support the taking of medicines.</td>
</tr>
<tr>
<td>Other Patients</td>
<td>Because they are empathetic in the process, influence patient experience.</td>
<td>Offer support.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Take advantage of the meeting to encourage their peers.</td>
</tr>
</tbody>
</table>

The activities are divided into 6 main steps to describe interaction between actors, devices and emotions involved or other significant variables such as time. This information was obtained from three different meetings to do an analysis of the patient journey, then it is
The two devices available were introduced to the physician. The first operates with a Flir A310™ camera, it is more complex to assemble and design for plantar pictures only, the physician did not use it by herself. In Figure 8 shows from P1 to P5 example pictures of visible image of five different patient’s foot then from A1 to A5 are plantar thermographs. The first requirement born in this season when Doctor told an advice that perform lateral and dorsal foot’s pictures demonstrate in picture R5. The second operates with a Flir Lepton™ camera, is the size of a tablet and plug into the power outlet. The doctor was invited to use it by herself during her consulting session and she accepted in Figure 8 gives an example from L1 to L4 about her work.

---

### Consultation experience journey

<table>
<thead>
<tr>
<th>Preparation of consultant</th>
<th>Presentation and greetings</th>
<th>Explain purpose of meeting</th>
<th>Examination</th>
<th>Take notes</th>
<th>Making treatment decision</th>
<th>Conclusion and goodbye</th>
<th>Filling out the chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
<td>Extends hand and makes eye contact</td>
<td>Keeps quiet and nod.</td>
<td>Reflex hammer, Dissection tool, Thermometer, Stethoscope, Blood pressure device</td>
<td>Pan and chart sheet</td>
<td>Makes stronger rapport, asks, and listens</td>
<td>Pan and prescription sheet</td>
<td>Preparates the file for follow-up</td>
</tr>
<tr>
<td>Nurse supports him</td>
<td>Shakes hands-sometimes smile</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 7 Consultation experience journey. Source: Adaptation from TU Delft (2017)**

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*Figure 8 shows from P1 to P5 example pictures of visible image of five different patient’s foot then from A1 to A5 are plantar thermographs. The first requirement born in this season when Doctor told an advice that perform lateral and dorsal foot’s pictures demonstrate in picture R5. The second operates with a Flir Lepton™ camera, is the size of a tablet and plug into the power outlet. The doctor was invited to use it by herself during her consulting session and she accepted in Figure 8 gives an example from L1 to L4 about her work.*
From this first approach with a physician and five patients, it was verified that steps 1, 2 and 3 of the methodology are met. We will continue to work with more doctors to corroborate that the requirements obtained are the definitive ones to begin the conceptualization and development of the product. The requirements are listed below:

- 360 freedom mobility allow to perform lateral and dorsal pictures of foot. Damage above ankle indicates patient needs a Doppler study.
- Time required for thermograph pictures is 3 minutes equal of points by pressure evaluation.
- Intuitive interface like zoom action, one click to take the thermograph and easy access to keyboard.
- Improved reaction rate of the interface.
- Allow to keep track of poorly controlled patients.
- Live thermographic vision to explore patient and see the extension of damage at real time.
- Doctor decides when to take pictures or create/open patient files.

**Design challenges and start influence**

It is important to connect the use of the thermographic device live vision with the Doctor’s experience and knowledge for diagnosing a diabetic foot pattern, both are important factors that influence technology adoption and provide effective feedback to the medical research. This insight is based on the Doctor patient 1’s photograph experience, because the thermographs are all in bright and dark blue-green shades as a result as bad blood pressure control due to a high dose of medication, she suggested lowering the dose and
measuring the daily pressure for 5 days, ruling out a clinical picture of low blood flow that causes diabetic foot.

The application of new meaning through design is required to maintain the human-machine link (influence emotions) to innovate devices and to improve the technology as it enriches the definition of the diabetic foot pattern to adopt thermography in the diabetic patient consultation routine, as a consequence the regular use of the device will give feedback for future system requirements and telemedicine with the objective of automating the diagnostic.

When analyzing the interaction among medical, patient, and device other important new meaning found was 360 freedom mobility to take pictures as Doctor advice and here is the first conceptualization challenge, the idea for thermic noise -active- blockage and how it works with cooling base too.

**Conclusion and future work**

The technological problem is proposed together with a research and design plan for the implementation of a thermographic device for the prevention of plantar ulcers in diabetic patients and it was possible to highlight the importance of design as an influence to aligned designers, engineers and doctors activities to develop the product.

Emphasize 1, 2 and 3 stages of the proposed “Asignification” method, emotions increase the understanding for implementation, knowledge and experience in medical device development (MDD) process to create one for preventing diabetic foot ulceration and dismiss stress at patient journey. Breaking with the traditional steps of the medical sector that avoid the possibility of conceptualize in contact with final users, high volume production, based on pilot distribution and production programs.

This developing methodology delimited “interpreters” actions in theory and in practice strengthens the interaction between teamwork and human-research, then, it is possible to achieve "radical change of meaning" in the adoption of technology through influencing user behavior/routine and selection preferences. First three steps show an iterative process between INPUT, 360 research and Synthesis method stages because the cycle has been repeated 3 times to reach the requirements as 360 freedom mobility, Live thermographic vision on as long as the doctor wishes or the idea of thermic noise -active- barrier and how to interact with pictures required of different foot positions.

The present work may be the basis for future research and work on how Dark Horse interaction will help to avoid redundancy of existing products and to define the diabetic foot pattern to look for thermography with an Algioiologist work to be performed from April to May and support general practitioners in detecting pre-diabetic foot ulceration symptoms as a result, they send their patients with the appropriate specialist to be attended with the purpose of preventing the formation of ulcers, as more information in 360 research stage will be collected and processed in Synthesis stage, Ideation process at Conceptualization stage will be strong and will facilitate the evolution of rapid prototyping, verifying or replacing current data validation. Data will tell volume production needed in medical market for our thermograph device then select distribution network, process and material.
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The Impact of Collaborative Design on New Product Development: An Empirical Study of B2B E-Commerce Project in Taiwan

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Collaborative design provides a strategic and operational means for the achievement of organisational competitiveness. The information technology (IT) industry in Taiwan can be seen as a progressive industry with some ongoing important developments. The main objective of this research is to study the impact of collaborative design on new product development by B2B e-commerce project in IT industry. A cross-case analysis of the themes relating to the research purpose was conducted. The insight of these questions is generated through multiple case studies. The cross-case analysis was adopted coding for patterns and relationships among the data using a qualitative analysis software tool –Nvivo. The results present the key factors in term of collaboration issues by e-supply chain integration perspective. Such findings underscore the importance of recognising collaborative design on new product development.

keywords: collaborative design; new product development; B2B e-commerce; e-supply chain integration

Introduction
Collaborative design provides a strategic and operational means for the achievement of organisational competitiveness. The information technology (IT) industry in Taiwan can be seen as a progressive industry with some ongoing important developments. In order to examine the industry closely, this research study develops a case study on six major companies that have implemented collaborative design systems for innovative product development. These companies were investigated by case study approach. Breaking down
the research study further, the particular focus is laid on the identification and evaluation of the key factors that influence collaboration and relationships in innovative new product development (NPD). Drawing on the research findings and analysis, the research study contributes to the field of IT industry by extending the knowledge on e-commerce technologies as they impact on the collaboration of innovative product, the integration of design chain processes with other business processes and the impact of the performance of the new product development process on the overall business performance. Therefore, the main objective of this research is to study the model of collaborative design for innovative product development in IT industry. We attempt to examine the factors why ICT adoption is required in the organization of IT industry, which ways on how IT can assist innovation management in deepening itself into the process of collaborative design, and the benefits that the IT has produced. The insight of these questions is generated through multiple case studies. A cross-case analysis of the themes relating to the research purpose was conducted. This research adopts the model of e-supply chain collaboration from Chang and Graham (2012) to measure the performance of B2B e-commerce Project (e-Engineering Design Collaboration) by four perspectives (Value, Relationship, Process, Innovation) in e-supply chain integration (Chang & Graham, 2010). (see Figure 1)
Collaborative Design on New Product Development

Collaborative Commerce

It is apparent that companies will have to adopt ‘collaborative commerce’ (c-commerce) to remain competitive in most industry segments (Gartner, 2004). The Gartner Group (2004) defines collaborative commerce in the following terms: “c-commerce is the collaborative, electronically enabled business interaction among an enterprise’s internal personnel, business partners, and customers throughout a trading community. This trading community can be an industry, industry segment, supply chain or supply chain segment” (Gartner, 2003). Perhaps the most essential element of c-commerce is the extension of a company’s knowledge assets to include those outside the company. When intellectual capital is leveraged across companies, the benefits of c-commerce can be realized. Sharing intellectual capital and combining core competencies with partners are the major ingredients of collaboration (Laudon & Travel, 2007; Bstieler & Hemmert, 2015; Fang et al., 2015). A good example is that of collaborative product commerce (CPC) for new product development (NPD). (Bstieler & Hemmert, 2015)

Recently, firms have been trying to focus on the re-engineering of the NPD process to achieve cost reductions and make the whole process more effective in the time-to-market issue (Hardaker et al., 1998). Howe et al. (2000) explored how e-commerce can support product development by examining the impact of the integration of Internet and Intranet applications with a stage-gate product development system for supporting and accelerating NPD. Soliman and Youssef (2001) argue that the role of knowledge management in improving product development in an e-commerce setting has been investigated. In a study by Huang and Mak (1999) Internet-based e-commerce is often involved in supporting various activities of the product development process. In order to use the IT/IS application, firms obviously need to reconsider improving current business processes to be more efficient for collaborative product development (Vuotto, 2004). C-commerce should be considered as an e-business strategy rather than a solution that can be offered by vendors. It benefits an enterprise by extending the enterprise’s visibility and cooperation throughout the value chain (Sgarioto, 2001; Donthu & Unal, 2014).

Collaborative product commerce (CPC) is a core practice of c-commerce, which enables trading partners to create, manage and use data in a shared environment and, furthermore, to design and develop new products throughout their life cycle. In the NPD field, global R&D teams work together not only on paper studies but in implementing worldwide enterprises. CPC is an advanced tool of product data management (PDM) to support global design teams who work together for the NPD. Moreover, CPC is integrated with PDM and is a globally Web-based function. It is also called e-PDM. The product development process is not a linear design process but a non-linear design process. The information resource comes not only from the R&D department, but from other departments, and even more so from worldwide customers and strategy vendors (Kelly, 2001; Fang et al., 2015). Moreover, CPC is an emerging design philosophy that enables companies to be more responsive to the needs of everyone in the design process. According to the Aberdeen Group (1999), it is “a class of software and services that uses Internet technologies to permit individuals... to collaboratively develop, build, and manage products throughout their entire life cycle”. In the product development stage, the strategy team members join and manage the
development concurrently and collaboratively. It ties together all the business, supply and design functions for the facilitation of design information throughout the life cycle of a product. It represents the next generation of Web-centric PDM applications that will control the flow of design-relevant communications throughout the global enterprise.

**Network and virtual organization**

Recently, there has been increasing interest in terms of business network and virtual organisation. A major factor is ICT development and application; this trend has been made possible by the dramatic improvement of inter-organisation communication and coordination processes enabled through a wider array of information technologies. Similar to e-commerce, IOIS and B2Bi networks are formed by integrating existing ICT infrastructures in order to make trading and production networks or supply chains more efficient (Hoogeweegen et al., 1999). Thus, the need for competitive advantage is driving many firms and entire industries towards not only vertical integration, but also virtual integration (Cooper et al., 1997). SCM provides the synergy gained from the integration and management among members. In addition, since the participating firms in the network and the structure of their business processes can change over time, it is also important to be aware of such changes on the functioning of the network. Basu (2004) reports that the effective functioning of a business network depends upon three factors: (1) effective management and implementation of key business processes within each component firm; (2) effective communication and coordination between the various firms within the network; and (3) creation of an effective interface between the network and its environment. Therefore, organisation networks need effective process integration and information management to achieve a collaborative performance.

Virtual organisation has been successfully adopted as a business strategy. A virtual organisation requires a great deal of integration and coordination between firms (or department, teams, persons) that often requires electronic communication and sharing of information. Craven et al. (1993) demonstrated that effective collaboration and joint working are actually dependent on the well-defined communication model established between partners, and ensuring that these are effectively understood and openly supported between and within the extended enterprise. Generally, the communication model changes within the company itself, then the link extends to suppliers and customers. Similarly to an organisation network needing to be restructured and transformed into an inter-organisational communication network that provides more flexibility, connectivity, visibility and cooperability, global communication network requires an ICT-based information sharing model for supply chain integration (David & Laurence, 1995). Member companies can be fully linked together through the information superhighway for their mutual benefit, with the aim of better customer service and satisfaction through quick response (Hoogeweegen et al., 1999; Hoek, 2001). In addition to evolving towards greater integration, communication and cooperation, companies necessarily must develop closer relationships and trust with service and materials providers (Hoogeweegen et al., 1999). Trust enables open communication, information sharing and relationships management in a clear way, and also helps to speed up the contract process (Troy et al., 1998). Therefore, trust plays an important role in creating competitive advantage by reducing management costs, transaction costs between organisations and impacting positively on knowledge creation. The implementation of this extended enterprise (e.g. e-commerce or e-business)
requires a solid virtual organisation foundation. The core of such alliances is an understanding of channel goals, the roles of particular players, sharing of information, cross-organisation functional shifting and a long-term commitment to the partnership. (Donthu & Unal, 2014; Fang et al., 2015)

**B2Bi e-commerce for e-supply chain integration**

B2B integration (B2Bi) is the widespread enabler of most current e-business strategies, such as collaborative e-commerce (or c-commerce), collaborative networks, SCM and CRM across multiple channels of delivery, for example Internet and wireless devices. The integration of applications saves operations cost and time, while creating a competitive edge, for those corporations that share application information either internally or with external trading partners (Fang et al., 2015; Gopalakrishnan et al., 2015). B2B transactions are a significant form of today’s SCM activities. B2Bi basically concerns the secured coordination of information among businesses and their information systems (Linthicum, 2001). B2Bi provides a technology framework for B2B collaborative e-commerce. This framework is based on the latest XML standards defined in the B2B domain, such as RosettaNet, ebXML, BizTalk and Web services, needed to support cross-organization business processes, data, applications and systems. It promises to transform dramatically the way business is conducted between partners, suppliers and customers. All companies (e.g. large, SMEs and new) can experience increased growth and success through tightly integrated partnerships within supply chain collaboration (Linthicum, 2001; Samtani, 2002). In addition, B2Bi allows the creation of a supply chain that involves greater integration, collaboration and exchange of information with its suppliers and customers. Such supply chain integration is based solely on pull-based supply networks (Samtani, 2002). Frohlich and Westbrook (2002) classify Web-based supply chain integration strategies according to two dimensions: Internet-based demand and supply chain integration. The resulting categories are low integration, demand integration (e.g. e-commerce), supply integration (e.g. e-procurement) and demand chain management integration (which is the joint application of the previous two strategies).

Therefore, a B2Bi strategy for supply chain integration should be laid out and executed in such a way as to: have an integrated, real time application-to-application and system-to-system integration, with all the existing and new trading partners; eliminate all manual steps in business processes in order to conduct secure and real-time commerce transactions over the Internet; have the flexibility to accommodate the different modes of interactions of each partner; and, finally, have the ability to adapt to change quickly and easily in this dynamic age of B2B collaborative e-commerce (Linthicum, 2001).

**Research Methods**

**Case Study Approach**

A research design using case study methodology is subject to modification as the study progresses (Eisenhardt, 1989). Eisenhardt suggests that overlapping data analysis with data collection offers increased flexibility for modifying or adding to the collection process, e.g. probing a particular topic or construct that emerges. However, the case study approach is the most common qualitative method used in IS research (Eisenhardt, 1989; Chiu, 1995; Thatcher & Foster, 2003; Carton et al., 2008). There has been increasing interest within case
study research in organisational and social issues associated with IS development and implementation. It has also been successfully applied in cross-organisational (Shah et al., 2002; Thatcher & Foster, 2003) and market contexts (Fletcher and Wright, 1996). In particular, case study research in the IS (information system) field is considered to be appropriate when theoretical knowledge about a phenomenon is limited or when there is an essential need to capturing the research context (Eisenhardt, 1989; Chiu, 1995; Da Silveira, 2003). Therefore, the case study method is an appropriate research strategy at any stage of knowledge on a phenomenon in IS studies (Cavaye, 1996).

This research is to primarily investigate supply chain integration with an emphasis on the use of B2B collaborative e-commerce as an organisational strategic tool to improve supply chain performance. The overall objective of this research is to examine empirically the effectiveness of B2B e-commerce project in the Taiwanese IT industry, and to assess the relationship between the implementation of collaboration-based B2B e-commerce and supply chain performance. The main samples were drawn from the IT industry in Taiwan, which had already implemented collaborative design projects. The main sample is composed of six companies that were selected and analysed for the purpose of this research study. The sample has been created with a multiple case design, as it enhances external validity (Voss et al., 2002) and may be used to test the analytical generalisation of the ensuing concepts such as replication logic (Yin, 1994). Data collection in this study is through in-depth interviews and focus group with managers in each company. The data was collected through conducting interviews mostly with MIS project managers in charge of related e-supply chain projects. A total of thirty-two interviews were carried out on respondents from the six companies. Such interviews provided complementary information and validated the contents gathered from other managers interviewed. Interview time varied, but a typical interview lasted between one to two hours. All interviews had the same structure; they were based on questionnaires with open questions. In order to encourage answers to questions, prompts and probes were considered. Most interviews were tape-recorded with consent and transcribed for further analysis. This was very helpful in building a simple case study protocol and a case study database (Yin, 1994). As mentioned above, in order to understand the critical factors of interaction between B2B e-commerce application and supply chain collaboration in this study, the research method must be able to obtain ample details to get close to the research problem and achieve the research objectives. For this purpose, this research interest requires rich data and multiple sources documenting how supply chain members interact and evolve through the use of collaborative design. This is a difficult task for most pure quantitative methods. Therefore, a qualitative case study approach is suggested as being the most suitable research strategy (Yin, 2003).

Data Analysis
The use of a common structure for data collection and data analysis in all cases enables a chain of evidence to be maintained for the comparative analysis of different cases (Yin, 1993). The case analysis included searching for patterns and relationships among the data using a qualitative analysis software tool (see sub-section 5.7). Throughout analysis, researchers attempt to gain a deeper understanding of what they have studied and how they have gone about refining their interpretations. In case study analysis, one useful strategy is to adopt a coding system (Strauss & Corbin, 1998). Coding in qualitative research is a way of classifying and then ‘labelling’ text in order to facilitate later retrieval (Miles and
Huberman, 1994; Ryan and Bernard, 2000). Applying a code is often thought of as a reductionist process, as indeed it is when numeric codes are used to present an experience, characteristic or attitude (Richard & Morse, 2007). Text can then be viewed by category as well as by source. The facilitating data management, the classification of text using codes assists researchers to move from document analysis to theorizing (Ryan & Bernard, 2000; Richard & Morse, 2007). In ‘qualitative coding matrix’ (QCM), Lowe (1991) has systemised the steps and process of analysis to ensure that the qualitative data collected is analysed in a rigorous manner. The QCM presented three levels of codes: ‘open’, ‘axial’ and ‘selective’. ‘Open’ codes are low-level descriptive labels. They entail no interpretation, but the attribution of a class of phenomena to a segment of text. ‘Axial’ codes are created by the researcher using their own judgement on those ‘open’ codes that have similar characteristics. At the end of the ‘axial’ coding phase the relationship of one ‘axial’ code with another is drawn in the form of a diagram. The resulting selective codes are up-graded ‘axial’ codes which have been drawn together from different sources where triangulation can be established (Graham, 1998). Each of the data sources (e.g. interviews, focus groups, documents) are open to a range of different interpretations.

Furthermore, NVivo is an example of computer-assisted qualitative data analysis software (CQDAS). Throughout the coding process, NVivo was used to facilitate the management of data and codes and to maintain a perspective on all of the data without losing its richness (Bazeley & Richards, 2000). Computer software such as NVivo allows data to be stored, coded and retrieved with comparative ease once the researcher has mastered its numerous applications and idiosyncrasies. It is also very helpful when building a rigorous database for the data analysed, and useful to look at the data emphasising relationships within various sources (Richard, 2005). Using NVivo, it is much easier and less time-consuming than manual approaches to do cross-case analyses, to help develop concepts and do complex thinking about the ideas or hypotheses quickly and easily (Ozkan, 2004; Richard, 2005). NVivo assisted in the QCM approach to analyse and code data. NVivo was also mapped for functional applications. These involve generating categories of information (open coding), selecting one of the categories and positioning it within a theoretical model (axial coding), and then explicating a story from the interconnection of these categories (selective coding). In addition, six cases by a cross-case analysis of the themes relating to the research model constructs were also conducted by NVivo. Queries to support cross-case analysis always involve using a ‘Matrix Coding Query’ (see Figure 2).
Results and Discussion

Introduction of E-Engineering Design Collaboration Project

The strength of an industry supply chain and its ability to cope with the challenges of globalisation has already become one of the most important factors affecting firm competitiveness. Product R&D is a particularly important element here. After evaluating the environmental factors impacting on different industries in Taiwan, the Department of Industrial Technology launched e-Engineering Design Collaboration project, the aim of which is to help companies to establish an interactive model for collaborative design with customers, suppliers and technology design partners at the new product development stage. Effective application of IT and new processes can be used to reduce lead time, increase synergy between companies in different sectors and encourage manufacturers to focus more on the new product R&D stage in the value chain, thereby enhancing industry competitiveness. Tatung, FIC, Sunonwealth, Compeq, HP and Amtran were the six companies participating in e-Engineering Design Collaboration project. This project was also positioned as a pilot project targeting the IT sector; the companies participating included leading international buyers (such as HP/Compaq), leading Taiwanese central manufacturers, primary suppliers and secondary suppliers. The collaborative design framework that resulted was extremely comprehensive. The main emphasis in project implementation was on helping manufacturers to transform themselves from traditional original equipment manufacturing (OEM)\(^1\) providers into original design manufacturing

\(^1\) An OEM supply relationship refers to a contractual arrangement in which the contract manufacturer provides manufacturing services based on the product design, specification, quality standard and, in some cases, designated components furnished by the outsourcing firm.
ODM providers and Collaborative Design Manufacturing (CDM) providers, while working to strengthen collaborative design R&D management capability. The idea is to integrate different companies’ R&D capabilities at the product development stage, developing collaborative design business models that can meet the needs of the leading international IT buyers (Figure 4). In addition, by establishing a highly efficient collaborative design operations system it should be possible to make the leading international buyers more dependent on suppliers in Taiwan.

![Diagram of e-engineering design collaboration](image)

*Figure 3 The workflow of e-engineering design collaboration with their alliance partner. Source: adopted from HP e-business project report.*

However, the main goal of e-Engineering Design Collaboration project was that the participating companies should achieve the following objectives by adopting collaborative design at the new product development (NPD) stage as follows:

1. **Early involvement**
   Many of the different companies (supply chain partners) involved in product development as early as possible can help to reduce lead time and time to market

2. **Simultaneous involvement by multiple parties**
   By making effective use of information tools, the obstacles imposed by distance and by time differences can be overcome, facilitating the smooth exchange and sharing of product information, the rapid solution of the problems that crop up during the process of NPD and the formation of a consensus, thereby reducing the time required to develop and design new products.

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2 If a supplier can provide product design and manufacturing outsourcing services, we may call this type of contractual arrangement ODM supply.
(3). Design-In and Spec-In
The Taiwanese IT component manufacturers and their suppliers have built a collaborative relationship with their customers that are based on a high level of trust and collaboration. The establishment of collaborative design mechanisms at the product development stage will make it possible for the downstream customers to directly design supplier products into the specifications of their own products (design-in). When marketing their products, the customer will be able to adopt a total solution strategy, recommending the use of the Taiwanese manufacturers’ products (spec-in), so that these products are sold together with the customer’s products.

The Impact of Collaborative Commerce on New Product Development
In order to measure the impact of the collaborative B2B e-commerce project on supply chain performance, this research adopted e-supply chain integration perspective to test the conceptual model (Chang & Garham, 2010) and to investigate supply chain integration with an emphasis on the use of B2B collaborative e-commerce as an organisational strategic tool for improving supply chain performance (Chang & Garham, 2012). These perspectives act as key themes to ground the research model in respect of the related critical factors and they are described below.

(1) Value perspective
Chircu and Kauffman (2000) suggested that the positive impact of ICT on enterprise performance should be considered as the value of e-commerce technology. The key value of using e-commerce technologies in the e-supply chain collaboration were seen by the firm as providing ‘integrated’ information flows for physical flows, wherever possible, so as to reduce problems and help to optimise the system. This allows companies that share information to shorten processing time dramatically, eliminate value-depleting activities, and improve quality, accuracy, and asset productivity. These results are drawing the attention of many corporate executives. The e-business strategy is viewed as the foundation of value creation with organisation, employee, supplier and customer (Park et al., 2005; Yu, 2005). In particular, improving the organisational performance is crucial in achieving customer satisfaction, and this underpins the customer-service-relationship linkage for long-term business profitability. This reflects Martinsons et al. (1999) and Yu (2005), who promoted the need for e-business strategy to provide the customer with better value and improve business profitability at the same time. Most companies in the supply chain collaboration have developed their focus from an internal firm level to external supply chain performance. This new focus has created new challenges as firms try to improve their organisational performance and business profitability with their supply chain partners. The main objective of e-supply chain collaboration is to improve customer satisfaction (Govil & Proth, 2002) and to maximise the overall value generated by flows of information, product, service, finance and knowledge across the whole supply chain stage (Bowersox et al., 2007). In order to build on core competitive advantages, a company needs to strengthen its e-business capability by greatly increasing efficiency, reducing costs and raising customer satisfaction. The application of B2B e-commerce technology therefore can reduce the costs of supply chain collaboration and have a major impact on firm profitability. It provides organisations with an improved method for strengthening their competitive advantage.
(2). Relationship perspective
Effective supply chain collaboration is concerned with managing the relationships with suppliers and customers to deliver customer value at low cost with high levels of customer satisfaction. The customer services offered to customers can be almost infinite, including approaches to collaborative activities, such as shared forecasts and marketing data. Christopher (1998) similarly highlights the focus of SCM as the management of relationships in order to achieve a more profitable outcome for all parties in the chain. This has also been achieved by developing strategic partnership relationships with suppliers to collaborate and share information to deliver superior customer value at least cost to the chain as a whole (Park et al., 2005; Yu, 2005). Huxham (1996) commented that collaborative advantage was concerned with organisations’ exchange of information, shared resources and enhancement of each other’s capacity for mutual benefits and a common purpose by sharing risks and rewards. Power and trust are regarded as two principal antecedents of risk in the context of strategic alliance. Power reflects a set of supply-chain relationships and an agenda for managing them which is based on the dominance of large companies over their less powerful trading partners (see Das & Teng, 2001). Because of their bargaining power, the ‘collaboration’ in the trading network can dictate the terms on which they do business with the ‘strategic alliance’. A key component in the strengthening of this partnership is the development of trust-based relationship, technology and information-sharing agreements that link the supplier and the buyer together. Trust enables open communication, information sharing and relationship management in a clear way, and also helps to speed up the contract process (Troy et al., 1998). The lack of trust, internally, has become a great barrier to reaping the significant benefits that a good supply chain collaboration can have in smoothing the bullwhip effect and providing leverage to supply chain visibility. Therefore, trust plays an important role in creating competitive advantage by reducing management costs and transaction costs between organisations, and impacting positively on knowledge creation (Gopalakrishnan et al., 2015). Through the establishment of corporate strategic alliances, the overall supply chain competition has been enhanced, and is able to provide customers with instant services and to respond quickly to their needs. The core of such alliances is an understanding of channel goals, the roles of particular players, sharing of information, cross-organisational function shifting and a long-term commitment to the partnership (Donthu & Unal, 2014). Global business success depends upon the alignment of the global business strategy and the e-business strategy within organisational networks. This point can be noted on the subject of e-Engineering Design Collaboration project through establishing a collaborative relationship between the supply chain partners within a supply chain network. The collaborative relationship is more suitably referred to as business-to-business (B2B) relationships for earning competitive advantage for organisations competing in global markets under the influence of the phenomenon of globalisation. Network organisations for supply chain collaboration should consider: (1) information sharing with key trading partners; (2) IT application for B2B integration; and (3) collaborative partnership for long-term relationships and trust. (Bstieler & Hemmert, 2015)

(3). Process perspective
Managing change is one of the most important issues facing organisations. It requires attention to managing the change process itself, including anticipating and addressing the
concerns of those who might be affected by the change. The emerging BPR is referred to as ICT-enabled organisational change. The essence of BPR is the assertion that business processes, organisational change, team structures, IT/IS adoptions and employee responsibilities can be fundamentally altered to improve internal (identifying the effective processes for achieving business value and improving operational performance) or external (market environment, customers, suppliers and partners) business processes. Gunasekaran and Nagi (2004) argue that e-commerce technology has provided a means of achieving fundamental changes in the business process, management and operation of organisations. Through the implementation of an e-commerce project, besides the review and improvement of the internal processes that help enhance the overall efficiency and reduce the operating costs, the business processes have been extended to the upstream suppliers, which has led to a substantial increase in the supply chain’s information transparency and strengthened the business information flow and interaction. The implementation of B2B e-commerce projects is primarily the main integration mechanism that facilitates BPR within and between supply chain members. Successful e-supply chain project management comprises various skills, knowledge, people and cultures for a complex teamwork. In particular, cultural diversity also strongly affects the collaboration among project team members. Cross-cultural cooperation is significantly more demanding than communication in collaborative teamwork, because culturally different individuals have less common information and understanding, which affects project success. It has been further noted that regardless of a sophisticated and technically advanced e-commerce system, incompetent end-users lacking appropriate skills and knowledge are likely to fail in demonstrating the expected performance levels (Yu, 2005). The factors of consultants’ capabilities and top management support are also considered to affect the project success, so, for example, an organisation with no clear e-business strategy, with limited technological resources and no plans for acquiring more, with weak project management, with poor external links, and with a rigid and unsupportive organisation would be unlikely to succeed in innovation. By contrast, one which was focused on clear strategic e-business goals, had developed long-term links to support technological development, had a clear project management process which was well supported by senior management and which operated in an innovative organisational culture would have a better chance of success.

(4). Innovation perspective
Successful innovation in supply chain collaboration is strategy-based and depends on effective internal and external linkages. Within the area of linkages, developing close and rich interaction with markets, suppliers of technology and other organisational players is of critical importance. Linkages offer opportunities for learning – from tough customers and lead users, from competitors, from strategic alliances and from alternative perspectives. Knowledge management has been recognised as an important asset within an organisation since business success is critically dependent on diffusion of knowledge and innovation in all aspects of the internal organisational learning and external supply chain collaboration. Inter-organisational collaboration within the supply chain has become a major focus of organisations. Collaborative teamwork ensures that systematic cross-functional communication and knowledge transfer improve knowledge management efficiency and effectiveness (Bstieler & Hemmert, 2015; Fang et al., 2015). Through
collaborative e-commerce technologies to share experiences, they also are highlighting the need to develop people skills and process competence as well as to utilise appropriate IS to facilitate the trading of partner information. In addition, effective knowledge management enables innovative organisation and technological application through learning and managing employees. A good example is that of collaborative product commerce (CPC) for new product development (NPD). It is the extension of a company’s knowledge assets to include those outside the company. Sharing intellectual capital and combining core competencies with partners are the major ingredients of collaboration. It was suggested by Pick (1999) that the optimum way of improving a relationship was to enhance company performance by satisfying the needs and wants of the partnering firm through exchanging resources such as information and knowledge for the benefit of supply chain members. Managing an e-supply chain project’s success, however, will become increasingly vital in developing both skill and knowledge in a collaborative team. In a knowledge management environment, where the emphasis is on using collaboration to generate results, active technologies are more applicable to the knowledge transfer. The value generated at this level is the innovation generated during the interaction with collaborative teamwork. Organisational teams are formed to achieve a project goal. B2B e-commerce technology helps in the faster achievement of these goals through the use of interactive workspaces. Organisations need tools to help them store and transfer this knowledge in such a way that it can be easily retrieved and shared across the organisation. These tools include a wealth of information on the very latest e-supply chain concepts and initiatives, assistance with standards development (e.g. B2Bi RosettaNet), professional services, knowledge transfer and training and e-commerce technology implementation. All of this is offered in support of companies that are looking to drive their supply chain performance to new heights of excellence. Organisations must rethink to set up an internal online e-commerce system, joining an industry-wide electronic marketplace (e-marketplace) and implementing e-SCM across the entire value chain.

Conclusions
This research hopes to understand the impact of the application of B2B collaborative e-commerce, to measure the performance of design collaboration and to offer concrete suggestions for conducting successful innovative product competitive strategies. It has been identified that e-business strategy, with intensified collaboration, is one of the keys to success in the e-supply chain integration. This research has found that major structural change is having significant consequences on the functioning and organisation of individual enterprises, as well as on entire supply chain systems. Undoubtedly, this is also bound to have implications for firm e-business strategies, for the organisation of change management and of inter-firm relationships, and for the integration of business process and innovation.

In addition, the development of effective collaborative relationships normally takes years of good cooperation efforts and considerable investment in resources. Generating trust in collaborative initiatives requires business partners to set up expectations about the dynamics of the relationship. The promise of collaboration is that trading partners will be able to leverage repositories of knowledge, competencies and capital assets that will permit them to realise complex market opportunities. Day (1994) notes that suppliers must also be
prepared to participate in the customer’s development processes, even before the product specifications are established. According to Petersen et al. (2003), information and technology sharing can often lead to better supplier solutions, which may also result in lower costs. Therefore, sharing accurate information and knowledge transformation are trusted by every stage results in a better matching of supply and demand throughout the supply chain and a lower cost. Therefore, IT component manufacturers and their suppliers have built up collaborative relationship with their customers that are based on a high level of trust and collaboration. The establishment of collaborative design mechanisms at the product development stage will make it possible for the downstream customers to design-in their producers’ products into the specifications of their own products. When marketing their products, customers will be able to adopt a total solution strategy, recommending the use of the manufacturers’ products (‘spec-in’), so that these products are sold together with the customer’s products. Thus, the international buyers can become a joint partner with the manufacturers to define the specification of the target technology and develop it together through collaborative technology.

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About the Author

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Section 1.b
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Introduction: Interdisciplinary Perspectives and Trends in Open Innovation

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Open innovation has been described as a means of assisting firms utilising ideas and knowledge from inside and outside the firm. It has been defined as “a distributed innovation process based on purposively managed knowledge flows across organisational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organisations business model” (Chesbrough et al, 2014, p vi). Open innovation strategies may lead to better financial performance by reducing costs related to innovation, increasing commercialisation and financial gain.

Understanding open innovation in some way explains how sharing knowledge with internal and external stakeholders can promote innovation. Understanding processes can reinforce the importance of engaging with customers early in concept development and design stages of new products and services. Also openness can promote co-creation between firms, customers, suppliers, academia and government. The essence of such cooperation by internal and external stakeholders creates relationships to explore common interests and goals.

From an open innovation perspective, value creation and capture is accomplished by (i) outside-in open innovation, i.e. ideas drawn into the organisation from the external environment. This involves opening up organisation’s innovation processes to external inputs and contributions, (ii) Inside-out open innovation utilises unused or underused ideas and assets gathered from outside the organisation and (iii) Coupled open innovation links outside-in and inside-out open innovation processes combining knowledge inflows and outflows to collaboratively develop and commercialise an innovation.

Traditionally, knowledge is considered as being held by the firm as core competences and it is assumed that this is a source of sustainable competitive advantage. Accordingly knowledge used in, and resulting from, innovation and the knowledge resulting from the innovation remains within boundaries of the firm. Open innovation opposes this view as it
integrates diverse knowledge from the wider environment into the business ecosystem and creates new knowledge for multiple stakeholders.

Due to the inter-disciplinary nature of open innovation it can be discussed and theorised from many viewpoints, such as strategy, value chain, business models, core competencies, knowledge creation and more recently in design management. Levels of analysis vary with considerable research frequently conducted at organisational level, while more is needed in areas such as inter-organisational value networks. To date, large organisation have been at the focus of open innovation research, primarily because they are able implement open innovation to some degree without strategic change. More recently, open innovation practices in SMEs have become important, as these small firms have insufficient resources to cover all innovation activities and must look beyond firm boundaries for growth opportunities. Thus, inter-organisational networks are important drivers of innovation in SMEs as they often struggle to make the best use of strong network ties. Exploring open innovation in SMEs can provide insight into how best to utilise their networks.

Open innovation research faces many difficult questions and the focus of this track is to explore the interfaces between open innovation and knowledge creation.

“The smart art market products from the contemporary art world: A case of specific exhibition from Taipai” paper 1 by Fu and Lin, considers how this has become a vehicle between art and mass communication. The authors suggest that this widens access and can be considered a new economic model for selling art. Digital technology is ubiquitous and democratises the consumption of art so that high quality art can be offered to the public at affordable prices. Accessing large audiences has the potential to increase profit through the consumption of cultural artefacts in the virtual and in real world, simultaneously. The study utilises semiotic methodology to explore representations of image and symbolism through metaphors embedded in the pictures. Principles of metaphors and image schemes provide tools to aid interpretation the artist’s work. Three artists work are evaluated in this paper, Mika’s photography, Rèbecca’s princess illustration and Tong’s topography of different countries. The smart art market uses technology to reorganise contemporary art in order to capture social, culture and economic value.

Paper 2 by Canik, Bohemia and Telebasic, “Mapping coupled open innovation processes from activity theory framework”, presents a case study that explores how organisations undertake coupled open innovation in medium sized enterprises. This exercise evaluates design management literature and practice. Activity theory methodology is utilised in a novel way to analyse the phenomenon. It is very difficult to capture open innovation activities and processes and the authors explain that their proposed method emphasises who is doing what, why and how in complex environments. The case study findings revealed how importing and exporting mechanisms were undertaken in joint R&D projects using seven categories, namely, object, subject, community, division of labour, instruments, rules and outcomes. Mapping importing and exporting mechanism based on the seven categories is the main contribution of this study. It showed that leveraging joint R&D projects through to commercialisation is still challenging. Organisations do not fully benefit from the outcome of these projects. From this it was recommended that more studies focus on the commercialising of R&D projects through, IP strategies and new
business models. The implications for design practice include design thinking and design tools to steer the open innovation processes that will help the organisation to understand the processes, develop open innovation models and identify needs for both products and services through open innovation processes.

Paper 3 by Fain, Wagner, Kay and Vukasinovic, “Bespoke innovation: filling the gap between the classic and user-centred open innovation.” This paper explores the boundaries of open innovation by considering the properties and problems associated with different forms of governance. It considers variations of open innovation categories and associated forms of governance in terms of public and private goods. Public goods: (i) technical standard setting organisations, involves interaction between parties and transfer of knowledge resulting in a technical compatibility standard; (ii) User innovation, describes collaborative innovation such as the open sources movement. Private goods: (iii) Classic open innovation, where intellectual property only has value if it leads to commercialisation; (iv) Bespoke and customisation, a form of user-oriented open innovation where knowledge required to produce a specific new product maybe distributed across the partners, contributing to the final innovation. An illustrative case describes a traditional heavy-engineering company delivering bespoke products tailored to the need of the customer on a contract basis. Findings highlight the four forms of open innovation to explain different governance systems and in the case example of bespoke innovation. Customers’ needs define the design of the products while assets remain locked within the boundaries of the firm undertaking the product development. Implications from this paper suggest that each variant offers valuable lessons and highlights issues related to managing open innovation. Classifying and defining variants of open innovation provides a useful basis for identifying and analysing similarities and differences between alternative forms of governance.

References

About the Track Facilitators

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The Smart Art Market Products from the Contemporary Art World: A Case Study of Specific Exhibition from Taipei

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The power of the Smart Art Market product has become the vehicles between art and mass consumption of communication. Furthermore, it has across national boundaries and cultural regions that took part in the consumption and public opinion actively. In this trend, typical exhibitions is bridging to an economic model, and Smart Art Market presents a new logic of trade and valuation, ensuring fair access, distribution and acquisition for widely types of art collector. Indeed, this contemporary art exhibition attracts large audiences all the time, such crowed visitors entering the art zone places as the Museum of contemporary art, cultural and creative industrial park, a commercial gallery to visit and establish tourist consume. It breaks the last form of art. On the other hand, Smart Art Market product expand the value systems from the contemporary art world. Within the exhibition program, symbolic meaning from the original work has been discussed and explored.

keywords: Symbolic value; exhibition; product; cultural consumption

Introduction

The smart art market product or called popularly of “cultural goods” develop followed with big money’s relationship to “cheap” contemporary art, which with the changing of art appreciation to art consumption. This type of smart art product is still infinitely duplicable, easy transferable and it can be used and accessed by anyone, yet it has a defined owner. It began in the 1960s, as Pop Art commercialized the avant-garde—not just selling the avant-garde, but also involving commercialism in defining the avant-garde.
Which is the first time associated with big money because its occult aims and uncertain future have been successfully translated into homely terms. (e.g. James Panero, 2009). Furthermore, the possibilities that workmanship and technology offered the smart art market produce or design, or it is a self examination of industrial product development. From a silkscreen by Warhol, he set up the factory, reproduce the type of art object, with low-priced print entered public life, by means of Pop art promote clearly of commercial artist and business artist. Digital networks facilitate, accelerate and expand the distribution of art commodities, which increases potential access to investing in them from any type of demographic capable of market exchange.

It is worth to noting the smart art market has the ambition to bring quality art to the masses at affordable prices (James Panero, 2009). James Panero made a discussion that since exhibition history enhances value, the collectors of what we might call “market art” have a vested interest in seeing their work take up space in traditional public collections. Be the "Shallow pockets" consumption of contemporary art, John Storey (2001) defines “cultural consumption” as something that is labelled as a culture. Through the practice of cultural consumption, people to create a new thing, to achieve different social and personal purposes. It suggests an economy similar to the one for cinema or music, where it is the appreciation by a large audience that drives the profit. Especially, the products are printed by digital printing is best used for items that require high amounts of detail. For example, the photography and illustration publishing etc. It is worth to noting the span of time with high-effect and benefit to attract enough attention of curators. Like any other type of art object, the potential of cryptographical certification also enables these digital art objects to be exchanged as property. This projects shape today's art trade since traditional exhibition lose power on graceful value, the consumer of what we might call “market art” have a vested interest in seeing their work take up space in traditional public collections. Mass consumption do have the financial leverage to make it happen.

In the climate of consumption aspect, exhibit zone turn to a magnetic field which serve metaphor and persuade strategies from art work. The role of “Art products” consume as take part in cultural receptor, or a social activity, a daily practice. Miller (1987) convey cultural consumption is a process that involves dynamic relationship between subject and object, through the consumption of cultural goods, they complete the process of cultural identity get into the social structure and were shaped at the same time. But what’s the relationship between the typically exhibition and smart art market? Why quantities of visitors attracted to the typical exhibition both online and in person? What about the saying of the bubble co-existed with a short-lived, over-evaluation, followed by a crashing correction. We focus on discuss all these asking at following sections.

**Building Symbolic Value**

The discussion on France Forum in 1960s, Origins of semiotics theory developed by Saussure and other scholars (e.g. Roland Barthes,1964 means of how image element be the messages conveyed by a system of signs; Christian Metz, 1968 for diverse and dialectical analysis of symbolic concerns on movie features.) becomes the spindle of the cultural symbol of Visual Unscrambling. In late 20th Century, Mieke Bal have publishing programe: “Seeing sign-The use of Semiotics for the understanding of visual Art” which included in Cambridge University Press ‘The subject of art history’. It is well-established
the Symbolic Value in cognitive art content⁴. Since semantic framework growing influence deeply on image symbolism and concept transfer of vision communication. The studies have addressed the subject of visual, pictorial, metaphor (i.e. metaphor occurring in a picture) has been the subject of research in recent years. This is in keeping with the metaphor of a symbol conceived as primarily cognitive structuring human thought and action. (Isabel Negro Alousque, 2013) The decoding method using the theory of semiotics: “It is a point of view, to examine the processes related to Visual works; it is a conceptual tool, providing detailed analysis of the work.” (Liao Xintian, 2008) Yang Y. F. (2006) suggests that a code refers to the result of decipher process, rather than stay alone after created by artist.

In the symbolic universes, Jeehyun (2010) reminds the shape has deeply meaning, has a conversation. It is refers to the concept of denotation, connotation, and myth, as subsequent theorists to offer an existential analysis dimension of meaning. Above all, the construction of "Denotation" and "Connotation", in semiotics, they are terms describing the relationship between the signifier and signified (e.g. the basic elements of a sign). An analytic distinction is made between two types of signified a denotative signified and a connotative signified. (Daniel, 2014) Meaning includes both denotation and on notation. Barthes initially argued that only at a level higher than the 'literal' level of denotation, could a code be identified - that of connotation. (Hall, 1980)

Second, Myth and its role today. The function of “Myth” is to talk about “things”, or we are informing “text”, purifies it, makes it innocent, gives it a natural and eternal justification, it gives them a clarity which is not that of an explanation but that of a statement of fact. (Barthes 1987, Daniel Chandler, 2014) Myth refers to the narrative threads from which a culture's mythology (e.g. a mythical worldview as a frame of reference) is woven (Malan, 2015). It is this constant game of hide-and-seek between the meaning and the form which defines myth. Jackmeier has provided a review of that viewing events in your life as a series of metaphors you may then see your life as myth. Third, Interpretation myth as a metaphor. From the contemporary metaphor theory's idea, Myths were made plausible because of metaphor thinking, as opposed to modern scientific thinking, namely that the world and human lives are open to the influences of otherworldly forces and beings (Bultmann, 1965, Schultz,W, 2000). Furthermore, there are resemblances between myth and mythology and contemporary theory of the terminology of metaphor; of conceptual metaphors constituting a conceptual system, within which metaphorical expressions find their meaningful place. (Gert Malan, 2015)

While the system of metaphor that structures our everyday conceptual system, allows us to understand abstract or inherently unstructured subject matter in terms of a more concrete or at least more structured subject matter. (Lakoff, 1993) Black argued that metaphor is a way of communicating that operated on a deeper level of conceptual structure rather than on mere word meaning. The meaning conferred by a metaphor is the result of a confrontation of the dissimilar elements constituting the metaphorical process and unlocking the meaning, which will be based on the interpreters' personal associations (Van Luxemburg, Bal & Westeijn, 1983). Though metaphorical in content, the circuits reflect a reality, that is real correspondences in real-world physical and social experiences since childhood. (Hausman,C, 2006; Lakoff,G, 2014)
Lakoff’s theory suggests the cognitive Metaphor on the principles, that humans are neurologically empowered for metaphorical reasoning. This description of a conceptual system, demonstrates the power of metaphor to construct (new) worlds. The various versions of the comparison view assume that metaphors can be paraphrased. As a relatively complicated process, make effort approaching the “contemporary calligraphy art”, but without imposing a certain conclusion. While metaphor occupy one of central role in “symbol” discuss structure. The Cognitive Metaphor Theory is based on the following principles (Lakoff, 2006; Isabel, 2013):

- Metaphor is primarily a cognitive mechanism.
- Metaphor involves understanding a domain of experience, (e.g. the target domain) in terms of a more concrete domain.
- A metaphor is to be regarded as a mapping, (e.g. a fixed set of conceptual correspondences) between a source domain and a target domain, where one or more features of the source are projected upon the target.
- Any linguistic metaphor, or metaphoric expression, is an instantiation of a conceptual metaphor.

The relevant metaphors and metonymies used interpret images, Evans and Green (2006: 190, Isabel Negro Alousque, 2014) propose the following image schemas:

- Space: up-down, front-back, left-right, near-far, centre-periphery, path, straight-curved, scale
- Containment: in-out
- Multiplicity: part-whole, count-mass
- Balance: axis balance, point balance equilibrium
- Force: compulsion, blockage, counter force, diversion, enablement, attraction
- Cycle
- Attribute: heavy-light, dark-bright, big-small, warm-cold, strong-weak

For example, the photos table taken by fact finding in exhibition site. With signifers founded interpret images denoting the relationship with signified. Which captured the observation method as image schemas provided.
Table 1  Exhibition corner, Writer’s express. 2016

<table>
<thead>
<tr>
<th>Display corner</th>
<th>Signifier</th>
<th>Signified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A character in the book of middle place</td>
<td>Girls’ story</td>
</tr>
<tr>
<td></td>
<td>A chair with a book by central</td>
<td>Read alone</td>
</tr>
<tr>
<td></td>
<td>Red background corner</td>
<td>Wait for</td>
</tr>
<tr>
<td></td>
<td>olive green</td>
<td>drown-in feelings</td>
</tr>
<tr>
<td></td>
<td>Man-made birdcage</td>
<td>Shackle</td>
</tr>
<tr>
<td></td>
<td>Triangle set</td>
<td>A group of onlookers</td>
</tr>
<tr>
<td></td>
<td>Visitors (wondering or not)</td>
<td>Performance</td>
</tr>
<tr>
<td></td>
<td>Lock an painting</td>
<td>Ignore</td>
</tr>
<tr>
<td></td>
<td>spotlights</td>
<td>Run away</td>
</tr>
</tbody>
</table>

Identify the Text

Only a few “sign” can access and make use of the art market⁶. On the next case study, and the principles of metaphor and the image schemas provided the tool capture the codes from the text which we trying to focus on. In order to inform readers (deciphers) to interpret artistic works, there are varies and extends meanings ultimately. (e.g. unremarkable meaning system, consumption characteristic, the Costs of production, produce “culture consumption”.) Correspond the artist vision language, or story, it is necessary to use them to get the denotative level and Myth. As it is, we introduce three of widespread or expanded text by the art Observation, which from contemporary art world, to debate the semiotic describe and try to understand the following issues:

• Can the symbolic value help understand a healthy market?
• Does the semiotic analysis answering the bubble be insisted?

For general speaking, exhibit the individual art pieces is intrinsic to social, historical and aesthetic value, which is determined by a wide audience judgement on the social, emotional and visual qualities. It is provided individual experiences evidence of the heavy presence of specific type of art product plans on symbolic value. Obviously, MIKA’s aesthetic appreciation by Photography, Rébecca’s princess illustration, Grace Tong’s contemporary typography, from different countries and different profession agree on access to the market.

1. MIKA has built good relationship with mass media and public for years. Include integration service with films and stars. She controls the symbol act out relax, and organized. When describes her work in the philosophy of deep thinking questions and aesthetic subjects. She proposed the ambition to bring quality art to the masses at affordable prices, enabled by its low transaction costs and little material Resources.

5. Grace Tong display the cross-border text for the first time. Fashion design impact with ancient art form, contemporary typography to be the key of symbolic value, which is determined by a wide audience that judges the social,
emotional and visual qualities that the piece offers to them. Combined Taiwan young designer to localize a meaningful link turn reflected efficiently.

6. "The Secret Lives of Princesses" throw out a social issues totally, with clear symbols, get the Viewers. Rébecca make the roles call for soul inside. Consideration of specific life, and normal sweat, that is why get into mass consumption stable. In her Smart Art Market product sale plan, metaphor has a pragmatic role and contributes to the communicative function of the advertising discourse.

Smart Art Trade Shaped by Myth Speculation
As advanced above, we use a cognitive approach to analyse the three “text” which are three contemporary artist’s exhibitions in Taipei area. From the start to identifying the text we put forward of questions used to expanding the description around them.

• Who created the sign? Are the codes broadcast or narrowcast?
• What are the significant signifiers and what do they signify?
• Does them allude to being fact or fiction?
• Does the text operate with a realist representational code?

The importance of the selection of "texts" for the study of semiotic basis, We offered three exhibitions selected in the Taipei of a similar period of exhibit in 2016, which taken possession of typically contemporary Art site in Taipei. Specifically, they are Japan's photographic artists Mika Ninagawa, France illustrate artists Rébecca Dautremer, Taiwanese contemporary calligrapher Grace Tong. The three broadcast exhibition advertise by Sponsor, local media, Facebook, Elle, Vogue, and respective cooperation brand. Overall speaking, the three types of brilliant features had to represent the cross boundary realistic in contemporary art carriers, as well as the “sign” counterparts in diversity cultural. Which paired texts made the semiotic analysis more interesting. However, the view from semiotic universe with the paraphrased based on complicated process including a domain of self-experience, and the conceptual system. So, make effort approaching the truth of “text”, open the pluralistic discussion space of the meaning system is the article aims to do in this section.

MIKA NINAGAWA Exhibition
Japanese photographic artist Mika Nakagawa, puts on the personal overseas exhibition last 50 days at Taipei Museum of Contemporary Art (MOCA Taipei) in the Spring of 2016. Which present her photography in series built up over 20 years. Focus on Japanese aesthetics philosophy topics, the exhibition opened by “goldfish”, “Sakura” and “chrysanthemum” in the entire visit route. For highlight which is specific code selected to smart art product development plan.

Figure 1  Exhibition poster http://www.mocataipei.org.tw
As the following table represent, the exhibit records (e.g. or potential collectors) on the right, and the smart art products examples (e.g. taken from exhibition records and the artist homepage) on the left. We set aside a double headed arrow with “A” in it, which supposed to create “Myth as metaphor” meaning system perspective to balance two side of explanation of text. And we put “B”, “C” in followed cases studies. Instead of infer precisely from one side to another, we provided reveal the symbolic meaning hided for culture consume.

Table 1 Interacting A between Exhibition Text and Smart Art Products.

<table>
<thead>
<tr>
<th>Exhibition text</th>
<th>Smart Art Products (Homely terms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image of exhibition text]</td>
<td>![Image of smart art products]</td>
</tr>
</tbody>
</table>

As a point of decoding intellectual value of artists (the real source of value), It is particular concerned that Mika expresses deeply observe in a real object which is the features of Japanese philosophical reflection on life. For example, the “TANBI”. “TANBI” a general term means to worship and pursuit of beauty, but used to describe the homosexual love for old usage⁷. (e.g. It has been replaced by mass written.) Mika leads her audience wallowed in the beauty of “Sakura”, as a work of art metaphor, “Sakura” bloomed explosive, but short time. At a mythic level we finger out this sign as activating the myth of ethnic feature rooted in culture Japan. Where the land for “Sakura” and the logic of “beauty disappear” or the definition about “emptiness”. In addition, the subject of “goldfish”, which stand for human-made creature. As exhibition catalogs offer, artist understanding the goldfish stressed on the artificial aesthetic values with aimless swimming for freezing time, sharing transparent genetic factor, and viewed by others with cold eyes. This terms of addicted into living object inform in “chrysanthemum” too, which her camera get extremely close by. “A” here, it transforms culture into reality, it is the extraction, historical, quality of colonialism. This is another paired reason that choices “A”, “B”, “C” connecting with each other. The tool of “Myth” with the double headed informing the meaning innocent, act economically, unlock the “text”, and push the talking widely as much as the visitors can.
The Secret Lives of Princesses Exhibition
Rébecca Dautremer, known as the French illustrate master, exhibit her best-selling portraits of “The Secret Lives of Princesses” series at “1914 Huashan” creative Park in Taipei. They are 28 illustration books, each of them lived with a “princess”: Princesses de Pétsec, Princesses de la nuit, Princesses Kouskah, Princesses d’Esperluette etc. As an across-culture communication exhibit plan, the strong element in her drawing shows female experiences of growing up, as well as their social property.

Table 2 Interacting B between Exhibition Text and Smart Art Products.

<table>
<thead>
<tr>
<th>Exhibition text</th>
<th>Homely terms</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.jpg" alt="Image" /></td>
<td><img src="image2.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>

A “princess” referred as a sign, appeared consistently across a project or artwork to represent different attributes or appearances. But in Rébecca characters, first to remind the clearly protagonist details: a shy, self-conscious young woman; cultured, intelligent woman, a beautiful, much-loved, accomplished woman, Maxim’s kind, loyal oversee woman, the friendly, outgoing woman, A vulgar, gossipy and wealthy woman and so on. Each of these stories play the role of clue that deliver a wonderful secret: the structural relationships between the various signifiers to reality. The sign will packaged by dark little heroes, the delightful Alice, the wicked fairy Carabosse, the terrible Captain Hook, out of books. They should tell Nathanael that they are in great danger and at risk of disappearing forever. “B” here more suggested as “fairy”, which a mythic level in original function. But these codes call for social moral deeply in local places. It is not entirely referring to feminism, or the feminist movement in Taipei, but the link is existed, a curator won’t try deny details which take a risk to lose consumers.

Table 3 Interacting A between Exhibition Text and Smart Art Products.

<table>
<thead>
<tr>
<th>Princesse de la fatrasie</th>
<th>Signifier</th>
<th>Signified</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.jpg" alt="Image" /></td>
<td>Green Household dress</td>
<td></td>
</tr>
<tr>
<td><img src="image4.jpg" alt="Image" /></td>
<td>Raised her left hand</td>
<td></td>
</tr>
<tr>
<td><img src="image5.jpg" alt="Image" /></td>
<td>Loudspeaker</td>
<td></td>
</tr>
<tr>
<td><img src="image6.jpg" alt="Image" /></td>
<td>Words spray</td>
<td></td>
</tr>
<tr>
<td><img src="image7.jpg" alt="Image" /></td>
<td>The bloody red shield</td>
<td></td>
</tr>
<tr>
<td><img src="image8.jpg" alt="Image" /></td>
<td>Soldiers, Red</td>
<td></td>
</tr>
<tr>
<td><img src="image9.jpg" alt="Image" /></td>
<td>Alignment of spears</td>
<td></td>
</tr>
</tbody>
</table>

Housewife (ID)  
Nervous tense  
Puzzling and conflict  
Quarrel  
Weakness and Strength  
Overwhelming  
Insist on
Table 4 Interacting A between Exhibition Text and Smart Art Products.

<table>
<thead>
<tr>
<th>Princesse d’Esperluette</th>
<th>Signifier</th>
<th>Signified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall table lamp</td>
<td>Knowledge</td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td>Comfortable sensation</td>
<td></td>
</tr>
<tr>
<td>Glasses</td>
<td>Reading life</td>
<td></td>
</tr>
<tr>
<td>Book</td>
<td>Step by outside world</td>
<td></td>
</tr>
<tr>
<td>Pieces words</td>
<td>Oddity</td>
<td></td>
</tr>
<tr>
<td>high-legged Chair</td>
<td>Careless of gossip words</td>
<td></td>
</tr>
<tr>
<td>Small naked feet</td>
<td>Self-management</td>
<td></td>
</tr>
<tr>
<td>Ladies’ Shoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Be looked-down</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In this two tables, at a connotative level we associate this illustration with Princesse de la fatrasie and Princesse d’ Esperluette, qualities of the “signifier” column, but also with connecting depression in the “signified” column.

Read the Ink Exhibition

The Modernism calligraphy artist Grace Tong from Taiwan, taking out her 20 works from “Silent Movement” calligraphization in 2011, to this crossover “Read the Ink” exhibition after 5 years. According to the artist herself explained: “Calligraphy is an ancient art form from china, but I supposed to do modernism typeface.” The “ink line” from Tong’s work insisted a central role. Which she renew the writing skills and spiritual creation in the ink line, respect the conception, morphology, space perception from traditional performance. To stay with avant-garde, Tong set aside the art form, but with how was an artist communication with fashion world, how the aesthetic value infects youth generation.

Figure 2 Exhibition record. DMA 2017 http://www.chinatimes.com

There are six fashion designers from Taiwan, to exploits the various instantiation of the chain symbolic value. Among the three texts, the calligraphy art case is the publishing most on, associate with Tong’s art business years by years and the fashion designers’ close relationship with Globe Fashion magazines, videos, newspapers. In this exhibition space, interior design with black, with the spotlight shines on the work. In order to focus on impressions of detachment, silence, nature or even mystical, the space give up more opportunities which interact with visitors.

Table 5 Interacting C between Exhibition Text and Fashion design. http://www.eslite.com
The column on the right is single out Shao Yan and Chiehms works for the photo materials. “C” help us to make sense of our experiences within a culture. Myths here can be seen as extended metaphors. When our eyes are caught by two opposed colors: black and white. Meanwhile, we have entered into the “emptiness” space guide by Ink art. It is a concept of Buddhism, no matter how Tong emphasizes the “line”, the space will be the Myth of calligraphy art work. Eastern artist operates the code involved related to fashion world. And so it confirms Myth has in fact a double function: it points out and it notifies, it makes us understand something and it imposes it on us. (Daniel Chandler, 2014)

For another four designers, Justin Chou’s made a preliminary discussion on the use of ink writing skills which are:

- **Jiao (焦)**: The brush dipped in natural coke, result ghostly black. Highlighting the the point of hook or cracked, or the image space of black dark but within breath.
- **Nong (浓)**: Pure of thick black.
- **Gan (干)**: Mix several waters, produce vigorous, ethereal experiences between water and ink.
- **Dan (淡)**: The proportion of water and ink in the automatic status.
- **Shi (湿)**: It is a raining experience, cause the paper screen absorb enough ink water, and expanded like a Sponge.

Shao Yan research on the structures of Tong’s single calligraphy word. Especially, the line’s onset and course. Homme proposed the idea of a fairy tale inspiring by Tong’s modernism typeface, the imagination from ethnic feature in world view. Jerry Wang described the characteristics of chemical reaction from painting paper. He trying to change a stage to figure out Tong’s producing which observing “dissolve in and dissolve out.” Chiehms focus on the main element of Tong’s art. With texture transfer to direct application.

**Benefits of semiotic analysis**

Signs and codes are generated by myths and in turn serve to maintain them (Lash, 1990). The three “text” analysis with relevant details contribute a practice of exhibition visit. Play a role of deciphering define the signs and codes which use to stay communication. Furthermore, there is an advisement about publishing for diverse audiences (e.g. the writing of exhibition books or book of the exhibition. The data in Sarah Anne Hughes (2014) supported exhibition publishing which promotes their brand, shares research
endeavors, generate an income. Since the scholarly writing is loosing the visitors, the interesting Myth experiences information could be the choices for curators. Yet, there are shortcomings of our analysis which is the data from art institutions. In the choice of exhibit text, the official ticketing data, the sales of smart art products, not only get more specific and clear clue about why this study text be chosen but also influence the branches of the study.

**Summary**

The present article has attempted to discuss the interaction between the exhibition and economic value with symbolic value. Depends on symbolic text related to reality, the broadcast codes from exhibition are the key in this construction of smart art market. First, it has provided empirical evidence of exhibition text, Symbolic value thus works as an advertising strategy. Like metaphors, myths help us to make sense of our experiences within a culture. Popular usage of the term ‘myth’ suggests that it refers to beliefs which are demonstrably false, Myths can be seen as extended metaphors. (Lakoff & Johnson 1980, 185-6). For this sight, the aspect from art collector take every type of clear symbol in product is the beliefs and start the communicative potential. If we turn to the communicative impact of multimodal metaphor in advertising discourse, it must be emphasized that the primary intention behind the Smart Art Market Product is an act of persuading. Which metaphor usually take part in communication. (e.g. closely related to the rhetoric of the text). Second, while an attempt to reorganize the economic and symbolic value of contemporary art which maintaining and assuring social, cultural, and financial capital returns⁷. It leads to question a bubble of art market value but repair specific under the considering of “Myth” talking. Depending on the exhibition, as a medium of communication which explains and connect audience into group identification. As such, the low cost of time and the technology of the smart art products would eliminate many traditional upfronts. Nevertheless, with shortcomings and conclude after art review, rational analysis, it carried out following points:

- The exhibition do open system of valuation, distribution and trade.
- Compared with “A”, “B” and “C”, The “C” from Tong’s exhibition more color with a crowding-source mode. “A” viewed by a form of patronage, and “B” will be personal expressive needs for possessing art that matters.
- Both of the smart art product ensures access to the ownership of critical artworks enabled by affordable prices and simple digital platforms.

They represent the realities social value is democratically established and preserved within a sustainable economy⁸.

**References**

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Mapping coupled open innovation processes from Activity Theory framework

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Organisations have started to adopt open innovation processes to supplement their internal competencies and resources. Adoption of these processes assist them in keeping up with the pace of technology and protecting their competitive advantage in the market. Despite the significance of open innovation processes, there are few studies focusing on them. The purpose of this study is mapping coupled open innovation processes to contribute to the field of open innovation. The case study research was set up to explore how organisations undertake coupled open innovation processes from the perspective of employees working in a small-medium sized enterprise. The Activity Theory was used as a research framework. The research findings revealed how the importing and exporting mechanisms of coupled processes. The findings are discussed to fill the knowledge gaps in the existing literature and help design management academia and practice identify future work areas.

keywords: design management, coupled processes, activity theory; SME

Introduction
The concept of open innovation has drawn attention by researchers of innovation studies, such as Chesbrough, Vanhaverbeke & West (2006), Enkel, Gassmann & Chesbrough (2009), Gassmann (2006) and Huizingh (2011). It is an overarching umbrella to cluster trends of innovation studies (Huizingh, 2011). From a practical perspective, it enables organisations to protect their competitive advantage (Enkel et al., 2009) and adapt themselves to the changes in the market (Chesbrough, 2003). Despite these significances:
The field of open innovation is still at an early stage; it offers a wide field in which academics, practitioners and policy makers can be active. (Gassmann, Enkel & Chesbrough, 2010, p. 7)

This paper will aim to explore the following points to contribute to the field:

• mapping how organisations undertake coupled open innovation processes from the perspective of employees working in a small-medium sized enterprise (SME)
• identifying future work areas for design management literature and practice

To address the above points, we will explore the open innovation processes in organisations and identify the potential areas for design management research and practice. We have selected a case study research method and Activity Theory (AT) evaluation framework.

First, we will review the literature on open innovation in organisations. Then, we will introduce the case study, which will be followed by discussion and recommendations for further research.

Open innovation in organisations

Henry Chesbrough introduced the concept of open innovation in 2003. Chesbrough (2003) points out that organisations cannot have all the internal resources to innovate because of the changes in the industry as he called those changes erosion factors.

These erosion factors, such as increased mobility of workers, more capable universities, declining US hegemony, and growing access of start-up firms to venture capital, changed the conditions under which firms innovate (Chesbrough & Bogers, 2014, p. 16).

Since Chesbrough (2003) introduced the open innovation model to overcome the erosion factors, more researchers, such as Chesbrough & Appleyard (2007), Chesbrough, Vanhaverbeke & West (2014), Dodgson, Gann, & Salter (2006) and Enkel et al. (2009) have further explored this model. Chesbrough & Bogers (2014) defined of the open innovation model as:

...a distributed innovation process based on purposefully managed knowledge flows across organisational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organisation’s business model (p. 17).

The innovation in the above definition, is understood as “the development and commercialisation of new products, processes or services” (Chesbrough & Bogers, 2014, p. 17). The pecuniary mechanisms involve monetary activities as acquiring and selling; non-pecuniary mechanisms cover social activities as sourcing and revealing (Dahlander & Gann, 2010). Because these mechanisms are deployed via knowledge flows, it is vital to understand how knowledge flows work. Gassmann & Enkel (2004) entitle the knowledge flows under three main concepts: i) outside-in process, ii) inside-out process and iii) coupled process (see Figure 1).
Outside-in process
In this process, organisations integrate external sources in their innovation process. This can be done via acquiring (pecuniary) and sourcing (non-pecuniary) (Dahlander & Gann, 2010) as well as obtaining, integrating and commercialising (West & Bogers, 2014). Gassmann & Enkel (2004) defines this process as:

*Enriching the company’s own knowledge base through the integration of suppliers, customers and external knowledge sourcing can increase a company’s innovativeness (p. 6).*

Inside-out process
This process enables organisations to profit from unused innovations through exploitation so other organisations utilise them via their business models (Chesbrough & Bogers, 2014). It also allows innovation to reach the market faster than internal Research & Development (R&D) commercialisation (Enkel et al., 2009; Gassmann & Enkel, 2004). This process is defined as:

*Earning profits by bringing ideas to market, selling IP and multiplying technology by transferring ideas to the outside environment (Gassmann & Enkel, 2004, p. 6).*

Coupled process
Organisations adopting this process co-create together via alliances, cooperation and joint ventures that the purpose is developing and commercialising innovation (Enkel et al., 2009). The definition of this process is:

*Coupling the outside-in and inside-out processes by working in alliances with complementary partners in which give and take is crucial for success (Gassmann & Enkel, 2004, p. 6).*
Piller & West (2014) suggest an interactive approach towards coupled process. They emphasise the collaboration between organisations and individuals to innovate. They base their research on the open innovation study of Gassmann & Enkel (2004), user innovation studies of von Hippel (1988, 2005, 2010) and co-creation studies of Normann & Ramirez (1992) and Wikström (1996). In regards to their definition, user innovation is a collaboration between organisations and users whom the knowledge is obtained to generate solutions for public good; whilst co-creation is:

*an active, creative and collaborative process between a firm and individuals during a product/service development process in which participants contribute to a task initiated and facilitated by the firm* (Piller & West, 2014, p. 39).

Piller & West (2014) suggest that coupled processes have various dimensions. There are: i) external actor ii) coupling topology iii) impetus for collaboration, and iv) locus of innovation (see Table 1). Piller & West (2014) explain these dimensions as following:

- The topology of relationship has three forms. These are: i) dyadic, ii) network and iii) community with dyadic relationship being most common one.
- Impetus for collaboration can be top-down and bottom-up.
- Locus of innovation can be between two parties (bi-directional) where innovation occurs internally or multiple parties (interactive) where innovation occurs outside the organisations.

*Figure 1  Open innovation processes. source: Gassmann & Enkel (2004, p.6)*
Table 1  Multiple Dimensions of coupled open innovation processes source: Piller & West, 2014

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Actor</td>
<td>Firms: customer, supplier, complementor, rival</td>
</tr>
<tr>
<td></td>
<td>Other organisations: university, research lab, government, other non-profit</td>
</tr>
<tr>
<td></td>
<td>organisations</td>
</tr>
<tr>
<td></td>
<td>Individual: customer, user, inventor, citizen</td>
</tr>
<tr>
<td>Coupling Topology</td>
<td>Dyadic: single partner</td>
</tr>
<tr>
<td></td>
<td>Network: multiple partners</td>
</tr>
<tr>
<td></td>
<td>Community: a new inter-organisational activity</td>
</tr>
<tr>
<td>Impetus for Collaboration</td>
<td>Top-down: initiated by the upper management</td>
</tr>
<tr>
<td></td>
<td>Bottom-up: developed through employee or customer collaborations</td>
</tr>
<tr>
<td>Locus of Innovation</td>
<td>Bidirectional: innovation created within organisation</td>
</tr>
<tr>
<td></td>
<td>Interactive: innovation jointly created outside the organisation</td>
</tr>
</tbody>
</table>

To implement these processes, researchers suggest different stage models (Cooper, 2008; Piller & West, 2014). The study of Van der Meer (2007) introduces three innovation stages: i) the concept stage (to invent the ideas), ii) the development stage (to convert the ideas to the project) and iii) the business stage (to transform projects to new business) and these stages are based on the open innovation Stage-Gate model of Cooper (2008). Piller & West (2014) propose a different process model clustered into four stages: i) defining, ii) finding participants, iii) collaborating, and iv) leveraging. Their study outlines the current-state of these stages and highlights that organisations mostly fail to commercialise in the leveraging stage. The key activities regarding each stage are listed in Table 2.

Table 2  A process model for open innovation processes source: Piller & West, 2014

<table>
<thead>
<tr>
<th>Process Stage</th>
<th>Key Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining</td>
<td>Problem formulation</td>
</tr>
<tr>
<td></td>
<td>Institutions and rules: including contract terms, IP</td>
</tr>
<tr>
<td></td>
<td>Resource allocation and strategic commitment</td>
</tr>
<tr>
<td>Finding Participant</td>
<td>Identifying participants with right characteristics</td>
</tr>
<tr>
<td></td>
<td>Motivating and retaining a critical mass of collaborators</td>
</tr>
<tr>
<td></td>
<td>Selecting the right participants</td>
</tr>
<tr>
<td>Collaborating</td>
<td>Governance of the collaboration process: organising, monitoring</td>
</tr>
<tr>
<td></td>
<td>Interaction platforms and other tools</td>
</tr>
<tr>
<td></td>
<td>Openness of firm attitudes, structure and processes</td>
</tr>
<tr>
<td>Leveraging</td>
<td>Integrating external knowledge</td>
</tr>
<tr>
<td></td>
<td>Commercialising the knowledge through product and services</td>
</tr>
</tbody>
</table>
Although, the studies of Van der Meer (2007) and Piller & West (2014) lay foundations for understanding coupled processes, still, Piller & West (2014) emphasise the need for further studies. They recommend that further studies can investigate the coupled processes from the perspective of employees to understand what happens inside the organisations. Therefore, this study focuses on the perception of employees regarding how their organisations undertake coupled processes.

In addition to previous studies (e.g. Van der Meer, 2007; Piller & West, 2014), this study will divide coupled processes into two mechanisms: i) importing mechanisms (acquiring external knowledge and sources into organisation) and ii) exporting mechanisms (exporting internal knowledge and sources to outside of the organisation). These mechanisms will be explored within a case of an Innovation Institute. An outcome of this study has a potential to help design management academia and practice identify the future research areas.

The case study to explore open innovation in organisations

We have selected the case study organisation regarding its relevance to explore coupled processes. Before deciding the organisation, we have investigated different types of organisations that adopt coupled processes. Potential case study organisations were research institutes, SMEs, universities, suppliers and end users. Among them, we have selected research institutes because of following reasons:

- They can be considered common partners of coupled processes that they partner with universities, suppliers, other research institutes, competitors and end users.
- Our insight was that they might have good balance to import and export knowledge throughout innovation process and the focus of this case study is investigating importing and exporting mechanisms of coupled processes.

The research institute chosen for this case study is based in East London and we will refer to this organisation as East London Innovation Institute (ELII) throughout the paper. The institute was selected for the following reasons:

- ELII jointly collaborates with universities, suppliers, end users and other research institutes to work on Research & Development (R&D) manufacturing projects of the automotive sector. This makes them a suitable case for this research as it can be inferred that they adopt coupled processes of open innovation.
- ELII believes that their innovation derives from collaboration and they import and export knowledge to manage their purpose. As this research aims to understand importing and exporting mechanisms distinctively, this makes ELII an appropriate case for this study.
- One of the authors of this paper worked as an intern in the organisation throughout her Master’s dissertation process. This had allowed her to intimately understand the organisation structure.
- There was a time limitation during the dissertation period and ELII was the most accessible research institute because of their existing collaboration with Loughborough University.
Research framework: Activity Theory

As stated above, one main concern of this paper is to have a comprehensive analysis of the phenomenon. We have chosen Activity Theory (AT) and we will explain the theory and its relevance with this study in this part.

What is Activity Theory?

Activity theory (AT) (Engeström, 1987) has its roots in the studies of Marx and Engels and Vygotsky, Leont’ev and Luria (Engeström, Miettinen & Punamäki, 1999). Waycott, Jones & Scanlon (2005) define the theory as “a collection of broadly defined concepts that are open to interpretation” (p. 111).

In AT, see Figure 2, an activity is a unit of analysis and provides “the dialectic relationship between subject and object” (Vygotsky, 1978) incorporating these related elements: instruments, rules, community, and division of labour (Engeström, 1987).

![Activity Theory Model](source: Engeström (1987, p. 136))

Engeström (1993) defines AT characters as following:

- **Object**: “the ‘raw material’ or ‘problem space’ at which the activity is directed and which is moulded or transformed into outcome” (p. 67)
- **Subject**: “the individual or subgroup whose agency is chosen as the point of view in the analysis” (p. 67)
- **Community**: “multiple individuals and/or subgroups who share the same general object” (p. 67)
- **Instruments**: “physical and symbolic, external and internal tools (mediating instruments and signs)” (p. 67)
- **Division of labour**: “both the horizontal division of tasks between the members of the community and to the vertical division of power and status” (p. 67)
- **Rules**: “the explicit and implicit regulations, norms and conventions that constrain actions and interactions within the activity system” (p. 67)
The relevance of Activity Theory with this research

AT is significant for this research because of three main reasons. We will explain these reasons in this part.

Firstly, Hasan & Kazlauskas (2014) state that AT is all about “who is doing what, why and how” (p. 9). Moreover, Huizingh (2011) emphasises that:

Open innovation requires managers to make new decisions in developing and exploiting innovation activities. When, how, with whom, with what purpose, and in what way should they cooperate with outside parties? (p. 6)

We think that we can generate comprehensive research questions based on the study of Hasan & Kazlauskas (2014) and Huizingh (2011). For example, we can ask participants who the collaborators are, or with what purpose their organisation collaborates with them.

Secondly, organisations have a level of obscurity including formal and informal interactions in the innovation process (King & Ockels, 2009). For example, employees in the process can also create tacit solutions for their daily work problems that might lead to innovation (Macpherson & Clark, 2009). Similarly, Cash, Hicks & Culley (2015) emphasise the significance of AT to analyse ‘unconscious’ data. Therefore, AT can help us reveal the obscure part of the process.

Finally, AT is a significant framework for observations and interviews to observe complex environments (e.g. modern workplaces) (Cash et al., 2015; Hasan & Kazlauskas, 2014). It allows researchers to make a multi-dimensional analysis (Cash et al., 2015; Hasan & Kazlauskas, 2014). Our research is complex because we want to observe the importing and exporting mechanisms of innovation and AT characters can allow us to have a clear mapping of the process.

The Case Study Methodology

The Research Design

The main purpose of this study is distinctively analysing importing and exporting mechanisms in coupled processes from the perspective of employees. We have determined two main research questions to investigate in the case of ELII:

- **Research Question 1**: How are importing mechanisms undertaken in joint R&D projects?
- **Research Question 2**: How are exporting mechanisms undertaken in joint R&D projects?

We have investigated these research questions through semi-structured interviews divided into question and card sessions. We will explain why and how we conducted semi-structured question and card session in this part.

To begin, semi-structured interview is a flexible research method that researcher makes a conversation with participant by using pre-prepared questions, but researcher might ask follow-up questions to participants in need (Fylan, 2005). We have selected this method because this method allows researcher “to delve deeply into a topic and to understand thoroughly the answers provided” (Harrell & Bradley, 2009, p. 27). Furthermore, Barriball
& While (1994) state that this method is useful to observe complex phenomenon with confidential information like this case study.

We have generated research questions based on AT. The study of Hasan & Kazlauskas (2014) and Huizingh (2011) have guided us to design research questions, such as who, what, what purpose. We have listed these questions in Table 3.

Table 3  Semi-structured Interview Questions based on AT categories

<table>
<thead>
<tr>
<th>Activity Category</th>
<th>Semi-structured interview questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object</td>
<td>Could you select a project that you have collaborated with your partners? What is this joint R&amp;D project about?</td>
</tr>
<tr>
<td>Subject</td>
<td>Which employees did you work with? What was their role in the project?</td>
</tr>
<tr>
<td>Community</td>
<td>Which organisations did you collaborate for this project? What was the role of each organisation in the project?</td>
</tr>
<tr>
<td>Division of Labour</td>
<td>How was the division of labour between organisations?</td>
</tr>
<tr>
<td>Instruments</td>
<td>Which instruments/tools did you use throughout the project? In which way, did you use them?</td>
</tr>
<tr>
<td>Rules</td>
<td>Which rules did you follow throughout the process? In which way, did you follow them?</td>
</tr>
<tr>
<td>Outcome</td>
<td>With what purpose, did you develop this project?</td>
</tr>
</tbody>
</table>

In the card session, we have used a card sorting technique that has helped us map whether AT characters are imported or exported. This technique is a data collection method that is used in interviews to find out the mental model of interviewee who categorizes concepts from their existing knowledge (Daniels, De Chernatony & Johnson, 1995). The reasons to choose this technique are:

- It is efficient to understand the mental model of interviewees in complex environments (Daniels et al., 1995).
- The study of Chatzakis (2015) demonstrates the efficiency of cards when observing innovation activities in a short time.
- It provides flexibility to the interviewees, who can sort concepts from their existing knowledge by using visual cards (Gammack, 1987).

We have also designed the cards based on AT. As the unit of analysis maps the relationship between object and subject, we have designed object and subject cards to understand the relationship between object and subjects and the direction of the activity (importing or exporting). Figure 3 illustrates the subject cards to represent employees and partners of ELII. Object cards are designed in a way that participants can write the objective and duration of the innovation activity (See Figure 4).
The Research
Eight key employees from ELII participated on the research. They were identified via snowball sampling method (See Figure 5). The research started with question session and ended with card session.
In the question session, participants replied to the AT questions, which are introduced in the previous part (see Table 3). In the card session, i) the researcher summarised the question session to a participant by placing visual cards to the board and then ii) the researcher and participant drew lines between the placed cards. The aim of this exercise was to map the roles of participants in the project and their relationship with other participants and activities to understand how they import and export knowledge. Besides, question session is summarised that had allowed researcher and participants to cross check the answers (see Figure 6).

![Figure 5](image_url) An example of end of the card session board with one of the interviewee (some of the cards text was blanked out to preserve anonymity)

To analyse the data, we have initially transcribed the answers of interview questions and coded these using NVivo. We have coded those answers into activity characters: object, subject, community, division of labour, rules, instruments and outcome. Moreover, we have used photos taken during the card sessions to understand whether activity character is imported or exported (see Figure 5). Table 4 summarises the data analysis.
Table 4  Analysis of research questions

<table>
<thead>
<tr>
<th>Question Category</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
<td>As they have work on R&amp;D projects, we make sure the objective of the project is importing ideas to export R&amp;D projects as Van der Meer (2007) suggests.</td>
</tr>
<tr>
<td>Could you select a project that you have collaborated with your partners? What is this joint R&amp;D project about?</td>
<td></td>
</tr>
<tr>
<td><strong>Subject</strong></td>
<td>As we have interviewed with employees of ELII, we have identified them as subjects of the project. Based on their role in the organisations and pictures of card session, we have decided whether they import or export knowledge.</td>
</tr>
<tr>
<td>Which employees did you work with? What was their role in the project?</td>
<td></td>
</tr>
<tr>
<td><strong>Community</strong></td>
<td>Based on the role of the organisations in the project and card session, we have decided whether they are part of importing or exporting community.</td>
</tr>
<tr>
<td>Which organisations did you collaborate for this project? What was the role of each organisation in the project?</td>
<td></td>
</tr>
<tr>
<td><strong>Division of Labour</strong></td>
<td>We analysed the answers whether there is any hierarchical relationship between organisations to decide whether there is a bottom-up or top-down division of labour.</td>
</tr>
<tr>
<td>How was the division of labour between organisations?</td>
<td></td>
</tr>
<tr>
<td><strong>Instruments</strong></td>
<td>To detect importing and exporting instruments, rules and outcome, we have followed the same procedure that we introduced in previous questions.</td>
</tr>
<tr>
<td>Which instruments/tools did you use throughout the project? In which way, did you use them?</td>
<td></td>
</tr>
<tr>
<td>Rules</td>
<td></td>
</tr>
<tr>
<td>Which rules did you follow throughout the process? In which way, did you follow them?</td>
<td></td>
</tr>
<tr>
<td>Outcome</td>
<td></td>
</tr>
<tr>
<td>With what purpose, did you develop this project?</td>
<td></td>
</tr>
</tbody>
</table>

The Research Findings
We have summarised the case study findings revealing how importing and exporting mechanisms are undertaken in joint R&D projects in Table 5.
Table 5  How importing and exporting mechanisms are undertaken in joint R&D projects

<table>
<thead>
<tr>
<th>Importing</th>
<th>Exporting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
<td><strong>Subject</strong></td>
</tr>
<tr>
<td>Ideas</td>
<td>Engineers in ELII</td>
</tr>
<tr>
<td>R&amp;D Projects</td>
<td>Managers in ELII</td>
</tr>
<tr>
<td><strong>Community</strong></td>
<td>Suppliers</td>
</tr>
<tr>
<td></td>
<td>Universities</td>
</tr>
<tr>
<td></td>
<td>Public and</td>
</tr>
<tr>
<td></td>
<td>government funding</td>
</tr>
<tr>
<td></td>
<td>bodies</td>
</tr>
<tr>
<td></td>
<td>Users</td>
</tr>
<tr>
<td><strong>Division of labour</strong></td>
<td>Bottom-up division</td>
</tr>
<tr>
<td></td>
<td>of labour</td>
</tr>
<tr>
<td>Bottom-up division of labour</td>
<td></td>
</tr>
<tr>
<td><strong>Instruments</strong></td>
<td>Research tools (e.g.</td>
</tr>
<tr>
<td></td>
<td>CAD software,</td>
</tr>
<tr>
<td></td>
<td>technical equipment)</td>
</tr>
<tr>
<td></td>
<td>Manufacturing</td>
</tr>
<tr>
<td></td>
<td>Resources (e.g.</td>
</tr>
<tr>
<td></td>
<td>factory, funding,</td>
</tr>
<tr>
<td></td>
<td>prototyping tools)</td>
</tr>
<tr>
<td><strong>Rules</strong></td>
<td>Timeframe</td>
</tr>
<tr>
<td></td>
<td>and funding</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Technical sources</td>
</tr>
<tr>
<td></td>
<td>and knowledge</td>
</tr>
<tr>
<td></td>
<td>New resources</td>
</tr>
<tr>
<td></td>
<td>New partnerships</td>
</tr>
<tr>
<td></td>
<td>Competitive</td>
</tr>
<tr>
<td></td>
<td>advantage</td>
</tr>
<tr>
<td></td>
<td>Leadership</td>
</tr>
<tr>
<td><strong>Rules</strong></td>
<td>Contracts</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Technical sources</td>
</tr>
<tr>
<td></td>
<td>and knowledge</td>
</tr>
<tr>
<td></td>
<td>(e.g. intellectual</td>
</tr>
<tr>
<td></td>
<td>property)</td>
</tr>
<tr>
<td></td>
<td>Business growth</td>
</tr>
<tr>
<td></td>
<td>Innovation</td>
</tr>
</tbody>
</table>

The analysis outlines the joint R&D projects in terms of seven AT categories. We will explain the research findings for each category in this part.

To begin, the main **objective** of this study was investigating the process of importing ideas to export R&D projects. Therefore, all projects introduced by participants covers this process.
Main **subjects** are engineers and managers working for ELII. Whilst engineers import their knowledge to the process, one main responsibility of managers is to export the imported knowledge to the partners.

Regarding **community**, suppliers (e.g. resources), clients (e.g. prototyping tools), universities (e.g. research area), public and government funding bodies (e.g. funding) import their knowledge and sources to these projects. On the other hand, private and public research institutes, SMEs and universities (e.g. Ph.D. projects) export their knowledge and sources throughout this process.

As a **division of labour**, bottom-up division of labour is followed by organisations because there is no hierarchical difference between partners. Participants also explained how the process is undertaken by employees and partners in terms of division of labour. The projects are given to project managers (e.g. research engineers or managers of the organisations or multiple managers from different partners) and they have the full responsibility from the beginning to the end. They follow the Stage-Gate model that is divided into following steps: defining the research problem, setting up the project members (consortium), developing the project (collaboration process) and commercialising it. In the beginning of the project, the research problem is identified and rules (e.g. IP, contracts, project timeline) and resources are defined based on the problem. After selecting the participants, collaboration process starts. Each member to update members and exchange knowledge. At the end of the project, the ideal scenario is commercialising these projects via spin-off venture companies and IP strategies. However, in this case study, participants state that they fail to commercialise most of the joint R&D projects. Although they have the intellectual property rights of these projects, they do not know how to profit from them.

**Instruments** vary based the requirements of these projects. In general, organisations need research tools (e.g. CAD software, technical equipment) and manufacturing resources (e.g. prototyping tools, factory, funding) that they import from suppliers, clients and universities. By using these tools, they export reports (e.g. feasibility reports), presentations, posters, videos and prototypes to explain the outcome of these projects.

**Rules** are generally set up in the beginning of the project as a contract. Main criterion of the rules is to decide on how organisations benefit from the project (e.g. how to share the IP, the roles of organisations). Also, duration and funding of the project affect the rules.

As an **outcome**, organisations exchange (import and export) the knowledge and sources to complement their competencies. If they have good strategies throughout the process, they can import new resources to the organisation. As they gain technical expertise on the field, they can use that to have a competitive advantage and be leader in the market. Moreover, external organisations can use the exploited knowledge and sources to innovate and grow businesses.

**The discussion on the case study and the open innovation concept**

We will discuss this case study within two following purposes:

- The significance of case study findings to the open innovation concept
- The potential areas for the future design management studies
Firstly, this study shows that the **objective** of joint R&D projects is to convert ideas to the main projects that are ready to commercialise as a next step (van der Meer, 2007). This study reveals that engineers and managers are the **subjects** of these processes. This research does not reveal what happens inside the organisations in detail. As Piller & West (2014) emphasises, we also recommend new studies to understand how coupled processes are undertaken internally.

Similar to the literature (Enkel et al., 2009; Laursen & Salter, 2006; Piller & West, 2014), the case study reveals that users, suppliers, universities, public and government research institutes and SMEs are members or **community** of the joint R&D projects. Piller & West (2014) state that the locus of innovation can be considered interactive on coupled processes. This study contributed to the base of knowledge by identifying whether this community import or export their knowledge (See The Research Findings).

Impetus for collaboration (Piller & West, 2014) is a bottom-up **division of labour**. Furthermore, the joint R&D project of this case study implements Stage-Gate model aligned with Stage-Gate model of Cooper (2008). Moreover, the activities undertaken in stages (defining, finding participant, collaborating and leveraging) have many similarities with the study of Piller & West (2008). As they also argue, this study shows that leveraging from the joint R&D projects is still a challenge that organisations do not fully benefit from the outcome of these projects.

In addition, Sundbo & Gallouj (2000) emphasise that there are no strict external and internal **rules** in these processes. This study also shows that rules are mainly defined by the contract done in the beginning of the project. **Instruments** used for these processes are outlined in the previous chapter, but literature lacks information regarding this aspect.

Lastly, in line with the literature (Gasmann & Enkel, 2004; Kogut, 1988), this research shows that the main **outcome** of coupled processes is sharing knowledge. There are also other outcomes aligned with the literature (keeping up with technological developments and protecting competitive advantage, complementing the competencies) (Chesbrough, 2003; Enkel et al. 2009; Koschatzky, 2001; Lichtenthaler, 2011). One main challenge is to commercialise joint R&D projects.

**Conclusion**

The main purpose of this research was to explore how coupled open innovation processes are undertaken in innovation organisations from the perspectives of employees. In addition to the study of Van der Meer (2007) and Piller & West (2014), the main contribution of this study is observing these processes in a comprehensive way through mapping importing and exporting mechanisms based on AT categories. Moreover, design practice and research can especially take advantage of these findings by analysing the research findings and evaluating recommendations of this paper.

As open innovation is a new field, there are some limitations that should be taken into consideration. These are as following:

- Literature review of this paper mainly covers open innovation literature, whilst design literature has not been reviewed for this research.
- Piller & West (2014) state that coupled open innovation processes are based on open innovation, user innovation and co-creation. However, this case study
findings do not provide information about user innovation and co-creation aspects of these processes.

- The case study is a weak point of this paper because there is almost no example on the literature using the similar methods used for this research (cards, AT). Therefore, authors of this paper have difficulties to design the research, which might affect the reliability of the findings.
- The joint R&D projects are investigated from the employee perspective of one organisation and this might affect the reliability of the findings.

**Recommendations**

Aligned with the significance and limitations of the study, we recommend the following points that future design management studies can explore:

- There is a need for reviewing design management literature to outline the research done so far about open innovation processes.
- This study shows that leveraging from the joint R&D projects (commercialisation process) is still a challenge and organisations do not fully benefit from the outcome of these projects. Future studies can be focus on commercialising R&D projects via IP strategies and new business models. For example, design management literature can specifically focus on mapping commercialisation processes and whether design can contribute to these processes.
- Each category of AT might be explored in more detail because there is a lack of information. For example, there is little information about instruments used in coupled open innovation processes. For instance, design research might focus on the instruments to identify the problems and develop new solutions.
- The case study findings do not provide information about user innovation and co-creation aspects of these processes, so the future studies might focus on these aspects.
- This research shows the efficiency of case studies to understand the phenomenon but there is only one case study conducted. Therefore, more case studies can be done to have reliable findings.
- More studies are needed to understand how open innovation is undertaken internally by employees.
- The research methods (Activity Theory and card) used for this study should be experimented and improved by conducting further case studies.

**Implications to Design Practice**

We consider that design practice can help overcome the identified challenges of the coupled open innovation processes. The potential design practice contribution areas might be as following:

- Setting up a consultancy agency that offers design thinking methods for organisations to help them to steer through the open innovation processes
- Designing tools (e.g. set of visual cards) and setting up workshops (cognitive idea generation sessions with partners) to help organisations consciously understand these processes
- Developing business models and services for open innovation processes
• Designing new products and services by identifying the needs of open innovation processes

References


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Bespoke Innovation: filling the gap between the classic and user-centred open innovation

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In this paper, we explore the possible boundaries of open innovation by looking at the properties and problems associated with various forms of governance which all have claims to be regarded as open innovation. We look first at some basic forms of open innovation governance before looking at the case of a relatively neglected but increasingly important variant, bespoke or customised innovation. We discuss the implications before finishing with some tentative conclusions.

keywords: open innovation; bespoke innovation; user innovation; standard setting innovation

Forms of open innovation

The concept, problems and opportunities of open innovation were first scoped out and elaborated in some detail by Chesbrough (2003). More recently the concept has been defined as “a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organizations business model” (Chesbrough and Bogers, 2014, p.17). The transaction may be pecuniary or non-pecuniary, for example in a dynamic knowledge sharing network there may be loose norms of reciprocity and obligation in which a beneficiary from network membership at one time and context may contribute into the network at another time and context (e.g. Dyer and Nobeoka, 2000).

Perhaps very appropriately this is a very open definition which might in principle cover a variety of governance regimes and practices. However, in his original statement of the open innovation agenda, Chesbrough (2003) argued that intellectual property (IP) only has
value in open innovation if it leads to commercialisation (2003, pp.57 and 156). Open innovation as framed in Chesbrough (2003) placed heavy emphasis on business models and management of IP on a private good basis to exploit opportunities in pursuit of commercial profit. We shall describe this as “classic” open innovation.

In recent years, the scope of open innovation has been broadened (or loosened) to include other forms of governance that can appear difficult to square with the original statement of intent set out in Chesbrough (2003). For example, there are numerous technical standard setting organizations or committees (SSOs) which may involve various interested parties such as commercial organizations seeking to influence the setting of a standard to enhance their own chances of subsequent innovative success. The interaction between parties may involve transfer of technical knowledge, e.g. in the form of contributions to technical specification drafts (Leiponen, 2008. p.1906).

The intended outcome of many of these SSOs is a public good in the form of a technical compatibility standard (Lemley, 2002; Simcoe, 2012). At first sight it would seem difficult to square with the notion of open innovation because the direct output is an agreed standard, not a commercial innovation. However, from the perspective of participating firms the SSO may be regarded as an open exchange stage of a fuller innovative process that will intendedly lead to commercialisation. If such a transaction seems consistent with the spirit of open innovation as originally intended, then it becomes more difficult to exclude SSOs from inclusion in the open innovation tent. Indeed, Waguespack and Fleming (2009) analyse the Internet Engineering Task Force (IETF), a community that develops standards for the Internet as pursuing a form of open innovation.

The private good – public good relation is a crucial discriminator between SSOs and what is more commonly seen as open innovation. But many of the characteristics and problems of, for example, alliance formation, transactions and IPR are common to both SSOs and conventional forms of open innovation. At the very least gains may be made from exploring lessons to be learned from comparing (and possibly contrasting) the respective cases.

A further related innovation process is what Bogers and West (2012) describe as user innovation and Chesbrough and Bogers (2014, pp.20-21) describe as open collaborative innovation, this most notably analysed by Von Hippel (1988; 2005). Like many SSOs, user innovation governance systems such as the open source movement are concerned with the production and use of public goods; however, unlike SSOs the donor in the case of open innovation is typically not seeking any direct payback (pecuniary or non-pecuniary) for providing the technical information. While there may be some (often minimal) restrictions placed on the use of information by a user, there is typically no direct reciprocity between donor and user such as are common in commercial technical transfer agreements.

Chesbrough and Bogers (2014) and Dahlander and Gann (2010) note potential commonalities and complementarities between open and user innovation, including that business models may help to commercialise innovative possibilities after the public good knowledge has been captured by user initiated innovation. In these respects, there are also potential commonalities between SSOs and user innovation despite the differences
already noted; both SSOs and user innovation focus on the public good stage that can be intended to be a prelude to eventual commercial innovations.

All three forms of governance could be said to be concerned with processes involving distributed innovation with purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms. The organizations’ business models may not be so visible at the public good stage of SSOs and user innovation, but in each case, may begin to kick in once organizations have the opportunity to exploit the output of the respective public good stages. So it would seem that all three forms of governance are at least broadly interpretable as open innovation consistent with Chesbrough and Bogers’ definition (2014, p.17)

However, there is a fourth distinctive form of innovation which may also merit consideration in this context; bespoke or customised innovation. This can be another form of user-oriented open innovation where the knowledge required to produce a specific new product may be distributed across the partners contributing to the final innovation (Rayna, Striukova and Darlington, 2015). It is also an area where technological advances are disrupting traditional scale-based methods of manufacture. For example, 3D printing is a type of manufacturing process where a three-dimensional object is created by adding successive layers of materials. Its ability to reduce minimum efficient scale of output and increase potential variety of innovative outputs means that barriers to potential users customising innovation to their needs can be considerably reduced. While not all 3D printing activity need involve collaboration, Rayna and Striukova (2014) note cases where 3D printing can be analysed as business model open innovation and observe that customers can take a stronger and more active driving force in the innovation process because of the co-creation process between customers and firms. By implementing reliable, traceable and structured web-based communication channels between customers and firms, the bespoke innovation facilitates an emerging and growing industry of personalised/customised mass production of goods. Great opportunities of bespoke innovation in industry of medical devices, wearables, jewellery, car industry etc.

Here we look at the case study of bespoke product development processes in a heavy manufacturing environment of a market-leading company designing, engineering and supplying air and gas handling equipment. The case serves the purpose of illustrating the proposed conceptualisations, rather than representing a structured case study. The method employed to analyse the case was action research. Action research aims at solving real life problems within a specific context, thus the objective of knowledge developed from action research is to “provide a better understanding in order to support and promote better managerial and organisational practices” [Palshaugen, 2009, 231, cited in Kocher et al, 2011]. This ultimately suggests that researchers and practitioners should design field-experiments in order to provide a novel solution to a specific problem the practitioners’ organisation is facing [Fendt and Kaminska-Labbe, 2011]. We are using a flipped approach to argue this case. The conceptualisation of the proposed theoretical frame emerged from exploration of innovation practices within this case.

The case
The case company operates in a traditional heavy-engineering environment delivering only bespoke products tailored to the need of the customer on a contract basis. Due to
the nature of such work the product development process needs to be both transparent and articulable within the company to facilitate communicability, traceability and accountability. However, the product development process also has to be flexible enough to accommodate innovative approaches brought about by different expertise within project teams. It is thus paramount that cross-functional collaboration is established internally with the voice of the customer delivered from external sources. The case company has developed selection software in collaboration with key customers to achieve the integration needed across these different levels of internal and external collaboration. This software is distributed to the new customer and used to define the specification of a desired product. The sales and R&D functions continuously interact with the customer in order for the specification to deliver all the relevant requirements of the product.

The interaction between the case company R&D and sales functions and the customer continues until the company understands exactly what the customer needs in terms of general technological knowledge, eg. what pump pressures they want to achieve, the system within which the product will be integrated, etc. This intense collaboration typically diminishes progressively through the course of product development. Once the product requirements are agreed with the customer through the selection software, the R&D function within the case company takes over full responsibility for design and development. At the same time, there is no transfer of knowledge to the customer as to how the product is actually developed, the IP remains with the case company. A monitoring regime is agreed once the new product is actually installed at the customer site. This enables the company to monitor performance of the product and more closely match actual performance to the needs of the customer as originally specified through the selection software. The benefit to the customer at this stage comes through just-in-time maintenance with the monitoring system also delivering data on potential issues and break-downs. This in turn provides technical feedback to the case company that can inform and improve the product development process to help serve future customers.

Discussion
We have looked at variants of what have been described in the literature as open innovation: standard setting organizations; user innovation where the raw material to be transformed into innovation comes in the form of a public good; and bespoke innovation. What has been relatively neglected up until now is how these family derivatives of the open innovation imperative compare with the original conception of open innovation as set out in Chesbrough (2003).

Chesbrough (2003) built up the case for open innovation by looking at numerous examples of open innovation success (and failure). In the panoramic audit of corporate innovation performance carried out in Chesbrough (2003), the key question that kept on recurring was whether or not the corporate boundaries were permeable in terms of managing flows of new ideas in either direction - what were to be later christened as Inside-Out and Outside-In open innovation. Central to this open mind-set was the notion of IP management (Chesbrough 2003, pp. 56-57; 155-76) with the firm being an active buyer and seller of IP using mechanisms such as corporate venture capital, licensing, spinoffs and external research projects (Chesbrough, 2003, p.155).
We note that what is Outside-In open innovation from the perspective of one partner is Inside-Out open innovation from the perspective of the other partner. They are both sides of the same coin. Essentially all open innovation in the sense typically adopted by those following the trajectories signposted by Chesbrough (2003) has at its core the powerful unifying notion of a transaction where a technological idea developed in one organization is traded on a private good basis and finds a use in another organization. It is this emphasis on the open innovation firm actively buying, selling and transferring IP on a private good basis (what we describe below as “classic” open innovation) that could be said to potentially differentiate it from the other forms of open innovation discussed above.

Table 1 illustrates the major difference between these four forms of open innovation, with the caveat that we are representing extreme or ideal types here and in practice actual governance systems may not fit so neatly into just one of the four boxes. Open innovation in the “classic” sense described by Chesbrough (2003) tends to describe a cooperative agreement between two or more organizations to pursue innovative opportunities involving transfer of technical knowledge on a private good basis. That tends to contrast with the roles and preoccupation of both SSOs and user innovations in respect to their emphasis on the public good characteristics of technological knowledge. But bespoke innovation of the type looked at here and user innovation are similar in that there is no technology trading agreement. In the case of user innovation, the firm draws on a pool of technological knowledge without reciprocal obligations in the form of pecuniary or non-pecuniary benefits to the donor organization(s). And in the case of bespoke innovation looked at here, it is market and user knowledge and specifications which crosses organizational boundaries, what Teece (1986) described as the complementary asset of technical knowledge tends to remain locked up within the boundaries of the firm undertaking the product development.

Table 1  Forms of openness in innovation (Source: authors)

<table>
<thead>
<tr>
<th>Private Goods</th>
<th>Public Goods</th>
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<tbody>
<tr>
<td>Technology transfer agreement</td>
<td>&quot;Classic&quot; open innovation</td>
</tr>
<tr>
<td>No technology transfer agreement</td>
<td>Bespoke innovation</td>
</tr>
<tr>
<td></td>
<td>Standard setting organization</td>
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<tr>
<td></td>
<td>User innovation</td>
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</tbody>
</table>

The implications of all this encourage a reconsideration of the generality and specificity of principles and findings related to open innovation. The original core idea of “classic” open innovation where technological knowhow is traded across organizational boundaries on a private good basis raises potential issues of transaction costs (Keupp and Gassmann, 2009), appropriability problems (West, 2006) and absorptive capacity (Spithoven, Clarysse and Knockaert, 2011) to name just some areas of concern. The public good nature of both SSOs and user innovation would seem to mitigate some of these issues, and up to a point that may be true but they can raise other issues. User innovation may be able utilise the knowledge source on a free or low cost basis, but there are questions over whether this governance model is transferable outside certain special or limited cases given it lacks the hard-edged market incentives and rewards that can accrue from controlling or selling IPR as in “classic” open innovation. Also, SSOs may notionally be in the business of generating a technical standard as public good, but that does not mean they can necessarily avoid
such issues as game playing by participant organizations, domination of the SSO by powerful firms or alliances, and proprietary concerns that signalling preferences might leak clues to other participants regarding the trajectory of the firm’s commercial aspirations.

Like SSOs and user innovation, bespoke innovation may avoid some of the most severe issues associated with “classic” open innovation since the knowledge flow across organisational boundaries tends to be predominantly market or user specific and not involve technology transfer. However, this can be at the expense of introducing, exacerbating, or just illuminating other problems. For example, there can be internal cross-function problems of coordinating and integrating the technical and marketing assets necessary for fully bespoke delivery of a new product, as well as possible issues of balancing and integrating the roles and needs associated with generating new products with the dictates of current business. Also, there may be the opportunity cost of the loss of scale that a more standardised off-the-shelf approach to technology provision might have achieved.

Table 2 provides comprehensive comparison of all four different innovation forms. Classic open innovation and SSO innovation were well described already in the past, thus hereby we would like to emphasise another important difference between user innovation and bespoke innovation: namely user innovation typically focuses on communicating with customers/users or only observing them in order to obtain ideas and solutions which would be beneficial for the company. This can be done by marketing research campaigns exploring how the customers use existing products from company’s portfolio, or by investigation of customers’ needs and wishes, but with no immediate compensation of them. On the other hand, bespoke innovation is designed to serve both, customer and company. The customer initiate the innovation process by providing the company with all details about requirements and needs and then the innovation is proceeded by the company to provide the customer with personalised/customised end product or service. After the end of the innovation process, the IP rights normally remain in the company if there is no other agreement.

Table 2 Differences of open innovation forms

<table>
<thead>
<tr>
<th></th>
<th>“Classic” open innovation</th>
<th>Standard setting organization</th>
<th>User innovation</th>
<th>Bespoke innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner of IP</td>
<td>Upon agreement</td>
<td>Internal or public domain</td>
<td>Shared</td>
<td>Internal</td>
</tr>
<tr>
<td>Innovation flow direction</td>
<td>Coupled</td>
<td>Outwards</td>
<td>Inwards</td>
<td>Coupled</td>
</tr>
<tr>
<td>Public/private good</td>
<td>Private</td>
<td>Public</td>
<td>Public</td>
<td>Private</td>
</tr>
<tr>
<td>Management of innovation</td>
<td>Shared</td>
<td>Internal</td>
<td>Shared</td>
<td>Shared</td>
</tr>
<tr>
<td>Innovation outputs</td>
<td>Missing knowledge</td>
<td>Standards and guidelines</td>
<td>Public opinion</td>
<td>Customer needs, requirements, customisation</td>
</tr>
</tbody>
</table>
Application of innovation form outputs | Licensing, subcontracting, joint venture | Exchangeability, comparability, control of products and services | New products through customer innovation, new use of existing products | Customised or personalised goods and services

**Conclusion**

In the final section, we tie some of these threads together with some provisional conclusions.

In this paper, we looked at open innovation and compared the original or “classic” interpretation of open innovation with broader interpretations that have developed in recent years. From our perspective, it appears that each variant offers valuable issues and lessons related to the core open innovation problem of purposively managing knowledge flows across organizational boundaries using various incentivising mechanisms in manners that are consistent with organizations’ business models. What we conclude from this study is that it is important to identify the types of knowledge flows and property rights issues in analysis of different forms of open innovation. That is the key to differentiating the major variants of open innovation, and it is hoped that the sorting and classificatory process we have pursued here will help provide a useful basis for identifying and analysing the similarities and differences between these alternative forms of open innovation governance.

**References**


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Introduction: Design Creating Value at Intersections

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The theme track includes 11 submissions with 27 authors representing 15 universities from 9 countries. This diversity is also reflected in subjects of the submissions, although sharing an interest to discuss what value creation means in different contexts – and intersections. Our theme highlighted how people from different disciplines coming together create value at different intersections. The subject and field of design has changed, or rather expanded to include new knowledge practices, technologies, including a move from a focus on artificial outcomes to services and business models as outcomes of a design process. The emergences of new intersections where design can create values are hence a logical outcome of this development – and this is of course also reflected in the expansion of design research.

The understanding of design methods and processes can create space for new learning processes in organizations and in different networks. Young, Lievesley, O’Leary, and Warwick present a study where they mean that “Design is actually coming of age” and this has opened up for new roles for design in organizational contexts. They present a revision of the discourse on the nature of and relationship between design and other disciplines. Their article advocates a new para-disciplinary term for the post-disciplinary state of design in its contemporary practices, acting as the ‘inter-discipline’ within organisations that are intent on the strategic development of their innovation capacity and potential. This in turn can increase the adaptability and pro-activity of organizations to meet ambiguity and uncertainties that organizations are working with. This is for instance highlighted in the article by Koria and Best, another submissions in this track, where they, in the form of a conversation, discuss how we need to engage deeply with “evolvability”
to benefit from ambiguity and the unexpected. They claim that this means moving from trying to see the future into trying to create it.

The issue of the value of design for economic development is still an important issue for research. The research on how design brings economic values has had a bias towards industrial countries while ignoring many other countries, sometimes referred to as third world countries. In many NIC (newly industrialized countries), especially in Asia, the interest for design has led to investments and institutionalization of design in the education system. There is a growing interest for design from a business and management perspective also in African countries. The article by El Hilali gives an overview of the situation in Morocco and discusses the emergence of design management and its obstacles to become accepted in an emergent economy based on institutional theories. The issue of how design can contribute to businesses is however still on-going in most industrialized countries. Ford and Terris address the issue of how cooperation between higher education institutions (HEI) engaged in design research, can effectively support SME’s in new product development. This is done when HEI actively participate in the design process whilst simultaneously working with SME’s to facilitate the development of knowledge networks local to specific SME’s. HEI are in this process acting as an intermediary.

Design is often used as a synonymous to innovation without always reflecting upon what constitutes product novelty. Holmquist, Magnusson, and Livholts, in their article discuss the tension between novelty and tradition in design and material innovation. They emphasize how new meanings can rise from the tensions between new and old and they present cases of how these tensions were perceived by customers as particular valuable. They also discuss how designers work deliberately on creating these dissonances although still honouring the quality of the craftsmanship.

Design is increasingly recognized for creating value in the intersections of society and social challenges, sustainability (environment, social, economic), and the circular economy; the oncoming global challenges have an interdisciplinary nature, and design has the potential to create value in multiple intersections. At the same time, the very concept of value is changing. What was seen earlier as a simple profit/loss equation is now recognized as a complex construction where value is created and consumed in novel ways and where well-being co-exists happily with profit, and eco-footprint is increasingly linked to customer experience. Hesselgren, Hasselqvist, and Liridona do claim in their article that design has certain values for exploring and bridging the intersections of everyday life and individual’s decision making to achieve a more sustainable lifestyle, in their case sustainable transportation. In particular they argue that co-design methods can be useful in dealing with complex problems and enable decision-making by communicating the experiences to people with power to trigger and direct change.

There is a growing awareness that designers need to know more about how we as human being changes our capabilities when we grow older. With an increase in life expectancy and decrease in fertility the elderly population has started to account for a disproportionate number in many countries. Innovations for elderly, as a segment, have become a business case. Wang and Chen have conducted a study of elderly users’ understanding of images and perception of products, something that change, as we grow
older. They claim that this knowledge is something designers need to have when designing for elderly. Also children is increasingly a segment with special views of the world, not the least the world of shopping, a theme that Rusman; Yin, and Dhillon have explored in their article about children’s shopping experience.

It is of paramount interest to try to understand what value design does create in new intersections, why it is created and how it happens. Several of the submissions in this track bring up the value of design thinking and the role it has for business strategy, for instance in article by Jalote-Pama, Badjoko, and Deshmukh. They describe an integrated design thinking framework for guiding business problem solving towards nurturing innovation. They demonstrate the value design thinking creates by inducing systems thinking and adopting a human-centred approach to business problem solving. Another approach, also based on design thinking, is brought up by van der Marel and Joore who argue that a designerly approach of design thinking can enhance capabilities in education, an area that to a great extent need new thinking and new ways of approach learning.

Service design is a field that is increasingly seen as one of the core areas of design and innovation, however with many different approaches and a great variety of toolkits to use when developing new services. One submission in this field highlights the role of gamification in service design. Ihmäki, and Heljakka show in their article how the customer journey is enhanced through gamification and how this creates a value system for a ski resort. In this development process the network of actors and their relationships that jointly create an offering are essential for its success.

We were expecting contributions to see how design is creating values in new areas and not only on product and company level but also on social and societal level. Sustainability has a long history of interest among designers and this interest continues with new aspects. We were hence curious to see what those addressing these themes would bring to the conference, and indeed we can see how the field of design and the value creation has expanded without neglecting what we understand as the core of design.

Papers

The following papers are included in the conference proceedings for this track: Design creating value at Intersections

2. El Hilali, N. Design emergence in Morocco as an African country: a pending institutionalization
3. Ford, P., and Terris, D. NPD, Design and Management for SME’s
8. Rusman, M.S., Yin, Y, and Dhillon, Y.S. Effects of atmospheric variables on children during shopping activity: a conceptual framework of children shopping experience

9. van der Marel, F., and Joore, P. Enhanced Capabilities through Design-Based Approaches

10. Wang, Chun and Chen, L. Cognitive Study of Products’ User Interfaces for Use by Elderly People


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Design Thinking in Business Strategy: Applications in Human Resource and Pricing

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Design is being positioned as design thinking in management literature, from being a contributor of aesthetics to playing a strategic role, not only in innovating products/services but also transforming businesses. To incorporate design into corporate processes raises two issues: (a) need for an integrated design thinking framework to support business problem solving and (b) cases illustrating application of design thinking in corporate processes. This article describes an integrated design thinking framework for guiding business problem solving towards nurturing innovation. Based on this framework, business leaders were trained in design thinking by the author. Two select application cases are described, where the trained leaders have applied design thinking to corporate processes leading to the optimisation of business processes in human resource management and pricing. This article contributes by demonstrating the value design thinking creates by inducing systems thinking and adopting a human-centred approach to business problem solving.

\textit{keywords: Design Thinking; Corporate Strategy; Pricing; Human Resource}

\section*{Introduction}

The era of management is proceeding towards complex, fuzzy, and interdependent challenges that are often a result of rapid technological advancements and dynamic customer aspirations. Managers are struggling to formulate strategies with ambiguous and often unpredictable data sets from multiple customer touch points, in an attempt to respond and capture dynamic market needs. According to Martin (2009), managers are
usually trained to formulate strategies from well-defined problems and known data sets and provide risk-averse outcomes. This training often does not enable the managers to deal with ill-defined wicked problems and they rely on interpreting ambiguous data to propose solutions.

Contrary to the managerial approach, designers are trained to solve wicked problems, (Cross, 2001; Dorst, 2011; Owen, 2008). Martin, 2009 states that designer formulate human centred strategies, and develop new propositions from the ambiguous data derived from disparate sources, termed as abductive thinking. The contemporary management literature has indicated a repositioning of the role of design from being a contributor of aesthetics to playing a strategic role, also termed as ‘design thinking’ in innovating not only products, services but also transforming business (Martin, 2009; Norman and Verganti, 2013). In this article the term design thinking can be understood as ‘a creative and systemic problem solving process that can holistically envision or shape new products, processes, businesses, and future societies (social change) by driving user- and context-sensitive solutions (Jalote- Parmar, 2015).

The application of design thinking in business problem solving faces the following two challenges, that this article will address: Firstly, to be able to apply design thinking to a given problem requires ‘design attitude’ which is essentially the approach which designers perceives, frames and solves problems. Michlewski (2015) emphasizes the need to inculcate design attitude in organizations is critical and it receives less attention then needed. Jalote Parmar (2016) state that although design literature proposes that design thinking plays a strategic role in organisations, the inculcation of design attitude in business leaders is severely under emphasised. Brown, 2009, proposed a popular five stage process-based model of design thinking focussing only on product innovation. This model does not include established constructs that are critical towards design problem solving such as problem framing (Dorst, 2011) and systems thinking (Checkland, 1981). This necessitates the need of an integrated design-thinking framework which can inculcate design attitude, in business leaders towards business problem solving. Secondly, although the literature captures several applications of design thinking in product and service innovation such as Bang and Olufsen (Autsin & Beyerdorfer, 2007), Apple (Thomke & Feinberg, 2012) and Intuit (Smit, 2015). However, there exists a gap in literature defining cases in which design thinking has been applied to solve complex business problems leading to innovation in organisations (Meisiek ,2016; Rusk, 2016).

Addressing, the aforementioned gaps, the contribution of this article is twofold: (a) it describes the integrated design thinking framework for formulating design attitude in business leaders, and (b) it demonstrates the value of design thinking by describing two cases where after being trained in design thinking, business leaders have applied the design thinking framework in business problem solving and inducing innovation. Both the cases demonstrate optimisation of business strategy for talent management and designing value based pricing process in organisations. The following sections describe the integrated design-thinking framework and its application in two organisations:
Integrated design-thinking framework

Brown, 2009, proposed a popular five stage process-based model of design thinking leading to product innovation. This model specifies key stages of how the designer acts on a problem to develop products. This model does not include how the designer perceives/frames at a systems level or visualises/ processes the problem by engaging with the context and multiple stakeholders. Design literature has strongly emphasised several value points in design problem solving that lead to innovation which are not covered in the above model such as –how the designer frames the problem which leads to innovation (Dorst, 2011), co-designing with multiple-stakeholders a critical factor in design problem solving that to leads to innovation (Jalote Parmar & Badke-Schaub, 2008). This necessitates the need of an integrated design-thinking framework which defines design attitude - the approach to which the designer perceive the problem that can guide business leaders in approaching complex problem solving. Rusk, 2016 states the need for evaluation of design management education where seeing things in a new way is central to how knowledge is generated and collaboration happens in organisation.

To develop the framework first a primary study was conducted with 30 senior managers with 15-20 years of experience in Indian corporates to investigate the factors that influence the business problem solving specially related to approaching a problem and radical thinking. Details of this study related to formulation of the framework is not a part

Figure 1 The Integrated Design Thinking Framework: The Banyan tree that defines the key constructs of design thinking necessary to induce design attitude in business leaders
of this conference paper and is forthcoming (Jalote Parmar, 2017). Only select factors from the study are mentioned in this paper: (a) managers are trained to be risk averse and don’t often challenge the existing status quo or reframe the problems (b) managers seek already proven data set to make decisions, (c) managers find it difficult to make decision or formulate a strategy based on ambiguous and disparate information direct from field is provided to them. They require large statistically proven data to be able to formulate a strategy, less number of people interaction in field is not an evidence enough for them. (c) managers are quick in providing solution for problem without having a holistic or systems view of the problem (d) managers can brainstorm based on known and large data sets and formulate assumptions without going out in the field to interact with actual stakeholders (e) managers look at human data as numbers, not people and relation to their aspirations (f) managers often find it difficult to visualise the end solution, they are more focussed on high level planning the strategy, process and execution (g) learning by doing is not a part of tight schedules and process based problem solving process managers, where the managers are more focussed on the deliveries and meeting tight timelines (f) managers solve problems in specific departments, interlinking problem solving between departments within an organisation is not a norm.

Based on the above findings and connecting it with the known constructs of design problem solving as mentioned in design literature (Archer, 1979, Cross, 2001, Dorst & Royalkkers, 2006; Dorst, 2011; Checkland, 1981), the integrated design-thinking framework called ‘the banyan tree’ is proposed (Figure 1). The framework uses South Asian ‘Banyan tree’ as a metaphor to denote an adaptive organisation. The tree represents a living organism that is context aware because it continuously senses, adapts, and grows around its environment. Similar to the banyan tree, the new age organisations and managers should be able to develop dynamic capabilities in order to sense and seize opportunities. The seven leaves of the tree [depicted as circles in the Figure 1] are inter-related and symbolise the key constructs that defining the design attitude and are critical to design problem solving. These constructs aid in developing holistic propositions after continuously and iteratively sensing and synthesising information from a global context. Further helps them to challenge the existing way of doing things and solve problems by creating collaborative environments. The following constructs of design attitude have been integrated in the framework and have been explained in Table 1 (Appendix): (a) Context Aware/sense & Respond (b) challenging the existing status quo or reframing the problems (c) abductive thinking/ sensing opportunities from ambiguous data, (d) systems thinking (d) visualisation iteration. (e) co-design, (f) Agile/breaking silos (g) empathy, and (h) Visualisation/Prototype

The trunk of the tree represents the knowledge funnel which was proposed by Martin, 2009. The knowledge funnel represents the processes through which knowledge flows in an organisation and how by applying design thinking for complex problem solving can create an innovative and adaptive organisation. As stated by Martin (2009), the ideas generated from applying design thinking approach should be continuously fed into the knowledge funnel.

**Overarching Method**

Senior management executives (n = 35) with a minimum of 15 -20 years industry experience from 20 large, mid-sized corporates and independent consultants were trained
in design thinking by the first author through an executive programme at a premiere management institute in India. The proposed design thinking framework was taken as a basis for training managers in developing design attitude and in application of design thinking for business problem solving. Post the training for four months the trained managers were observed and where required consulted by the first author (through emails and skype discussions) for application of design thinking in business problem solving. The following sections describe two cases of application of design thinking framework by the above trained managers. These managers from two organisations have addressed problems of human resource specifically in creating talent management system and in creating value-based product pricing.

**Case 1: Application of design thinking to design a value-based pricing process**

*Company background and problem*

A mid-sized multinational European chemical company (Company X) with a net worth of 300 million euros was involved in a pricing transformation project. The transformation strategy involved making a shift from cost-based pricing to value-based pricing across the main product lines, within 30 countries in the Business to Business (B2B) market. Cost-based pricing can be understood as pricing that is dictated by market conditions, whereas value-based pricing is when the company sets its prices in a range determined by what the customers are willing to pay. Hence, a value-based pricing strategy requires the company to have an in-depth understanding of the customers’ needs and a value perception of its products.

Currently, Company X applies ad hoc methods to understand its customers and apply the learnings in the pricing process. Because of the ad hoc approaches, decision-making becomes inconsistent and time consuming, often resulting in a disconnect between the customer and the offering. For example, Product Z was launched after a request from the sales organisation and as a validation to offer a medium range alternative for a premium product. The product portfolio exceeding 5,000 Stock Keeping Units (SKU) was to be sold in 10 countries with different economic conditions and buying power from those of the present customers. However, a single price point was offered for the product. Customers’ price deviation demands from the marketing teams were often attended on an ad hoc basis. The pricing problem was solved dynamically, with a focus on providing short-term resolutions, depending on daily operations and decision makers’ availability.

*Application of Design Thinking to pricing transformation*

One of the managers trained in design thinking (second author) is a pricing consultant working for Company X. This manager applied the fundamentals from the integrated design thinking framework to design value-based pricing. The mangers in the first stage of problem solving, conducted a field study with the objective of formulating a systems level understanding of ground level issues of multiple stakeholders involved with the pricing process in the Company X. This included conducting interviews (n = 20) in a span of two months with stakeholders (n = 8) involved in multiple functions of the pricing process. The study also included field visits (n = 10) by the manager in Company X. The stakeholders included country sales directors responsible for business development of the brand,
managers within marketing and sales department, the chief financial officer, and the chief operations officer (COO). The stakeholders were present in the five European countries and interviews were conducted through conference calls. Post the study the findings were analysed by making an affinity diagram and a strategy for new value based pricing was offered. This solution was implemented in the organisation and will be discussed in the section below. First, the key findings from the field interviews are described below:

Results: Key findings from the field study

• Disconnect between sales and marketing: The findings revealed that there was a relative disconnect between sales and marketing department on the requested price level and the product features offered. The sales department handled direct customers (32% of the revenue) and distributors (68% of the revenue) of the total volume to negotiate prices, sales, and contracts. The product development department, developed the products, decided on the initial price positioning, product feature, and R&D, and monitored the production request. However, although both the sales and product management teams interacted with the customers, the interactions were not simultaneously conducted. The problem solving focus linked to pricing was theoretically converging but factually disconnected because the sales and product management teams often did not agree on the following points: (a) market needs, (b) R&D product features and services, and (c) the targets that were considered achievable in terms of profitability.

• Lead time for decision making: A long lead-time, ranging from 5 days to 6 months, was necessary to take the appropriate actions following a market feedback. Information exchange between the sales and marketing teams was, in some cases, not progressing because the same issues remained unsolved for an extended period. Market feedbacks were addressed using an ad hoc and not systemic approach. For example, during a conference call, a country sales director stated that ‘product Y did not have the feature that corresponded with the current market needs’. The marketing team responded that ‘the specifications had been validated 6 months ago and seemed to correspond with the competition’s offering’. The country director countered that ‘the price point of this product is too high, nearly 17% too high, as the features are in some way obsolete’; no decision or follow up action was taken following this critical exchange of views.

Proposed design of value based pricing process

Based on the aforementioned findings and the addressing of the key issues, a strategy for value pricing process was designed. Empathy, systems thinking and codesign was used as a focal point to develop a hands-on iterative pricing process. This involved seamlessly multiple stakeholders among different departments (sales, marketing and product development, and accounts) to retrieve and validate market feedback and customer reactions. The process enabled two activities: value based selling (as opposed to the selling of just products with a price) and innovation stimulation. These two elements result in value creation. To make the process iterative, the two way interactions between sales and the customers/distributors occurred throughout the year. This informal and continual manner of conducting the process rendered it more natural for the clients who tend to notice only the effects of the process and not the underlying administration. Once
retrieved, the market feedbacks were processed by pricing management and product management.

Figure 2: New collaborative value based pricing process with iterative customer feedback and multiple stakeholder engagement.

The information flow was kept simple; six different sources were used to retrieve information: sales employees (eight seniors), distributors or dealers (nearly 26), product managers, suppliers, social media, and focus group. The customer’s expectations of and responses for Company X products and services were then commonly defined, providing a first common base to both sales and product management with objective information and a direct channel of communication. Figure 2 explains the proposed pricing decision making process in which the sales and product management obtain a direct feed of information from four different sources. At the second layer, the sales and product management team need to communicate and exchange information, standing point, and requests on the basis of the same information that they validated together. Before the escalation, they agreed on the method to operate; only the matters that really required the intervention of senior management were escalated to the top management, thereby yielding a decision with a strong information base and analysis previously conducted by the sales and marketing (product management) teams.

Benefits of value based pricing process

- Challenging the traditional method of solving the pricing problem in the company as well as empathising and later codesigning with multiple stakeholders involved in the pricing process helped in identifying the major cause of certain price deviations. As Company X evolves in a distributor/dealers market, identifying the original source of an information or request can be challenging. By ensuring that information is being relayed distinctively from all channels, isolating the source becomes feasible.
- The new process significantly reduced the decision lead-time between sales and marketing (product management); the decision time was reduced to 4 hrs to 48 hrs, depending on the urgency of the request. Previously, considerable time was required to make a decision, considering the changing environment and the
ongoing structural and functional changes. Reducing the lead-time and including the multiple stakeholders’ opinions at different stages made the decisions easier to apprehend. Less than 10% of request now required the involvement of VP/board-level employees to be solved.

- The proposed new formal process provided a base for key decision-making in terms of pricing and product’s value. The margins were defended and increased by 2% without loss of market share. It addressed the previously explained key issues because the decisions were being made without a systematic or systems thinking approach and this troubled the stakeholders. The new solution eliminated the complexity of the decision and helped the stakeholders focus on their areas of accountability and fulfil their responsibilities.

- Incorporating regular customer feedback in the pricing process contributed to understanding the customers’ willingness to pay for estimation. Empathy was used to understand customers’ perception of the products, expectations from the products, and value of the products, which were the essential determinants of the willingness to pay. For the company, this insight helped in modifying the products and services to reach the desired value level, enabling the company to price the products and services without losing market shares.

- The newly designed processes adopted the six-sigma approach—define, measure, analyse, design, and verify (DMADV). Design Thinking constructs were incorporated at all the stages of the DMADV, as sense and respond, empathy, co design and iteration were the leading principle for each stage. The applied process was flexible: step one, ‘define’, was used to identify the need for the process. This involved creating clarity, simplicity, fairness, gaining of time and ability to work with small and large flow of information which is not intensive for the stakeholders; step two, ‘measure’, was an motivation to implement a process with at least some quantifiable information, such as the number of decisions that required the attention of the top management versus the ones that could be handled at a lower level of decision making (i.e. less than 10% out of the approximately 40 cases required the involvement of the top management); step three, ‘analyse’, was used for the analysis of the role of each stakeholder and subsequently place them and make them interact accordingly; steps four and five, ‘design’ and ‘verify’, respectively, were used as an extension of the natural flow of decisions and to validate the results. If the decision-making process and market intelligence are actually useful for the major cases and do not show any signs of weakness, then the results were found valid.

- A workshop was conducted with all stakeholders, country sales directors, and marketing, finance, and operations personnel. Stakeholders were asked open-ended questions to receive their input, expectations on prices, customers, and strategy and to trigger a structured debate. The design of the questions and the method of translating the qualitative feedbacks were also considered a contribution from design thinking because it focused on being sense and responsive and empathising with multiple stakeholders. The question typically asked after the reception of the inputs was what should be a good way of approaching and obtaining feedback from the customers? This provided
additional basis to design all key elements of the pricing process, with the reoccurring objective of translating the customer’s perspective into the process and products.

Case 2: Design thinking application in human resource’s ‘talent management’

Company background and problem
Company Y is an Indian mid-tier Information Technology service provider; it has firmly established itself as a digital transformation partner for its customers, with an annual turnover of (US$ 440 million). It has a complete technology services portfolio including digital, applications, infrastructure, and industry-specific solutions. The company envisages being ahead of the curve in digital space, where mostly all leading clients of the company are using the companies’ digital services, thereby enabling their business transformation. The continual growth in the company pressures the talent management team to identify and retain talent inflow. The company continually endeavours to engage, retain, and up skill/reskill the talent. In addition, the global attrition rate in IT companies is high and in Company Y, it exceeded 17% in the year 2016. New employees joining further pressurize the companies with increased salary demands; they also take time to understand the complex business process and systems, thus increasing the risk to the ongoing business and impacting customer satisfaction. Another challenge is to rightly distribute the available talent across the running projects and programmes. Teams have an inherent tendency to retain talent, although they might not really be using their entire potential. When there are bigger teams and more than 1000 associates to be handled, finding such hidden, partially utilised talent is difficult. To address this issue of identifying, training, and retaining talent globally, the organisations are investing in automation in the form of software robots. Automatisation is thus helping move dependency from resource to system by automating the decision making process; however, the complete visualisation of the decision making process from a multiple stakeholders’ perspective to optimise bench management is still missing.

Application of design thinking to talent management problem
One of the trained managers (Third author) is an Associate Vice President (delivery head) in the organisation. To address the aforementioned complex problem related to talent management, the manager applied the integrated design thinking framework. The problem solving process begin by conducting 3 field studies with multiple stakeholders. Based on the findings a new strategy for talent management including new policies, process and a multiple stakeholder digital system with mobile application was proposed. This strategy was codesigned with multiple stakeholders, implemented and tested. To understand issues of multi stakeholders involved with bench management, a field study was conducted in the following three stages:

Stage 1: Semistructured interviews and focus groups were conducted for over a week with members of the delivery team (n = 10) that included delivery managers (DMs), leads, and associates. DMs and leads dealt with associates daily and also faced the client for fulfilled/unfulfilled needs. Associates also had their own expectations and beliefs that
surfaced during the discussion. The DM, in addition to ensuring software delivery, is responsible for managing the resource distribution in multiple projects and taking care of talent up/reskilling for current upcoming technologies relevant to projects. Leads ensure quality and timely delivery from developers and their right utilisation.

Stage 2: In this stage, semi-structured interviews (n = 10) were conducted with the Associate Relations (AR), the Programme Control Office (PCO) and Resource Management Group (RMG) representatives. During these sessions, previous survey results on reasons for job exit and great place to work were discussed. Furthermore, challenges related to associate rotation and associate onboarding/off-boarding were understood in detail.

Stage 3: In this stage, one meeting with the learning and organisational development (L&OD) group and training department was conducted to consolidate, verify, and share the learnings of the first two stages.

**Key findings from field study**

- Lack of opportunity for rotation: More than 80 discrete technologies require expertise. In the current scenario, because associates were working in one project, they were locked with one set of technologies, making it difficult to move them across projects.

- Need for optimal use of resident talent because external hiring is very costly: Associates with niche technical and functional expertise who can be useful in some other projects should not be locked in projects where such technical expertise is underutilised. The team structure should be modified after considering the needs of the project and to meet the margin expectations.

- Need for the visibility of available and upcoming work (pipeline) in business units: To align adequately talent and achieve optimisation in talent utilisation, a clear visibility of available and upcoming work is required; to complete the task in real time and seamlessly, a single source of truth is needed.

- Lack of transparency: A lack of transparency is not by design but inadvertent; unavailability of system and a single source of truth makes it difficult for all stakeholders, including the junior most associates, to examine the data that they should have access to.

**Codesign with multidisciplinary teams:**

A codesign workshop was conducted involving multidisciplinary stakeholders (n = 20) [Figure 1]. The objective of the focus group was to discuss the findings in previous meetings and identify possible solutions. The participants included stakeholders from different departments connected to the talent management value chain: an AR team, which is an extended arm of the human resource (HR) team in big Business Units (BU) (n = 4), (b) PCO (n = 3), (c) delivery managers (n = 12), (d) and heads, RMG (n = 1) participated in the workshop. Participants were divided into three groups. The contextual enquiry method was adopted to draw insights from all the stakeholders and then build an affinity model; the key issues were identified and clustered into categories. Thereafter, the participants were asked to provide multiple solutions for the insights gathered.
Key findings from codesign process:

- Working in silos: The Delivery Team, RMG, PCO, L&OD, and training department worked in silos without regular interaction. The delivery team’s requirements were not clearly understood by the other stakeholders. Each stakeholder was striving to improve their statistics; however, when the systems view of the target was generated, no interconnections were observed, particularly related to attrition, fulfilment of vacant positions, revenue loss, gross margin impact, deployable pool availability, and per year per associate training achievement.

- Lacking systems view: During the session, the talent management problem was realised to be handled at the organisational level and not at a Business Unit level.

- Lack of transparency: A lack of transparency about the status quo of the talent management process was observed between the different BUs and stakeholders, including the associates.

![Figure 3: Focus group session to facilitate codesigning with RMG, PCO, HR, and DM](image)

- Mismanagement of associate placement: Associates were not included in the right projects considering their skills; they were assigned one project for a long duration. Technically smart associates were sometimes stuck in operations handling production tickets. Smart associates could not achieve rapid career growth because of hierarchies; in other words, fast tracking was absent and associates with niche technology expertise were stuck in projects where that technology was not used. Cross engagement movement was not frequently conducted.

- Missing integrated view: The multiple IT systems in the organisation were not integrated towards creating one understanding of HR actions such as (a) Talent availability for RMG function (b) Oracle Human Resource Management System (HRMS) for Resource Data (c) Performance Management System for Appraisals. These systems provided isolated views of different sections’ talent management and did not provide an integrated ‘hire to retire’ view that enabled better management. The analytics on the talent data gathered with the aforementioned systems was not available for informed decision making.
Proposed Design of New Talent Management System

To address the above issue, a multilayered strategy emerged from the preceding session. First a ‘Tiger’ team was formed as the key touch point to interact with the multiple stakeholders and the senior management. The Tiger team had one representative from each department to integrate each person’s perspective in decision making and governing policies. Second, the initiated process was changed. The pool management was now rigorously handled by a team called Reserve Work Force (RWF); the rules for releasing associates in this pool and further up/re-skilling were stringent and focused. Results are now extracted from the system and used in the CEO metrics reporting during quarterly reviews. Third, to aid in better visualisation of the talent management process and the status quo of all stakeholders, a prototype software along with a mobile application was developed. This system is described in detail as follows:

To track the progress and to take corrective actions, the baseline was first set first to determine the resource distribution target of a project. The actual resource loading then indicated the deviation, which could now be tracked at individual project manager-level, thereby enabling the delivery head or Business Unit head to take informed decisions for any movement of resources. The pipeline data was fed from the various IT systems into the new proposed system. The available talent was mapped against the forthcoming needs. The available current technology expertise and deviation from target resulted in an immediate creation of a training plan for the associates that was automatically published to the training department, allowing them to publish their training plan and invite nominees. The HR stakeholders were provided dashboards to track the band and expertise levels where the attrition was higher and plan for preventive actions; they could now monitor the deviation of per-resource training needs according to the organisational mandates and the actuals at any instance. Associates could view their position in comparison with all the other employees with similar skills on technology and solution expertise. The standardised assessment and representation helped them be aware of how their career is shaping. The dashboard and user profiles for the multiple stakeholders facilitated the information visualisation and customization of the talent management process. As a next step, it will be integrated with the existing RMG and HRMS systems for
the resource data. The development of the software was an iterative process; it began with white-boarding and creation of a paper prototype. After obtaining the approval from the various stakeholders, the technical team developed this functional prototype in two months using MySQL as the database, Java, Spring, Hibernate, and Fusion Charts.

Pilot testing and iteration of talent management system
The system was implemented in limited release mode. A section of the team with all roles covered had access to this application. First, the data entry from 500 associates spread across the USA and India were incorporated into the system and the content was verified and cleaned. This data entry exercise provided the first stage results with the system usage. These inputs were collected and multiple iterations were performed to improve the content and technological platform. In the second stage, the software was accessible to 1500 associates across shores along with other stakeholders.

Observations in talent management after system deployment
Two months post iteration with end users, the following key findings were observed:

- Corrective measures for talent distribution, training, and assessment: In a single dashboard, viewing the status of training plan, technology expertise, and background profile was easy, current projects, technologies applied and not applied in current projects, and project profiles of the associates sent for training could be accessed by the training department and the senior leads of the BU. Managers could visualise the talent pool in a single dashboard, thus, allowing relevant decision making and prioritising of resources. This visualisation allowed corrective action for talent distribution and assessment because the transparency was very high between stakeholders. For example, the associate’s training needs were quickly identified and linked to the programme needs and client roadmap, eventually leading to customer satisfaction and balanced teams.

- Career progression visualisation: Employees such as a newly joined associate, a mid-career associate, and managers could visualise personal career progression and also compare their growth with that of the other associates with similar skills. A happiness index was included in the system, which was given as a solution by the management trainee. The happiness index helped in understanding the aggregate satisfaction of the associates, providing the HR teams with a daily updates and analysing the trends. If happiness index increases or decreases some instances, they can also check the activities happening on or around those days and can try to create an environment that ensures the happiness index is at or exceeds the acceptable mark.

Conclusion
The article described the integrated-design thinking framework and its application in managerial problem solving that has led to optimising talent management and creating value-based product pricing in two global organisations. The article demonstrates how the constructs defining design attitude (problem solving) have been instrumental in guiding managers’ ability to sense and perceive problems holistically and at a systems level. Furthermore, the managers can challenge the status quo of the existing solutions and reframe problems from a human-centred perspective by involving multiple stakeholders.
They can engage with the multiple stakeholders and break silos between clients, customers, and internal departments to iteratively and collaboratively design solutions. The human-centred reframing of problems and the agility in iteration leads to a co-working culture in the organisations that also has a long positive impact on customer relations. This article contributes to the design and management literature as a case of application of design thinking in core business processes. The proposed design thinking framework is by no means an absolute framework but provides a pathway address the need having such integrating frameworks which can guide managers in business problem solving. Further work needs to be done in understanding how managers solve problems and how the design problem solving can guide them. This research can guide further development of the integrated design thinking framework.

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http://www.iimahd.ernet.in/assets/snippets/workingpaperpdf/ 19759117412015-10-01.pdf


About the Authors

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## Appendix 1

**Table 1: Components of design attitude /design problem solving**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Context awareness/ sense and respond:</strong></td>
<td>Dorst (2011) states that complex problems have their formulation and roots in a specific context that requires defining and analysis before the framing and solving of problems. This essentially builds on abductive logic to interpret the unpredictable and ambiguous information derived from a dynamic business landscape. This design attitude, when ingrained in managers, induces skills to ‘act like sensors’ to gather information from disparate sources. Context awareness requires foresightedness (Wilkinson, Mayer, et al., 2014) and the ability to be ‘a class observer’ to visualise futuristic propositions and innovations (Kelly, 2001; Verganti, 2009; Jalote Parmar, 2015).</td>
</tr>
<tr>
<td><strong>Challenging assumption/ Reframing opportunities:</strong></td>
<td>Design thinking problem solving begins with the reframing of the problem by challenging the existing status quo of the selected problem, entity, product, or process. Design thinking emphasises the development of a new perspective by reframing the given problem to generate a new meaning/value and create newer patterns and propositions that often result in disruptive innovation (Verganti, 2009; Dorst, 2015). The ability to challenge the status quo of a given entity should be engrained in managers through thought leadership to allow the freedom of challenging the existing order to reframe opportunities.</td>
</tr>
<tr>
<td><strong>Empathy:</strong></td>
<td>Empathy involves immersion in the problem context; it includes analysing the problem context in the field to understand the interconnections between users, workflows, systems, technologies, and cultures (Cross, 2001). Field immersion provides design thinkers (a) a macro and micro view of the problem context, in other words zoom in and zoom out of the problem; (b) a perspective, problems and needs of multiple stakeholders that are connected to the ‘problem context’; and (c) provide insights to constraints arising from the context the user is operating in, and how these constraints are impacting the work (Jalote Parmar &amp; Badke-Schaub, 2008). Hence, when the concept proposal is ready, these constraints can be applied to test the solution’s applicability in the live context.</td>
</tr>
<tr>
<td><strong>Systems thinking:</strong></td>
<td>Problem understanding and solutions must be proposed not in silos but after considering the interconnections. Checkland (1981) states that systems thinking works under the premise that all components, people, and society’s technologies are interconnected.</td>
</tr>
<tr>
<td><strong>Agility/ breaking silos:</strong></td>
<td>Design thinking problem solving relies on two approaches to solve a problem: (a) breaking silos, the creation of interdisciplinary platforms and teams between the different functions of organisations to address problems. As nonconformists, design thinkers move between different functions to iterate thoughts and develop solutions; occasionally, they even cross hierarchical boundaries within organisations to complete the task; and (b) agile, the creation of consistent mechanisms in the organisation that allow quick testing of concepts/prototype with multiple stakeholders and context, whether it is a product, process, or a policy. This requires a decentralised decision making process and the framing of agile organisations that</td>
</tr>
</tbody>
</table>
prioritise action while improving the speed and quality of the decisions. According to Birkinshaw and Ridderstråle (2015), agility implies the speed with which the organisation responds and adapts to both long and short term changes in the business context.

**Codesign:** Co-design means that the end customers and multidisciplinary stakeholders are brought into the decision making process early on. Retaining persistence and transparency in communication is the key towards establishing co-design in creating new products and solutions. Early adoption of domain specialists and end users also leads to early adoption of the product (Jalote-Parmar & Badke Schaub, et al, 2010). The reason being there is correct identification of the issue, and multidisciplinary view of the context. Facilitating this approach to co-design should be a formal part of the innovation process in organizations.

**Visualisation/Prototype:** The planning and patterning of any task towards a desired foreseeable end constitutes the design problem solving process. It includes acts of internalisation of the problems and also externalisation of solutions by visualising existing situations into preferred ones (Simon 1969; Owen, 2008). Quick externalising of thoughts can be done through prototyping, which may range from a low fidelity to a scaled up model depending upon the stage of development.
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Cognitive Study of Products’ User Interfaces for Use by Elderly People

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This study investigated elderly users’ understanding of images and their perception of products. Various product function images served as testing samples, and participants were required to rank the various images. The results of this study revealed that the elderly participants easily recognized concrete images or images that were familiar. The elderly participants had various views concerning simplified images. Associative images that could not be associated with objects from daily life were not efficiently recognized. In the present study, we only explored the effect of shape and elements used on elderly people’s understanding of images. The results of this study can serve as a reference for designers when constructing a product’s user interface to be used by elderly people.

keywords: elderly people, user interface, understanding of images

Introduction
Population aging is a global challenge and is occurring in both developing and developed countries. In an aging society, products and services cannot target only young people because elderly people are increasingly a substantial and crucial consumer group. Elderly people are typically unwilling to use new products; however, given sound design and instruction, age does not have to be a barrier to new product use (Bruder et al., 2014). Aging cannot be avoided, and the problems caused by aging can be physical, sensory, or cognitive (Lu, 2011). The present study focused on cognitive problems such as memory decline, declining logical and thinking abilities, and slow reactions. These problems can negatively affect elderly people’s independent life skills and willingness to learn.
In daily life, elderly people frequently interact with home appliances in various ways. The user interface of home appliances can be simple or complex. As is found on smart phones, the user interfaces of some washing machines and ovens contain both pictures and words, which help users operate the machine and obtain feedback. Intuitive use of a product interface involves the subconscious application of one’s prior knowledge of the product in use. Gudur et al. (2011) investigated elderly adults and people with little prior experience with technology who use complex interfaces to determine whether their prior knowledge had any impact on their ability to use certain interfaces. They investigated interface designs with descriptive text, icons, and a redundant design with both descriptive text and icons to examine the participants’ strategies for intuitive use of the interface. The main findings of that study were that people older than 65 years old completed tasks with the text-only interface faster than they did the redundant-design interface, and maintaining attention was critical to them completing tasks through the redundant interface design faster and with fewer errors. If the picture employed in a user interface is creative but cannot be understood intuitively by users, then the picture cannot effectively help users operate the machine (Chen, 2011). In semiotics, an image is defined on the basis of prior experience and the use of symbols. However, with low prior experience in the use of electronic products and generational differences in the level of experience elderly adults have with electronic interfaces, using an image in an interface does not necessarily inform the user about how the product should be used; this is particularly pertinent because of differences in the images used, a possible decline in the cognitive abilities of elderly users, the probability of an interface causing an increase in cognitive load, and possible discouragement leading to a decrease in their willingness to learn. Elderly people with declining memory and visual function often have difficulties and feel frustrated when attempting to understand how to operate a machine, thereby affecting their motivation to use the machine (Bruder et al., 2014).

A large percentage of elderly people live alone and elderly care is a crucial social issue. Therefore, safe and easy-to-operate products with friendly user interfaces should be designed for elderly people, enabling them to use the products required for daily life and maintaining their independence (Cai, 2004). User-friendly products can meet the requirements of elderly people, reduce the burden on caregivers, and enhance elderly people’s self-esteem. Numerous studies on the cognitive functions of elderly people, elderly care, image naming, and color comparison have been conducted; however, few studies on intuitive and interactive image design have been performed from the perspective of elderly people’s declining cognitive functions and visual semantic transformation. In addition, there are no detailed design methods currently used by researchers or designers to address this issue. Brambati et al. (2006) investigated how patients with a neurodegenerative disease named and categorized objects and discovered that they used different parts of their brain to define the semantic features of living and nonliving entities. Humans were demonstrated to define the semantic features of living entities based on their sensory characteristics and the semantic features of nonliving entities based on their action characteristics. Harrington et al. (2007) used a naming test in their cognitive research and investigated neural activities related to imagined writing and drawing, which were considered to be complex cognitive behaviors. Drawing involved profound semantic processing through
perception, whereas writing involved lexical conversion (e.g., naming and spelling). They revealed that neural responses in the anterior motor cortex, inferior frontal gyrus, posterior inferior temporal lobe, and parietal lobe were similar during drawing and writing. Although both drawing and writing can elicit a neural response, drawing is highly stimulating to the brain and extremely useful for stroke rehabilitation and aphasia treatment.

Researchers have used various methods to categorize images. Images can be a simile or metaphor (Sun, 2002); for example, the image of a phone receiver symbolizes making a phone call, or an object can be associated with a cultural symbol. Chen (2014) revealed that users with a high education level may prefer recognizable images. Some researchers have used the outline of an object to determine how people understand a simplified image. Xu (2010) simplified the contour of an image to investigate the relationship between preference and simplification and revealed that the preference of untrained subjects was negatively correlated with image simplification; thus, people with no design background did not prefer simplified images to more complicated images. Symbols are used so widely because of our complex cognitive processes, through which abstract concepts can be visualized and understood. For elderly people with declining cognitive functions, the semantic conversion of symbols is time-consuming and easily leads to misunderstandings. Currently, the user interface of home appliances often contains buttons with multiple functions; however, the words or images on such buttons cannot completely express what the button is for due to limited space. Because the physical and cognitive functions of elderly people are in decline, they often have difficulty intuitively understanding the user interface of a product; accordingly, they may feel frustrated and anxious and lose motivation to use the product. In the present study, we investigated how elderly people understood images and symbols in a user interface. Building and designing a friendly environment helps elderly people live independently, so we aim to design a user interface according to how elderly people understand images and symbols. The results of this study can serve as a reference for designers when constructing their user interface.

**Methods**

**Subjects**

In this study, 25 elderly people (10 women and 15 men) participated who were between 65 and 93 years of age (average age = 71.8 years; SD = 7.6 years). We did not classify the participants into age groups because this is an initial discussion of an experiment designed to elucidate the cognitive processes of elderly adults’ interpreting the meaning of images in user interfaces. The recruitment criteria were as follows: (1) no injuries to participants’ hands or limbs; (2) participants’ vision was normal or corrected to normal; (3) participants could speak clearly, had a normal mentality, and did not have a neurodegenerative disease; (4) participants typically operated one or more home appliances in their daily life; and (5) participants were elderly people who could live independently. Those who did not meet the recruitment criteria were not invited to participate in this study.

**Task Design**

In the present study, we investigated how the user interface of a product should be designed for use by elderly people. Before the experiment, we investigated the user...
interface of existing home appliances on the market (e.g., oven, hot plate, washing machine, microwave oven, electric fan, stereo, and television remote control) and summarized the commonly used function icons, which were divided into six groups: (1) reservation, (2) cooking, (3) adjustment, (4) switch, (5) timing, and (6) menu functions. Each group consisted of five sample images (realistic or abstract). Each sample image was designed in black and white. The size of each sample image (2 × 2 cm²) was identical to the typical size of an icon in a user interface (Table 1).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Sample images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservation function</td>
<td><img src="image1.png" alt="Sample Image" /></td>
</tr>
<tr>
<td>Cooking function</td>
<td><img src="image6.png" alt="Sample Image" /></td>
</tr>
<tr>
<td>Adjustment function</td>
<td><img src="image11.png" alt="Sample Image" /></td>
</tr>
<tr>
<td>Switch function</td>
<td><img src="image16.png" alt="Sample Image" /></td>
</tr>
<tr>
<td>Timing function</td>
<td><img src="image21.png" alt="Sample Image" /></td>
</tr>
<tr>
<td>Menu function</td>
<td><img src="image26.png" alt="Sample Image" /></td>
</tr>
</tbody>
</table>

A tablet personal computer (PC) (Samsung Tab 7.0) was used in the experiment. A one-on-one interview was conducted with each participant, the duration of which was not constrained. Each participant was allowed to make one mistake when the first group of sample images was used for the experiment. The interview was undertaken at each participant’s home to avoid disturbance.

Prior to the experiment, the author explained the purposes of this study and the sources of the research samples to the participant and obtained the participants’ consent to participate. Subsequently, the participant was informed that six function groups were employed in this experiment, with each group consisting of five images. The images were presented on the tablet PC. The author first explained the function of the images on screen, speaking slowly, and asked the participant questions (e.g., “This is a reservation function button that we can use if we want to set the rice cooker to come on at noon. Please list the following five images from most to least recognizable”).

As a participant was performing the task, the author recorded their oral rankings of the images. If the participant encountered difficulties, the author would help the participant. If a participant encountered problems when the first group of images was presented (e.g.,
the participant did not understand how to perform the task), the author again explained how to perform the task, using language that the participant could understand. The sample images were presented in following order: reservation function, cooking function, adjustment function, switch function, timing function, and menu function. Each participant had only one chance to perform the task, and after a participant finished ranking a group of sample images, they were requested to rank another group of sample images. The images were all presented in the same sequence for all participants.

Results
The purpose of this study was to investigate how elderly participants understood functional product images and to identify which image characteristics lead to rapid recognition by elderly people. We invited participants to rank images to determine whether and how they understood the images. SPSS was used to analyze the ranking data and Kendall’s coefficient of concordance (W) was employed to evaluate the ranking consistency among various sample images. Images that ranked first, second, third, fourth, and fifth scored 1, 2, 3, 4, and 5 points, respectively. The analysis results are presented in Table 2.

Table 2  Statistics for various functions

<table>
<thead>
<tr>
<th>Functions</th>
<th>Samples</th>
<th>Mean</th>
<th>Standard</th>
<th>Kendall’s W</th>
<th>Significance (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservation</td>
<td>a</td>
<td>1.96</td>
<td>1.207</td>
<td>0.344</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>4.22</td>
<td>1.041</td>
<td>0.344</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>2.20</td>
<td>1.000</td>
<td>0.344</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>3.44</td>
<td>1.446</td>
<td>0.344</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>3.18</td>
<td>1.068</td>
<td>0.344</td>
<td>0.000</td>
</tr>
<tr>
<td>Cooking</td>
<td>a</td>
<td>1.84</td>
<td>0.800</td>
<td>0.544</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>4.40</td>
<td>0.957</td>
<td>0.544</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>3.44</td>
<td>0.821</td>
<td>0.544</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>3.48</td>
<td>1.194</td>
<td>0.544</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>1.76</td>
<td>1.012</td>
<td>0.544</td>
<td>0.000</td>
</tr>
<tr>
<td>Adjustment</td>
<td>a</td>
<td>4.04</td>
<td>1.020</td>
<td>0.430</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>3.16</td>
<td>1.028</td>
<td>0.430</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>1.60</td>
<td>0.764</td>
<td>0.430</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>2.32</td>
<td>1.215</td>
<td>0.430</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>3.88</td>
<td>1.333</td>
<td>0.430</td>
<td>0.000</td>
</tr>
<tr>
<td>Switch</td>
<td>a</td>
<td>2.00</td>
<td>1.291</td>
<td>0.193</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>3.16</td>
<td>1.143</td>
<td>0.193</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>3.92</td>
<td>1.256</td>
<td>0.193</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>2.80</td>
<td>1.225</td>
<td>0.193</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>e</td>
<td>3.12</td>
<td>1.536</td>
<td>0.193</td>
<td>0.001</td>
</tr>
<tr>
<td>Timing</td>
<td>a</td>
<td>3.44</td>
<td>1.557</td>
<td>0.171</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>3.36</td>
<td>1.551</td>
<td>0.171</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>3.36</td>
<td>1.075</td>
<td>0.171</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td>2.96</td>
<td>1.241</td>
<td>0.171</td>
<td>0.002</td>
</tr>
</tbody>
</table>
The degree to which the sample images were recognized for each function was as follows, ordered from most to least recognized: a, c, e, d, and b for reservation function; e, a, c, d, and b for cooking function; c, d, b, e, and a for adjustment function; a, d, e, b, and c for switch function; e, d, b, c, and a for timing function; and b, a, d, c, and e for menu function.

Agreement on the recognisability of images in each group was significant and consistent. The menu function images did not achieve significance because the participants found no marked differences among the images and thus could not easily rank their recognisability.

**Discussion**

Among the reservation function images, the participants determined that Samples a and b were the most and least recognizable images, respectively. Sample a contained a number (“24”), which helped the participants intuitively understand that this image was for setting a time frame; however, Sample b easily misled users (for example, some participants said that Sample b was for setting a half-hour time frame or denoted a timing function).

Among the cooking function images, the participants found Samples e and b the most and least recognizable, respectively. Sample e used a frying pan to express the cooking concept. The score for Sample a was similar to that of Sample e; however, some participants reported that Sample a might denote cooking soup. Most participants did not recognize Sample b, which uses a chef’s hat to express the idea of cooking; some participants thought that Sample b was the image of a toaster. The two-dimensional image in black and white for Sample b probably rendered it difficult to recognize.

The participants reported that Samples c and a were the most and least recognizable adjustment function images, respectively. Sample c used plus and minus symbols to indicate adjustment, thereby enabling the participants to find the function quickly. Some participants found the circles surrounding the plus and minus symbols in Sample d confusing because the circles appeared to be more noticeable than the symbols. Sample a, using arrows to indicate adjustments, was not intuitively understood by the participants, who needed to think about it before they understood it.

Among the switch function images, the participants reported that Sample a was the most recognizable image and Sample c the least. Sample a is the most commonly used in user interfaces, so the participants will have frequently used Sample a in their daily life, resulting in intuitive recognition. Therefore, images familiar to users should be employed for user-interface design to help users understand functional meanings. Other participants easily recognized Sample e. Sample c contained a dotted curve and numerous participants had difficulty understanding this image.

The participants reported that Samples e and a were the most and least recognizable timing function images, respectively. Sample e represents a stopwatch and was not
excessively simple or complex, thereby directly expressing the function represented in this image. Sample a resembled Sample e, containing a stopwatch and a hand; however, the image of the hand affected most participants’ understanding of Sample a.

Sample b was reported to be the most recognizable menu function image, and Sample e the least. Most participants intuitively recognized Sample b because this image is frequently used in user interfaces to represent settings. The score for Sample a was similar to that for Sample b because Sample a contains a list of items, which was intuitively understood by some participants. Sample e was excessively simple and the participants needed to perform a semantic conversion to understand this image. The elderly people found an excessively simplified image difficult to understand.

Images are a type of two-dimensional expression, whereas words are a type of one-dimensional expression. Humans typically receive information visually; images can attract viewers’ attention, can easily be understood, and can more efficiently express meaning than words. The application of images changes with time. Some images do not necessarily have a meaning, but this can change once a receiver has successfully interpreted the image.

**Conclusion**

In human–computer interactions, mental models are used to explain the cognitive processes users employ to understand how to operate an interface, specifically the interface architecture, function, and internal operation. The cognitive processes that users adopt are based on a combination of user-perceived external messages and prior experience. The sample of participants in the present study comprised middle-aged and elderly people with different life experiences and from different cultural backgrounds, some of whom exhibited varying degrees of physical and mental decline, thus providing a diverse sample of participants with notable individual differences.

Image design involves cognitive psychology and visual perception. To meet user requirements, image designers need to understand users’ perception of images. Chen (2011) proposed four types of images: concrete, abstract, compulsive, and integrated images. Concrete images refer to images that are highly associated with objects familiar to users, whereas abstract images can be used to express the concept of an object that is familiar to users. Compulsive images refer to images that are highly frequently used, and integrated images are typically employed to express complex messages or abstract concepts.

Image designers and receivers should reach a consensus on image design to reduce cognitive differences in the understanding of images and help users easily obtain required information. Excellent design rules are thus required for the design of a useful image. In the present study, we explored what types of images effectively helped users understand the functions of home appliances without the assistance of words. According to the results, we propose the following suggestions:

Some participants reported that the timing function images resembled the reservation function images, which should be addressed and remedied. For example, the image of a clock could be used solely to represent reservation functions, whereas numbers could be
used in timing function images. In future studies, how to discriminate timing function images from reservation function images should be investigated.

Excessively simplified images containing dotted lines or simple lines cannot be easily interpreted and understood.

Excessively complex images also cannot be easily understood. For example, Sample a for the timing function has a large hand holding a small clock, so the clock does not quickly attract the attention. Therefore, simple and clear images should be designed for user interface; otherwise, the images may not attract users’ attention or be understood efficiently.

Sample e for the adjustment function was an indicative image, using speakers and plus and minus symbols to indicate the adjustment of a volume level; thus, the image did not directly refer to something but required interpretation through the association of ideas.

With the development of science and technology, computer hardware and software in two aspects of progress, making the interaction between the computer and the user interface type and mode of operation played a significant change. On the hardware side, "visual display terminals "is presented to the "computer screen"; in software, information is presented in a way that "terminal technology" is linear-oriented. To the graphical interface changes. So that the "user interface type" from the programming language to the WIMP (windows, icons, menus and pointing device). Current user interfaces mainly consist of images; however, because of the limited size on a user interface, images cannot always deliver precise messages to users and words are still crucial for users to be able to operate a product. Suitable images should be simple, recognizable, understandable, and attractive. Various types of images can be designed because—in addition to shape and elements—sound, color, and dynamic presentation can affect message transmission and functional operation. These factors can affect elderly people’s understanding of images. In the present study, we explored how shape and elements affected elderly people’s understanding of functional images.

This study investigated elderly people’s understanding of images and the results of this study contribute greatly to the literature. Future studies on image categorization should be conducted. We suggest that in future studies, participants should be divided into two groups—those with and without experience in operating home appliances—to determine the effect of user experience on the understanding of images. Whether a user interface containing only images and no words can effectively and efficiently convey functional messages to users remain to be investigated.

Acknowledgment
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References


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Design strategies for exploring and bridging: Intersections of everyday life and decision-making for sustainability

HESSELGREN Mia*; HASSELQVIST Hanna and SOPJANI Liridona

KTH Royal Institute of Technology, Sweden
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Transitions of unsustainable everyday practices into more sustainable ones require new approaches to explore possible futures and encourage change. Trying new practices and experiencing alternative configurations of socio-material assemblages can increase reflexivity as well as assist in exploring potential futures. Design can assist in co-creating possible futures and bridging discussions about the preferred strategies to reach them. If sustainability is defined as an on-going process calling for dialogue, there could be potentials for using practice-based design research, and in particular co-design approaches, at the intersections of these dialogues. By analysing methods for reflexivity and collaboration in two design research projects within sustainable mobility, we here suggest design strategies for prototyping change at an individual level and communicating the experiences of such change to people with power to trigger and direct change. This may be particularly useful for addressing sustainability which both requires dealing with complex problems and extensive collaboration.

keywords: sustainable mobility; co-design; bridging; living prototypes

Introduction
Many current transportation practices, especially fossil fuelled car driving, are unsustainable and cause severe problems for the planet and many of its inhabitants. Therefore, encouraging changes towards sustainable mobility solutions is of uttermost importance. In order for these changes to take place, people need to make different choices in their everyday lives to form more sustainable transportation practices. For the
individual, this requires openness to change and willingness to try something new which, given the uncertainties and inconveniences that can come with changing practices, need to be accompanied by other support. To give up efficiency, flexibility and comfort associated with car driving, is for many considered unrealistic in the everyday puzzle of logistic activities. To replace car driving with sustainable transportation can be experienced as a transitional loss (Randall, 2009) that at first can be difficult and even undesirable. But for those who embrace that losing something can consequently mean gaining something else, and who discover new benefits when replacing one transport mode with another, the transition to sustainable practices can be smoother. To mourn a loss can also be considered a reconfiguration process (Sennett, 2012) where new meanings take shape when sacrifices are done. Trying new practices and experiencing different configurations of socio-material assemblages can increase reflexivity as well as assist in exploring potential futures therefore opening up new design spaces (Suchman, 2012).

However, for new everyday practices to emerge it is not enough with individuals being curious to try different practices out, but support by decision makers at various levels is also necessary (Strömberg et al., 2016). Establishing new social practices, defined as the interdependent relations between the three categories of elements: materials, competences and meanings, requires various types of support (Shove, Pantzar, & Watson, 2012). To generate support for development of new sustainable transportation practices, collaborations between different actors are crucial (Kemp & Loorbach, 2007; Verganti, 2008). It is difficult for a single stakeholder to successfully supply the materials (such as innovative vehicles and necessary infrastructure) as well as build the competences (like teaching how to drive it) and form new meanings (for example enabling acceptance of new norms) (Hesselgren & Hasselqvist, 2016). When striving to design for changes towards sustainable mobility, with all its complex and wicked problems, we believe, cooperation between different stakeholders can be a fruitful way forward. Strengthened cooperation includes both formal and informal aspects of collaborating (Sennett, 2012). By bringing not only co-design tools and techniques but also co-design as a mindset and approach to design research (Sanders & Stappers, 2012), we believe both these aspects can be cared for. Co-design as a mindset is based on an understanding that all people are creative. We argue that bringing everyday life to decision makers can be nourishing for co-creating potential sustainable futures.

Shaping futures clearly needs to be a democratic process but this is problematic when it comes to future sustainability transitions (Geels, 2010). Geels clarifies that sustainability transitions have three added complexities compared with many other societal transitions. First, sustainability is a normative goal whereby debates about relative importance will flourish and, since sustainability is a problem of collective good, many private actors will have no direct incentives to address sustainability issues. Second, there are different strategic approaches to making decisions for sustainability that depend on two opposing views: on one side there are those who advocate technical challenges to be met with green innovations, including top-down approaches and with emphasis on governments’ responsibilities and experts’ knowledge. On the other side, there are those who suggest a broad social transformation process including new lifestyles where bottom-up participatory approaches should be used to create engagement. Third, Geels claims, many
of the sustainability challenges, including environmental problems such as climate change, are global, intangible and mainly about the future. These problems are more challenging as opposed to those that can be experienced locally, visibly and immediately. According to Geels, addressing these three added complexities when dealing with sustainability transitions requires crossovers between research fields. Also Robinson (2004) calls for transdisciplinary thinking where different fields, sectors and actors cooperate and form partnerships to address the challenges of sustainability. Robinson further argues that there is not one single successful approach available, but instead new forms of social learning are needed. Hence, sustainability can be seen as a process, rather than an end-state, encouraging multiple views to be expressed and experimental practices used to try out possible futures (ibid.). If sustainability is defined as an on-going process calling for dialogue and openness, there could be potential for using practice-based design research, and in particular co-design approaches, at the intersections of these dialogues.

We argue for bringing practice-based design research, as an approach with its methodologies, methods and tools, to other research fields with the aim to create change for sustainability. Our contribution is a set of design strategies for exploring prototypes of alternative future everyday lives, and for bridging everyday life with decision-making. We suggest a combination of strict and soft strategies and argue for balancing these strategies. In this paper, we start by introducing practice-based research and relevant research methods within this approach, including interventions in everyday life and co-design methods. Following this, we describe how we have used these methods in two different design cases within sustainable mobility. Hence, this paper is both about method and its resulting learning. Concluding are discussions of the design strategies that facilitated exploring by doing and supported bridging by co-creating.

Framing methods

Design research, with a practice-based research approach, is when research activities are carried out through the design practice. Practice-based research in general can be useful to enrich the affected practice (Borgdorff, 2010). With practice-based research it is also possible to learn about the tacit knowledge within the practice and to make this embodied knowledge explicit and visible. Tacit knowledge encompasses the things we know, for example about a practice, but that is difficult to express verbally (Sanders, 2002). As Schön (1983) describes, learning by doing is one way to articulate knowledge and to be able to articulate the practice, you need to engage with it and to reflect in, and on, the action. Through this engagement in reflection, also the tacit knowledge can be teased out. This approach is foundational to practice-based research and is widely used by design, architecture and artistic research scholars.

These are also expanded in action research approaches, including participatory action research where both the participants and researchers engage in problem solving activities with intent to take action, which can be useful to understand change (Eden & Huxman, 1996). Not only do these methods encourage openness but they also foster a research culture of inclusiveness and collaboration. In interventions created and studied in action research, the researcher often wants to both understand the situations as well as improve them (Cassell & Johnson, 2006), which has similarities to design’s intentions of creating better futures. Participatory design approaches traditionally emphasize empowerment
and provision of resources for participants to actively deal with their problems (Bødker et al., 2000) and there is trust in the users themselves having expert knowledge on their own practices. As such, the designer’s role is primarily to be the facilitator, as opposed to the expert on the individual practice, and to enable the participants’ emerged knowledge to be used at a higher level. Designing together with users as a co-creative approach is particularly useful in generative design research (Sanders & Stappers, 2012). Not only is it foundational within this approach to actively engage with users, similar to action research and participatory design research, but there is also an agreement to acknowledge all people as creative (ibid.). To release creativity, in for example generative sessions where future possibilities are co-created, different types of decision-making need to be encouraged (ibid.). To complement rational decision-making, where “thinking first” is followed by decision, it can be useful to introduce “seeing first” and “doing first” approaches (Mintzberg & Westley, 2001). “Seeing first” is more related to the arts where many elements have to be combined into creative solutions. “Doing first” is typically used in crafts and design and it is particularly useful when the situation is novel and confusing, for example when disruptive technology is entering a field creating a situation of flux, or when addressing complex issues such as sustainability. When following this third approach, making and trying out are important activities and the focus is on experiences (ibid.).

We argue practice-based design research can enrich other research areas by bringing different ways of investigation. There are, for example in social science, calls for new ways of knowing and methods to research the increasingly complex and messy world. As Law (2004) claims, if researchers are to understand realities that are complex and messy, new ways to think and new practice are needed. Building on Law’s call for new methods, Lury and Wakeford (2012) present inventive methods as ways to explore knowledge generation. Inventiveness is a matter of use and its capacity cannot be secured in advance, but reflexivity is one of the principal requirements (ibid.). Furthermore, Lury and Wakeford describe devices as hinges or clutches between concepts and practices, and as such they are terms for thinking processes. Other suggestions for new methods come for example from Suchman (2012) who proposes configuration as a method toolkit. This includes considering how humans and machines are configured and to possibly re-configure these into new socio-material constellations. All these inventive methods are highly relevant in practice-based design research where devices and re-configurations of socio-material assemblages can be used as research methods, specifically when approaching research questions with an open mind in search for various alternatives rather than specific solutions. New or changed configurations of social-material constellations to purposely disrupt everyday practices can be a way to open up for new design spaces. Conducting research in the wild, where also non-researchers are invited into the research process may enable studying material-social interactions (Callon & Rabeharisoa, 2003).

If sustainability is regarded as a process of adaption and continuous learning, the mindset of design including its methodology, methods and tools, can be important and useful. With a design approach encouraging “doing first”, learning takes place all along. Also, learning by doing pays attention to many different layers of knowledge, including tacit knowledge, and through reflection in action, and on action, a culture of openness and
ambiguity is fostered, particularly useful when trying to understand complexity and mess. With design’s experimental practices and thinking across temporal scales possible preferred futures can be tried out. Furthermore, with a co-design approach, various actors, users as well as decision makers from different fields and sectors, can be brought together by the design process to collaborate. This inclusive and transdisciplinary process, where the designer acts as the facilitator and brings out the expertise within each and everyone, is useful to address sustainability challenges. The designer facilitates dialogue, which is needed when negotiating sustainability, by encouraging stories to be told and bringing these stories into the conversation. Possibly, design’s primary role when engaging in sustainability is to make people realize that multiple options exist and that there is not one pre-decided future. Instead, there are many possibilities of how to live, and these needs to be discussed and debated. Design can assist in co-creating possible futures and bridging discussions about the preferred ways of reaching them. Design methods can contribute to this in various ways, and in the two cases presented in this paper we highlight the methods used for each case and how the combinations of methods affected the prototypes of future mobility.

Case 1 – A Car-free Year for three families

In the research project “A Car-free Year” we explored transitions towards sustainable transportation practices by removing the car from the everyday life of three families with children living in Stockholm in Sweden. The families’ cars were replaced by light electric vehicles, such as electric bikes, box bikes, a scooter and a four-wheeled motorcycle (see Figure 1) which the families selected and rented from the project. They also walked, biked, used public transport and used home delivery services.

The car-free year took place between October 2014 and October 2015. During the year the families formed new practices related to transportation and they were supported by the project for example by access to bike service and expert advice on challenges such as winter biking. Together with the project the families prototyped a life without cars, and by the end of the year they expressed that being car-free had become normal.

To explore a broad set of challenges related to not owning a car, we selected families that were different in terms of previous car use, type of housing, age of children, and activities they engaged in. Although the families previously used the cars to different extents, replacing car trips with alternative transportation modes had a great impact on all the families’ lives. It affected how they dealt with situations such as going to work, taking children to sports activities, doing grocery shopping, going on holidays, meeting family and friends, and renovating at home.

We studied the changes in transportation related practices mainly through monthly interviews and observations in the families’ homes. To encourage reflection, and to elicit tacit knowledge, the parents in the families used a trip diary where they, one week per month, registered facts about their trips as well as emotional aspects and other thoughts on their new practices (see Figure 2). To further support reflection, the parents used the mobile app Moves¹ to automatically log all their trips and the connected tool Move-o-

¹ https://moves-app.com/
scope\(^2\) to visualise their travel patterns (see Figure 2). Since the families were used to having access to a car, many reflections on being car-free were made in relation to their previous car use. How other people approached transportation and what others said about their participation in the study were also triggers for reflection.

While the families did not have access to their own car during the year, they had the option of borrowing or renting a car (or taxi) 24 times, when they could find no other solution. They documented all such trips on a designated sheet (see Figure 2), which gave us insights into the perceived limitations of car-free living. The option of using a car was for example used for buying a new toilet when an old one broke down, going to a summer

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\(^2\) [http://move-o-scope.halftone.co/]
house in an area with poor public transport, and coming home from a party on New Year’s Eve. The allowed car trips became a safety net, although the participants were very motivated to minimise the number of car trips they made.

Based on the families’ stories about positive and negative experiences of car-free life and practical and emotional aspects of changing to more sustainable transportation practices, we created design concepts for how products, services and the city better could support car-free living. We could not cover all aspects of car-free living in the concepts but we strived for a variety in types of practices represented, main users and stakeholders involved, and types of support imagined. The concepts were developed together with a design company and the families were also involved in the process. Collaboration between different stakeholders was central to many of the concepts, which included ideas such as workplaces as enablers of trying alternative transportation modes, the city rewarding cyclists with points to be used to pay for bike services, shared digital public transport cards for children’s sports teams, and links between physical infrastructure and digital tools that highlight benefits of alternatives to the car. The concepts were visualised as non-photorealistic 2D images that aimed at striking a balance between being concrete enough to convey the families’ experiences and abstract enough to trigger new ideas (see Figure 3 for an example). As a complement to the concepts, we created a video where the families shared stories from the car-free year and reflected back on the experience.

![Figure 2](image)

Figure 2  Examples of trigger material: trip diary (to the left), 24-car-trips card (at the top right) and visualisation of trips for different transportation modes (at the bottom right).

The concepts, in combination with the video, were used to communicate the knowledge from the study in several meetings with decision makers with an influence on transportation practices, such as local and national politicians, and companies. The aim
was to support reflection on possible futures for sustainable mobility in relation to the responsibilities and power of the respective stakeholder. Due to the decision makers’ pressed schedules, the meetings did only leave room for beginning to discuss alternative futures. The discussions shifted between thoughts on details, such as choice of colours on road signs, and greater implementation challenges and additional opportunities. One of the main barriers identified for most of the concepts was that implementation depended not only on the stakeholders in the room but was also related to responsibilities of other decision makers. In general, the concepts and the video were appreciated for giving a rich picture of transportation related everyday practices and challenges and opportunities of car-free living.

For more details on the outcomes of the project and implications for design of services and technologies supporting sustainable transportation, see our previous work (Hesselgren & Hasselqvist, 2016).

![Concept example describing possible future biking infrastructure where cyclists are rewarded points that can be used to pay for bike services.](image)

**Case 2 – Mobility Pool and no car to work at two workplaces**

In the study Mobility Pool, a collaborative project between academia, private sector and public actors, we explored how two large workplaces could support their employees in commuting to, in between and from work with an alternative to fossil-fuelled cars. A pool of ten light electric vehicles, which was a four-wheeled motorcycle (see Figure 4), was set up as a mobility service to engage two types of users: people taking their fossil-fuelled car every day to work (in the project referred to as *caretakers*) and people commuting with public transport, bikes, or walking to work but in need of a vehicle during office hours for meetings between offices or errands outside of the office (in the project referred to as *daytime users*). In the project, we aimed to intervene in the routines of going to work or travelling for short distances by providing more environmentally friendly alternatives.
Between September 2015 and September 2016, 16 users joined as caretakers of the light electric vehicles and used them every day to commute to and from work instead of using their private, fossil fuel-driven, cars. To some extent, the new vehicles also replaced their private cars in the evenings and during weekends. The light electric vehicles were provided by the project and the users volunteered as caretakers and paid a monthly fee to co-own the vehicles during the project. This co-ownership included rules such as bringing the vehicles everyday to and from work and responsibilities such as daily maintenance and charging of the vehicles. In addition, they shared the vehicles with other colleagues (the daytime users) during work hours. The caretakers had different personalities, lifestyles, household sizes, and living distances from their workplace, which allowed us to explore and understand diverse everyday practices and how the combination of a light electric vehicle with bike or public transport could support those practices. Before the project, all caretakers primarily went by car to work but they were interested in trying new possibilities. For one of the participating workplaces the project was divided in two periods of six months, where seven caretakers were recruited for the first six months, and then seven new caretakers were recruited for the next six months. In the other workplace, with a smaller pool of light electric vehicles, two users signed up to be caretakers. At both workplaces, the light electric vehicles were available during daytime for all employees in the departments where the pool was set up. The daytime users could book the vehicles for use during work hours through a digital booking system, and this type of use was free of charge.

The caretakers were of our primary focus since we wanted to explore how the light electric vehicles affected both their commuting practices and their practices outside of work. Thus, this group of users was heavily engaged in the process of exploring future scenarios together with the researchers. We conducted sets of deep interviews with caretakers before, during, and after trial periods, as well as organized workshops during the trial to capture their experiences, both at individual and group level. Different design methods were used to engage them in discussions such as mapping experience journeys, storytelling, mapping values, mapping barriers and enablers as well as visualizing activities (see Figure 5). The caretakers were important actors in the development process of the new mobility service, and they reflected on their daily practices including the challenges...
and benefits of giving up their private cars. Their involvement allowed them to both reflect on their practices and provide input for us researchers to study how transformation of transportation practices could be facilitated.

During the workshops, the caretakers shared their stories and experiences with the group and were involved in a dialogue about minimizing the use of their private car. They talked about their everyday lives in which at times the new mobility alternative was a huge support, such as for quick grocery shopping. At other times it had brought them challenges, like when fitting bulky sports equipment or doing large shopping with the family. These were constraints that emerged as they lived with the new vehicles, and through experiencing it, they were able to reflect and make more conscious decisions about their choices of transport. As these trials were part of developing the innovation with users in focus, these experiences were input for the design and development phase. This input, brought through analysis of interviews and workshop materials was brought to the other stakeholders in the project whom were decision makers in the process of developing solutions towards more sustainable transport futures. The caretakers’ experiences provided room for dialogue and alternative design spaces. With tangible materials, such as rough films of users presenting their experiences and maps of post-it notes, the decision-making could be further informed and, in generative sessions, storyboards and scenarios were co-created (see Figure 6). For more information regarding the project, see our previous work (Sopjani et al., 2016).
Discussing exploring and bridging

While the cases above have many similarities, there are also important differences in how practices were explored and how participants’ stories were bridged to decision makers. Following we discuss how some of the strategic choices were balanced in the two cases and how this facilitated reflection and co-creation. These design strategies, we hope, can be inspiration for others who aim at creating change for sustainability.

Each of the projects had two separate phases. In the first phase participants tried, and learned from, new everyday practices and we aimed to facilitate this by using different strategies for exploring. The second phase was related to bringing the participants’ learning forward in design conceptualisation and communication of everyday life to decision makers. In this phase we tried different strategies for bridging (Sanders & Stappers, 2012). The strategic choices were balanced to achieve co-creation and hence learn for sustainability. We explored prototypes of alternative everyday lives and bridged this learning to decision makers. We believe this is particularly useful when it comes to addressing sustainability, which both requires addressing complex problems and extensive collaboration (Schot & Geels, 2008). Design is motivated by both problem solving, connected to the physical world, and sense making, more related to the social world (Manzini, 2015). As such, there are potentials in using design to address sustainability. In our framing, design approaches initiated dialogues that were not limited to either top-down or bottom-up perspectives, but created intersections across. However, a limitation in this paper is that the framing occurred in a Scandinavian context where the tradition of participatory problem solving may influence openness and inclusiveness in decision-making. Trying out these strategies in other cultures and traditions of decision-making may lead to different actions.
Exploring prototypes of alternative everyday life

A significant difference between the two cases described is the strategies for exploring alternative everyday life and learning while doing. These can be seen as moving on a scale from strict to soft ways of trying and learning in the exploration phase. When prototyping everyday life, making people try out alternatives, the purpose is to reconfigure their lives and practices. Configuration has simultaneously a reflexive and generative character (Suchman, 2012) that we wanted to explore and different strategies were used to do so.

Table 1  Summary of strict and soft strategies in exploring.

<table>
<thead>
<tr>
<th>EXPLORING</th>
<th>Strict strategies</th>
<th>Soft strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trying</td>
<td>What</td>
<td>Add-ons</td>
</tr>
<tr>
<td></td>
<td>Removals</td>
<td></td>
</tr>
<tr>
<td>How</td>
<td>Rule (top-down)</td>
<td>Guide (bottom-up)</td>
</tr>
<tr>
<td>Learning</td>
<td>What</td>
<td>Discussions</td>
</tr>
<tr>
<td></td>
<td>Reports</td>
<td></td>
</tr>
<tr>
<td>How</td>
<td>Formal</td>
<td>Informal</td>
</tr>
</tbody>
</table>

The strict strategies for trying out alternatives can create more radical change, which however can be more difficult to test in real life. Possibly, participants might bend the rules to fit the prototype to their everyday lives. Using soft strategies to prototypes of everyday life, can be easier for the participants to adapt to, but might only create incremental change. Also in the learning phases of the projects, the categories of strict and soft strategies can be applied as different ways to access knowledge about the participants’ everyday lives in the prototypes. Strict strategies, including formal reports and meetings, can be used to access required detailed information, but they can also entail a focus on rational information which not necessarily enables a deeper understanding. With soft strategies, informality can instead be emphasized to possibly bring out more emotional reflections. Inviting discussions, as a soft strategy, can encourage reflections and development of mutual learning amongst both participants and researchers, but require mutual trust for more sensitive issues to be revealed. (See Table 1 for a summary of what and how the strict and soft strategies were used when trying and learning.)

In the Car-free Year project, we took a more radical approach by removing the car from the families’ everyday lives, which also pushed them far towards forming sustainable transportation practices. However, the strict strategy of disrupting and reconfiguring the families’ practices was softened by the 24-trip car-allowance, in order to make participation in the study seem less impossible. The softer overall strategy in the Mobility Pool project, where instead a new vehicle was added to the vehicles the participants already owned, had a smaller impact on the participants’ lives. To encourage exploration of new practices, the intervention was made stricter by rules regarding for example when to bring the light electric vehicles to work.

During the car-free year, the participants could choose for themselves, which types of light electric vehicles they wanted to use. This softer strategy enabled them to try various practices, and they were also allowed to change their set-ups throughout the project period. In Mobility Pool, on the other hand, the stricter strategy was implemented by
simply adding the particular light electric vehicle to encourage substitution of the private vehicle. However, the participants in this project softened this themselves by using the vehicle more differently and bending the rules. In both cases, finding a balance between hard and soft ways to try out alternative practices was important for making the most out of each case. We found that experimenting in the wild requires a balance of reconfigurations, to enable life to still go on.

To get to the knowledge the participants obtained throughout the project periods, the research teams used various methods and tools. In A Car-free Year, the travel diary was a helpful more formal tool to encourage reflections and for the participants to report their trips. The diary had a formal structure, but still allowed for open reflections. This was also useful to prepare the participants before the monthly interviews. The one-hour deep interviews had a formality in their semi-structured discussion guides. At the same time, the informality of these interviews, often taken place around the kitchen tables in the families’ homes, softened the dialogue. Also the one-year research process encouraged the informality of these discussions as all project members got to know each other. In Mobility Pool, the settings for interactions with participants were more formal, as they took place at the workplaces together with colleagues. However, as these were conducted as creative workshops, informality was encouraged but the primary focus on work life, as opposed to private life, made these discussions more formal.

The learning in Mobility Pool was also facilitated in the co-creative sessions where the participants were asked to generate possible refinements of the product-service system. Here, the learning developed mutually with the discussions in these co-creative sessions aided by the provided tools. In A Car-free Year, the travel diaries and digital tools provided the research team with a vast amount of information, but the more emotional aspects, such as the challenges of living outside the car-norm, came from dialogues after trust had developed. Balancing formal with informal, and reports of details with reflective discussions, were necessary strategies to understand the participants’ experiences.

**Bridging everyday life and decision-making**

In the next phase of the two research projects, different strategies were used to bridge everyday life and decision-making. These strategies can also be viewed as moving on a scale from strict to soft strategies for conceptualizing and communicating. When conceptualizing, knowledge from the prototypes of alternative everyday lives is packed into concepts of systems. Designing at a system level requires attention to the different parts as well as their relations (Ceschin & Gaziulusoy, 2016). When communicating the findings with decision makers, the concepts invite to discussions and co-creations where the decision makers can use the families’ and users’ stories to create their own.

**Table 2** Summary of strict and soft strategies in bridging.

<table>
<thead>
<tr>
<th>BRIDGING</th>
<th>Strict strategies</th>
<th>Soft strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptualising</td>
<td>What</td>
<td>Elaborate</td>
</tr>
<tr>
<td></td>
<td>How</td>
<td>Professional</td>
</tr>
<tr>
<td>Communicating</td>
<td>What</td>
<td>Presentations</td>
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<td></td>
<td>How</td>
<td>Formal</td>
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Use of strict strategies in conceptualisation can help to create trustworthy messages, but can also distance the audience. Soft strategies can be used to include the audience to ensure commitment, but even if a vision is shared it can be difficult to align for change. Different strategies can also be used when communicating concepts to decision makers. Strict strategies for communication can ensure expected information is brought to decision makers, but this does not guarantee change will take place. Communication with the use of soft strategies can inspire to think beyond existing solutions and open up for imagination of potential futures, however the direction of change can be more ambiguous. (See Table 2 for a summary of what and how the strict and soft strategies were used when conceptualising and communicating.)

In A Car-free Year, the concepts that were co-created with the design agency, describe socio-material relations of how a city could welcome more car-free families. The concepts were built on extensive analysis of and attention to system relations as strict strategies to conceptualisation. However, to clarify that these were proposals, not solutions, they were visualized as non-photorealistic 2D renderings. To further balance, and soften the concepts, the 2D visualisations were complemented with the video with the families’ stories. The families own words brought concrete details from everyday life to the more high-level and abstract concepts.

In the Mobility Pool project, on the other hand, the level of the concepts brought into these co-creative sessions were intentionally very sketchy and not as finished and detailed as in the Car-free Year project. In this project, the conceptualization mainly took place in co-creation activities, emphasizing soft strategies, and included people who were not so used to creative work. However, as we, in line with e.g. Sanders & Stappers (2012), believe that all people are creative, this simply implied that more attention needed to be paid to the prerequisites of the co-creative sessions. Also the other stakeholders in this project were brought into similar inclusive co-creative sessions further developing the concepts of possible future pool solutions. With service design methods such as customer journey mapping (Stickdorn et al., 2011), it was possible to move beyond the product level to include a system perspective to identify some of the real challenges around making the employees refrain from travelling by car to work. As the concepts were deliberately presented as unfinished, emphasized by the inclusive making of them as the sessions went along, and at the same time specifically related to the particularities and details of each workplace, the dialogues around the concepts were enabled.

The projects also used different strategies, soft and strict, for communication. In the Mobility Pool project, as the stakeholders with decision making powers participated as project members, the communication took place over the whole project period and co-creative sessions were immersion rich. This allowed for emphasis on soft strategies. In some of these longer sessions, the stakeholders were, through the concepts and films, immersed into the everyday lives of the participants who had tried new transportation practices. The discussions became more informal as the project members got to know each other over the project period. The initial concepts were co-created as part of the communication process and, by including all stakeholders in the dialogue, new values, also at corporate and societal level, of shared mobility solutions were identified. Even though
all stakeholders shared the same vision to improve conditions towards more sustainable mobility, it was difficult to get alignment around the respective strategies for reaching the vision as each stakeholder also had to relate to its own organisation’s strategies.

In A Car-free Year, the communication with decision makers was instead organised as a series of presentations with politicians and corporate decision makers. This meant an emphasis on more strict strategies. These presentations were shorter and more formal but the concept visualizations and films still managed to open up the discussions and the decision makers could start imagining possible future options. The stories of how people had lived in prototypes of possible futures enabled empathy for these people to develop as well as provided context for imagination, also among the politicians, creating possibilities for alternative design spaces. However, the decision makers quickly located others’ responsibilities for enabling sustainable mobility changes. This points at the need for a co-creative mindset enabling dialogue for sustainability transitions.

Moving on

In this paper we present two design research projects where sustainable transportation practices were tried out in real life and the results from living in these prototypes of potential futures were brought to decision makers. We discuss how this practice-based design research, including the applied co-design methods, increased participants’ reflexivity and encouraged stakeholders’ collaboration. By paying attention to reflexivity and collaboration, we suggest design strategies for prototyping change at an individual level and communicating the experiences of such change to people with power to trigger and direct change. Practice-based design research with a co-creation mindset, we believe, can be a complement to transition research for sustainability. This particular research approach, we argue, can be useful in dealing with complex problems by openly exploring potential futures, and supporting communication processes by inclusively bridging everyday life to decision makers. These applied strategies may serve as inspirations for others to try out and learn from as well as potentially push for making change with a designerly co-creative mindset.

References


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Effects of atmospheric variables on children during shopping activity: a conceptual framework of children shopping experience

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Although children are recognised as an important market segment, research on how children feel, perceive and experience shopping environment is still very limited. This study developed a conceptual framework of children shopping experience based on a review of 20 years of related research on how shopping atmospheric variables affect children aged between three to seven years old during their shopping journey. These articles are sourced from well-known academic databases including “Sage Publications”, “Emerald Insight”, and “Elsevier”. The conceptual framework explains how atmospheric variables influence children shopping experience from four perspectives: the role of children during shopping, act and response towards the shopping variables, variables as an agent of socialization and response from parents. Specific sub-level factors have also been summarised under each category for retail managers and designers to consider when designing a shopping atmosphere for this specific target customer.

Keywords: Children experience, parent, shopping atmospheric variables, children socialization

Introduction
In a retail context, the term atmospheric was defined by Kotler (1973) as intentional control and structuring of environmental cues. Through his meticulous marketing research, Kotler described atmospheric as the air surrounding a sphere or more colloquially as the quality of the surrounding space. Since then, a large number of studies
have confirmed great impacts of retail’s atmospheric variables on customer behaviour from divers perspectives, such as retail density (Michon, Chebat, & Turley, 2005), shopping companion (Borges, Chebat, & Babin, 2010), physical surroundings (Bitner, 1992), music (North, Sheridan, & Areni, 2015), colour (Brengman & Geuens, 2004) other customers and sales associates (Kim & Kim, 2012) and atmospheric cues of women’s fashion store (Ballantine, Parsons, & Comeskey, 2015). This is due to the fact that atmospheric variables can affect the customer’s behavioural response, number of items purchase, customer’s perception, product quality (Turley & Chebat, 2002) and store patronage intentions (Laroche, Laroche, Teng, Michon, & Chebat, 2005). In most competitive situations today, the well-designed of retail atmospherics can help to improvise the uniqueness and effectiveness of the shopping environment (Lucia-Palacios, Pérez-López, & Polo-Redondo, 2016). Nevertheless, Turley and Chebat (2002) found that different categories of customers appear to respond and behave differently towards similar atmospheric variables within the same environment. Therefore, Turley and colleagues suggested that retail environments should be crafted with a particular consumer in mind, with the intention to attract new customer and gain continuous loyalty from the existing ones (Grewal, Levy, & Kumar, 2009).

Children customers have been identified as ‘future customer in the making’ (Ebster, Wagner, & Neumueller, 2009; Feenstra, Muzellec, de Faultrier, & Boulay, 2015; Valkenburg & Cantor, 2001) and are considered as important as adult customers to retailers (Wiener, 2004) because they are powerful family influencer, have considerable amount of pocket money and their favour towards specific brand lasts well throughout their adulthood (de Faultrier, Deli-Gray, Matura, & Árva, 2014; Valkenburg & Cantor, 2001). Children between this age group falls under the perceptual stage category (de Faultrier, Deli-Gray, et al., 2014), and is an interesting age group for the research. Firstly, this is because it is a crucial stage where the children show clear emotion, developing and retaining their own character and imaginative ideas how to run their life. They show great difficulty on resisting the temptations of a snack or a toy, while at the same time are still able to interact or respond to the attention given to them (de Faultrier, Deli-Gray, et al., 2014; Valkenburg & Cantor, 2001). Secondly, as their negotiating skills and skills to verbally addressed their perspectives are still at the limited (Slunjski, 2015), bargaining with them might be a little challenging, leading to conflicts which then makes the shopping journey exhausting and inconvenient for parent (Badot et al., 2016; Cowles, 2002).

Although children are recognised as an important market segment, research on how children feel, perceive and experience shopping environment is still very limited (Ayadi & Cao, 2016; Badot et al., 2016; de Faultrier, Boulay, de Faultrier, Feenstra, & Muzellec, 2014), especially for younger children customers. The purpose of this study is therefore, to explore key shopping atmospheric variables that have great impact on children ages between three to seven years of age shopping experience when being accompanied by parent/s within a shopping environment.

The objectives of this research is threefold:

2. To review and analyse previous research related to children customer experience within the shopping environment.
3. To construct and propose a conceptual framework on the effects of shopping atmospheric variables on children shopping experience.
4. To provide suggestion for future research direction that may be used by other researcher who aim to further into this topic interest.

Literature Review

Shopping atmospheric variables
Research within atmospheric area has been carried out using stimulus-organism-response (S-O-R) model to understand how store atmosphere may affect customer behaviour during their shopping process (Donovan & Rossiter, 1982; Mehrabian & Russell, 1974). Using this model, researcher investigates how the stimuli of the store atmosphere (S) have influenced customer’s (O) emotional state, which then generates response (R) whether to approach or to avoid the store. Donovan and Rossiter (1982) found that the framework introduced by Mehrabian and Russell (1974) called PAD dimension that measures how store environment produce customer’s emotional states works well on studying customer responses and behaviors within retail environments. Pleasure (P) is identified as a degree in which a person feels good, joyful, happy, or satisfied. Arousal (A) refers to the degree in which a person feels excited, stimulated, alert, or active in the situation and dominance (D) refers to whether an individual feels in control of, or free to act in the situation (Mehrabian & Russell, 1974). While pleasure and arousals has been regularly studied (Laroche et al., 2005; Machleit & Mantel, 2001), researcher found that dominance factor is not relatable or is context specific (Brengman & Geuens, 2004; Donovan & Rossiter, 1982). In addition, Turley and Milliman (2000) found five main categories with total amount of fifty-seven atmospheric variables that may critically influence customer’s evaluation and behaviour in retail environment. The main categories are external variables, general interior, layout & design, point of purchase & decoration, and human variables. While the way each individual responds towards these variables may differ from each other, research found that each customer will engage with their shopping environments in a holistic manner (Mattila & Wirtz, 2001).

Shopping environment
Over the years, designers from various design disciplines and marketers have been working together to provide a product, service or interior of a shop that are able to meet their marketing goals (Bruce & Bessant, 2002). From consumption to trading space, retail space such as shopping centre has evolved alongside social needs and is recognized as the third place after working place and home (Johnstone & Todd, 2011; Mulhern, 1997). To cater the current customers’ demands, most of the modern shopping places have expanded their function, providing entertainment, relaxation (Goss, 1993), excitement (Lucia-Palacios et al., 2016) and education (Joseph, 2013) for customer. In long term, these modern shopping space is labelled as tourist attractions and family leisure space (Bucha, Rizwan, & Shahid, 2015; Jones, 1995). As stated by (Bitner, 1992), the design of retail environment should consider to incorporate both the needs of their ultimate users and also the requirement of various functional units. Therefore, shopping environment is designed by technical and marketing people to create a liveable selling environment that encourages not only practicality but also psychologically experience that appeals customer
(Ming Lim & Hultén, 2015). The creation of environment should allow customers to experience a convenient and pleasant shopping journey that encourages positive shopping mode, store visits, customer’s satisfaction and customer’s loyalty for generations (Cowles, 2002; Feenstra et al., 2015; Ming Lim & Hultén, 2015).

For example, previous research highlighted that a clear focus at the point of sale could provide better communication (Cowles, 2002). Careful layout arrangement could promote ease of navigation and movement especially for customers with wheelchair or child’s pram (Ballantine et al., 2015; Cowles, 2002) and the presence of shopping aid such as shopping cart with children seat could offer a convenient shopping journey for customer (Cook, 2003). On the other hand, visual clutter may add distraction to parent, lack of service facilities may create inconvenience (Cowles, 2002) and inappropriate location of children entertainment unit may lead to conflicts between parent and children (de Faultrier, Deli-Gray, et al., 2014). To avoid these problems, retailers begin to look into how parent and children experience their selling environment in order to attract and create a more pleasant and memorable shopping experience (Cook, 2003; Feenstra et al., 2015) through the design of their store atmosphere (Ayadi & Cao, 2016). However, research also shows that some retailers think that by providing space for children, they will behave in a way that could diminish other people’s experience (Feenstra et al., 2015; Ming Lim & Hultén, 2015).

Designing space for children

One of the challenges in designing a shopping environment is that the initial design of the retail space is often performed by the architects and store designers originating outside of the main-line marketing functions (Bitner, 1992). Therefore, Bitner suggested that the creation of an environment should be made as similar as designing a product, in which it means the designing of the environment should be made by considering the marketing side and also the subjects within the space as a whole. In designing shopping environment for children, Exley and Exley (2007) and Slunjski (2015) suggested that it is important for a designer to figure out attractive factors for children and continuously study how children use and interact with the environments to attract and fascinate children when occupying the space. This is because the way children understand and perceive their environment is different from adult and they will feel safe, comfortable, welcome and engaged actively within an environment that positively evokes their sense of belonging (Exley & Exley, 2007; Slunjski, 2015).

To achieve this aim, recent multidisciplinary research by Slunjski (2015) suggested that the designing of children space requires networking and collaboration among stakeholders including pedagogues, designers, architects and many other experts that may contribute towards the process of developing, shaping and designing the features of the children facilities and spatial features to achieve a balance between form and function. In addition, Exley and Exley (2007) pointed out that the participatory involvement such as collaborative workshop involving children may support learning and reveal unexpected design opportunities. Other than direct workshop participant, some researchers use observation, guided tours, cameras, maps, recordings, 2D and 3D images of the space to gain insight into ways how children experience space around them (Dudek, 2005; Slunjski, 2015). These methods are adopted due to the limited capabilities among children to
verbally describe their perspectives and way of understanding their ideas (Slunjski, 2015). By using these methods, researchers have gathered deeper understanding into how children perceive the space, how they use it and to what extent it is available to them, what are the meaning of objects in the environment is (toys, furniture, stimuli) or which activities are perform within the space. Understanding how children perceive and experience the environment will help to identify the design criteria needed and generate ideal outcome to provide a positive children experience (Slunjski, 2015).

The scenario of contemporary parent and children shopping activities
Place have various meaning for people and as highlighted by Ironico (2012), children experience consumer spaces and goods as symbolic resources that merging their fantasy and magic imagination with the actual purposes of selling space, products and promotional stimuli. In today’s modern lifestyle, bringing children to the shopping centre is typical to parent as shopping centre has been recognized as urban family leisure space (Bucha et al., 2015; Jones, 1995). Children relates their first purchase selections and first purchases in supermarket, especially for product like toys and candy (Cook, 2003; Young, 2004). In Western societies, parents authorize (Bauman, 2006), give command (Valkenburg & Cantor, 2001) and make decision (Cook, 2003) but children, most of the time, will greatly influence their family purchasing choices (Ebster et al., 2009; Ming Lim & Hultén, 2015; Pettersson, Olsson, & Fjellström, 2004; Valkenburg & Cantor, 2001). As a matter of fact, research by (Tyler, 2009) pointed out that children are recognised as the main customer since their influence on adult spending power is worth over £200m in the UK alone (Wiener, 2004). In term of loyalty, their preference towards specific brand or place lasts into adulthood, putting them as market influencer in future (Cowles, 2002; Valkenburg & Cantor, 2001).

Borges et al. (2010) states that shopping companion helps one make better shopping decision, reduces stress level, enhance a buyer’s confidence, which then make the overall trip more enjoyable. Interestingly, a companion may also reduce positive shopping values. Research found that having family companion particularly children could make parent experience embarrassing moments, more difficult to make purchase decision and stressful (Ebster et al., 2009; Miller, Jackson, Thrift, Holbrook, & Rowlands, 1998; Tyler, 2009) due to the children’s behaviour. As a result, parent may employ strategies (Ebster et al., 2009), give warning (Ayadi & Cao, 2016), or even shorten their shopping trip (Ming Lim & Hultén, 2015). Research by (Kazdin & Rotella, 2013) found that some parent who worries about children safety are considering safety harness. Social factors are another dimension that affects overall children shopping experience (John, 1999; Johnstone & Todd, 2011; Mulhern, 1997). By socialising, children build their sense of belonging and familiarity to the space and engage with modern community they live in (Mulhern, 1997). Because of these factors, research into how children feel, perceive and experience their shopping environment while being accompanied by parent is crucial and need further investigation.

Methodology
Figure 1 show the methodology flowchart for this study. Research published in refereed journals between 1999 until 2016, which focus on children involvements in retail or shopping environments have been collected and reviewed. The selected research included
origin from various databases including Sage Publications, Emerald Insight, Elsevier and ResearchGate. Relevant articles are sourced from Journals of Retail & Distribution Management, Young Consumers, Consumer Culture, Retailing and Consumer Services and Applied Developmental Psychology. The selection of keywords are shopping atmospheric, children customer, retail store, shopping experience, shopping environment and other related terms. Only papers written in English are reviewed for this study.

This research is children context specific. Although previous studies involved children from various age of background, only data that refers to children aged between three to seven years are analysed. Research focusing on children within other industries such as pure online shopping (Thomson & Laing, 2003) or health environment (Whitehouse et al., 2001) were excluded. Based on the selections criteria, seventeen study were reviewed in this research. The sets of data gathered are then extracted, listed, examined, compared, and conceptualized using open coding method (Bryman, 2012) before categorizing and grouping them under the sub-factor. To ensure validity of group, the data is then re-evaluated to avoid wrong grouping or double coding. Once finalized, the sub-factors are then linked together under four main factors.

![Methodology Flowchart](image)

*Figure 1 The methodology flowchart used to study the effects of atmospheric variables on children during shopping activity*
Results
The research analysis found that shopping atmospheric variables might affect children experience during their shopping activity through four main factors. Figure 2 shows the conceptual framework for this research with the list of each main factors and its sub-factors. Role of children during shopping activity refers to how children demonstrate their role as young customer and family purchase influencer. Children act and respond refers to ways children engage with the shopping variables, merchandise, and express their emotions towards certain event and situation. The third factor refers to how one specific human variable can affect the children’s socialization value, while the last one refers to how children receive respond from parent following their request and behaviour when they engage with the atmospheric variables.

![Figure 2](A conceptual framework for the effects of atmospheric variables on children during shopping activity)

1) Role of children during shopping activity

Role as young customer
Children active role as customer begins once they start spending their own money as early as three years old (de Faultrier, Deli-Gray, et al., 2014; Deli-Gray et al., 2016) to buy snacks, sweets and toys (Ayadi & Cao, 2016; Johnstone & Todd, 2011). Children think that product and brands are the most salient aspects of the marketplace and are not sure of the existence of this place besides providing them snacks and sweets (John, 1999). They are easily influenced by television programme and hypermarket’s advertisements (Badot et al., 2016; John, 1999) since they have limited understanding of the persuasive intention in marketing strategy (John, 1999). A research by John (1999) shows that children consumer knowledge and decision making skills were developed gradually along their cognitive abilities as they grow up. Their understanding of shop function starts only between the age of four to seven years old (Ironic, 2012) through exposure to the store, products for sale, shopping skills and pricing (John, 1999). As they reach preschool or kindergarten years, they already understand the actual meaning of shopping through observation, family exposure, interaction with peers, mass media and marketing institutions (Feenstra et al., 2015; John, 1999). However, their understanding of value is still limited (Deli-Gray et al., 2016); price is only relative to size. In terms of understanding money, John (1999) found out that children find money unimportant while Deli-Gray et al.
found that children in France understands the need for money and are able to relate the concept of price and payments activity from their self-observations. The knowledge, skills and values gained by the children during their childhood will benefit them as future customer (John, 1999).

**Role as family purchase influencer**

Children play important role as family purchase influencer (Valkenburg & Cantor, 2001) especially when requesting their own products, such as clothes, snacks, toys and candy (John, 1999; Ming Lim & Hultén, 2015). Young children, especially the one who sits in their buggy or cart makes fewer purchase requests compared to children who are not (Ebster et al., 2009). In today’s family purchases, over 33% from overall purchasing at point-of-sale is influenced by children (Ming Lim & Hultén, 2015). Research by Ming Lim and Hultén (2015) however states that children may not always get what they want since parent purchase decision are influenced by children’s age, household income and price of products they request. For examples, parent are found to agree less towards suggestion from children aged three years and below (Ebster et al., 2009) and children from higher income families have more influence over their family purchase decision (John, 1999). As they grow, they will have more understanding towards their family purchase preference, develop their consumer skills further and have more say towards the purchase decisions (de Faultrier, Deli-Gray, et al., 2014; Ebster et al., 2009; Ming Lim & Hultén, 2015; Valkenburg & Cantor, 2001).

2) *Children act and respond towards shopping variables*

i) *Engage with shopping variables*

Children between three to seven years adapt and actively respond towards shopping variables (Ayadi & Cao, 2016; John, 1999; Valkenburg & Cantor, 2001). They pay more attention to the hedonic elements of the store rather than getting involved with their parent’s purchase activity (Ayadi & Cao, 2016). They appreciate the whole experience cognitively, emotionally and physiologically through responding to the visual, aural and tactile elements (Ayadi & Cao, 2016; Feenstra et al., 2015). Children can also relate their memories and recognise their space through its environment variables such colours, music (Ayadi & Cao, 2016) and images from television shows (Cook, 2003). The more familiar they are to the space, the more they explore the surroundings and variables around them (Ayadi & Cao, 2016). However, children explores differently than adult (Wiener, 2004). Feenstra et al. (2015) and Badot et al. (2016) found that stores serves not only as a trading place, but also as a place to learn, play and have fun for children. This is also because children especially boys, are uninterested in purchasing process and creatively entertain themselves through playing (Ayadi & Cao, 2016; Cook, 2003). This is largely influenced by their character- adventurous, always seeking for surprise, prefer something different, love to explore, investigate further through questioning and want things that stimulate their emotions (de Faultrier, Deli-Gray, et al., 2014; Wiener, 2004). They also love games and be involved with interactive and shopping activities with their parent (Deli-Gray et al., 2016; Wiener, 2004). As a result, children always explore the shopping surroundings through playing (running, play hide and seek, dancing, sliding or surfing) in selling space, fitting rooms or even at the lift’s lobby area (Ayadi & Cao, 2016; Ironico, 2012).
Engage with merchandise in-store

Children love shopping especially visiting shop where they can engage with merchandise (de Faultrier, Boulay, et al., 2014; Ironico, 2012; Wiener, 2004). They recognize product through their characters, shape, colour, size and brand (de Faultrier, Deli-Gray, et al., 2014; John, 1999; Wiener, 2004). Frequently, children are also attracted to certain merchandise that are aesthetically appealing to them even if its main function and purpose may differ (Cowles, 2002). They enjoy toys, friendly looking animal and adventurous characters (Cowles, 2002; Valkenburg & Cantor, 2001). Children often grab any product they see, making impulse purchase request to their parent (Cook, 2003). However, children pick up products not only to purchase them, but also as their imaginary medium. Adult handles merchandise in-store with extra caution while children may use merchandise differently than it is intended for (racks as a place to hide, clothes as a guitar, mannequin as life size dolls or product’s label as an airplane).

Express emotions towards event and situation

Children express positive and negative emotions during shopping trip as consequences to certain situations and surroundings (Feenstra et al., 2015). Research by Ayadi and Cao (2016) found that the way young children express their emotional and physiological responses towards surroundings are not clear as to older children. In general, children react positively when they feel their activity is interesting, when they receive souvenirs or gifts and when they get or can play with something they want (de Faultrier, Deli-Gray, et al., 2014; Deli-Gray et al., 2016; Feenstra et al., 2015; Ming Lim & Hultén, 2015). They respond to music with prominent rhythm and dance when listening to it (Ayadi & Cao, 2016). In other situation, children behave negatively by screaming, whining and crying when they don’t get what they want (Deli-Gray et al., 2016; Valkenburg & Cantor, 2001). Hopefully by showing their emotions, parents have a change of mind and agrees to them (Deli-Gray et al., 2016). In addition, children may also express negative emotions when they are forbidden to play or when they have to stop playing as they had to leave the store (Ayadi & Cao, 2016).

3) Variables as an agent for socialization

Bonding place for parent and child

Most of the time, children are accompanied by parent during their shopping journey (Ayadi & Cao, 2016). With this routine, children recognized shopping environment as a place to strengthen family bonding or place to get treats from their parent (Ayadi & Cao, 2016; Deli-Gray et al., 2016; Johnstone & Todd, 2011). Some activities that help encourage parent and children socialization are having meals, celebrating event, choosing products or having fun together (Deli-Gray et al., 2016; Johnstone & Todd, 2011).

Socialization with peers

Public space is recognized as a place that encourages conversation and interaction between people (Johnstone & Todd, 2011). For children, they learn to socialize with their peers through role-play, playing together or imitating each other behaviour (Ayadi & Cao, 2016; Wiener, 2004). Therefore, it is quite common to see children actively responding
and joining their peers playing around the cashier counter or display racks, although they don’t come to the shop together (Ayadi & Cao, 2016). Occasionally, a group of children may be found playing together while their parent browse or make purchases. Research by Feenstra et al. (2015) found that children may also communicate with peers to share their experience during the workshop or commercial events (Feenstra et al., 2015).

### Attention received from store employee

Children may also develop their consumer socialization skill and understanding of product’s information through their communication with store employee (Cowles, 2002; Feenstra et al., 2015). Understanding children may be hard because they can be unpredictable and irrational, so store employee needs to spend more time and show good manners as they are role model, observed by the children (Tyler, 2009). Research by Cook (2003) found that children prefer similar treatment as adult and they don’t like to be treated as “babies” (Wiener, 2004). The way children receive attention from store employee is crucial because children’ satisfaction influence parent’s satisfaction and business success (Cowles, 2002). However, employee characteristics are not standardised and they show varied attitude such as professional, friendly, helpful, proud or even unhelpful when entertaining the children (Badot et al., 2016; de Faultrier, Deli-Gray, et al., 2014; Tyler, 2009). This is why some children may receive unfriendly treatment from store employee and in certain cases, the children reported that they have being pushed, warned and scolded by the retail employee. (de Faultrier, Deli-Gray, et al., 2014).

### 4) Respond received from parent towards children behaviour

#### Access and flexibility to explore the surrounding

Parent are found giving access and flexibility for children to freely explore their shopping surrounding for fun and as a way to let them experience something different from their daily routine (Feenstra et al., 2015; Ming Lim & Hultén, 2015). Most of the time, parent will let children explore the shopping variables available around them like following printed footprints or graphic elements on the floor, or communicating and playing with the store employee (Ayadi & Cao, 2016; Feenstra et al., 2015; Ironico, 2012). Small children will explore every nook and cranny of the store possible including areas that permit entrance only to retail employees (Ironico, 2012). Some parent may also give children permission to help with the shopping activities such as helping them at the self-checkouts, passing purchases or manoeuvring shopping cart (de Faultrier, Deli-Gray, et al., 2014; Ming Lim & Hultén, 2015). By giving permission to help, children are found more likely to co-operate during their shopping process (Ayadi & Cao, 2016).

#### Conflicts with parent

Children in-store behaviour may sometimes lead to conflicts between parent and children, turning smile into frown instantly (Ayadi & Cao, 2016; Badot et al., 2016). Factors that may lead to conflicts are varied, from agreeing on food selections (Cook, 2003) or when the children are playing somewhere with restricted entrance (Ayadi & Cao, 2016). In addition, conflicts may also happen when children start to scream, whine and cry when they don’t get what they want (Valkenburg & Cantor, 2001). As a result to their negative expressions, parent may get less enjoyment and struggle with their shopping process (Ayadi & Cao,
The way parent respond to conflicts are varied; some may give warning, express disappointment, educate or will ignore them (Ayadi & Cao, 2016; Ming Lim & Hultén, 2015). This is because for some parent, scolding causes embarrassment (Ebster et al., 2009). As consequences, parent may shorten their shopping trip, spend less time and money at the store (Ayadi & Cao, 2016; Ming Lim & Hultén, 2015). As an alternative to avoid conflicts, inconvenience, tiring and complicated shopping process, some parent may leave the children with their partner and then proceed shopping alone (Ayadi & Cao, 2016; Cowles, 2002; Ming Lim & Hultén, 2015).

Negotiation and parental control

Parent and children interaction is an important factor when studying children's responds to store atmosphere (Ayadi & Cao, 2016). Parent in Western society pays more attention to their children’s opinion (Valkenburg & Cantor, 2001) and use discussion and negotiation to educate their children (Ming Lim & Hultén, 2015). However, the way children communicate to express their desire will influence their parent decision whether to ignore, grant or reject their children's request (Ebster et al., 2009; Ming Lim & Hultén, 2015). Small children express their desire using the word ‘want’ but as they turned to five years old, they start to negotiate, explain and make excuse to get something they desire (Valkenburg & Cantor, 2001). At this age, the selection of word change to ‘I wish’ or ‘I hope’ (Deli-Gray et al., 2016). Children may also express their desire differently such as by demand, appeal, urging manner, observations, discussion and proposition (Ebster et al., 2009; Ming Lim & Hultén, 2015). Parent want their children to be obedient (Ayadi & Cao, 2016) and may use their control power to teach and protect their children through the employment of strategies by giving them something to hold, eat or play with (Cook, 2003; Ebster et al., 2009). For parent, they think children are not independent and still cannot rationalize their decisions (Cook, 2003; Tyler, 2009). However, parent agrees more easily if their child request for something like food that could be consumed in the store (Ebster et al., 2009; John, 1999). Research also shows that parent who always shop with their children discuss more about their purchase request because the parent are more concern on their children’s socialization and consumerism skills (Ebster et al., 2009).

Concern for children’s safety

Parent worry about their children's safety in public spaces and wants their children nearby at all time until they can take care of themselves (Ayadi & Cao, 2016; Cook, 2003). Occasionally, some parent gives permission to children to roam or play around the shopping surrounding, while monitoring and securing safe distance between themselves (Ayadi & Cao, 2016). Parent are also more cautious with other children who might play too rough with their own (Cook, 2003).

Discussion and conclusion

This research concludes that children experience their shopping journey through their role in shopping activity (self-experience), act and respond towards shopping variables (space and place), socialization factors they involved with (human) and responds they received from parent as consequences to their behaviour (shopping companion).
The findings also reveal intersection values that children experienced with parent, peers or store employee. These intersection values are unique since previous research often focus only on specific type of customer (Lucia-Palacios et al., 2016; Michon et al., 2005). In this research, children are found to engage extensively towards shopping atmospheric variables more than what stated by Turley and Milliman (2000) including towards peers (human variable), entertainment and services, fitting rooms (layout and design) lifts and escalators (external variables). Children adapt, explore and view their surroundings differently than adult. Their physical feature and childhood imagination encourages limitless exploration around the shopping environment. With these contemporary children shopping scenario, it is interesting to point out that designer, architect and other stakeholders should consider revisiting some design criteria when designing space, product, service or furniture for children within the shopping atmosphere.

Through this exposure, children are benefiting from self-explorations and observations, which then help build their socialization skills, confidence level, decision-making skills, product evaluations and understanding towards consumerism. For parent, understanding children experience in the shopping environment may help them make better strategies for an enjoyable shopping experience together.

This research also concludes that children experience pleasant emotions while shopping, as they express happiness and joy when they get what they want or when playing within the shopping spaces. They also respond towards arousals around them and are found dancing, as they get stimulated when listening to music played in-store. As for dominance, although children might show intention to play or make purchases, their decision is strongly influenced by parent’s considerations. In certain situations, parent may express disagree towards their requests. This indicates that children are being submissive, as they are not allowed to decide freely during their shopping journey.

As for managerial, it is crucial to stress out that children may influence their parent’s decision to spend money and time when shopping together. Understanding on how children experience their shopping atmospheric variables may open new opportunities for managerial to implement strategies that could benefit their customer experiences and businesses.

**Limitations and directions for future research**

As this research is based on reviews from related academic journal articles, future research should explore how shopping atmospheric variables affect children’s experience via actual field studies and empirical research. Data collection from observation, interview, video recording or ethnography study may provide further understanding on how children experience their shopping activities and environment. This will also give researchers first-hand accounts of the shopping atmospheric variable experience.

Secondly, as this research focuses only on brick and mortar store environment, other shopping domain such as pure service settings or online store web atmospheric is not covered in the study. Future research may look into how children experience their web atmospheric variables when they are developmentally ready for computers as early as the age of three (Deli-Gray et al., 2016).
This research focuses only on Western culture and cannot be generalised into other culture. Therefore, alteration to this proposed conceptual framework may be needed before it can be used to investigate children experience from other cultural background. Comparison between different cultures may reveal interesting understandings on how children from other culture would respond towards their shopping atmospheric variables.

Lastly, future research might be broadened into the effects of other public space atmospheric variables on children, as this research focus only on shopping atmosphere. Further investigation on how other specific atmospheric variables may reveal interesting findings and understandings of children experience on that specific area.

References


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Enhanced Capabilities through Design-Based Approaches

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Design Thinking is often referred to as a valuable addition for educational models to promote a way of learning that encourages collaborations with people who work, think and act differently. Despite being used in multiple situations and described by numerous lists with characteristics, little is known about how it could affect people’s lives beyond the professional environment. The Capability Approach was used as an inspiration to explore with designers how it has influenced their lives through an interactive installation and in-depth interviews. Respondents reported better imagination, reasoning, thinking, using of skills and talents, freedom of expression, and ability to imagine another’s situation as a result of their designerly attitude. It is argued that integrating design thinking in educational models potentially transforms how people interact in society.

*keywords: Capability Approach; Design Thinking; Education*

1. Introduction. Design Thinking for Education

Educational models do not solely prepare for professional careers. They target transformations of students beyond knowledge, skills or attitudes, to shape ways we subconsciously are, think, do and interact in our daily lives. The classroom should thus be a safe place where students practice various ways of thinking and become familiar with different perspectives and reflect on what they feel they have reason to value to be able to be and do (Holley & Steiner, 2005). The in traditional educational model's encouraged desire to possess the right answer silencing conversation partners translates to numerous aspects in people's lives, for example when discussing the best way to take your business forward with your partners, when suggesting a vegan menu to your family for Christmas.
dinner, when arguing more money needs to be made available to welcome migrants in a political debate, or when asking your neighbour to not watch movies after 10pm because the walls are thin and you want to rest. It affects interactions in personal, professional and social environments, underscoring the need for educational methods to consider human development in terms of personal, professional and societal challenges.

Taking societal challenges into account in educational models is not new. Industrialisation has pushed educational institutes to focus more on efficiency, compartmentalization and measurable outcomes leading to social stratification (Treiman, 1970). Freire mentioned his 'practice of freedom' already in 1967 (Freire, 1967). In the words of Jane Thompson:

*Education either functions as an instrument which is used to facilitate the integration of generations into the logic of the present system and bring about conformity to it, or it becomes the 'practice of freedom', the means by which men and women deal critically with reality and discover how to participate in the transformation of their world.* (as cited in Mayo, 1999, p. 5).

More recently, also Razzouk and Shute (2012) stated: "if we are serious about preparing students to succeed in the world, we should not require that they memorize facts and repeat them on demand; rather, we should provide them with opportunities to interact with content, think critically about it, and use it to create new information" (Razzouk & Shute, 2012, p. 345). Design Thinking claims to help both developing new products or services and "opening up the fixed mindset that the day-to-day operation of jobs creates in people’s functioning" (Efeoglu, Møller, Sérié & Boer, 2013, p. 254). Both for professional environments and educational models Design Thinking is thus often mentioned to be a valuable addition.

2. Critiques, Characteristics and Potential of Design-based Approaches

2.1. An Introduction to Design Thinking

To understand the potential of Design Thinking for educational models, some core qualities of design-based approaches need to be agreed on. The term Design Thinking was coined by David Kelley, founder of the Stanford d.school—the Hasso Plattner Institute of Design at Stanford University, and founder and chairman of IDEO, the renowned global design company, to describe the general outlines of creative processes that have been around for centuries (Glen, Suciu, Baughn & Anson, 2015). It describes a team-based, multidisciplinary approach to problem solving derived from the field of industrial design to support people to push for innovation in their field (Camacho and Kelly, 2016; Glen et al., 2015). Applications can be found in various fields to address messy, ill-structured problems incorporating thought processes and methods underlying design practice (Glen et al., 2015). Purposefully not specifying methods or tools, it is best understood as a way of seeing and consequently interpreting the world in all its complexity (Liu, 1996). Through iterations and inviting multiple perspectives to the conversation various representations of concepts and ideas are always considered to solve issues, which then through identification of patterns and relations combined with critical reflection inform further design efforts (Do & Gross, 2001; Lloyd & Scott, 1995).
2.2. Critiques on Design Thinking

Design Thinking has since its conception - the term, not the process - received a lot of backlash and is even said to already be on its return (Badke-Schaub, Roozenburg & Cardoso, 2010). This happened partly because over time many different practices have been labelled Design Thinking, and described as "1. an iterative process, 2. a ‘special’ way of understanding and creatively solving so-called wicked problems, 3. user empathy, 4. a tool for collaboration, 5. a mindset, 6. a toolbox for user research and group creativity, 7. prototyping, or 8. a culture" (Plattner, Meinel & Leifer, 2015, p.168). To better capture the essence of Design Thinking many have avoided labelling, and instead attempted to list phases or characteristics related to Design Thinking (e.g. Bootcamp Bootleg, 2010; Brown, 2008; 2009; Lawson, 2006; Liedtka & Ogilvie, 2011; Efeoglu et al., 2013; Brown, 2008; Dunne & Martin, 2006; Meinel, Leifer & Plattner, 2011; d.school, 2010; Waloszek, 2012; Cigaina, 2013; Vetterli, Brenner, Uebenrnickel & Berger, 2012). The popularity of Design Thinking made many design agencies decide to develop toolkits, sharing their way of designing, presenting creative approaches as something easily adoptable and usable following a few steps and techniques. These ways of describing tend to be quite arbitrary, as they are "always incomplete", "non-exclusive" and "at different levels of granularity" (Badke-Schaub et al., 2011, p. 44). The issue with either labelling the concept or listing phases or characteristics of either processes or participants, is that these oversimplifications are never able to incorporate the unique identities of participants influencing those truly creative, chaotic exercises (Wendt, 2015). The simplistic understanding has caused people to see Design Thinking as a quick fix, resulting initially in disappointing results. Like any other approach, it takes time to become familiar with methods, tools and techniques, to make them your own and to be able to intuitively adapt them to specific contexts and present skillsets and preferences.

2.3. Design Thinking to Develop Personality

We consider design-based approaches not just to be activities intended to push for innovation. Instead they are journeys of creativity incorporating conscious reflective practices in which everything is done with intention (Camacho & Kelly, 2016). To allow free reflection, the initial problem is revisited many times, and reframed whenever insights from literature, experience or new perspectives are uncovered, allowing for unusual, big, innovative ideas (Camacho and Kelly, 2016). Inviting alternative perspectives is essential here, since people with similar backgrounds tend to tunnel as a result of automatic thinking (Kulkarni, Cambre, Kotturi, Bernstein & Klemmer, 2016; Gurin, Dey, Hurtado & Gurin, 2002), whereas increasing the team's diversity adds more divergent perspectives and confronting questions resulting in a discontinuity pushing people out of the comfort zone. The tensions resulting from an exchange of critiques over assumptions, beliefs and values can lead to conflict if people are unable to move out of the comfort zone, yet, if harnessed constructively, can be turned into creative opportunities "yielding more active, effortful and conscious thought" (Kulkarni et al., 2016, p. 1117). Tools or methods to empathize with stakeholders that are missing can be used to intentionally create a discontinuity and reveal potential tensions. It is never about finding a middle ground where parties give in, but about finding innovative solutions, new ways of thinking or other ways of working that benefit all stakeholders, in Buddhism referred to as the Middle Way (Grenny, McMillan, Patterson, & Switzler, 2002; Smith, 2016). Harnessing and
dealing constructively with tensions rising from diverse perspectives thus is a core element of design-based approaches. Intrinsic motivation and embracing discontinuities supports participants to move "away from the comfort zone to re-invent and develop their personality" (Efeoglu et al., 2013, p. 254).

2.4. Design-based Approaches as an Educational Model
Part of the beauty of using design-based approaches as inspiration for educational purposes is that it is clear enough to guide novice designers yet open enough to make room for a master: “It is innately human because it mirrors the process of the stories we tell, the transitions we make and the development we experience” (Drake, 2016). It therefore has great potential for students, faculty, companies, politicians, locals and others, since they collectively possess both new naivety and knowledge of industry and regulations. Considering different angles in respectful and equal learning environments supports creating inclusive opportunities for innovation, without winning, compromising or losing (Grenny et al., 2002). Design-based approaches thus claim that professional and personal environments can be transformed, enhanced by generating genuine empathy between people with diverse backgrounds and various roles (Kulkarni et al., 2016).

2.5. Studies on Design Thinking
Several studies targeting creative arts saw an increase in mutual understanding and awareness of individual differences strengthening relationships (Leckey, 2011; McNiff, 1992; Ulrich 1992) and in an educational setting Pearce (2016) found that participants developed stronger relationships after engaging in creative exercises. Grenny et al (2002) also concluded that when people produce something with another person that is truly creative, it’s one of the most powerful forms of bonding there is. On top of that Sellaro (2014) found that “trustors transferred significantly more money to trustees after engaging in divergent thinking as compared to convergent thinking. This observation provides support for the idea that interpersonal trust is controlled by domain-general (i.e., not socially dedicated) cognitive states” (Sellaro, Hommel, De Kwaadsteniet, Van de Groep & Colzato, 2014, p. 1). This matches with Leckey’s (2011) results, who found that “participation may contribute to improvements within the individual’s immediate social networks” (Leckey, 2011, p. 508).

Engaging in design activities also seems to increase participants’ level of understanding, reflection, and self-regulation (e.g. Koh, Chai, Wong & Hong, 2015; Cast, Hastie, & Rovegno, 2011; Ching & Kafai, 2008; Liljeström, Enkenberg, & Pöllänen, 2013). Enhanced deductive reasoning skills may contribute positively to situations in which multiple aspects are "abstract, apparently incomplete, contradictory or otherwise untenable" (Gustafson, 2015, p. 1). A designerly attitude may thus improve the ability to deal with unfamiliar territory beyond the comfort zones and in situations that are otherwise hard to assess without oversimplifying the issue (Gustafson, 2015), becoming more competent to solve wicked problems. Being more competent in complex situations can potentially lead to transformations of hegemonic structures and ideologies through higher understanding of originally resisted assumptions and values (Brown, 2004).

A review done by Razzouk and Shute (2012) aimed to "examine either the differences between novice and expert designers or characterize expert behaviour in the designing process" (Razzouk & Shute, 2012, p. 344). They found however that "experimental
evidence is lacking in the field of design research" (Razzouk & Shute, 2012, p. 344). For the scope of this research we aim to explore which capabilities are being enhanced when using design-based approaches. Focus is thus not on what people know, or what they can do in a professional or creative setting, but on how it may affect other aspects in life, either directly or indirectly. The question we aim to answer thus becomes: 'How can design-based approaches influence people's capabilities?'

3. Method: Mapping Merits of a Designerly Attitude

The aim of this research was to explore with designers what the merits of a designerly attitude are by identifying which aspects of their lives have been influenced as a result of becoming familiar with design-based approaches. This was achieved through three phases, briefly described in table 1, and in more detail in this chapter.

Table 1  Structure of the research

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
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<tbody>
<tr>
<td>Phase I</td>
<td>Choice of Amartya Sen's Capability Approach as an explorative framework.</td>
</tr>
<tr>
<td>Phase II</td>
<td>Appropriation of the Capability Approach by defining categories for the interview and domains for the panel</td>
</tr>
</tbody>
</table>
| Phase III | Gathering data using two formats:  
| | A. Writing stories of change on a panel displaying Capability Domains  
| | B. In-depth interview around Capability Categories |

3.1. Phase I. Measuring Development with the Capability Approach

Existing research focused mostly on differences between novice and expert designers or on professional and creative skills and characteristics (e.g. Razzouk & Shute, 2012; Efeoglu et al., 2013; Koh et al., 2015). In this research, we aimed to create a mapping with both novice and expert designers to identify which aspects of their lives had been influenced by design-based approaches. Although various approaches could be used for this exercise, we selected Amartya Sen's Capability Approach (CA) because of its wide spectrum of abilities that people may have reason to value (Mink et al., 2015).

The CA is concerned with how development can enhance what people have reason to value to be and do in life. Sen (1933-present) is an Indian economist and philosopher. He developed the CA in the 1980s as a response to traditional approaches to economic welfare (Sen, 1999). He argues that in developmental work it is not income or commodities that are ultimately important, but what they allow us to do and to be, the kind of lives they enable us to live (Sen, 1999). A similarity can be drawn for educational development, in which the focus should also "not solely [be] on trained potentials (as skills, abilities and aptitudes)" (Mink et al., 2015, p. 1639). Although those may be important for professional careers, what is ultimately much more important is what type of people it helps shape, which choices and freedoms it helps create (Zheng & Walsham, 2008), or in short what central and basic things it helps them to be able to do (Burchardt and Vizard, 2007). Sen focuses on ‘capabilities’: the freedom of action and decision and the actual opportunities that people have as a result of a developmental intervention. In this research, we thus look at what opportunities, or what expanded freedoms people experienced as a result of obtaining experience with design-based approaches.
This philosophical, sociological approach is not well-known in the designer’s world. This is no surprise as it is very difficult to translate this philosophy into working evaluative criteria. A predefined list with key topics to be discussed throughout interviews however can be highly beneficial (Larsen & Flensborg, 2011). The CA is valuable in the sense that it challenges researchers to create a list of relevant human capabilities in collaboration with the envisioned users (Sen, 2003; Nussbaum, 2001). Several scholars have attempted to make the CA operational and created different lists, which allow for evaluation and reconsideration (Nussbaum, 2001; Alkire, 2007). By probing people with questions of many different topics and asking them to reflect upon those topics it can give rich insights in their habits, freedoms and values, as well as underlying reasonings (Mink et al., 2015).

3.2. Phase II. Defining Capability Categories and Domains

A list of relevant capability categories and domains to explore the impact of design-based approaches had not yet been created. In order to create this all lists created by Alkire (2005 & 2007), Anand (2005, 2007 & 2009) and Mink (2015) were combined in one overview. This overview contained both abstract phenomena, such as leisure or freedom and very specific activities, such as having food and work.

The topics mentioned in the lists were categorized by the researchers, who both have an educational and professional background in design. This was continued until one list of 48 capability categories was created (see table below). The defined list of capability categories was categorized in four domains for the panel: Body (physical being), Mind (mental being), Activities (doing) and Social Context (social being).

Table 2  Capability Domains and Categories

<table>
<thead>
<tr>
<th>Domain</th>
<th>Categories</th>
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<tbody>
<tr>
<td>Body</td>
<td>Life expectancy</td>
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<tr>
<td></td>
<td>Health</td>
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<tr>
<td></td>
<td>Diet</td>
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<td></td>
<td>Ability to visit doctors and hospitals</td>
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<td></td>
<td>House or adequate shelter</td>
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<td>Ability to move home</td>
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<td>Sense of safety while walking</td>
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<td>Protection from violence</td>
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<td></td>
<td>Bodily sovereignty</td>
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<td>Sexual satisfaction</td>
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<td></td>
<td>Choice in matters of</td>
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<tr>
<td></td>
<td>reproduction</td>
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<tr>
<td>Mind</td>
<td>Ability to sleep</td>
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<tr>
<td></td>
<td>Stress level</td>
</tr>
<tr>
<td></td>
<td>Sense of usefulness</td>
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<tr>
<td></td>
<td>Sense of fear and anxiety</td>
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<tr>
<td></td>
<td>Perception of the world</td>
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<td></td>
<td>Imagination</td>
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<td></td>
<td>Ability to think</td>
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<tr>
<td></td>
<td>Reasoning</td>
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<td></td>
<td>Concept of what is right</td>
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<td></td>
<td>Engagement in critical</td>
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<tr>
<td></td>
<td>reflection</td>
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<td></td>
<td>Idea of a good life</td>
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<td></td>
<td>Life planning</td>
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<tr>
<td>Activities</td>
<td>Freedom of expression</td>
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<tr>
<td></td>
<td>Participating in political and religious choices</td>
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<tr>
<td></td>
<td>Seeking work on an equal basis</td>
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<tr>
<td></td>
<td>Working as a human being</td>
</tr>
<tr>
<td></td>
<td>Doing useful activities</td>
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<tr>
<td></td>
<td>Moving freely</td>
</tr>
<tr>
<td></td>
<td>Pleasurable experiences</td>
</tr>
<tr>
<td></td>
<td>Avoiding non-beneficial pain</td>
</tr>
<tr>
<td></td>
<td>Laughing</td>
</tr>
<tr>
<td></td>
<td>Playing</td>
</tr>
</tbody>
</table>
Using your skills and talents | Participating in recreational activities
---|---
Social context | Ability to live with concern for and toward others
Acceptance by others | Love and care for others
Lasting friendships | Ability to imagine another’s situation
Self-respect | Ability to live with concern for and in relation to animals
Sense of dignity | Ability to live with concern for and in relation to the world of nature
Sense of feeling equal | Sense of being discriminated against
Meaningful social relations | Ability to share emotions and feelings
Ability to imagine another’s situation | Ability to imagine another’s situation
Ability to live with concern for and in relation to animals | Ability to live with concern for and in relation to the world of nature

3.3. Phase III. Gathering Insights through Three Different Formats
People were asked to report what shifted for them as a result of their experience with design-based approaches, the assumption being that this experience developed a designerly attitude which had influenced other aspects of their life. Two different manifestations were designed in an attempt to map those shifts: (A) an interactive installation and (B) an in-depth interview.

3.3.1. Interactive Installation with Stories of Change
The interactive installation was set up at the Dutch Design Week in Eindhoven October 23rd until October 30th 2016 and free for anybody passing by to write their personal story of change on a small piece of paper and put it on the panel. This panel was aesthetically pleasing to attract people to the stand (see figure 1). The researcher and his colleagues assisted by clarifying the purpose or invite people over to share their story. The installation did not explain the Capability Approach; people were free to share anything they felt was meaningful.

People were guided through the process in several steps. First people were asked to pick a card from the board on the left where cards were pinned down with magnets. They could choose from three options: a red card if they identified as an expert designer, a yellow card if they identified as a novice designer, or a blue card if they identified as a non-designer. The main aim of this question was to attract people’s attention, as it was a fairly easy question to answer, and it would commit them to continue to the next step. How participants identified themselves was left to their own definitions. Participants then wrote their story of their personal transformation as a result of using design-based approaches on their cards. Support was given by indicating they could consider either how they feel about themselves, what they do and how, or how people treat them. After writing the story down, participants attached their story to the board with a magnet in one of the Capability Domains. Body and Mind were clustered in this installation to simplify the task. Initially people were also asked to indicate how much the change had impacted their life, but this was removed after the first day since people expressed difficulty doing so.
Figure 1  Design of the interactive installation. On the left board it reads: ‘Step 1. Pick a card that best describes what type of designer you identify as. Use this card on the other panel to share your (expected) personal transformation as a result of using design-based approaches. I identify mostly as: Expert designer, Novice designer, Non-designer.’ On the middle board it reads: ‘Step 2. Write the story of what has changed (or might change) for you as a result of using design-based approaches on your card. Consider either how you feel about yourself, what you do and how, or how people treat you. Place your story along that line to indicate how much it has changed you: Your body and mind, Your activities, Your social context.’ One the right board it reads: ‘Merits of Design Thinking. Besides a proven and repeatable problem solving protocol design thinking is also said to be successful in developing people. NHL University of Applied Sciences is therefore developing educational models based on design thinking in co-creation with professionals and society.’

The installation was present at the Dutch Design Week for eight consecutive days (see figure 2). 90 response cards were added during this week. 7 cards were removed because they were illegible or not related to the provided question (e.g. ‘I do not understand this question’). Whenever the left board was running out of cards, new ones were added. 42 cards were placed in the domain Body and Mind, 33 in Activities, and only 8 in Social Being.
3.3.2. Interviewing to Identify Changes in Capability Categories

If people expressed an interest in the topic, they were invited to participate in the interview. By talking through a wide variety of topics, answers remained open to many potentially impacted areas of life. All capability categories were discussed to explore where shifts had occurred as a result of using design-based approaches. The interviews were semi-structured to enable a free and open dialogue with the participant (Bowman and Crews, 2009), to allow for providing deeper and richer views into behaviours, reasoning and personal experiences. Cards with visualisations of all capability categories were present at the table to create curiosity and provide a physical overview of the answers. One side of each capability card was in colour, the other in grey (see figure 3).
After participants had agreed with the interview being audio-recorded, a brief introduction was given about the topic and aim. The interview would last for about thirty minutes.

Figure 3  Design of the capability category cards used in the interview
First the interviewer asked about the familiarity with design-based approaches, e.g. years of experience, type of design, intention to use more or less design-based approaches, etc. to get acquainted and awaken the right mindset. Then participants were asked to indicate which capability categories displayed on the table they felt had changed as a result of using design-based approaches. Affected capability categories were left upright showing a coloured depiction of the category, unaffected categories were turned upside down revealing the grey side. Participants were free to think out-loud or to themselves. Afterwards, participants explained their choices as far as they hadn't done so during. If necessary participants were probed with questions like ‘Which ones were very easy, either definitely affected or definitely not?’, or ‘Which ones were you unsure about?’.

At the end of the interview participants were asked whether they had any questions, comments or suggestions for the researcher, and they were asked if they were interested in being kept up-to-date regarding the research results. A photo was taken of the cards on the table to capture the data.

In total 22 people were interviewed. Initially there were no criteria to participate in the interview, but after interviewing two non-designers, it turned out to be a frustrating exercise for participants to imagine what could have been influenced, or what would be influenced in the future, so experience with design-based approaches became a prerequisite to participate.

![Figure 4 Impression of the in-depth interview](image)

4. Results

4.1. General

Participants for the interviews were selected randomly, resulting in a group of people with a wide spectrum of design experience ranging from just half a year into their design
studies to a lifelong experience in design practice. All results were treated equally to explore immediate impact and long-term changes together. For the data analysis, the interview data were leading, since there participants were asked to reflect on all categories. Panel cards were interpreted and linked to capability categories to see where these stories matched up with the interview results.

The 20 novice and expert designers indicated that an average of 28 out of the 48 proposed capabilities were influenced because of using design-based approaches. Mostly categories from the mind domain were influenced (across the 12 categories an average of 16 participants indicated a change), followed by the activities domain (12 categories were mentioned by an average of 14 participants), the social domain (13 categories were mentioned by an average of 13 participants), and least influence was given to the body domain (11 categories were mentioned by an average of 8 participants). Each domain is discussed in further detail in the following paragraphs.

Figure 5  The relative impact on the capability domains.
4.2. Body

The body domain was considered the least influenced. Around half of the participants indicated these categories weren’t something they can influence, but rather something that happens to them, or is dependent on external factors, such as money. A slim majority did indicate an effect on their health (12) as a result of using design-based approaches: some felt it had improved because they now better understood what they were doing which had made them more peaceful, whereas others indicated a negative correlation because they could never let go of their designerly attitude even after working hours. Some participants linked this also to their life expectancy (9). House or adequate shelter (11) and the ability to move home (10) was mostly considered as one and the same thing, which for some had changed because they now felt they could see more possibilities in terms of where or how they could live. Participants indicated that through better being able to listen and express what they wanted they had seen a positive change in their sexual satisfaction (6), protection from violence (6) or bodily sovereignty (5). Diet (4) provided doubt for many participants, but most concluded this was not impacted specifically by design-based approaches. Choice in matters of reproduction (4), sense of safety while walking around your house (2) and ability to visit doctors and hospitals (2) were quickly dismissed by almost all participants, as these were considered aspects that are available for everybody.
4.3. Mind

Figure 7  The mind domain. The radius is relative to the number of participants that indicated an effect on that capability category. The aura around the circle is relative to the amount of mentions of this category on the panel.

All participants agreed imagination (20) had increased, also shared by many stories on the panel, rippling into all aspects of life. Through confrontation with a lot of material from many different perspectives, people explained, they were forced to be imaginative, encouraging them to always consider bringing more people in. One person also indicated it had changed from dreaming to a technique one can apply anywhere, whereas other participants saw more possibilities, looked beyond the functionality of products and were now more aware of what could be changed, also affecting their perception of the world (16), idea of a good life (16) and concept of what is right (12). In the discussion, it became clear it is a combination of how you perceive what is around you, with an ability to imagine how things could change. The results suggest also that these designers believe their reasoning (18) and ability to think (17) has changed because of becoming familiar with design-based approaches. Because they felt they were better able to communicate their emotions, ideas and perspectives, they felt their sense of usefulness (16) had also increased. Some believed their increased imagination and reasoning skills also contributed to their engagement in critical reflection (15), since in design exercises they have had to reflect on their own perspectives related to those of others, and by doing so have gotten to know themselves and their assumptions much better. This was shared by several
people who shared stories on the panel, who indicated that they learned to 'design themselves', through which they were able to find themselves and learn to love themselves more, increasing their confidence and resulting in an enhanced trust of their own creativity and ideas. Only some people indicated an effect on sense of fear and anxiety (6) and ability to sleep (7), which they linked to increased stress levels (10). This was explained by a feeling that everything can always be better, that there is always room for yet another iteration, causing some restlessness. In the discussion however they also indicated they were now better able to deal with unfamiliar, stressful situations.

4.4. Activities

Figure 8  The activities domain. The radius is relative to the number of participants that indicated an effect on that capability category. The aura around the circle is relative to the amount of mentions of this category on the panel.
Many categories in the capability domain 'activities' were influenced because of using design-based approaches according to the participants. The most important one was using your skills & talents (18), which was often linked to the category sense of usefulness in the domain 'mind'. Both novice and expert designers indicated that through offered approaches and methods they were better able to communicate their thoughts, which previously were often dismissed as weird or unfeasible, hereby increasing their freedom of expression (17). This was often directly linked to experiencing designing as more pleasurable experiences (16), with more laughing (15). Participants indicated that because design as a field is becoming more popular, their expertise allowed them to work in more places, allowing them to move more freely (16) and feeling they were doing useful activities (13). Playing (14) was considered by some to be an essential part of their design practice, whereas others dismissed it completely. In the discussion, it became clear that those who had seen a change meant solely in their work. Nobody indicated an impact on playing activities outside of their professional life, although some did feel that also participating in recreational activities (13) had received a boost. Some clarified that through their design activities they were more exposed and open to new, or alternative ways of recreation. Half of the participants believed that linking working as a human being (12) or seeking work on an equal basis (11) to familiarity with design-based approaches was nonsense, yet the other half indicated that knowing these approaches justified what they were doing, making them more valuable and respected co-workers. Only a handful felt they could participate in political and religious choices (6) more, mainly because they were already involved with these groups and now felt their ability to contribute was enhanced. Avoiding non-beneficial pain (3) turned out to be difficult to comprehend. Only some indicated that their experience with listening more intently and choosing words more carefully to get an idea across, also aided them in guiding conversations away from potentially aggressive conflicts.
Almost all participants indicated their ability to imagine another's situation (17) was enhanced through using design-based approaches, because when designing, according to the participants, you become more aware of people from different cultures, also those geographically close to you, creating a higher understanding of other people's motivations and perspectives, even without having a common language. It thus opened the eyes of some participants of how things could be different from their initial assumptions. This was usually linked to the ability to share emotions and feelings (15), because as part of designing with others, they have had to exchange emotions and identify core values of people, also improving their ability to live with concern for and toward others (13). The panel stories underscored this finding, as people expressed their empathy increased, and through identifying reasons behind people's decisions in design exercises, got better at identifying what is considered truly important. This was often combined with experiencing more acceptance by others (12). Because of existing trends to make design more sustainable the designers also indicated their ability to live with concern for and in relation
to the world of nature (15) had been enhanced. Because of expressing emotions and ideas more, many participants felt their sense of dignity (14) and self-respect (14) had improved, supported by many stories on the panels, stating that they feel like important shapers of society, trust their creativity more, and through the increased popularity of design methods are better able to explain and justify their ways of thinking and working, increasing their sense of feeling equal (8). Participants indicated they have learned how to quickly bond with those who think differently, enhancing their capability to form meaningful social relations (13) and lasting friendships (8). This also influenced their ability to feel more love and care for others (10). Sense of being discriminated against (5) was not relevant for most because they had never felt discriminated against, and despite having felt excluded in the past, they indicated labelling the former situation as discrimination would be too extreme. The ability to live with concern for and in relation to animals (2) was mostly unchanged and not clarified.
5. Discussion. Creative Exercises as a Means towards a more Harmonious Society

5.1. Most Enhanced Capabilities

![Diagram showing the most influenced categories across all domains.]

Respondents expressed an enhancement of their ability to think and reason. On top of that it came as no surprise that all interviewees indicated an increase in their 'imagination'. Using skills and talents and the freedom of expression were also enhanced. Additionally, the results suggest that being able to imagine another’s situation is also strongly enhanced through design-based approaches. All these categories were backed by stories shared on the panels. Mentioned often on the panel were also self-respect, sense of dignity and doing useful activities increasing people’s confidence and ability to tackle wicked problems in society. Participants indicated that they often now treat their daily activities as design, and that the combination of these capabilities helps with increasing trust in the future, since it enables them to see how things can be changed for the better, making them readier for change happening around them. Through intense, creative
contact with people who think differently, an interviewee concluded, we can create more harmonious living conditions.

5.2. Design-Based Approaches for Social Inclusion

In this research designers indicated that outside their professional environment their trust in the future has improved because of becoming familiar with design-based approaches. This was attributed to their ability to imagine another’s situation and sense of feeling more capable to communicate with people who think differently from themselves. They indicated they were better able to imagine, reason and think to come up with solutions and communicate those to others increasing their freedom of expression. Many respondents also reported an increased level of confidence now that they could show the value of their ideas better. If more people develop this attitude, this may enhance well-being and help community integration, as was also found in Pearce's (2016) study, leading to a more inclusive society where people feel more free to express themselves and are better at understanding differently minded people. The results suggest understanding of other viewpoints, habits, values, or assumptions can be increased through designerly ways of seeing and interpreting the world, also encouraging the inclusion of wider varieties of people.

5.3. Design-Based Education

Integrating design-based approaches into educational models might thus aid students, both designers and non-designers, to better harness tensions arising from different perspectives and explore opportunities for creativity. Ending in something harmonious, the creation of something shared by all parties increases bonding. This can have personal, professional and societal benefits as it stimulates innovation and increases understanding of people different from one another leading to more understanding, and less confusion, fear or anger. To create a better world, it can thus be argued integrating design thinking in educational models can be a meaningful step forward.

6. Conclusion

Through this research, we aimed to answer the question: 'How can design-based approaches influence people's capabilities?' There seems to be a potential good fit between using the capability approach to map the impact of design thinking. This research was based on personal reflection by designers, so more research is necessary to identify how familiarity with design-based approaches affects situations outside the workplace. More non-designers also need to be included in further research to find out what is needed to make these personal transformations happen.

Design-based approaches are not claimed to be the only or best way to improve personal, professional and societal environments, but the results do point towards a correlation between designerly attitudes and an increase in capabilities that could benefit a more inclusive society. The results suggest that people familiar with design-based approaches experience an enhancement of their imagination, reasoning, thinking, using skills and talents, freedom of expression, and ability to imagine another’s situation, as well as an increased trust in the future where many different perspectives are being valued. Based on this research it thus seems integrating design-based approaches into educational
models can contribute to people’s personal development and to a transformation towards a more harmonious society.

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Gamification of the Customer Journey at a Ski Resort

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This paper explores the enhancement of the customer journey at a Finnish ski resort and aims to create a theoretical framework for using gamification in the service design process. We have used the service design method and design tool Comicubes as a solution prototype, which ski resort workers engaged with to create a new gamified concept for its target consumers. The customer journey map provides a structured visualisation of a user’s experience at a ski resort. The customer journey enhanced through gamification creates a value-creating system for the ski resort, which presents the network of actors and their relationships that jointly create an offering. This study presents the results of a service design process for a customer journey, which goes through four stages presented in new play theory, namely wow, flow, double-flow and glow. These stages guide the designers and developers using gamification to give customers an overall more interactive and engaging experience in a real ski resort context.

Keywords: gamification, Comicubes, customer journey, service design, new play theory

Introduction
This paper introduces the Comicubes concept - a service design method that is used in our case study in the gamification of the customer journey in a productive brainstorming session with a ski resorts marketing staff and game developer. The study explores the enhancement of the customer journey and our aim is to create a journey with more engagement and enjoyment for the customer by using the concept of gamification. Gamification is defined
as the use of game design elements and game thinking in a non-gaming context (Deterding et al. 2011).

Customer journey is a visual oriented method for conceptualising and structuring peoples’ experiences. The customer journey usually starts when the customer wants or needs a product or services and will continue to the point where the product is reclaimed, redeemed or renewed. The organisation’s aim is to manage this journey in such a manner that maximises value both the customer and for the organisation. (Nenonen et al. 2008)

We suggest that by gamifying the various stages of the customer journey throughout the ski resort’s services, more consumer engagement will follow. Gamification has already been successfully used in marketing, business, health, education and tourism. (Feifei et al. 2014) The application of the game design elements in tourism is already present but to our knowledge, gamification of the customer journey of a ski resort has not been explored before.

The Comicubes tool is both a service design method and a solution prototype with many concepts that make up solutions. We suggest that Comicubes could be used as a basis for creating appearance or performance-based prototypes. The Comicubes functions as a platform, which participants can engage freely with and exhibit the key behaviours one seeks to understand in the envisioned experience.

Case Study

In Finland ski resorts offer a lot of services and winter fun in Lappish (Northern Finland) settings. Customers can enjoy well maintained slopes, efficient ski lifts and stunning views. In the resort under scrutiny, the ski season lasts more than 200 days. The multifaceted ski area is suited for children, adults, beginners and experts. In our case study, the ski resort wants to enhance its service design and make the resort more inviting for today’s customers through gamification. Using the Comicubes service design method and tool to design enhancements of the customer journey the resort staff aims to highlight the touch points, which are important for the gamification of the ski resort.

Our study tries to understand the service design of the customer journey through the concepts of gamification, and to propose a conceptual framework, which aims to evaluating how the Comicubes solution prototypes may offer implementing solutions for the ski resort.

Our research questions are the following:

- How can the concept of gamification together with a framework introduced in new play theory be used to enhance consumer engagement at the ski resort under scrutiny?
- What kind of design outcomes does the use of the Comicubes tool and service design method provide in designing of the gamification of the customer journey?

The gamification of the customer journey refers to a series of touchpoints, involving all activities and events related to the delivery of the service from the customer’s perspective. This view helps in understanding the service experience across multiple contacts but does not offer an overall view of the service structure or an integrated approach the different levels of gamification service design.
Defining Comicubes

In this study, we have used the Comicubes concept as a starting point to design the gamification of the customer journey. The original Comicubes concept consists of 24 foldable cardboard cubes with 6 sides each. Altogether, in the one-side version this makes 144 sides, and the double-sided version 288 sides of information layers to fill with either images (such as photographs) or text (letters, onomatopoetic utterances or words), or as in classical comics, juxtaposes and serial images together with text. In previous workshops as in the one presented in this paper, we are using a small number of (blank) cubes only.

Comicubes concept as a multisensory gamification concept invites the user to manipulate/rotate/organize-stack/build sequences of the parts in either random order or according to the customer journey wishes. The Comicubes, as seen from the perspective of this paper, is a solution prototype and potential implementation tool that may stimulate creativity, which allow exploration of dimensions of its gamification for customer journey. (Ihamäki, Heljakka 2016) Through a test pilot study, described in this paper, we seek answers in order to understand both the nature of envisioned concept of gamification customer journey and the processes, which evolve around it, once put into the real life context of a ski resort.

Service Design and the Customer Journey

Service design is one strong way to bring the new customer power into the design and improvement of services in a structured and productive manner. (Reason et al. 2016, 3) The goal of service design is to provide positive and meaningful experiences or interactive solutions. (Hassezahl 2010) In the service design, we can describe that creative design process can seem both frivolous and confusing at first, but prove to have massive impact on bringing innovative services to market and bringing the organization along on challenging change journeys. (Reason et al. 2016, 8) One of the methods in service design is the Customer Journey, which is the visualisation of the touchpoint where users interact with the service are often used in order to construct a “journey” – an engaging story based upon their experience. When you design a new service, you need to identify the touchpoints where users interact with the service, which is crucial and sometimes even difficult to make decision the place where you think that customer want to interact with service. Customer experience in contrast, is process-oriented including all the moment of contacts and emotions during the experience (Schmitt 1999).

Service design has been traditionally viewed as a specific stage of the new service development process (Edvardsson et al. 2000) The Customer Journey is the cycle of the relationship or buying interaction between the customer and the organisation. It is a visual, process-oriented method for conceptualising and structuring customer’s experiences. (Nenonen et al. 2008) The Customer Journey means that customer will change, that is why the model will take into account user’s mental models, the flow of interactions and possible touch points. They may combine user profiles, scenarios and user flows and reflect the thought patterns, processes, considerations, paths and experiences that user go through in their daily lives.

The customer life cycle usually starts when the customer wants or needs a product or service and will continue to the point where the product is reclaimed, redeemed or
renewed. The organisation aim is to manage this journey as maximises values both for the customer and for the organisation. Once the touchpoints have been identified, they can be connected together in a visual engaging enough to make it easily accessible to all, but should also incorporate enough to make it easily accessible to all and incorporate enough detail to provide real insights into the journeys being displayed. This means that the customers doing the journeying become far more than just names on a page. Basing the map around materials the customer themselves has produced helps facilitate empathic engagement, which is crucial for conveying the myriad emotions that most journeys are made up for. (Stickdorn, Schneider 2011, 158-159)

Service design takes the customer journey as a starting point. It describes the service from the customer’s point of view before, during and after engagement. The customer journey is a systematic approach designed to help organisation understand how prospective and current customers use the various channels and touch points, how they perceive the organisation at each touch point and how they would like the customer experience to be. This knowledge can be used to design an optimal experience that meets the expectations of major customer group, achieves competitive advantage and supports attainment of desired customer experience objectives.

**Principles of Gamification Used in Creating Social Engagement**

Gamification platforms offer complex tools for design thinking, “gamification” the term offer a shared currency across the academic and business divided, while the concepts’ process can support effective business solutions. (Herger 2012) Pragmatically “gamification” also has a growing focus of academic communication, and we are using this in our work as a dialogue with authors sharing common interests.

**Gamification**

The term of “gamification” did not see widespread adoption before 2010, when Deterding define gamification is the use of game design elements in non-game context. (Deterding 2010). Garner (2014) define gamification as the use of game mechanism and experience design to engage and motivate people to achieve their goals. He describes that game mechanics are the key elements which are common to many games, such as points, badges, and leader boards. Garner also present that experience design is the journey that players take with elements such as game play, play space and story line. Garner proposes that gamification is a method to digitally engage rather than personally engage, meaning that players interact with computers, smartphones, wearable monitors or other digital devices. The goal of gamification is to motivate people to change behaviours or develop skills, or drive innovation. That is why gamification focus on enabling players to achieve their goals – and as a consequence the organization achieves it is goals. (Garner 2014, 6) McGonigal (2010) proposes to construct games to solve real-world problems. She identifies player, while gaming to be “super-empowered hopeful individuals” supported by an environment that provides superior abilities for blissful productivity, social fabric, optimism and epic meaning. One San Francisco based technology company mentions that the core of gamification lies in increasing “…engagement and user retention by applying game mechanics such as levels, badges, quests, rewards and more to your products”. This official mission statement on the company’s website focuses on achieving business goals and influence the customers’ behaviours by means of gamified systems. In our research we
understand gamification as a concept to be used in order to motivate users to more creativity, become more active, perform more goal-oriented tasks, and create social experiences through challenges and competitions.

Social Engagement
Social engagement is the utilization of communities and support networks of users with similar interests, which users connect via the product or services site or application. Scott (2012) presents his study of meaningful play in which he described that in social engagement a change of behaviour is more likely because goals and objectives are reinforced and encouragement is provided to help accomplish tasks that will improve wellbeing. Combining meaningful play and social engagement provides a platform for users and their objective to evolve with the system while participating in a supportive and sometimes competitive community adding additional motivational factors. (Scott 2012) Social engagement can also be facilitated through discussion boards, chat spaces, and other methods of allowing players to talk to each other. Social engagement can also be facilitated through encouraging the user to connect their social networking spaces to their in-game profile, although this should not be forced upon a player. Social engagement can come through comparative scoring systems such as leader boards, players creating challenges for each other, players interacting with each other through game elements, or players working together toward a shared goal. By gamifying a system means to bring people together. These systems can tap existing friendships and social networks to encourage players to recruit others whom they already know, and allow friends to work together as a team in the system. The system can also create challenges that require cooperation to create people to work together in short-term encounters or get to know each other for longer-term engagement. These systems can also create the platform for those who are more experienced and keep them as mentorship-based relationships. (Nicholson 2015)

Gamification in Tourism
Gamification is a major trend for the coming years in tourism, which will appeal to consumers across all age demographics (WTM 2011). The application of gamification in tourism is still in its infancy which is mostly affiliated to the limited academic research discussing game design patterns and game design mechanism for service and marketing (Huotari and Hamari 2012) Motivation is a central topic in gamification as gamified systems are implemented to change customer behaviour for wanted and desirable activities. As in this case study we want to motivate customers to enjoyment and engagement of the gamification customer journey at a ski resort. Motivation in gamification uses a two-folded approach. First, extrinsic motivation focuses on applying gamified elements into a non-gaming context to stimulate external motivation. Second game thinking and motivational design has a positive influence on intrinsic motivation as it is done because of an internal desire to play (Groh 2012, Nicholson 2012) In tourism experience indeed motivating people needs a deeper approach to be successful and to encourage people into an activity, which is engaging and meaningful. As in this case study skiing and at the same time playing mobile game activities present new experiences for ski resort customers. Intrinsic motivation is defined as the doing of an activity for the pure enjoyment of the activity per se, rather than of its rewarding value, pressure or external stimulates (Ryan and Deci 2000) In tourism
gamification tries to address this intrinsic motivation by applying game design thinking in order to engage people into meaningful and effective tourism activities. Hence, companies need to have an understanding of the activity and customer journey, which is aimed to be designed as a gamified system in order to employ game mechanics in the right way and for the intended purpose. Addressing the intrinsic motivation of a customer is the most powerful motivator of gamification, as it leads to deep engagement into activities and with other people. A company’s ability to create a meaningful and effective gamified system will open the prospect of happy customers and committed employees. A well-designed gaming mechanics refers to both intrinsic and extrinsic motivation through gaming elements. One example advergames in tourism industry is “Ireland Town” from the National Tourism Development Authority of Ireland or “Holmenkollen Ski Jump” form Visit Norway. Those games are specially produced for the purpose of branding and advertisement to aim for strong recall of the game. The game gives tourists the opportunity to take advantage of special promotions or share check-ins and travel tips with their social networks. (Xu et al. 2014)

A Conceptual Framework for Gamifying the Customer Journey

Based on a continuum related to user experience in the context of object play (or i.e. interaction with material playthings) and proposed in new play theory (Heljakka 2013), we suggest that the conceptual framework of gamification of the customer journey has the following stages:

- **WOW** it is based on structured framework which organizes the wow experiences using gamification as a key phase;
- **FLOW** for each phase identifies the most important drivers as flow experiences and provide a set of the features of each driver;
- **DOUBLE WOW** provides a way of understanding how the customer who already has experienced a wow experience with the service perceives something unexpected.
- **GLOW** compares the customer experiences to what they have experienced before and gives them a pleasant memory footprint, which they want to re-experience. This means that the customer who has engaged with the service wants to come back again and again.

The stages as defined shortly above, will be discussed in more detail in the following.

**WOW**

As wow is a pleasant experience and what particular emotion we experience is depend of the underlying appraisal type. Desmet (2003) has developed a typology of emotion types that we generally experience in response to consumer products. There have five types represent pleasant emotions and three of these five are considered to combine to a wow experiences. They are pleasant surprise, fascination and desire. Pleasant surprise means that we experience surprise in response to products that we appraise as novel, both in terms of sudden and unexpected. To experience a pleasant surprise the product or service must be appraised unexpectedly and suddenly matching a concern. Fascination means that we experience fascination in response to products that we appraise as unfamiliar. If the product or service touches on our need of curiosity, we will experience the pleasant sense of
unfamiliarity that we call fascination. Desire means that e desire for product that we appraise as fit objects that call for possession. The product is appraised as a fit object because using or owning it will fulfil a goal, its design is delightful, or it expresses some desirable quality. This means that the one who experience wow in fact experiences a combination of pleasant surprise, fascination and desire implies that one who wants to design for Wow should design a product or service that is appraised unexpected, unfamiliar, promising and fit for possession. In our case the goal was to enhance a ski resort’s Customer Journey through gamification elements and prototyping with the Comicubes tool with the aim to design Wow elements at the beginning of the customer journey process.

FLOW
Flow is an optimal psychological state, which Csikszentmihalyi introduced in 1975. When a person will get into a flow state, the person becomes totally involved in an activity and experiences a number of positive experiential characteristic, including freedom from self-consciousness and get enjoyment of the process. Flow has been described as an intrinsically enjoyable state and is accompanied by an order in consciousness whereby the person experiences clarity of goals and knowledge of performance, complete concentration, feelings of control, and feelings of being totally in tune with the performance. Korzaan (2003) combines flow and the theory of reasoned action (Azjen 1991) to show that the psychological state of flow influences users’ exploratory behaviours and attitudes towards using the services. In our case we try to create the possibility for Flow experiences to occur in the Customer Journey process and design activities where customers can get completely involved and get immersive experiences.

DOUBLE WOW
In new play theory Double-Wow means that a plaything, once employed in play reveals a hidden feature which extends the ‘wowness’ of the artefact beyond the first encounter with it and wows the user again. In the context of service design, Double-Wow could mean a surprise encountered during the active use of the service, which will give the user a secondary wow experience.

GLOW
In new play theory Glow refers to user-generated value-creation in reference to a material artefact. For instance, when the player has creatively cultivated a toy e.g. interfered with its material substance in a creative and productive way, s/he has given it an added (auratic) value, namely Glow. In the context of service design, glow may refer to a lived experience that the user has contributed to personally by for example the creation and social sharing of personal content.
Prototyping the Customer Journey in the Case Study

Service design is an emerging field (Mager 2009) whose methods are still being developed and are often borrowed from related areas. The customer journey is a systematic approach designed to help organisations understand how prospective and current customers use the various channels and touch points, how they perceive the organisation at each touch point and how they would like the customer experience to be. This knowledge can be used to design an optimal experience that meets the expectations of major customer groups, achieves competitive advantage and supports desired customer experience objectives. (Nenonen et al. 2008) The overview of the customer journey provides enables the identification of both problem areas and opportunities for innovation, whilst focusing on specific touchpoints allows the service experience to be broken down into individual stages for further analysis. This structures visual presentation makes it possible to compare several experiences in the same visual language, and also facilitates quick and easy comparisons between a service and its competitors. (Stickdorn, Schneider 2011, 159)

We have used the Comicubes prototype tool in designing enhancements to the customer journey. The Comicubes concept is creative prototype tool, a hybrid combining images with a physical, three-dimensional tool. Hybridity means that the cube as physical material gets a digital layer or digital elements. Hybridity may occur in many ways in a plaything and prototyping. For example, Comicubes can get digital layer, which have QR code where you can add for sound, picture or video material. (Ihamäki, Heljakka 2016) We describe the Comicubes solution prototype as a method which users are observed engaging in planned activities around prototypes of proposed solutions. There are two types of solutions prototypes are used in this method: 1) Appearance Prototype, which simulates the appearance of the intended offerings, and 2) Performance Prototypes, which primary simulates the functions of the intended offerings. Through the observation on these prototypes, user experiences are revealed to validate or invalidate assumptions about proposed solutions. (Kumar 2013, 273) In our study the Comicubes solution prototypes are tested and validated in simulated environment ski resort area in Finland. Information is
gathered through observing the interaction and is recorded with video and taking pictures. The observations are then analysed to understand customers’ experiences and the impact they might have on proposed solutions.

We have tested the Comicubes solution prototype during a building session, in which participate five people participated. The participants are responsible for the ski resort’s services and their service design. We have started the prototyping session by explaining the theories behind service design, customer journey and gamification. After this, we have given the tool Comicubes including four blank cardboard cubes, from which the participants have been asked to create the Customer Journey for the ski resort area. The whole session took 4 hours and during the next day we recorded and analysed the developed Customer Journeys and re-designed the Customer Journey of the ski resort further.

![Figure 2 Ski resort gamification – Comicube solution prototype 1](image)

Our focus groups have used the Comicubes tool to create the customer journey through storytelling. They also make prototype of the game in ski slope, where they have designed activities familiar from game play. The main goal of the purposed session was to encourage ski resort staff to create gamification customer journey and to explore the possible engagement forms and elements of the enjoyments.

**Framing the creative space:** We prepared type of physical structures: first, diverse paper materials (cubes) that were open for multiple interpretation, like different types of cardboars, paper, scissors, glue, threads and rods. As a methodological structure, we decided to use the representation of prototype form of photograph ski resort map to serve as a basis for the generation of ideas, but we also elaborated specific critical questions to challenge the existing idea of the thinking cap to open the creative space for new design ideas. Critical questions based on places, what activities (to gamification of the ski resort area) you have to create that specific place for the customer.

**Reflection:** As a social structure, we worked as a two design teams. Both groups defined their idea and particularly their visualisation created an implicit mental structure that framed the selection of the materials for the prototyping activities. Customer journey gets
real meaning when groups present their ideas as the participants have taken into account small details which provide more ludic enjoyment for the customer.

**Result of Developing the Customer Journey at a ski resort through the Gamification Concept**

In this study we have described the gamification of the customer journey by using Comicubes as a solution prototype. The concept of gamification can be used successfully by encouraging customers to participate in activities, for example to find treasures in ski resort area. This makes the customer’s skiing holiday more meaningful and at the same time engage the customer more in ski resort activities. This case study describes the enhancement of customer engagement by exploring the customer journey by the use of the gamification concept in combination with a solution prototype, Comicubes. Results show that groups have designed game elements for the ski slope that generate social interaction, for example one exercise is that you need to solve problem with a group of people.

The gamification customer journey proposes a three-stages transformative gamification customer journey: onboarding, habit-building and mastery. The **onboarding** describes what the customer experienced before, when he begins the journey. It is stage of practice that helps customer (newbie) understand what to expect on gamified customer journey in ski resort. Game elements merge together and result into the “learn – practice – master”, that is one reason to use Comicubes as supported by compelling story of the customer journey.

![Figure 3](image3.png)

*Figure 3* Comicube solution prototype 2 shows a visualisation of the gamification of the customer journey, which ‘wows’ the customer in the first encounter with the resort’s ‘playground’.

The ski resort’s aim is to get customers to try new services. In this case study we have named the ski resort service created in the workshop as “The slope game”. The concept targets
families who want to gamify their skiing holidays. This is a unique concept planned in a Finnish ski resort, which does not have similar products or services to offer yet. The idea is to make story which lead the customer through the skiing and making exercises for example taking pictures and sharing them on ski resort’s screen.

Second state called **habit-building**, which mean that after some level of practice, that customer starts to understand the mechanics and purpose of the gamification customer journey. This means that activity loops and feedback system help him/her turn from a newbie to a regular. The customer experiences flow experiences at the second stage of the customer journey.

The third state is called **mastery**, which appears towards the end of the customer journey. The customer turns from a newbie to an enthusiast.

**Figure 4** Comicube solution prototype 3: A 3D visualisation of the gamified customer journey at a ski resort

**Conclusion and Future Research**

This paper provides a conceptual framework of using gamification in combination with new play theory in enhancing the customer journey in a ski resort by discussing game mechanisms that are applicable in the tourism industry. The Comicubes presents a solution prototype, which helps ski resort staff to enhance the customer journey through gamification. The gamification of the customer journey makes it possible to manipulate, identify, stimulate and evocate – and in this way enhance - the customer journey to invite the customer to enjoy and engage playfully with the ski resort.
The Customer Journey with using the Comicubes solution prototype method offers a systemic view of gamification service design levels and a flexible approach that accommodates the co-creative nature of customer experiences. Building upon concept and techniques from different research field, we present the Wow, Flow, Double-Wow and Glow framework which contributes in designing and developing new service models. We demonstrate that it can be effectively applied in different service innovation contexts, which opens new insights into developing new services like gamifying a ski resort.

One path of using the concepts of gamification when developing the Customer Journey is to start with unmet needs and use a light reward based layer as the tutorial to bring customer into the new service. These rewards should be quickly replaced with meaningful elements, such as Wow experiences, Flow experiences, Glow activities and opportunities to experience Double-Wow. The gamification services should be designed as layers that are create moments of authentic engagement between the participants, the external context, and the lead user groups. The goal of this journey is to present the service design customer journey with the framework of Wow, Flow, Glow and Double Wow, which all contribute to the process of detecting new needs and in ensuring that customers will get pleasant and surprising experiences throughout their personal journey which they want to share with other customers as well.

As proposed in the paper at hand, the Comicubes tool helps to tell stories about the customers’ current experiences and envision future ones, which can lead to greater customer insight and better service design concerning the Customer Journey.

References


About the Authors

**Pirita Ihomäki** received an PhD. degree from in 2015 and an MSc. degree in 2011 from the University of Turku. She is currently working as lecturer in Satakunta University of Applied Science and working also in the game industry as Digital Product Development Manager.

**Katriina Heljakka**, a toy researcher, holds a post-doctoral position at the University of Turku and studies toys and the cultures of play. Her current research interests include the emerging toyification of contemporary culture, and the hybrid and social dimensions of ludic practices.
This paper is an exploratory conversation on collaboration, shared value, ecosystems, platforms, silent designers, the unexpected and ambiguity. It is held together by the idea of evolvability and a continuous loop of creation and design. It aims to report a journey that has no real starting point and no end in sight, and while it refers to a number of thinkers, it does not subscribe to any single school of thought. It has deep foundations in various disciplines, but remains aloof of single perspectives. It has been written as an experiment, in respite from conventional formats of producing academic text. It does, however, maintain an engagement with the serious matter of creating the future of design innovation, suggesting that we need to engage deeply with evolvability to benefit from ambiguity and the unexpected. This means moving from trying to see the future into creating it, a fine task for design.

keywords: Design Innovation, Ecosystems, Collaboration, Evolvability

Foreword: On Obsessions and Failure

This paper is a dialogue, a conversation paper, an unfolding narrative and exploration, the musings of two people interested in the future of design. The wide and meandering discussion started on collaboration and ended there - wondering where are the spaces for design? Should we be looking for places where design can contribute to shared value (creation) within ecosystems - if so, how? If collaboration is a better way to create value (rather than leaving things to market forces), how can we justify the cases and how could design contribute? And is there a dark side to collaboration that goes unnoticed?

1 In line with Schön (1991) we understand reflective practice is a dialogue of thinking and doing through which one becomes more skilful.
2 A series of sessions in 2016-2017 in various interesting places over coffee and sometimes cakes.
In a world that is obsessed with high speed innovation and enamoured with the cult of the new, we as the design innovation community seem often to come close to losing our touch with reality. We strive to create lasting meaning in new products and services, only to find that in many (if not most) cases our services fail to create lasting impact, our intellectual outputs quickly becoming meaningless, our solutions are forgotten (more or less) as soon as they were introduced, and our investment in the collaborative efforts with our clients and stakeholders fails to result in longer term engagements. Widely speaking, the track record of positive transformation through design does not seem to reach the levels that designers would like, even though there are excellent examples of successful initiatives.

As organisations, we seem to be inventing but not innovating, being often incapable of diffusing our ideas and solutions to a widest possible audience, even though we invest tremendous effort into searching for (the most) novel ways of doing things. And when we succeed, it is often brand-based diffusion that is driven by extensive marketing investment made by financially driven business enterprises, often operating in and through non-designerly spaces. In addition, should we create valuable and diffused solutions for our clients and stakeholders, we often fail to capture and retain the (financial and other) added value and resources to develop our practice and skills still further.

On a personal level, we appear to travel through professional and personal encounters like ordinary psychotics that fit into the fabric of society on the surface but harbour deep and sometimes impenetrable issues and misfit between what we are doing, how we go about it, and how we should go about our engagements. Try as we might, in many cases we battle to create meaning in our engagements – and not due to lack of talent or application. Our abilities to collaborate make us social beings, but are we driving ourselves into dark corners of professional practice through this same will and skill of jointly doing things?

**A Conversation Starter: What is wrong?**

XY: What is wrong? That is a really good question. I think that the standard response, given in as many corridor conversations as there are designers, is that we are simply misunderstood, and we are not offered the opportunities to do well, our craft is not appreciated - as a discipline, as knowledge intensive service providing organisations, and as individuals that operate in the machinery.

AB: So, do you think designers should abandon all hope?

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3 See e.g. Yee at al. 2013 on transformative design cases.

4 We define innovation here as new, useful and successful. Success can be commercial or wide adoption of an idea into practice. Inventions can be useful and new, but they only become innovations when diffused widely (Koria 2009).

5 This is not intended as a critique towards profit making business enterprise, but a note that organisations are driven by very diverse overall aims.

6 The authors note that design can be both good business and a bad one. If you are paid by the hour for the value you create, you tend to be in a commodity trap, where the lowest price bidder wins. If you are the successful brand owner, design can be great business.

7 Referring to the Lacanian view, see e.g. Darian Leader (2012)
XY: No, I don’t think so...we all call for representation at the board level, attempt to justify
the value of our inputs through multiple metrics, and create new combinations of services
to create fantastic products, services and business models. But the discourse seems to be
that design is bobbing on the waves of globalisation with little direct control or authorship
of the direction of travel. Despite all the hype and the investment into the new cool,
organisational Darwinism is at play, and organisations wither away and people find other
things to do.

AB: Perhaps we are looking in the wrong direction. What if we simply do not understand
well enough the dynamics of collaboration in traditionally non-collaborative environments?
Are we trying to co-create in highly polarized environments, where relationships are based
on market transactions and not on collaborative efforts? What if the assumptions on the
importance of the human factor that the discipline, organisations and individuals carry with
them are simply not suitable for the work we do?

XY: If you say that you are essentially putting into question the validity of the whole human
factor school of thought? I mean, look at how much effort has gone into developing the
human factor discourse over the last decade and half, with the strong emphasis on
collaboration as the driving force. Together with reflective reframing, divergence-
convergence, future orientation, abductive approaches and empathy we subscribe to the
message on the user driven co-creation and collaboration as the key drivers of design
thinking and innovation. We may be assuming that our use of a collaborative toolkit (that
has been proven to unearth novel perspectives into how users, our clients’ clients and
stakeholders see and act), also forms the basis for interaction that we have with our direct
clients - would this not create shared value? In other words, are you saying that designers
may be assuming wrongly that there is a shared value basis for the interaction that happens
with clients.

AB: Designers often have a deep inner drive of wanting to make clients happy, solve the
problems of customers and communities, address the challenges facing humanity, and
make the world a better place - and they believe they have the abilities and tools to do so.
For example, service design tools are used to orchestrate brand touchpoints, improve the
user experience and offer choice, convenience and differentiation. Design Thinking is
engaged as a collaborative and participative process which can generate new ideas for
politics and societies, interactions and ideologies. There is no doubt that design
thinking workshops give us the momentary feeling that we share the same values, we have some
say in where we are going and we can make the world a better place.

XY: But are we really affecting change? Who are these people that design is serving and
making things better for – is it for all of us, as humanity, or is it really just business that
benefits? Are there cases where design tools and processes are, in effect, giving morally
bankrupt institutions an explicit customer journey map with which to dehumanize and
reduce the quality of our interactions for the benefit of shareholder value? Has the success

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8 See among others, Borja de Mozota (2006) referring to the four powers of design, or Pitkänen
(2013) on the return of investment of design.

9 To note that collaborative work underpins design thinking in many ways.
of design thinking and the short-term high of being taken seriously by business left us with a hangover and the rising awareness that design has been ‘upsold’ so as to make everyone a designer? Success does come with unintended consequences - ask any lottery winner - and this dark side of design (and collaboration) is one we would do well to at least acknowledge.

AB: Designers could start by self-reflectively researching and questioning the real intention behind a particular project. Is this intention aligned with a sense of greater shared value and a connection to our own personal values? Do we, as designers, want to align with a particular way of operating? Are (short-term) measures of success the right ones for the nature of design? Should we challenge whether (long-term) quality of life issues are even measurable? Do we align to Design (an identity and process toolkit) or design to Align (a conscious choice and intent for the future)?

10 It is also worth noting that too much collaboration can be bad for you. Too much teamwork exhausts employees and saps productivity.

Collaborating for Shared Value

XY: Suppose we do recognize that collaboration may not be the holy grail of getting things done, where does that leave the discussion on shared value? I mean, there seems to exist an inbuilt tension in design interventions between the creation of commercial and asymmetric value and the desire of the designers as individuals to create shared value and meaningful solutions in more symmetric arenas. This is very apparent in the interest that individual designers have towards initiatives that have aims to create something for the common good, doing something “meaningful” that makes a difference that we can share with each other.

AB: Is that a problem? As such the asymmetric distribution of value does not seem to be the key issue, but what value is created and by whom? What we are after are meaningful innovations that are concurrently valuable to users, organisations and businesses, the ecosystem and society at large. Perhaps individuals see value in happiness and a sense of belonging, being ecologically sound, getting and bringing value for money, while (business) organisations see profit and corporate social values as being important. The key value for ecosystems is linked to stability.

XY: So, you are saying that shared value is essentially on multiple levels and over multiple categories? How do we then know what the most important value to create is? And why

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10 Best, K (2016) Experiencing Processes. DESMA Avenues
12 Understood here as the unequal distribution of rents, benefits, profits from initiatives, usually favouring the commercial owners of the projects.
13 As a recent example, Cause2Create, was set up by a creative agency in the Hackney Wick and Fish Island design community, East London.
14 In line with the thinking of den Ouden (2011) and the value relationship between users, organisations, ecosystem and society at large.
would organisations that have been set up to create profit as their main value for their shareholders be interested in user value of the ecosystem related issues?

AB: I think that the value set is negotiated on a case by case basis. There is no single set that applies to all situations. What does apply to all of it is the need to consider value creation over multiple levels and across areas. In terms of living a good life, and how shared value could sit at the core of this, we would have to have some idea of how the creation of shared value contributes to humanity living a good life. If we frame design as a process that enables people to create shared value together, within an ecosystem, through cooperation and collaboration, then the process of design itself is allowing people to work out what their shared value is, together - what it looks and feels like and what it might means in the context of a specific ecosystem. Design then becomes a mediator of shared value and the medium through which shared value is created and communicated. It is a joint search for collaborative success - however defined.

XY: Could be. It is interesting to note that recently Bridoux and Stoelhorst\textsuperscript{15} proposed that collaborative work is more effective and more productive than work which is organised around market transaction principles. It appears that the default interaction is based on market transaction, and that creating collaboration require enabling environments - in other words pointing again to the need to have a conducive ecosystem. They also noted that collaborative modes of working are much more difficult to organize and maintain; if we go back to den Ouden (or even Moore’s earlier work\textsuperscript{16}) on value multilevel and multi-area frameworks (complex in itself) we can see why these are not easy to achieve. That being said, if you do not recognize the need for a wider framework, you will not see the path there either. But this does put us squarely back into the ballpark of collaboration as the key to create shared value. How would we go about it?

\textbf{Modelling Ecosystems}

AB: I think we really need to look at ecosystems when we start to look at how shared value is built up. Maybe go back to Moore’s early work as a starting point when he first outlined his thinking on business ecosystems in 1993. It has evolved quite a bit since then, and maybe we need to look at entrepreneurial, technical, start-up, and innovation ecosystems (to name a few). But what kind of ecosystems should we examine? I mean, we know that comparative-value ecosystems (such as the Silicon Valley) tend to emerge over time in specific locations driven by serial historical events, and cannot really be replicated\textsuperscript{17}. The industry ecosystems, such as the Apple or Microsoft ecosystem, are in turn created (or


\textsuperscript{16} See Moore’s early work (1993,1996) on business ecosystems, where the complexity was already charted. De Ouden (2011) introduced further complexity through her framework.

\textsuperscript{17} This implies that the actors must adapt to the ecosystem, and find it very hard to influence it in significant ways.
emerge) through the growth and success of central actor organizations and entrepreneurs\(^\text{18}\).

XY: I suppose one could look at the third type, the shared value ecosystems, that need a joint purpose and an understanding and may be built up on need without asymmetries, a tight coupling to a place or key actors or organizations\(^\text{19}\). In line with Bridoux and Stoelhorst, collaboration may be more efficient in creating value than market pricing alternatives, and in this case the designerly ways of thinking and doing can be highly useful in developing truly collaborative and cooperative environments and ways of working. I think there is a real opportunity to enhance knowledge on how design can contribute to the emergence of shared value ecosystems, both in business and social innovation contexts. Perhaps this knowledge can be also expanded and applied to other types of ecosystem contexts, where asymmetries exist in terms of capturing value.

AB: But where does design fit into the ecosystem discussion? While it is more or less straightforward to see the contributions that design makes to new products, services and even business models, it is not so clear how to create value with design to and in ecosystems, especially in situations which are not driven by a single entrepreneur, visionary or organization, and where there may not exist a strong history and path dependency in terms of locational advantages.

XY: Very much so. As you know, one of the difficulties in doing shared value ecosystem build-up projects in places like Egypt, Lebanon, Uganda, Tanzania, Chile, Mexico, the United Kingdom and north European contexts is related to the locality of the ecosystems. They all look different, they all work slightly differently, and they all operate under slightly different premises and leadership structures. It is very difficult to identify the mechanisms of shared value - this issue is a central one when we aim to create shared value ecosystems with business and social innovation aims. That noted, while we may not identify the shared value, could we maybe be able to create platforms that enable this value sharing, even when we do not really understand what is happening on the platform itself?

**Design as a Platform**

AB: When things are fuzzy, design thinking offers approaches that help make the world understandable to others. Maybe we need to look back to Christopher Alexander when he talks of complexity being one of the great problems in (environmental) design. His focus on a pattern language in design (kind of a pattern recognition) is a way to ‘search for some kind of harmony between two intangibles: a form which we have not yet designed and a context.

\(^{18}\) These ecosystems are characterized by the fact that value is both created and captured in asymmetric ways, i.e. central actors seek rent from the other players. As Iansati & Levien (2004) note, central actors also shape the ecosystem strongly, acting as hub landlords, extracting as much value as possible from an ecosystem without integration; or they can try to become hub dominators (e.g. Apple) and control an ecosystem. Most organizations will operate as niche players with differentiated specialized capabilities.

\(^{19}\) An example would be industry promotion organisations, start-up ecosystems, digital citizenship systems, to name a few, where central actors do not dominate.
which we cannot properly describe\textsuperscript{20}. I would argue that is an early form of a platform, where individuals can create value between themselves, within the parameters set out in the platform “pattern”. Typically, the platform owner does not, and perhaps cannot, know exactly how the platforms are being used\textsuperscript{21}. Evidently today we have shifted to predominantly digital versions.

XY: Yes, there is wide shift away from creating value in single transactions between people (sometimes called pipeline business) and towards platforms where value is created between those who operate (producers and consumers) on the platform, with a small part of benefits (monetary or otherwise) going to the platform creators (known as platform business)\textsuperscript{22}. The very format of the platform encourages shared value creation - it also allows (at least theoretically) for equitable and meaningful distribution of assets and benefits. These design platforms also need to be understood as incubators of sustainable growth and innovation in the artificial world\textsuperscript{23}. As Hatchuel notes\textsuperscript{24}, design theory cannot be restricted only to problem solving, as it is only a moment in a design process, and economic growth and value creation may result from expandable design abilities.

AB: Is design now fast becoming a platform from which, and with which, to gather insights about an ecosystem? A useful platform to collaborate, communicate, understand and make sense of things as part of the process of creating shared value within and through the ecosystem itself? If we talk about design as a platform where a designerly way of knowing, thinking and acting exists, then are we in fact offering a space where stakeholders can create shared value - and a process in which thoughtful alignment (not management) and

\textsuperscript{20} Christopher Alexander et al. (1977) A Pattern Language: an early exercise of thinking as (design) patterns, engaging also non-designers, useful when things are fuzzy, helping to make the world understandable.

\textsuperscript{21} That being said, big data and the current digital platforms do allow for significant tracing and tracking to happen. As Amrit Tiwana (2013) notes, platform ecosystems rely on thoughtful alignment of assets, and their evolution needs to be orchestrated, not managed.

\textsuperscript{22} The key difference between pipe and platform business is linked to the distinct monetization strategies. With pipe business the consumers are directly charged for the value that is created. With platforms, producers and consumers transact (e.g. Airbnb, SitterCity, Etsy); one or both sides pay a transaction fee, and often one side is subsidized to participate. Producers create content to engage consumers (e.g. YouTube), and the platform may monetize consumer attention (through advertising). In some cases, platforms may license intellectual property usage. The key question is to figure out who creates value and who one charges for it.

\textsuperscript{23} As Herbert Simon (1996) noted, economists need to have a good theory of design, proposing problem-solving as an entry point to a science of the artificial or a Science of Design (from decision-making to design theory).

\textsuperscript{24} Hatchuel, A (2002) acknowledges Simon’s shrewd revitalization of design (a subject largely neglected by economists). Simon maintained that design and creativity were special forms of problem solving while it is more likely that decision making and problem solving are restricted forms of design. Simon also had limited interest in the construction of social interaction which is a key resource of design processes. To paraphrase Hatchuel, unexpected designs of what something is can emerge from design platforms.
meaningful sharing (not transaction) are the capabilities needed. To paraphrase Nigel Cross, perhaps ecosystems have something to learn from design25.

**Platforms for Silent Designers**

XY: Fine, if we think of platforms as new ways to manage within the inherent complexity of dynamic ecosystems in design innovation, and we see platforms as true revolution26, where industry boundaries will blur as platforms reshape industries into interconnected ecosystems, who will then operate on these new competitive playing fields?

AB: As there are simply not enough designers to populate all the design platforms (nor would it make sense to do that), perhaps we need to go back to Angela Dumas and Peter Gorb when they talked about Silent Design27 as a design activity that goes on in organizations, but one which is not called design. It is carried out by individuals who are not called designers and who would not consider themselves to be designers. They also would not necessarily be aware that they are participating in a design activity. Maybe operating on platforms is about Silent Designers, the ones who are shaping the social structures of our society. But what would be the core shared value that would hold them together?

XY: I suppose we could go back even a bit further, to Victor Papanek: “All men [and women] are designers. All that we do, almost all the time, is design, for design is a basic to all human activity. The planning and patterning of any act towards a desired, foreseeable end constitutes the design process and attempting to separate design to make it a thing by itself works counter to the fact that design is the primary underlying matrix of life”28. This is the original call for the citizen designer, I suppose.

AB: Papanek also reminds us of the dark side of design in his Design for the Real World, saying that there are only a few professions more harmful than industrial design. He makes a point of linking design back to people, noting that one must engage in a socially and ecologically responsible way, to be radical and revolutionary. On another level, businesses often see humans as customers and consumers but not as humans. If they did, we would not have business models anchored in the consumer society, but in the shared value society and eventually a creator society. This is also an issue for platforms.

26 Daugherty, P (2015) The Platform Revolution. According to him, platforms are a new competitive playing field allowing for revolution and evolution: resting on the foundational ecosystem layer are the platform building blocks, rich in industry, future proof, with a service logic, and a two-sided network.
27 Gorb, P., Dumas, A. (1987) Silent design. Design Studies, 8 (3) pp. 150-156. Dumas and Gorb draw attention to the implications of how the scope and nature of ‘silent design’ could conflict and/or cooperate with formal design activity. Silent designers would generate further implications for the ecosystem and its stakeholders - the effect on the scope and nature of collaboration, cooperation, competition and conflict.
XY: What about Design for Good then? Just as there is a dark side, there is also the light one, where we can enable design platforms to support positive ecosystems of shared value, shared meaning and meaningful creating and sharing of value. After all, design is a shaping force, and as design platforms are open to all one can expect a range of approaches to design emerge and shape the world, mostly in piecemeal and organic approaches. In his patterns that define towns and communities, Christopher Alexander would see piecemeal as good!

AB: On a completely different level, we will also see artificial intelligence operating on these platforms (they already are in many ways) producing design solutions of sorts. It is a possibility that AI will undermine many aspects of design. But is this good or bad, and does it make designers fully redundant? Will the machinery learn the designerly ways? And how will they contribute to the creation of the unexpected and the new? Perhaps this will herald a new age of designer humbleness (today’s designers are not often educated for that!). It may also be that even darker clouds are in the horizon. Whatever is coming, part of it will be unexpected.

**Design and the Unexpected**

AB: An aspect of a design sensitivity and designer sensibility as human traits is how it connects to creativity, intuition, thoughtful alignment, being evocative and ultimately being human. People do not always use reason to make decisions, not all problems can be solved rationally and not all opportunities can be identified methodically. There will always be space within platforms and ecosystems for emerging unexpected stories and new lateral solutions to messy problems and complex situations.

XY: Management-led approaches seem to thrive on clarity and often view any lack of clarity as something that will lead to confusion. But there are other places that a lack of clarity can lead to: opportunity. How could design trigger more unforeseen opportunities and unexpected solutions from within platforms and ecosystems - things that could indirectly solve (complex) problems and create shared meaning and shared value? In the case of messy, problematic situations, Donald Schön talks about the application of reflective practice (by practitioners) to make sense of uncertainty in the search for an epistemology of practice, implicit in intuitive artistic processes.

AB: Is this an opportunity for designers to engage and even create new tools and processes that trigger this more lateral and less precise way of problem-solving and opportunity-finding? De Bono and lateral thinking comes to mind, but going further, there could be a place for random chance as a process that could inform a much more dynamic application for design. An interesting example of this is Oblique Strategies, a set of cards which began life as a collaborative act of Brian Eno and Peter Schmidt. The strategies present themselves as questions that are intended to jog the mind and ‘defeat creative block’. Their story is that

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29 This is well under way in social media platforms.
30 Some would argue hardly ever.
31 Which are all of the major interdisciplinary issues in the world today, such as pollution, security, welfare, poverty, health, and sustainability.
they both discovered they were using similar processes to solve similar problems in their work. They both kept a set of basic working principles which guided them through moments of work pressure. This pressure of time tended to steer them away from the ways of thinking they found most productive when the pressure was off. 33 Brian Eno’s reflective insights were that addressing problems head-on, in an obvious and rational way, is not always the best way to get results. The Oblique Strategies offered a ‘set of possibilities’ and a tangential way of addressing a problem that was, arguably, more interesting.

XY: For ecosystems and design, could this be a way to engage a non-rational (and non-linear) strategy to uncover unexpected possibilities? Are we in fact talking about how design could help us identify the opportunity in ambiguity, and could we view ecosystems and platforms therein as being filled with unexpected possibility? The key question may be linked to the ability to make systemic non-rational (and non-linear) sense of the situation to uncover unexpected opportunities. Perhaps this is a task for artificial design intelligence? Moving from random generation to generating from the seemingly random. Embracing ambiguity.

**Ambiguity as a Resource for Design**

AB: Seen from this perspective, we could consider an ecosystem as being saturated in opportunities to compete, cooperate and collaborate in unexpected ways. They are dynamic and interdependent by nature, often incomplete and messy, and for particularly challenging ecosystems, mutual survival is certainly a shared value. The design platforms could help us to make sense of the ambiguity and bring the unknown unknowns of the future to the realm of the knowable.

XY: There are many examples of designers working in challenging and challenged environments with what just happens to be around them. For example, frugal innovation, working with waste, saving resources, essentially eliminating design. In many ways, the position of Margaret Bruce and John Bessant34 of design linking creativity and innovation is still there. Creativity will always be needed, and innovation and design are converging in many ways, when design is increasingly done by people who do not have a traditional design education - innovation activities have been typically undertaken by a wide range of people in organizations.

AB: Designers work pretty well when faced with rather vague circumstances and incomplete information. A blank sheet of paper is not a scary encounter for a designer - it is an empty space (and platform of sorts) that holds the raw resource of unlimited potential. Situations that suffer from a lack of clarity can also hold latent possibility if one views things with an open mind-set. In Ambiguity as a Resource for Design (Gaver, Beaver and Bentford 2003) present ambiguity as a resource that can be used to encourage close personal engagement with systems.35 Ambiguity is not a problem, but an opportunity - intriguing, mysterious, and even delightful. By having people themselves interpret situations for themselves, they are made to grapple with systems and their contexts, creating a personal linkages and

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Similarly, Aoki and Woodruff refer to making space for stories and identify the importance of ambiguity as an important resource for resolving social difficulties, specifically in the context of personal communication systems and face-to-face social interaction. They also recognise that social relationships evolve and change.

XY: For ecosystems, does that infer that as people collaborate and create shared value within and across organisations, through design or otherwise, they get to know each other better and the relationship evolves out of ambiguity? This presents another dark side of collaboration pointed out by Cross, Rebele and Grant: that the people regarded by colleagues as the best information sources and most desirable collaborators have the lowest engagement and career satisfaction scores. They refer to this as being in demand yet disengaged.

AB: So, if designers are too good at collaborating, it just might create another set of problems for them?

XY: Maybe designers need to learn how to move away from collaborating with colleagues who keep telling them how great they are, while possibly taking advantage of them and their desire to do good. You know, be aware of intentions behind agendas and evolve how they work in the face of apparent success.

**Design for Evolvability**

AB: Ecosystems will change, people and places will evolve, platforms will be used for testing ideas and, inevitably, meaning and shared value may change in the face of shifting relationships and circumstances. This is of course completely normal and it is what keeps localities dynamic as they adapt and evolve. If we want ecosystems to be meaningful systems of shared value creation, then we must let the meaning and shared value of the ecosystem be free to evolve - outside of any business agenda for a clearly defined value-creation strategy. This does not mean that the shared value would not allow business organisations to do well, just as it would have individual people, ecosystems and society at large benefit, it just means that single agendas will not create meaningful innovations.

XY: Are we thus saying that the glue that makes it all stay together is evolvability? As I understand it, Design for Evolvability (DfE) is about designing evolvability into a system, and just like ecosystems thinking, it has deep roots in biological and social sciences. If we wish to enable evolution in man-made systems, we must design these systems to allow for the evolution to happen. In today’s world, we tend to design static solutions that may fill the needs today, but require extensive resource inputs to make them adequate for the world of tomorrow. That’s a bit silly in many ways, especially as there is intelligence embedded in

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36 They present three categories of ambiguity: ambiguity of information finds its source in the artefact itself, ambiguity of context in the sociocultural discourses that are used to interpret it, and ambiguity of relationship in the interpretative and evaluative stance of the individual.


the system. It is recognised that value in the future is driven by intelligent technologies, and we are still designing static systems.

AB: Yes, the concept has been borrowed from the original domain of real-time software architecture and design in complex systems, addressing the capacity of a system for adaptive evolution. Systems exhibit the need to evolve and therefore we should be designing and testing for evolvability, building them with an eye towards being amenable to future extensions and modifications; this requires both effort and resources. If the system itself does not have the needed evolvability, this adjustment, growth and adaptation becomes very difficult and future proofing impossible. Another matter are the legacy systems that exist today - somehow we have to also think about the evolvability of legacy systems. Should we strive to retrofit evolutionary capabilities?

XY: This would mean that we would have to move from foresight to forethought; from the intelligent system to the unexpected system; from holistic to piecemeal; and from design thinking to design platforming (design patterning). In a way, moving from trying to see into the future into actively creating it. This does have implications in terms of how we think and do, and it requires a firm belief that we can shape our future in ways which create shared value. And on another level, we should move from sense-making to sense-creating and from recontextualising facts to factualising concepts. Besides design professionals, this evidently needs to involve silent designers in the search of shared value.

Why is this interesting?

AB: I believe it’s the evolvability that is the driver of innovation at the end. When we started our chat on collaboration we were imagining that it is the shared value that is the ultimate reason why we want do things together. It is an important reason, no doubt, but at the end it is the ambiguity that drives evolution, and shared value is the result of the unexpected solutions emerging from ambiguity. And the unexpected are those opportunities that cannot be found or identified through linear, rational models. We need the ambiguity, we feed on it.

XY: Are you then suggesting that we will not develop beyond the current paradigms unless we really embrace the idea of evolvability? Seems to me we are in loop where designers act on many layers and positions, driving the engine of ambiguity? We know that ecosystems are a major source of innovation (business and social innovation) and design platforms contribute to shared value ecosystems. What is unexpected in this is that we argue that the

39 Some definitions of evolvability include Percivall (1994): ‘A trait of a system that allows the system to be easily modified due to changes in the environment’; Rowe and Leaney (1997): ‘A system’s ability to withstand changes in its requirements, environment and implementation technologies’; and Christian III (2004): ‘The capacity of a system to successfully adapt to changing requirements throughout its lifecycle without compromising architectural integrity. Furthermore, an evolvable system must meet the new needs of the customer in a more cost effective manner than developing a new system’.
silent designers are important as they help to create the unexpected. Which ends up being the truly valuable piece in the puzzle.

AB: Locality is important also, how an ecosystem develops and where it is – it is not a blank page – it is dynamic, a complex system with context shifts and shifting content created holistically and piecemeal. System evolvability is therefore connected to thoughtful alignment, not management. System evolvability is also the dynamic that powers the ongoing process, and keeps it in motion. Human ecosystems are dynamic and intelligent, but they are also inherently unstable and can disappear and be replaced by other ecosystems.

XY: Does this then mean that when we are looking at what comes after product, service and business design, we should look at evolvability? As I read it, we would then be concerned at the skills and abilities of creating concepts from ambiguity? This could mean a mix of products, services or operational and business models, operating or being prototyped on platforms in ecosystems? They could be tangible or intangible and they would have to create shared value on multiple levels and in multiple areas.
AB: Yes, and the key ability for the designer of the future is to ensure the evolvability. What this means in practice is the skill that one needs to develop are around, for example, thoughtful alignment (and not so much management) and thoughtful leadership\(^{40}\) (as opposed to thought leadership).

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\(^{40}\) According to Cathy Higgins and David Kreisher (Higgins Kreisher and Associates), the high degree of mental and emotional agility demonstrated by thoughtful leaders helps their organizations respond to extremely dynamic situations.

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Design emergence in Morocco as an African country: a pending institutionalization.

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If design management is worldwide institutionalized especially in developed economies, little is known about African design even though the continent is becoming an attractive economy thanks to his exponential growth and more political stability. Oriented toward one specific country: Morocco, this study through a questioning embedded in institutional theory brings an overview about design in a specific context. This research captures design management emergence in Morocco by spotting the light on the state of design institutionalization toward the creation of design value.

keywords: Design management, institutionalization theory, Morocco, Africa

Introduction
Design management as a reference to the business side of design, shaping strategy, process and outcomes is gaining today more recognition as a practice and a discipline able to enhance innovation, growth and sustainable development. Furthermore, the value of design management for worldwide organizations is today established (Mozota 2003); (Cooper & al. 2013); (Buchanan 2015)

Nevertheless, if research shows logical interest about developed economies as design emerged in those economies, little is known about design in other parts of the world. An overview of the main research on design history such (Walker 1989), (Doordan 1995); (Burdeck 2005) Margolin (2005), shows that Design in Africa is little studied.

However, there is an existent research related to countries out of the circle of developed economies. A close look at this literature, highlight an approach shaped by a pioneer dimension and the perspective remains, for instance, an initiation discovery.

Correlated to Africa continent, under our knowledge, design as, management, cultural heritage, industrial, education, and research remains unknown, nevertheless South African research under engineering and technology perspective\(^1\). The mentioned research mentioning “third world” classification reveals that the issue is little studied when it relates to the Africa continent. The same perspective is endorsed by Margolin (2005).

In the other hand, approaching not developed economies bring on the surface the challenge of country taxonomies economies. Shall we speak about a post-colonial country, third world, emergent economy, new industrial country, emergent market and so on. Any classification here encompasses criticism, debate and political stance. The countries labelled “third world, post-colonial (Dirlick 1994), differs in their sizes, political regime, economic performance, cultural backgrounds and historical experiences (Tomlinson 2003) and even Africa as a continent made up of 54 sovereign states, presents globally huge heterogeneity because of geography, political regime, economy, religion beliefs and social factors.

For instance, out of the African geography classification, framing young country as South Soudan which gains independence in 2011 and Nigeria as an OPEC petroleum producer with a population about 186 Million, is obviously a challenging task.

Under this consideration, related to design issue, our assumption here lies in the fact that research encompassing specific countries “third world” “post-colonial”, “newly industrial” remains methodologically awkward.

However, another classification presenting significant structural transformation framed this time on market dimension (Luo and Tung’s 2007), appears more inclusive as the focus is on a specific market where designerly goods are brought to the user.

The context of Africa is today significantly different from the past. The continent is on a new path development thanks to important advances in economy and governance, breaking from a past dominated by wars and starvation which makes the continent a huge potential market.

Mc Kinsey report 2016 on Africa “Lions on the move 2” mentions that by 2025, the continent will benefit from strong fundamentals as young and growing population, which contrasts with aging population in the other continents. Urbanization rate in this study is considered as the fastest in the world, and technological change is beyond an important

\(^1\) Cf. The international conference on design, development & research hosted by faculty of informatics & design cape peninsula university of technology, Cape Town, South Africa
acceleration. Rapid growth in consumer markets and business supply chains is then expected, which drives huge opportunities for national and international investors. Related to design, it’s important here to mention that the World Design Organization (W.D.O.) formerly known as the International Council of Societies of Industrial Design (I.C.S.I.D.) appointed for the first time an African president issued from South Africa. However, as an economic classification, the perspective chosen here is “emergent market economy” and “Global competitiveness index” taxonomy developed by the world Economic forum (Schaw 2016). It brings flexible approach and underline the transition concept meaning that an economy moves from a state to another one under specific fundamentals. Under this purpose, Morocco is classified as an “emerging market economy efficiency-driven”

At this point, the current research humbly aims to bring an overview of design management emergence within a specific African emerging market which is Morocco. The issue highlighted here could be defined in these terms: how design management value is emerging? What components facilitates this emergence and what obstacles prevent more accurate design management presence?

![Figure 1 Global Competitiveness Index WEF 2016](image)

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Morocco: an overview

As far as design issue is a matter of research investigation, a dedication to one specific country emerges with more pertinence, therefore we address here Morocco as a country. Related to this grid, Morocco appears as an efficiency driven economy, the idea of transition is relevant thanks to the context of globalization and fast change brought by the digital economy.

Situated on the western tip of North Africa with population about 33 million, the country contains a mix of indigenous Berber, Arab, African and European influences. Since the 17th century, the country is under the same monarchy. In his history, the country has faced French and Spanish colonialism for 44 years (1912-1956). A constitutional monarchy with an elected parliament enhances a global political stability.

According to Oxford Report on 2015, the country presents a pragmatic and inclusive approach to social and economic development as the kingdom is reliant on imports for energy products. Diversified GDP mix around tourism industry, textile production, high-end manufacturing for automotive, aeronautics industries, solar energy, IT services drives in this context the economy. The kingdom is increasing cooperation with both its traditional European partners and new markets across Africa.

Theoretical Background

In Management and organizational theory, the notion of emergence is crucial as it establish management good practice and research path toward best management (Johnes 2001)

Related to this idea, institutional theory (DiMaggio & Powell (1983); Scott (2001) brings significant tools and a frame for studying and taking the value of new ideas, new practices toward better goals achievements.

The framework offers a broad perspective of the three dimensions of institutional theory to help for understanding how design may create opportunities and economic value within a specific environment. Fundamentally, institutional theory has proven to be an appropriate framework for understanding complex environment, fitting emergence of new practices.

Scott 2001 advances the idea that isomorphism is the processes by which structures, including rules, norms, and routines become established as authoritative guidelines for social behavior in a society or environment.

DiMaggio and Powell (1983); Scott (2001) defines isomorphism through classification into three major ideas: regulatory (coercive), cognitive (mimetic) and normative. The coercive isomorphism admits that firms are forced to adapt to some practices by the legal regulations developed under institutional settings; mimetic isomorphism is defined as firms copying some specific organizational practices associated with success from other firms; and normative isomorphism is where subnational institutions and social actors act as disseminators of best practices which are adopted by firms under the influence of social actors in their environment.

Institutional theory perspective is here questioned for the study of design management emergence in Morocco as an African country. However, by questioned, our intention is
rather than just bringing an overview about design in Morocco is to confront design emergence to the question of institutionalization.

**Methodology**
To respond to the problematic statement highlighted here, a qualitative documentary study was conducted, tracking what is relevance to design management with the idea of observing design interaction under institutional theory perspective. The author as a scholar in design management in B-School observed facts, attended events related to the question of design in Morocco and even organized public conferences related to the question of design, being in this perspective, naturally a normative isomorphism actor toward a design institutionalization. Informal discussions with designers were conducted as the researcher is perceived by designers themselves in Morocco as an adjuvant toward an establishment of design as a strategic asset for the organizations. This ultimate consideration drives us toward introspective analysis by the fact that we are for instance part of the process of the institutionalization. (Wood 2015)

Considering design under the scope of emergence, the perspective will investigate the question of design education emergence before analysing the role of designers as key players and the structure of design output as a product and a service. The main objective here lies in the idea of figuring out how design is emerging at a certain degree regarding the institutionalization.

**Findings:**

*Toward normative isomorphism: Design Education landscape*
Education is a central issue for questioning the emergence of design, nevertheless, the craft as a cultural heritage is fundamentally a starting point. Through design history even the interaction is a kind of “Dangerous liaison” (Lees-Maffei, G., & Sandino, L. 2004), craft is obviously a territory from where design is emerging as it occurring in Morocco.

*Craft local heritage as a Moroccan Design Background*
Design History since the experience of Bauhaus and design emergence in Europe demonstrates that original craft is the background from where design arise (Itten 1975). Observing then craft as a practice and an industry brings an idea about the possibilities for an emerging design value creation.

Morocco as a country at the intersection of Europe, North Africa, and west Africa, benefited through history from multiples sources and cultural influences which shape strong crafting industry.

Related to this idea, isomorphism process is initiated by the fact that industry plays important role in the local economy landscape. Socio-political pressure drives then different governments to establish a ministry dedicated for this purpose since the country independence in 1956. Since then a conflictual logic is observed when the government is dealing with the craft industry.

Former ministries have integrated the craft to industry, tourism, fine arts, solidarity, employment, finances, air transport and social economy. The latter remains relevant upon
the fact that craft is up today a key factor in social employment. Revenues in 2014 calculated by
the ministry are More than 2 Billion U.S. $ with 7.5% growth per Year. (Ministry Report 2014)

A close look at the industry organization highlights a discipline taxonomy defined as pottery, stone, carpets, wood, wrought iron, basketry, leather goods, traditional clothes, shoes, dinandry, and jewels. More than 400.000 urban and rural artisans were identified. (Ministry Report 2014) This point explains the mention of “solidarity” in the naming of the ministry as artisan jobs inside a young economy are tinted with precariousness and low incomes.

Nevertheless this perspective, a sensibility toward design is emerging. The ministry specifically through his institutional communication, mention design in his interaction with craft, through a regional program bringing to craftsmen a products catalog created by designers as a guideline fitting some contemporary trends.

In March 2017, just before leaving her seat thanks to a new government elected, the actual ministry, with a support coming from an art foundation issued from a corporate company, approved a two-year agreement with an American design school. The objective is defined as a craftsman initiation to design discipline under a specific goal: increasing Moroccan craft industry penetration in the American market.

Under the institutional theory, observation identifies that the logic of craft consolidation under ministry institution, generates an action appearing as a normative isomorphism with the potential of building a coercive isomorphism. If the experience delivers an expected measurable success, multiplication of agreement with international design schools could play a significant mimetic isomorphism in an idea to increase exportation toward a specific market.

On the basis of craft coercively institutionalized under ministry work institution, it’s important to observe this time the context of education by spotting the light now on a specific craft education school.

“L’Académie des arts traditionnels” : A Moroccan Bauhaus?

In the context of craft as a fertile design background, it’s important here to mention the experience of a school dedicated to Moroccan craft education. The construction of the Mosque Hassan II at Casablanca city considered as, one of the six biggest in the world, brings to the light the richness of Moroccan craft and the fragility of the knowledge when craft masters retire without knowledge transfer to disciples.

Following the construction, a foundation depending on the mosque and the government initiates on 2013 the foundation of a public school dedicated to craft arts. The school mission is to contribute to give Moroccan traditional arts an essence and bring it into the area of knowledge through 3-year period education. The curriculum is divided into disciplines is defined as Wood Art, Calligraphy Art, Metal Art, Tapestry Art, Leather Art, Traditional interior exterior art (Zellige tilework, plaster, stone art) and Wood Art. The school gets his 1st graduated promotion in 2016.

For instance, it’s too early for getting a big picture about the effect of these graduates on design, but students interaction with multiple disciplines, through the exponential alumni
graduates, could let them play a key role in shaping future design value creation, inspired by the richness of the local heritage.

In this perspective, it’s interesting to observe similarities with the German Bauhaus experience, as the combination of several applied arts in one specific place, generates new thinking and new interactions leading to design emergence in Europe at the post world war II era.

As the school is government funded, which means that sustainability is granted, it’s conceivable to assume that future alumni work could be significant toward design value institutionalization at a cognitive and normative isomorphism, but right now, for instance, there is no institutional isomorphism logic interaction with industry highlighting design value. This point brings to the discussion design education at design schools.

**Design schools**

Related to design school, specifically, the foregoing discussion implies that mentioning the existence of three private schools stating that design is at their core curriculum is done regardless of their education quality.

The first one is “Artcom Ecole de design” created in 1988. The mention of design is assumed in the naming. The school states on his website that it’s a “Cumulus” member, in reference to the international network of design education schools. The official discourse extracted from the website emphasizes interior design and graphic design as the core school curriculum.

The second one is ESDAV (Ecole supérieure de design et d’arts décoratifs) created in 2006, the school develops in his discourse the idea of design at a strategic level.

The third one named (ESAD) was created just two years ago (2015) “Ecole des arts appliqués et de design” the particularity of this school lies in the fact that the mention of design seems to be understood at the strategic level. To advocate for this idea, the school mentions an international Moroccan designer as a sponsor for advocating design as a game changer in the economic landscape.

However, it’s important here to mention that two Moroccan Public School of arts with high selectivity at the entry: “École Supérieure des Beaux-Arts de Casablanca” and “Institut National des Beaux-Arts de Tétouan” provides design curriculum to their students.

Specifically, Casa Moda Academy, a public-private school created in 2008 dedicates itself to fashion design.

In this perspective, related this time to Business Schools, Esca Ecole de Management provides Design management, design thinking courses and initiates also partnership student exchange with a top ranked French Design School.

This overview of design education landscape states here that the background for the emergence of design value in the Moroccan economy at a strategic level exists from the education perspective, nevertheless, there is no logical isomorphism toward a design education institutionalization. Even, the indication of competition in an idea of mimetic isomorphism is deficient. There is overwhelming evidence that actors of design education are obviously young. A minimum of a decade seems necessary to observe the institutional dynamic logics toward institutionalization. Nevertheless, if design education exits at an
embryonic state, the consensus view seems to be that Moroccan designers are establishing the foundations for design management emergence.

**Toward Normative isomorphism: Design and designer’s emergence**

**Designers emergence**

As a post-colonial country, Europe proximity and historical openness and influences, several designers educated in worldwide school from the Moroccan Diaspora plays today key role in the emergence of Moroccan design. Thanks to their international visibility, they provide unique vision to different stakeholders about the strategic value of design in an idea of spreading design value, as all designers worldwide act.

In this context, Moroccan designers get a federation called “Fédération marocaine du design et du design industriel ». Since 2010, the organization is opened to all African Designers. The logic is to embrace the Moroccan new economic and geopolitical context in interaction with other African countries. As stated by African Bank Development, 85% of Morocco’s Foreign Direct Investment are right now targeting Africa.

The organization goal is to establish a link between designers, entrepreneurs, and design consulting agencies. According to his international designer it counts approximatively about 70 Moroccan and African designers and aims to establish concretes interaction and projects with the General confederation of Moroccan companies: the local employer organization. The output is local designers work exhibition and design activism toward the employer organization.

If designers emergence at the local context is significant. A nuance should be brought here as a factor reducing for now the institutionalization logic development. As design is not enough understood at a strategic level within local companies, the market is automatically reduced for designers working under consultancy mode. This issue increases badly competition rivalry among designers when this rivalry is expressed toward stakeholders in the state of design value initiation discovery. The mimetic institutionalization isomorphism is then slowed down. However, the main driver logic toward a design institutionalization remains the artifact and designers output.

**Design output emergence**

Following designers emergence as patricians, the purpose here is oriented toward designers outputs. In this context, two events: Africa Design Awards and Africa Design days plays a significant role as a normative isomorphism. Initiated by the same social design actor mentioned above, these events more than only Moroccan remains extended to the whole Africa continent. These events by spotting the light on talented and specific designers, highlights the results as design outputs to the public and stakeholders, showing the possibilities of design value creation. The web platform is dedicated for this purpose, in an idea of spreading Moroccan design work and African design creativity.

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3 Hicham Lahlou designer
Design output is crucial toward more accurate design institutionalization. Upon this consideration, design for public services and especially urban design gives the opportunity to observe design value at a large scale.

When the project of the largest cable-stayed bridge with a length of 950 meters of Morocco capital was initiated, the project of a canopy roof for the Tolle station expecting 20,000 vehicles per day was entrusted to Moroccan designer in collaboration with an architect.

The valuable idea here lies in the fact that an architect can make the canopy without the need of a designer, but hiring a designer was disseminated in the call of tenders by the government thanks to one specific person: The Highway CEO which appears to be aware of value design in an urban space.

Designer project through a specific concept challenges then architect work and brings specific value to the project. The designer concept was canopy taking the form of M as the first letter of the word Morocco. Getting a canopy with this specific form was a huge constraint and challenge for the engineers but it ends with an original canopy bringing significant value to the project.

This experience unique at the scale of Morocco and Africa brings a specific perspective and vision to design and architecture collaboration and provides a design reference to a
specific urban design in an emergent country, which enhances cognitive and normative institutional isomorphism.

Figure 3  Urban design emergence through Canopy designed by Hicham Lahlou designer

A Significant design emergence story in Fashion Design
When a holding family business company initiates a move toward fashion industry, a young CEO observes that traditional garments were never explored toward modernity. By hiring a young and talented fashion designer working on blurring the lines between modernity and tradition, the success was there. Moving from one store in 2002 to more than one hundred in 2017, the sales approximatively moves from one million $ to 10 million $ demonstrating by numbers how design can bring value. Under the branded name “Diamantine”, the company is still expecting growth. This specific story is expected to play a mimetic isomorphism when design will be understood as not specific to fashion among stakeholders.
A Significant design emergence story in product design
Related to products, the main designers took as inspirational source the background of Moroccan cultural heritage. Bringing to the light a unique design expression, companies from the west with design culture finds a new way to rejuvenate their creations.
In this context, a designer used Moroccan traditional patterns to create new products as a sofa used by Hollywood blockbuster movie and shoe shelf by luxury Italian shoe company. Thanks to international branded success, a mimetic isomorphism is expected under these creations.
Finally, designers work and the creation of network organizations appears in this context as big steps toward design institutionalization. However, the rhythm of these actions may appear slow, thanks to the obstacles inherent to the blurry vision that may get managers when they are not introduced to design management as a strategic value creation and the limited size of the market inherent to a new industrialized country. But, the work made here by designers, if it initiates a mimetic and normative isomorphism is still actually not sufficient toward better institutionalization.

**Leveraging design through intellectual property: regulatory isomorphism**

An interesting experience involving a partnership with public and international institution brings significant output enhancing at this point design institutionalization as regulatory isomorphism.

The first one is a national public institution which is the “Moroccan Office of Industrial and Commercial Property”: OMPIC reporting to the Ministry of Industry, Trade, Investment
and the Digital Economy. As a mission, the OMPIC oversees industrial property protection (trademarks, patents, industrial designs). The idea underlying this institution mission lies in the fact that intellectual property protection led to a better economy performance.

The second one is the international World Intellectual Property Organization in Geneva (WIPO). Through a pilot project launched by WIPO, two countries were chosen Argentina and Morocco to promote awareness and use of design-led strategies using intellectual property rights among small and medium-sized enterprises (SMEs). Morocco was chosen for this pilot experience and partnership with 26 selected companies was done. This project called “Namadij” implemented in 2016 was a success and unique experience showing that design could be leveraged within an economy through knowledge dissemination within creative industries. The benefit lies in the fact that it unlocks the creativity of companies by teaching them how to protect their creativity as an asset. Through coercive aspects inherent to intellectual property toward companies at the intersection of design and craft, the potential of design value is conveyed to stakeholders as an asset creator of tangible value. This experience as unique remains a significant first step toward a coercive isomorphism favoured by intellectual property principles.

**Obstacles toward better design institutionalization**

If a relatively background exists toward design institutionalization emergence, strong obstacles remain as a brake slowing down the process. These obstacles could be defined here in 5 points:

- As the market for design management naturally is emergent itself, competition between top designers could be fierce essentially on projects under prestige consideration, which brings to the front a rivalry when criticism over one designer philosophy work is constructed under rivalry. This discourse criticism toward one stakeholder discovering design or unaware yet about design value could blur and shape the wrong perception about design value creation. Informal exchange with designers demonstrates to us the existence of rivalry among leading designers.

- Our introspection thinking here led us to the idea that an existing rivalry in the context of design emergence could damage the comprehension of design. At this point, Morocco as an independent post-colonial country is French speaking, the word design is understood widely as a French word conveying an idea of superficial work in home interior rather than conception of artificial artifacts. (Krippendorf 2005) Despite the use of Arabic word “Tasmim” fitting more the English meaning, the word design in French-speaking conveys, unfortunately, an idea of decoration in the Moroccan context.

- The youth of design education institutions prevents them for more larger influence at a normative level. As mentioned above one of the school design cited was created in 2015! Decade or two are necessary for a wide normative and cognitive isomorphism.

- The weight and predominance of craft industry if it’s a fertile background for design creativity, the old perception dominates the perception even in the eyes of an official ministry dedicated to craft.

- The WIPO initiative with the partnership of Ompic demonstrates through the 26 companies selected that creative industries are unaware about design value and
intellectual property protection competitive advantage. A huge work is expected then toward SMEs working in creative industries.

- Lack of government institution dedicated specifically to design promotion as U.K. Design council for example.
- Lack of academia research in design management field, unfortunately, the author is the only researcher in the field within Moroccan academia.

**Conclusion**

As in the rest of the world, design management is emergent in Africa. In this research, we spotted the light on an African country Morocco.

Through institutional theory, a normative isomorphism was observed through a design educational ecosystem who shows a particular component. This characteristic is expressed by the existence of public art school showing similarities with the Bauhaus design school experience. As craft industry plays a key role in the economy of the country, graduated are expected to become designers with distinctive perspective.

Design value emergence appears then tangible in cognitive and normative isomorphism through top designers from the Moroccan diaspora graduated from European design schools. Nevertheless, the progression of design emergence remains slow thanks especially to the characteristic of an emergent economy.

At the regulatory isomorphism level, design value awareness regarding intellectual property and through an international project is contributing to the emergence of design in this specific country.

Nevertheless, if obstacles to fastest design emergence are important, upon institutional theory, the three isomorphisms are undeniably in a pending state. A decade or more is needed toward shaping the future of design management in this African country thanks to multiple normative initiatives as the upcoming world design organization event Design talks organized for the first time in Morocco. An upcoming research, up to five years could bring new insights able to bring better understanding of design emergence in this part of the world.

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Nabil EL HILALI is a professor Researcher at ESCA Business School Casablanca. In a transdisciplinary perspective, he holds Ph.D. in management Science from Audencia Business School / University of Nantes and Ph.D. in Humanities and Social Sciences from the University of Nice Sophia Antipolis France. Author of a Ph.D. dissertation on design in its interaction with branding and marketing management, his research focuses on the management of innovation, branding management and design thinking. His current work currently focused on African design management and design thinking as driven innovation, he is an international reviewer conferences on design.
Novelty and value are two key features of any type of innovation and have consequently received much emphasis in design and innovation studies. Lately, the predominant unilateral emphasis on novelty has been questioned in an emerging literature stream focusing on the role of tradition in innovation, and recent research has shown that a potential way of creating value is to use a combination of novel and traditional components, resulting in what is suggested as design innovation dissonance. Drawing on research through design, this paper develops the writing of production novellas from the design of three different design innovation processes, the deliberate use of tensions between novelty and tradition in material, form, manufacturing process, context, and history is described and analysed, in order to unveil explicit steps of the design process.

keywords: design, innovation, tradition, dissonance

1. Introduction

Two common denominators of most proposed definitions of innovation are novelty and value. That a specific product, service or process provides value to someone distinguishes it from a mere invention, which may constitute a new or improved functionality, but not necessarily a value. Moreover, the value of a new product to a customer or a user is not merely a matter of functionality, but is fundamentally a subjective perception that is influenced by information about a product’s origin, design, brand, etc. Novelty has this far
been seen as less problematic to observe and evaluate, but in recent works the unilateral focus on novelty in innovation has been complemented with studies underlining the innovation potential found in tradition. Based on studies of for instance Italian family-based firms (De Massis et al., 2016) and US biotechnology (Petruzzelli et al., 2012) it has been suggested that tradition in terms of materials, form, history, and location can provide value in innovations (De Massis et al., 2016). In a study of haute cuisine development (Petruzzelli and Savino, 2014), it was found that it was not necessarily the products' novel or traditional components per se that constituted the innovation, but rather new combinations between new and traditional components. A similar view on the use of tradition in innovation was recently presented by Holmqvist et al. (2016), who found that the deliberate combination of novel and traditional materials, forms, manufacturing processes, context, and history gave unique meanings to new products. More specifically, Holmqvist et al. (2016) identified tensions between the old and the new in the mentioned dimensions, and the new meanings arising from these tensions were perceived as particularly valuable by customers, by presenting different types of dissonance. This paper aims to take these initial observations further in order to disclose how designers work deliberately on creating the design dissonance that is at the root of the innovation’s uniqueness and value.

The paper is structured as follows. First, a brief exposition of theory is presented. Thereafter the methods used are described, followed by the empirical observations in the form of extracts from production novellas. Eventually, the results are analysed and discussed.

2. Exposition of theory

One of the problems in the wide field of innovation studies is that there are many different definitions of innovation (Crossan and Apaydin, 2010). The resulting pluralism (and confusion) is also accentuated by an ongoing proliferation of innovation types. Early studies of innovation mainly concerned product innovation, and frequently had a strong emphasis on technology and technological change. Lately, innovation has come to be more multi-faceted, as it has come to include also innovations in terms of e.g. processes, services, and business models. The resulting broadening of the innovation management field has also led to an increased emphasis on the role of design in innovation, where the notion of design-driven innovation (Verganti, 2008) has been proposed as a particular type of innovation with specific characteristics. Another shift in focus is the increased attention to changes of the meaning of new products (see e.g. Verganti and Öberg, 2013; Norman and Verganti, 2014). Comparing design-driven innovation with other well-established types of product innovation, it is clear that design-driven does not necessarily imply the introduction of new technologies, but that it may nevertheless introduce a new meaning to the product (Verganti and Öberg, 2013). A change of meaning can be the result of a new design, for instance by altering how a product is used, or the signals it sends to customers and users.

A potential shortcoming of the literature on design-driven innovation is that it basically relies on a dichotomization of the concept of novelty, referring to it as incremental or radical (Verganti, 2008). Verganti and Öberg (2013) clearly highlight that the degree of novelty can refer to both technology and meaning. Furthermore, they point out that new
meanings are context dependent, cannot be optimized, are outlandish compared to their
industry, and are co-generated by designers and users. The new meaning is expressed in
the form of a scenario of meaning, in which its constituent components are merged into a
whole (Verganti and Öberg, 2013). However, whereas the creation of new scenarios of
meaning constitutes a valid and constructive development of innovation management
theory, it presents only very limited insights in terms of action-oriented implications and
recommendations for practice. Summarizing the above, we can conclude that there is a
need for studies focusing on further exploring the genesis and emergence of new
meanings in innovation, with an emphasis on what specific design practices lie behind the
creation of new meaning.

A second aspect of the dichotomization of novelty is that it does not take into sufficient
consideration the combinative aspect of innovation. Already Schumpeter (1934) pointed
to this, by defining innovation very broadly as new combinations. A more recent seminal
work dealing with this is the work by Henderson and Clark (1986), in which it is suggested
that novelty can refer to components, as well as the interconnections between
components. Hence, an innovation can be created without the introduction of any new
component, but merely by a rearrangement of existing components according to a new
product architecture.

As mentioned above, another critique of the one-sided focus on novelty has also come to
be challenged. Without going into a discussion about whether something can indeed be
truly new or whether all new things derive from what already exists, it is clear that
innovations contain both previously existing and new things (Petruzzelli and Savino, 2014).
In an emerging literature stream, the use of established knowledge, skills, materials, and
locations, jointly regarded as tradition, is proposed as a potential resource in innovation
(De Massis et al., 2016). Studies of companies in different industries (see e.g. Petruzzelli et
al., 2012; De Massis et al., 2016) have clearly pointed out the opportunities residing in
deliberately using tradition as an innovation component in new products. However, the
works in this stream of literature, referred to as Innovation Through Tradition (De Massis
et al., 2016), primarily focus on the use of traditional components and the value of doing
so. A less emphasized aspect is how to exploit the combinatorial opportunities that reside
in the combination of novelty and tradition, pointed out based on a study of haute cuisine
(Petruzzelli and Savino, 2014). In accordance with the argued value of recombination,
Holmquist et al. (2016) identified such combinations as interesting for design innovation,
as they present a set of tensions, which can be used by designers to create unexpected
outcomes that do not simply fit into the coarse categories of novel and traditional.

Another particular aspect of these new combinations of the old and the new is that small
residual tensions between the design dimensions of form, material, manufacturing
process, context, and history give rise to a dissonance that is perceived as exciting and
valuable rather than annoying and/or disturbing. To understand the nature of this
particular design dissonance, as well as the micro-level design mechanisms behind it, we
set out to investigate the following research questions:

RQ1: How is novelty and tradition combined in design innovation?
RQ2: What is the role played by design dissonance between novel and traditional
components for the perceived value of a design innovation?
RQ3: How is design dissonance shaped and controlled in the design process, in order to
3. Methods used: Research through Design – the production Novella

For the purpose of exploring the value of novelty and tradition in design innovation, the methodology used in this paper is Research Through Design (RtD) (Frayling 1993) developed and applied by Holmquist through the writing of “Production Novellas” (see also Holmquist et al., 2016). As Frayling argues, science, research, art, and design are practices that are inextricably intertwined. The crafting of an artefact like a vase or a cabinet is a production process of thinking, shaping, and transforming a material through which knowledge is created. Further, the crafting of art and design take place in specific contexts and relations, which means that what take place outside the actual design of an artefact is also relevant for the design process. One of the challenges that Frayling identifies is that knowledge produced through art and design practice is intimately intertwined with communicative aspects. He writes that (Frayling, 1993: 5) ‘[…] we have a fascinating dilemma on our hands. As much about autobiography and personal development as of communicable knowledge.’ Thus, RtD is undertaken to gain new knowledge partly by means of practice and outcomes of that practice. The starting points in this paper are a series of design interventions conducted at studio Folkform in Stockholm, a design duo consisting of Anna Holmquist, the lead author of this paper, and her design partner Chandra Ahlsell. The design interventions are experiments working with the Swedish furniture and accessories design industry, combining old industrial processes and craft techniques in a series of design experiments illustrating the dissonance between traditional materials, forms, and manufacturing techniques. In this paper we acknowledge what Nagy Hesse-Biber and Leavy (2008) calls a method gap in the interface of tradition and innovation, which scholars in architecture, art, and design discuss (Leavy 2015; McNiff, Prior 2013; Rendell, 2010). In line with the idea of RtD, Leavy (2015:3) promotes the argument that art-based practice emerges through ‘shaping knowledge-building and communicative practices’. As a further development of RtD (Frayling, 1993), the methodology used in this study is the materialised writing of “Production Novellas” (see also Holmquist et al., 44: 2016). The Production Novella is an art-based methodology developed by Holmquist for RtD. It is inspired by Livholts’s (2015a; 2015b) untimely academic novella writing and experience based narrative research (Bruner 1991). Livholts (2015a, 2015b) combines diverse writing genres such as writing memories, letters, and research poetry and photography. The production novella contributes to the developing of RtD as a communicative practice by which the designer can work reflectively in research through design to re-invent materials, forms, and manufacturing processes linked with personal experience. This means that writing is used as a method of inquiry (Richardson 1994) in RtD, a retrospective narrating process by which the artist/designer/researcher create and communicate knowledge. In this paper Holmquist further develops the methodology of working with fragments of memories from the design and manufacturing process behind three different objects, a Vase, a candleholder, and a cabinet. As Livholts (2015a) illustrates, working with memories as short stories, reading, re-reading, listening, re-writing is an analytical, creative and reflexive practice, which creates mo(ve)ments and shared knowledge with readers. The writing of ‘small stories’ promotes the writing of situations, fragments or scenes, from the
production process written by the designer/researcher who re-constructs stories from artistic and design practice. The method allows working with concrete detailed representation to promote seeing, feeling, colours and to include situations and events that may be unexpected - a phone call, an invitation, a co-creator, to contextualise diverse cultural contexts and include situations that occurs in relation to the design. Thus constructing narrative experience becomes a tool to reflect on dissonance between tradition and innovation in the production process. Leavy (2015) describes writing in art-based narrative research, as storying and re-storying - a reflexive, participatory and aesthetic process to display multiple meanings. This narrative writing from personal experience allows the artist and designer to re-visit and think through the materials and micro-mechanisms leading to ITT working thematically with “dissonance”. Bruner (1991: 5-6) who gave rise to experience-based narrative emphasised physical objects as central for the creation of meaning. He argued that knowledge and skills can not automatically be transferred between cultures and domains and focus on interconnectivity and interpretations of culture and context, life and art. Central for Holmquist’s work is the creation of narrative meaning in the production process of crafting and design where she as an artist and designer works with materials and designing of physical objects in close relation to production in different manufacturing and design exhibition contexts. We will now turn to three different fragments from Holmquist’s “Production Novella Writing”, using them as a vehicle to identify and explore dissonance in design innovation and the micro-mechanisms underpinning ITT.

4. Three case studies exploring material dissonance in art and design practice, the Masonite Cabinet, the Crystal Vase and the Brass Candle holder.

The brief manufacturing narratives inform us how new meaning and value were added to three artefacts: a vase, a cabinet and a candleholder.

4.1 Industrial Intervention crystal vase, (Folkform 2011)

This design innovation of a series of Crystal vases started off with a road trip to the old glass works in the Czech countryside in 2011. I remember the first stop at the factory in Harrachov, in the Czech Republic, which was known for its tradition of hand cutting of Crystal glass. The owner of the factory met us, me and my partner Chandra Ahlsell, in the entry and his son showed us around in the glass works. It was busy inside, lots of sweaty men glass blowers carrying around crystal glasses everywhere, it was dark in the workshop space but the orange flames from the molten glass ovens, were as intense as the heat inside the glassworks.

We were allowed to borrow three old crystal vases that belonged to the glass collection of Skłarny Harrachov, designed by Rudolf Schwedler and Milan Metelak. The vases were hidden in the glass works in an old basement during the Second World War and found by the communists after the war. These vases became the starting point and inspiration for our new work. The traditional crystal patterns cut on the surface of the vases were beautiful, but at the same time extreme, because they were so strong in their expressions. The crystal cutting techniques created a brilliant sparkling effect as each cut reflected and
transmitted light through the glass vases on the shelf in the workshop. We asked ourselves how these traditional cutting patterns could be combined in new different ways to create new expression? To explore cutting technique further the next stop on the road trip was a factory working glass cutting decorations made by robot cutting. The building was very modern, we had coffee with the owner and he showed us different samples of advanced cutting techniques, completely new patterns could be made with his robot through advanced technology and a glass cutting automat. Throughout the journey we formulated the starting point for the shaping of the new glass series and we aimed to explore the interface between the mass produced and the handmade articles and to perform a series of Industrial Interventions where the handcrafted met industry, the machine met the hand. Could something new be created when traditional handicraft was incorporated into existing industrial manufacturing processes? In our final design and new interpretation of the cut crystal vase, one layer of pattern was cut by a craftsman by hand and then the second layer was slightly tilted and cut by a robot. This intervention was performed to challenge the expected value of the machine made with the uniqueness of the handmade. The collection of vases was later on presented at an exhibition at Färgfabriken Centre for contemporary art in Stockholm, Sweden and acquired by the National Museum in Stockholm for their permanent design collection. In the exhibition launch, which we named Industrial Intervention we created a scenography from the glassworks, with fragments from the production process and a video where the hand cut glass was looping in parallel with the process of the machine cut. The music from the video projection composed by Raymond Scott and Manhattan Research Inc was loud and filled the gallery when the first guests entered the space.

![Crystal Vase](image)

*Figure 1  Crystal Vase (Folkform 2011) patterns cut both with traditional hand cutting and high-tech robot cutting.*

4.2 Collage candleholder, (Folkform, 2011)

Malmö was covered in fog when we landed at Sturup airport in Sweden. The flight was
late. This was the first time, we, me and my colleague, Chandra Ahlsell, visited Rosengren Metal foundry, in Limhamn located outside of Malmö on the south coast of Sweden, to take part in the metal casting process of our new Collage candle holders. The foundry was mostly casting small bronze birds for gravestones and sculptures by local artists. To work with brass as a material was not something they usually did, but they promised to make an exception and give it a try. We arranged to stay two days at their workshop and take part in the moulding process when the first prototypes of the candleholders were made. We brought a documentary photographer to make pictures of the traditional sand casting technique that we were going to use for the casting.

The first sketch of the candleholders was made at our studio Folkform in Stockholm, Sweden, about 6 months earlier. However, I remember throwing the first sketch in the dustbin, I was too critical towards my own work, but my design partner, picked up the sketch from the bin and was convinced that we should develop it further. We continued the work by making a series of paper models and prototypes in wood to find the right proportions. Each candleholder comprises a candelabra, where the simple tea lights, pillar candles and hand-crafted votives were put side by side to create a collage, a landscape of candle typologies. Different forms of candles that usually were not put together in the same candle holder, were put side by side, to create a patchwork of contrasting candles. After spending hours in the industrial building during the casting of the candleholder, I remember the heat was intense towards the skin. The sand in the mould was slightly orange and oily. It was striking that each sand form was unique and was only going to be used once, knowing all the craft that was put into making this form. It was also fascinating that we were using the same old casting technique as 1000 years ago. Nothing had changed. The sand was shaping the melting, glowing, hot brass to become the design of the candleholder.

We named the exhibition that was held at Whyred art projects, a few months later Hand made Mass production, and raised the question “how can old industrial processes and craft techniques could be used in new ways?” I remember we spent the whole night building the exhibition at Whyred. We presented photographic prints from the foundry workshop and also brought back fragments from the foundry to Stockholm such as tools and a sand mould together with the candleholders. The exhibition was an attempt to introduce the audience to the knowledge of the craft that was behind the manufacturing of each piece and to make the manufacturing process visible and transparent in contrast to the often anonymous mass production.

We kept up our small scale self production for about a year, but the first series of candleholders were almost impossible to get delivered from the foundry on time. I was calling them every morning trying to speed up the manufacturing process. After some months the well established producer of metal objects and home accessories Skultuna Brassworks invited us to collaborate, the Brassworks are located in an enchanting valley in the heart of the idyllic province of Västmanland in Sweden, but most of their manufacturing is now located to Asia. Collage is in serial production by Skultuna and distributed all over the world. The limited first edition bronze version has been exhibited at the Stockholm auction house at the Museo Poldi Pezzoli and Mint Gallery in London to mention a few places. The bronze candleholders are still casted at Rosengrens metal foundry.
Figure 2 Collage Candleholder (Folkform, 2011) new combination of different types of candles in the same piece.

4.3 Masonite Cabinet with 18 drawers (Folkform, 2008)

The Production Novella writing on the Masonite Cabinet with 18 drawers was recently presented by Holmquist et al. (2016) and will be referend to in the following fragment of writing on a Masonite factory.

This piece of furniture was one of the first we designed in the Masonite hardboard material. The starting point for the design of the furniture was to combine the raw surface of the material in new ways, and to play with the composition of the drawers. This cabinet was all made from the standard humble wooden boards of Masonite we found at the factory in Rundvik in the north of Sweden, when we were there visiting. The boards had different soft wooden brown tones and thicknesses varying from 3mm to 8mm and some of the boards we treated with linseed oil to get an even darker colour of the material. In the final 18-drawers Masonite Cabinet we selected different kind of Masonite surfaces traditionally used only for their functional purposes and usually not combined. The different boards created the front panels of the drawers on the cabinet, each drawer was unique in its form and proportion and as a wholeness the new combinations of the material created a graphic and at the same time simple abstract expression. The different drawers played with proportion and form of the cabinet and were inspired by historical references and made by Cabinet maker Jonas Fjellman, but using this very humble chipboard material instead of more expensive materials traditionally used in this type of furniture, for example wood such as oak. We were using this standard building material in the cabinet to deconstruct material hierarchies and to create dissonances between form and expected choice of material.

The choice of the material and the design of the cabinet were also the result of spending hours with the material inside the beautiful brickbuilding factory and in the workshop to really get to know its qualities. We saw the new beauty in the raw Masonite boards and began to play with the different thicknesses and surfaces. Later on the same year we presented the Unique Standard collection that consisted of a series of furniture and an exhibition. The collection was first launched in a small display of Folkform’s work during the Prague design week and some months later we were showing the collection in Stockholm (2008) at the contemporary art gallery Crystal Palace. The exhibition was an independent design event outside the main furniture fair. The foundation for the design
process and the exhibition was to investigate questions such as how to combine simple industrial material in new ways to create new expressions. I later on realised that this approach was a way to explore design as value making and the design process as a tool to explore material hierarchies. We made several pieces of furniture in different materials with the same question as a starting point to find the answer through the material, form and the context. We saw the new beauty in the Masonite boards and began to play with the different thicknesses and surface treatments of the boards, such as linseed and oiled Masonite in combination with wax treatment. How could we make this material that had been forgotten since the 1950 renewed, and make people look at the material with new eyes? Through the design of the 18 drawers Cabinet we wanted to highlight the beauty of this simple mass produced industrial material by combining it in new ways in a new pieces of furniture. The furniture was later on acquired by the National Museum of art and Design in Oslo (2011) and sold at the contemporary design auction for 4600 EUR (2014). The cabinet is made in an edition of 10 pieces. In the work with the Masonite cabinet with 18 drawers we made a new interpretation of an old standard material. Traditional industrial material was used in new combinations and forms to create new value and expression.

Figure 3  Masonite Cabinet with 18 drawers (Folkform, 2008) a patchwork of different types of standard Masonite in the same cabinet.

Analysis and discussion
This paper aims to address the relationships between novelty and tradition in the design and material innovation process behind a series of artefacts. We suggest that a material dissonance composed through design was leading to a shift in meaning. The artefacts in this study were hand-crafted in limited editions. In the case of the sculptural brass Candle holder where different types contrasting candels were combined leading to a dissonance in the form expression of the candleholder, the candleholder later on become mass-produced by Skultuna brassworks. In the case with the Masonite Cabient with 18 drawers
made from humble Masonite wooden boards, the design dissonance was created by combining traditional building materials in new ways with an attention to details and to thicknesses and the perception of the raw surface of the material. In the case with the crystal glass vases, we suggest that the design dissonance was created by cutting traditional patterns both by hand and by machine and compose them in layers. All three artefacts were well crafted by master craftsmen in different workshops in Europe. An important part of the design process was to highlight the people and the places where the artefact was manufactured. It is clear that this constitutes examples of how tradition can be used in innovation, thereby underlining the potential residing in using “the old” to generate “the new”, as suggested by e.g. De Massis et al. (2016) and Petruzelli et al. (2012). In particular, the empirical observations point to the importance of recombination of old and new, earlier highlighted by Petruzelli and Savino (2014) in another industry. The study also presents some new ideas in this field. First we would like to stress the importance of extending the design components that can be traditional. In all three cases the use of traditional craftsmanship played a fundamental role in the resulting new meaning of the artefact. Secondly, the cases all result in design innovations where the resulting value is not the result of pure and simple harmony between design components, but rather constituted by a certain element of dissonance between its constituent parts. Whereas these dissonances are clearly notable for a skilled interpreter of design objects, they are at the same time contained to remain subtle, in order not to jeopardize the overall aesthetics. Arguably, the deliberate use of design dissonance in this type of innovation constitutes a potential pool of design value that can be tapped into by skilled designers.

While looking closer at the design innovation process we have explored how the designer is shaping design dissonance in material, form and manufacturing throughout the formgiving process by working with combinations of novelty and tradition. In the shaping of each artefact, the designer worked with the composition of the elements of the form to balance the material dissonance, a slightly disturbing form feature, expressed in the tension between novelty and tradition in materials, patterns, manufacturing techniques and contexts. The dissonance was shaped by design; as collages of traditional forms, as combinations of contrasting materials, or as new patterns of traditional ornaments, or as a slightly disturbing change of context, materials or form. The different explorations were communicated through exhibition launches where manufacturing narratives were built with inspiration from scenography. Fragments from the craftsmen’s workshops and old industrial processes were physically moved into new urban contexts, creating a spatial dissonance.

To sum up this discussion we suggest that dissonance through design is created by combining novelty with tradition in the design process, crafting new compositions of unexpected elements of forms and materials. By no means this is the only way dissonance can be performed through art and design practice, but it should merely be considered a presentation of a few examples and suggestions for further research.

References


About the Authors

**Anna Holmquist** is one of the founders of the art and design studio Folkform based in Stockholm, Sweden. The studio first entered the spotlight with their experimental work with materials. Folkform has also become an international name and has received several prestigious design awards. Their work can be found in the permanent design exhibition at Nationalmuseum in Stockholm and in The National Museum of Art, Architecture and Design in Oslo, to mention a few places. Anna Holmquist is also working with interdisciplinary design research at the Royal Institute of Technology in Stockholm focusing on materials.

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The para-disciplinary role of Design transforming innovation in organisations

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The research addresses the role of Design creating value at the intersections of disciplines in organisations. It presents a revision to the discourse on the nature of and relationship between Design and other disciplines. This paper advocates a new para-disciplinary term for the post-disciplinary state of Design in its contemporary practices, acting as the ‘inter-discipline’ within organisations that are intent on the strategic development of their innovation capacity and potential. The work builds on a synthesis of findings from a longitudinal range of practice-based design research projects undertaken across industry and the third sector over the last four years. Case studies of these projects demonstrate that the involvement of Design has resulted in successive levels of influence leading to the radical transformation of the organisations’ innovation strategies. The implication for the generic aspect of these findings are discussed in terms of inter-disciplinary discourses.

keywords: Design practice, Para-Disciplinarity, Transformation, Innovation

Introduction

Bremner and Rodgers (2013) contested that, “Design [as a discipline], again, finds itself in the midst of a crisis from a number of different perspectives, including professional, cultural, technological, and economic forces.” Instead, the authors of this paper propose that the evidence of particular current practices of the discipline can be interpreted as somewhat of an apotheosis, whereby Design is actually coming of age. That the evidence increasingly demonstrates the capacity of Design to act as a transformational process in support of other disciplines within organisations seeking to develop their innovation capacity and potential.
Bremner and Rodgers’ article built on previous observations by Friedman (1994) in his book Radical Modernism, which emphasized the responsibility of designers to avoid overspecialization and to see their work as an important creative aspect of a larger cultural context. Perhaps the passage of time has proven the advice but disproved the interpretation that the context implies a disciplinary crisis. Prior to Freidman, Richardson (1993) proclaimed that design “…is in a crisis of identity, purpose, responsibility, and meaning…” and that “…the viability of the profession as it is currently practiced needs to be seriously considered, its boundaries examined, and its values reconsidered.” Bremner and Rodgers took this as a mandate to explore design’s crisis as it contends with its disciplinary boundaries. Their approach was top-down, a generic sense-making theoretical interpretation based on critical discourse. The approach in this paper is countervalent, bottom-up, generating an alternative theoretical perspective from the evidence of specific contexts of design practice.

The Discourse About Disciplinarity

It is useful to remind ourselves of the original meaning of the word discipline, which concerns the suppression of base desires and is usually understood to be synonymous with self-control and restraint. Discipline is when one uses reason to determine the best course of action regardless of one’s own desires (Fowers, 2008).

Irrespective of our concerns and views about the current transformation of the discipline of design, we also have to remind ourselves that disciplines are designed to; perpetuate and domesticate doubt as healthy scepticism (Brown, 2009), produce a sense of belonging and submission to a set of regularized practices (Chandler, 2009) and, create a [bounded] space where expertise is internally unstable (Post, 2009).

Rodgers argued that the boundaries of the historic Design disciplines, ruptured and began to dissolve due to the changing relationship between the product of design and its production following the gradual introduction of digital technologies (Rodgers, 2008). His argument contended that these changes include the realization that an indeterminacy of professional boundaries now exists, and fluid patterns of employment within and between traditional design disciplines is commonplace. The implication is that this has been harmful to the practice of Design, that the seriousness or restraint required of the discipline has been diminished following this creeping dissolution.

Bremner and Rodgers (ibid:2013) concluded that the historic disciplines of Design have therefore been superseded by a boundless space/time they called “alterplinarity.” That a combination of crises of professionalism in Design, global financialization, as well as the rapid adoption of digital technologies have all modified the models of Design thought and action. Consequently, historic Design disciplines need to transform, moving from regularized practices to a responsive reformulation of practices revolving around net-worked communication infrastructures, which are yet to be disciplined, but will nevertheless serve as conduits for power to re-organize space and re-regulate time to do things.

John Chris Jones (1998) previously suggested that an “alter-disciplinary” or “undisciplinary” approach to research in Design should be considered because the nature
of a PhD qualification for designers should successfully integrate art and science—as art/science—a new discipline.

Erich Jantsch (1970) was the first to present a framework to describe forms of collaboration that involve alternative disciplines. His framework of disciplinary terms describes the specific characteristics that make different levels of cooperation explicit. The underlying intention is important, because it promotes the act of cooperation as being the most important feature of interdisciplinary studies. The basis of Jantsch’s framework was used by Bremner and Rodgers (2013: 11) in their critical discourse on existing forms of disciplinarity. The format of the framework as adopted and adapted is shown in Figure 1, below:

<table>
<thead>
<tr>
<th>Inquiry</th>
<th>Character of the Designer</th>
<th>Character of the Discipline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disciplinarity</td>
<td>Individuals demonstrate understanding of one set of conceptions and one methodological approach. They are able to generate unique questions and contribute new research in this field.</td>
<td>An understanding is demonstrated of one set of conceptions and one methodological approach from field of practice. Able to tolerate questions and contribute new designs in this field only.</td>
</tr>
<tr>
<td>Multidisciplinarity</td>
<td>Individuals demonstrate disciplinary competence and understand that their endeavors must be related to the endeavors of others in surrounding disciplines. They therefore come to know and use some concepts used in these disciplines.</td>
<td>An understanding is demonstrated of disciplinary difference and shows ability to learn from other disciplines.</td>
</tr>
<tr>
<td>Crossdisciplinarity</td>
<td>Individuals demonstrate disciplinary competence and know how concepts from other disciplines relate to their own, having mastered some of those concepts. They are able to constructively communicate with those from other disciplines.</td>
<td>An understanding is demonstrated of disciplinary difference and can follow problem-focus of other disciplines.</td>
</tr>
<tr>
<td>Interdisciplinarity</td>
<td>Individuals demonstrate at least two disciplinary competences. One is primary, yet they are able to use the concepts and methodologies of another discipline well enough to contribute to its questions and findings. New understandings of the primary discipline result.</td>
<td>An understanding is demonstrated of at least two disciplinary competencies. One is primary, yet it is able to employ the concepts and methodologies of another discipline. Strengthens understanding of the primary discipline.</td>
</tr>
<tr>
<td>Transdisciplinarity</td>
<td>Individuals demonstrate at least two disciplinary competences, neither of which is primary. They work in and contribute to both and generate unique conceptions and artifacts as a result of an emergent transdisciplinary perspective. They are able to communicate with individuals from a variety of disciplines in a synoptic manner.</td>
<td>An understanding is demonstrated of at least two disciplinary competencies, neither of which is primary. Results in a trans-methodological perspective. Abstracts disciplines to bridge new problems.</td>
</tr>
</tbody>
</table>

Figure 1: Bremner and Rodgers, adapted from Jantsch.

Bremner and Rodgers build beyond the hierarchy of existing terms developed by Jantsch and add a further set to describe the shift of Design as a discipline with regard to their interpretation of prevailing global crises, using a negative disciplinary discourse of theory informing practice. By doing this they infer that Jantsch’s five forms of discipline-arity are insufficient to describe the current context of Design. Their extended table is included in the section after the next, which describes the evidence from selected Design practice case studies. The authors use this extended table to highlight the relevance of the meta-level characteristics drawn from the cases, to provide a revision to the discourse about the
post-disciplinary state of Design, whereby practice informs theory, moving beyond the position of Bremner and Rodgers and others.

**Evidence from Design Practice**

The expansion of Design’s role across sectors in society has been a common feature of many research topics for the subject. Similarly, the nature of engagement of Northumbria University’s contract research has addressed all types of organisations across the private sector, public sector, the third or Voluntary Community Sector (VCS) and the enterprise sector. The research described in this paper specifically refers to the private sector of industry and commerce and the third or Voluntary Community Sector (VCS). The main difference between these sectors is that VCS organisations exist to fulfil a specific social purpose while private-sector organisations’ primary goal is to turn a profit for shareholders. Yet, in daily practice, working in the voluntary sector is not that different from the public or private sectors. People in all three sectors are working hard to do their jobs and produce a valued service (Reach, 2017). Within the private sector we find different scales and types of businesses that Design is making a contribution towards. For example, the Industrial Design discipline is no longer focussed on manufacturing industry as its concern; designers (Industrial, Product, Service designers and others) are now making a valuable contribution to a wide range of product service systems including financial companies through the design of their ‘products’ and services. Many of these organisations have not previously involved Design as a contributory discipline to their business delivery. The industrial case study example referred to in this paper is a medium sized enterprise that is a subsidiary of a global manufacturing corporation. Blaich (1993) made the distinction between categories of manufacturers where the business strategy and process are driven by different disciplines, i.e.; marketing (fast moving consumer goods (FMCG)), technology (capital and process equipment and components), hybrid manufacture with an engineering bias (e.g.; automotive), and Design as in the case of electronics products. These categories of manufacturers are useful to recognise in the interpretation of the meta-level characteristics of the cases in the last section of this paper. The VCS case study examples referred to are medium sized (EU criteria were used to define an SME) charities that were subsidiaries of national charity organisations.

The sampling design of the study involves multiple cases and multiple units of analysis, and in Yin’s terminology is a multiple embedded case study, (Yin 1994, p. 39). For the purpose of succinctness, one industrial case study is referred to in detail here, based on a Knowledge Transfer Partnership (InnovateUK, 2017) lasting two years with a UK subsidiary of a global technology-based process equipment manufacturing company and one VCS doctoral programme is referred to that studied three national charities through regional subsidiaries.

The template for each case study comprises; a brief description of the organisation, the initial operational level project, strategic level actions, the policy level influence that this led to and the subsequent transformational impact on the innovation culture of the organisation. This template refers to the Model of three levels of design impact (Young et al., 2001).
Methodology applied to the case studies

This research aimed to determine the transformational impact of Design practice on the innovation culture of a cross-section of organisations not used to the contribution of Design, so the designer’s practice was not guided by any previous engagement, as is required by the Action Research approach, which was the predominant methodology (Lewin, 1946, p. 38; McNiff & Whitehead, 2011). The selection of contrasting cases from industry and VCS organisations described above were examined for this purpose, supported by a case study structure (Yin, 2003) to ensure generalizable theory.

Data on the impact and value of the Design practice approach to a range of stakeholders was captured during, immediately after, and after several months using: semi-structured interviews; project meeting recordings; reflection-on-action logs; and design artefacts (Author3, 2015). An independent researcher interviewed project stakeholders at the end of the collaborations to ensure accuracy in the reporting of outcomes. Gathering data at several points of the project from multiple stakeholders enabled a triangulation of data that ensured validity (Jick, 1979, p. 602).

Once all collaborations were conducted, all case study data was analysed using a four-stage inductive analysis process (Thomas, 2006). The first-stage involved ‘cleaning’ the data (Miles & Huberman, 1994, p. 51) by converting it into a common format and placing it in chronological order. The second-stage involved hand-coding of the data in relation to the study’s evaluation objectives and encoding each related excerpt of text. In the third stage, all excerpts of text were then copied onto ‘post-its’ to allow for the creation of multiple coding collections (Guldbrandsen, 2006) by grouping similar quotes related to the same critical event across each case’s timeline. The correlation of activities across project stakeholders, data collection methods and the project timeline also helped to ensure the critical events were objectively identified (Crisp, Green Lister, & Dutton, 2005). Finally, these multiple coding collections were compared and contrasted across stakeholders, timelines and cases to isolate common categories (Warwick, 2015). These were then grouped and reduced to identify themes (Silverman, 2006, p. 307) and patterns (Reichertz, 2007, p. 221). The derived patterns were then discussed in peer reviews with the organisations and Design communities to verify and validate them to reduce any research/practitioner bias. (Warwick, 2015).

Industrial Case Study

The research was conducted in a manufacturing SME, referred to here as Company A, which had not previously engaged with a designer. The shift from operational to strategic level Design actions is described using the key organisational features, which were found to effect transformational change.

Company A: is a subsidiary of a US headquartered technology-based manufacturing conglomerate operating across international markets employing over fifty thousand people. It can be characterised as an innovative, technology-centric manufacturing business. Company A worked in partnership with Northumbria University through a two year KTP project to introduce a customer-centric and value-proposition driven approach (Hassan, 2012) to its new product development.

Initial Operational Level Project: Redevelopment of Existing Product 1 (EP1)
Establishing confidence in a Design capability.

First, an existing product (EP1) was redesigned. Industrial Design expertise was used to redevelop the external qualities and user-interaction of one of Company A’s product-ranges. Although its focus was this one product-range, the industrial design work took a wider strategic view and established some early design principles and a visual language that could extend to more of the company’s products. The timing of this design work coincided with the rollout of new brand-guidelines across the whole Corporation, so this first product-range became a high-profile benchmark for other parts of the business to follow. For example, for several months, EP1 was featured in the organisation’s foyers in both the UK and in the US head-office.

Industrial Design symbolising a corporation-scale change
The design language and principles that EP1 proposed, were extended to other parts of the business using mock-up product visuals. These were iterated based on feedback from various divisions, to arrive at a best-fit with the wide range of sales environments and competitors. Visual guidelines were then produced, which were rolled out Europe-wide, culminating in a major exhibit at the world’s biggest manufacturing trade-show, the Hannover-Messe 2015.

Premises and Processes were transformed
- Internal ‘Innovation Labs’ have been established and drawing tools and method cards were created to begin a roll-out of idea-generation processes across the organisation.
- The company’s proprietary Stage-and-Gate Product Innovation Process now integrates both Industrial Design and Strategic Marketing as the investigative resource used to define new value-propositions as well as confirming Industrial Design’s role in the downstream product development stages.

Strategic Level Actions: Development of New Product 1 (NP1)
Defining the value-proposition from a customer perspective.

The design-research work defined an issue targeting the food and beverage sector, which:
- affected a majority of retailers in the sector.
- was recognised by very few in the sector as affecting customer experience.
- was recognised by very few in the sector as a business risk.
- was currently unmet in the industry by any existing product/service offering.
- could be addressed with existing technologies.

Therefore, new value has been proposed without needing to rely on any technological breakthrough. Instead the food retailer realises an improved customer experience, reduced business risk and improved supply-chain relationships.

Testing the value assumptions with customers
Product NP1 was developed in response to this research stage, and key market-access strategies along with specific target customers were identified. NP1 was prototyped and demonstrated to a series of potential customers and their feedback was used to iterate the proposed product through several versions. Only then was it introduced to customers.
with global reach. It was included, by invitation, in one such customer’s annual selection of potential innovations for implementation. It was then selected to undergo 18-month long efficacy trials with a view to global adoption to meet the desired level of functional performance.

Evidence of the Impact of Design as Leadership

Senior Executives within the company were now paying attention to the actions of the UK site and were hearing about the role that Design was playing in key contracts that were being secured. They were also seeing a spike in sales of EP1 after re-launch, attributable to both technical performance improvements and the striking new external aesthetic. At this time, the same senior executives were engaged in determining where they would find and/or develop strategic leadership for the group of European manufacturing divisions. They eventually selected the UK site as the Divisional Headquarters across the six European manufacturing sites, a decision that was attributable in part to the successes outlined above.

Transformational Impact: Evidence of the widespread impact of the innovation

At this stage, the issue that NP1 addressed was in the public domain. As a result, one of the most influential industry-representative bodies concerned with the Food and Beverage sector, the International Society of Beverage Technologists (ISBT) added a new recommendation to its best-practice manual, which dealt specifically with the issue the customer-research phase had addressed. So, trusted international industry guidelines had changed as a direct result of the NP1 project. Furthermore, the NP1 now sits at the top of the company’s forecast for the main revenue generating potential of its new product lines in their 5-year forecast. Of the top 10 in that forecast, Industrial Design will have an investigative, value-identification role in at least 3.

Sharing the story of this customer-centric innovation approach within the organisation.

The profile of the UK division has transformed through this period with several aspects of the business being developed including the approach to innovation. Company A’s CEO in the USA has explained their view of the completed project as follows:

“At present the three sub-brands all produce competing products across these technology categories (having each grown up as independent companies before acquisition). UK Company A recognises that the substantial product-range rationalisation process necessary to deliver this new policy must be based on customer-centric approaches if it is to achieve the desired level of product innovation and market differentiation in each range. The UK division has the mandate to lead the rationalisation process in the largest of the three technology areas: filtration, and sees this process as a rare opportunity to reframe and redevelop its product ranges from a customer-value perspective. This was the central objective of the KTP and required an integrated approach to understanding Design-driven innovation in the international market context. The VP for Innovation sits on the board at Company A, giving this project high visibility at group level. The approaches and protocols developed through this KTP project have driven change at Company A and the successful strategies which were developed have been shared across all three EU filter manufacturing sites,
consolidating the UK’s position as a Centre of Excellence for R&D within the
Group. This KTP will safeguard Company A in the North East and position
the UK facility as thought leader in product and marketing innovation.”

VCS Case Studies: Charity A, B & C

The research was conducted within three charities in succession, referred to here as
Charity A, B and C, none of which had previously engaged with a designer. In each charity,
a Design for service innovation approach was used to explore an issue of their choice.
Although all charities had comparable income and all delivered public services, each had
differing charitable aims and customer bases.
Charity A is a local organisation that is part of a UK federation, hereafter named Network
A. They provide mental health and wellbeing services across three boroughs in North East
England, many of which are on behalf of a local council. In this project setting, the
designer (Author 3, Warwick) was asked to help the organisation consider what services
they should provide in a new geographical area.
Charity B is also a local charity registered with a national federation. Operating in one
borough in North East England, they provide a variety of community education services to
all ages. In this project setting, the designer was engaged to help the organisation improve
its earned income, particularly focusing on how it could improve its membership system,
which offered discounts on fitness, arts and children’s services to the local community.
Charity C is a national charity based in North East England. Their mission is to engage
children in reading and they offer a variety of services, both directly to the public and
through educational institutions, that address this aim. Here, the designer helped the
charity to consider the experience that their services provided and how they could be
improved to better meet the aims of the organisation.
In each of the three charities engaged in the study, the designer worked with a variety of
stakeholders; staff and volunteers who administer services directly to clients; middle
management; and executive leadership. Each collaboration lasted two months in order to
allow an adequate amount of data to be collected, whilst not demanding too much
capacity from the organisation.

Initial Operational Level Projects:
Charity A: asked the Designer to help the organisation consider what services they should
provide in a new geographical area. Tools, i.e. personas, idea generation, service
blueprints and touchpoint prototyping, were used to co-design a new recovery-focused
service that engaged service users differently. Following the Designer’s contribution,
Charity A successfully applied for a grant of £425,000 from BIG Lottery Reaching
Communities, to roll this service out across the region. Charity A’s national federation
commissioned a service design pilot with three other federation members following the
successful use of the practice.
Charity B: engaged the Designer to help improve earned income, particularly how the
charity could improve its membership system, which offered discounts on fitness, arts and
children’s services to the local community. Tools, i.e. visual customer journeys, staff
surveys and co-design workshops, were used to co-design a new membership system that
simplified the cost structure and reduced the price for those in receipt of benefits. The
Designer also helped to undertake engaging user research that formed an application to BIG Lottery, and they were awarded £190,000 as a result. Charity B has since contracted continuing Service Design support after the project to support their customer communication.

**Charity C:** asked the Designer to consider how the customer experience provided by the charity’s public services could be improved. Tools, i.e. observation, reframing the problem area and idea generation, were used to co-design and prototype nine concepts to improve the customer’s experience. As a direct result, Charity C saw a 300% rise in their annual pass upgrade rate, which equates to an extra £52,500 a year for the organisation. Consequently, the organisation committed to using the Design process again, enlisting service designers to support an upcoming project around the user experience they provide for people with cognitive and sensory impairments.

**Strategic Level Actions:**

All three charities received the same information about the Design approach before the collaboration commenced and the designer spent time initially introducing and demonstrating the different tools and methods of the approach to the various stakeholders. Despite this consistency, analysis shows that the understanding of the Design approach was different in each setting, which influenced the trajectory of the projects. To consider this disparity in outcomes, this section of the paper presents the shift to strategic level actions in relation to four key organisational features found to be required for the Design approach moving from an organisational level to strategic then policy levels to effect transformational change.

*Understanding the Design approach*

**In Charity B:** the CEO stated in his pre-collaboration interview that he saw the Design approach relating to the marketing of services. However, when the Design work challenged fundamental policies and structures in the organisation, for example interrogating the way that prices were set, he responded by reinforcing the need to focus on the communication of services rather than question the practice of how they were delivered.

In contrast, stakeholders in **Charities A and C** who had also not previously engaged a Design programme, did anticipate that the approach might challenge some of their current practice. Conversely, as well as not anticipating that the Design approach could challenge **Charity B**’s current organisational practice, the analysis shows that their Executive Management Team did not see this as a desirable role. This is indicative of their perception that the Designer’s role was to provide capacity to help them to reach their pre-defined outcomes, rather than question any of their aims. It is clear that in **Charities A and C** there was both an expectation and desire that the Designer would operate across the different levels of the organisation and challenge their existing processes, which was lacking in **Charity B**. As such, the roles that the Designer was allowed to play in setting B were greatly restricted.

*Receptivity to Change*

A pre-requisite for each collaboration was that each charity should identify that they want to review or change existing or planned service offers, however analysis shows that the organisations had different levels of receptivity to change. In **Charity A**, the organisation-
wide appetite to try new processes and be open to the outcomes that they presented, provided an ideal environment for the design activity to progress. Likewise, Charity C’s stakeholders identified that they were at an opportune moment in their development for external input, and stakeholders also reflected that they were comfortable with the concept of transformation. In contrast, a recent period of organisational restructure in Charity B meant that front-line staff exhibited a reticence to change, which posed a significant barrier to the Designer’s activity. Although stakeholders engaged in co-creation activities, the organisational fragility decelerated the project momentum, thus reducing the impact it was possible to achieve in the given period. Similar disparities in receptiveness to change can be seen in Charity B’s responses to proposals made throughout the collaboration that impacted on their current business model. Although the Designer demonstrated how improved customer-focused offers could help to increase income, their current financial difficulties limited the stakeholders’ ability to see how the services could be offered differently. Although Charity A and C also highlighted the volatile fiscal climate as a driver for change, they viewed the Designer’s engagement as an opportunity to explore ways of increasing or diversifying income in order to become more sustainable, and were therefore more responsive to alternative business models. Analysis of the inconsistency between Charity B and A&C shows that it is linked to the organisation’s desire for change to occur. The lack of appetite for change at an executive level in Charity B ultimately restricted the work of the Designer to incremental rather than strategic outcomes.

Valuing Process and Outcomes
The difference in outcomes across the charities can also be linked to the value that the stakeholders in each placed on the Design process, in comparison to tangible outputs. Analysis of the pre-collaboration interviews shows that Charity B’s executive stakeholders were focused on the results of the project from the outset. This emphasis on results in the data overwhelms any discussion of the value in the process itself. In Charity A, analysis shows that stakeholders placed huge value on the design process. Stakeholders’ desire to understand how to enact transformation meant that as they recognised the Design process as a potential vehicle for change, the designer’s input was increasingly valued. Their appreciation of the approach is also evidenced by the organisation’s request for a service design toolkit in order to provide a legacy to the collaboration, which demonstrated their commitment to embracing the approach long-term. Similarly, in Charity C the stakeholders recognised that their current service development processes were not effective, and that they also valued the different perspective that the Design approach brought. As such, the charity also pledged to continue using the Design approach again. Although data from post-collaboration interviews suggests that all stakeholders valued the Design process, it is clear that the desire to adopt a new approach was fundamentally lacking in Charity B, which placed emphasis on the tangible outcomes of the engagement, resulting in the restriction of the Designer’s influence to front-line services, and preventing a transformational outcome.

Compatibility between existing organisational culture and Design approach
In encouraging the use of the Design process in each setting, the designer advocated co-creation at every stage. However, in Charity B, current service development policy dictated that ideas should go through the EMT, who would then decide whether they
should be implemented. This practice did not facilitate a culture of co-creation. Data collated across the collaboration timeline shows that Charity B’s existing organisational policies dictated that finance was at the centre of the service development process, whereas a Design approach places users at the centre (Burns et al., 2006). Without a strong desire to alter the existing service development practice, the conflict between user-focus and finance-focus proved to be a barrier to the project progression and the extent to which Design could influence the organisation. In the case of Charities A and C, the principles of a Design approach aligned very much with the requirements of the organisation; focusing on user needs to build desirable, efficient and effective offers was both an expectation of the organisations, as well as being an aim of the Design approach. The case study data demonstrates that during conversations in both settings, the designer and staff recognised this common perspective, which strengthened their relationship and their ability to co-create. In both A and C, the symmetry between the existing organisational attitude and the Design approach allowed the designer to adopt the roles of a facilitator and provoker (Tan, 2012) much more successfully. However, in Charity B, there was a distinct disparity between the Design approach and the incremental service development approach preferred by the EMT. With such a discrepancy, the design process was not sufficiently valued to permeate the strategic levels of the organisation and create transformational outcomes as it had in the other two settings.

Transformational Impact: Evidence of the widespread impact of the innovation
Analysis found that whilst positive service innovations were observed in all three project settings, the collaboration only had a transformational impact in Charities A and C. It found that the outcomes of using design in a sample of three VCS organisations were:

- Financial gains (design directly supported the organisations to secure £1.2 million in funding and was used as evidence to secure a further £1.5 million).
- More customer-focused services (each charity developed new service(s) that were still in use 12 months’ post-collaboration and that they had changed the way that they engaged with their customers).
- And organisational learning (two of the charities made changes to their policies and processes).

Predictably, some of the research’s findings build on existing knowledge within the Design community, such as Design’s ability to create more customer-focused services (Gloppen, 2011; Hollins, 1993; Meroni & Sangiorgi, 2011). Warwick’s case study has verified this existing knowledge in a systematic and rigorous way. However, it also extended the contexts in which this can be claimed, which has significant strategic and policy level values for both VCS organisations, practitioners and educators (Warwick, 2015).

The understanding of precisely how the Design community and VCS community can work together represents new opportunities for all stakeholders. The study demonstrated that the relationship established between the designer and community to be critical to designing value in the collaboration. More specifically, the importance of trust, in order to form such relationships. The Design-led service innovation (Design for Service) approach and the designer, using such an approach, should operate as a ‘critical friend’ during initial engagements with a VCS organisation, in order to result in improved services and new organisational learning. Positioning the Design process and the designer in the role of a
A ‘critical friend’ in a charity allows their influence to permeate beyond the systems level, to the policy level of an organisation, resulting in a transformational impact (Warwick et. al., 2015).

**Derived Factors of Influence**

The cases above identified a range of common organisational features, which were required for the Design approach to move from an organisational level to a strategic then policy level, to effect transformational change in the organisation. The interpretation is that when Design acts as a transformational process in an organisation, it is having the greatest impact on the innovation capacity and potential of the organisation. If we ladder these features in the context of the two different sectors they comprise:

For an industrial technology-based manufacturing organisation:
- Defining the value-proposition from a customer perspective.
- Testing the value assumptions with customers.
- Sharing the story of this customer-centric innovation approach within the organisation.
- Establishing confidence in Design as a capability.
- Evidence of the Impact of Design as Leadership
- Industrial Design symbolising a corporate-scale change
- Transformation of premises and processes

For a VCS charitable services organisation:
- Understanding the Design approach
- Receptivity to Change
- Valuing Process and Outcomes
- Compatibility between existing organisational culture and the Design approach

A meta-level analysis of these features derived from the case studies reveals a pattern in the approach of successful Design within organisations, who have not previously had a history of using design as part of their product/service innovation development processes in the past. Resonance across the cases indicates a primary need to:

1. **Engage project challenges with stakeholders from a human-centred** (user-centred or customer-focused) Design approach on the operational development of products and services.
2. **Establish trust** with stakeholders in project teams and build confidence in the Design approach to address project objectives by connecting with and supporting other disciplines in the organisation (knowing that the initial acceptance of trust is likely based more on the intrapersonal and interpersonal skills of the designer rather than confidence in the Design process, per-se.).
3. **Be consistent** in thought, word and action, which seems to cultivate trust and confidence with stakeholders, especially across levels within organisational hierarchies.
4. **Communicate** and demonstrate the value of the Design process through its outcomes to all stakeholders using a combination of media and communication channels. This is particularly important in order to offset the difficulty of trying to describe the tacit practices that the designer brings to bear in the delivery of the Design process, in advance of practice.

5. Use successful outcomes of the Design process to gain permission *between disciplines* to progressively climb up the different levels of project influence (operational, strategic and policy levels).

Whilst the cases demonstrated the importance of these features acting in combination to achieve successful outcomes, the meta-level analysis indicates that the most significant in relation to the discourse about disciplinarity and the evolving role of Design in organisations:

**Trust:** builds confidence and respect and furthers influence. In each case study, the designer was working with an organisation that had not engaged Design approaches previously. Such projects can be viewed as ones that create both risk and interdependence between the designer and organisation; the two conditions that create the need for trust (Rousseau, Sitkin, Burt, & Camerer, 1998). The precise process and outcomes of Design cannot be guaranteed in advance, creating risk for the organisation and thus a reliance on the designer. This dependence is returned, as the designer needs the permission and time to engage with stakeholders, in order to create anything of value. The cases showed that calculative trust (where the trustor - the person imparting the trust - perceives the intentions of the trustee - the person receiving the trust - as positive) was required at the beginning of each relationship, in order to elicit the permission to co-design (Rousseau, Sitkin, Burt, & Camerer, 1998; Williamson, 1993). It was also found that relational trust (trust that develops during the relationship from interactions that occur between the trustor and trustee) (Rousseau et al., 1998, p. 399) was key to progress the use and application of design within each organisation. The cases demonstrate the importance of trust at the point of the initial application of the Design process, how it was obtained and what this means for human-centric (user-centred and customer-focused) Design-led innovation practice. There are no specific models on the development of trust in relation to Design innovation contexts, the nearest examples are those proffered by organisational discourse to support the development of trust. Mayer et al.’s (1995) model of trust is the most widely accepted in this literature, which comprises three aspects of perceived trustworthiness; ability, integrity and benevolence. Calculative and relational trust were used in the analysis of cases to examine how the aspects of trust were elicited in the initial phase of engagement and then during the course of each collaboration.

**Communication:** The importance of the role of the designer as interlocutor or communicator was promoted by Richard Seymour (2003?) in his article describing a chief function of the designer as interdisciplinary interlocutor. This strategic role was also recognised by Myerson (2007) at the Intersections conference 2007. The need for designers to improve their capacity as articulators of the Design process was previously identified by Buchanan (1985), including his reference to the importance of rhetoric, which he pointed out has been largely ignored in contemporary education curricula and practices, specifically including the education of designers. More recently, the designer’s role as a communicator was highlighted by Yee et.al. (2009) and Tan (2012) in respective
studies of the roles of the designer in Service Design and Design for public good contexts. More recently it has been written about by Yee, Jeffries and Michlewski, (2017), in their book; Transformations: seven roles to drive change by design.

The tacit nature of Design knowledge within the innovation process and practices of the organisation and its actors is a reason that the influence of design has not been acknowledged and given credence to in the past, where innovation breakthroughs have occurred. Effective communication of design-led innovation processes and outcomes are the only mechanism for deferring taciturn practice, until more of its action is capable of being revealed. Several doctoral projects are now addressing this conundrum at Northumbria University.

**Between Disciplines:** The importance of interaction between disciplines facilitated through a Design approach to effectively achieve innovation capacity within organisations is in no small measure down to the learning experience of design students involved in multidisciplinary innovation education over the last ten years. The development of multidisciplinary postgraduate programmes in innovation practices was an initiative prevalent in Design Schools in the second half of the millennial decade. These programmes contrived to break down the hegemony of traditional academic departments and discrete discipline approaches to learning about innovation. They were not only about developing students’ practical teamwork skills, they developed an affinity towards different mental models and disciplinary practices. They anticipated that multidisciplinary exposure has potential to create new knowledge that would not occur in discrete disciplinary contexts. The anticipation was that well-functioning teams not only get along in daily activities but can also create a shared body of knowledge that is more than the sum of individual contributors’ own knowledge and skills (Karjalainen et al., 2009). This concerns both the creation and sharing of explicit, implicit and tacit knowledge, and especially so-called “embedded knowledge” within the teams (Madhavan, Grover, 1998). Embedded knowledge can be defined as a result of the combination of team members’ tacit knowledge that is potentially created as soon as members get together. This type of knowledge is inherent in well-functioning teams; it is collective knowledge that cannot be held efficiently by individual members. Karjalainen and his colleagues in Helsinki understood that the better the learning team members’ mutually recognize and acknowledge their roles, strengths and limitations as well as their practices and thinking models, the more purposeful embedded knowledge is created as project outcomes and the greater the satisfaction of external collaborators. Furthermore, the sensitivity to generate embedded team-specific knowledge, or what could also be called multidisciplinary knowledge, can be nurtured through project-based learning. Embedded knowledge that a team possesses is transferred to “embodied knowledge” in the new product that the team develops (Madhavan, Grover, 1998). How successfully the embedded knowledge transfers to embodied knowledge is a function of how well the product meets the intended goals, and is a central challenge of multidisciplinary teamwork.

**Extended disciplinary framework**
An extended figure of the disciplinary framework is included here to help interpret the findings from the case studies in the section above. The authors use this figure (2) to
highlight the relevance of the meta-level features that are reinforced by data and the experience drawn from the cases, indicated as text blocks in grey-scale highlights.

### Similarities and Differences of the Disciplinary Dissolve (continued)

<table>
<thead>
<tr>
<th>Inquiry</th>
<th>Character of the Designer</th>
<th>Character of the Discipline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pluridisciplinarity</td>
<td>This problem-solving mode combines disciplines that are already related, such as design and engineering. Some of the various domains in design itself involve pluridisciplinarity.</td>
<td>An understanding is demonstrated of a combination of disciplines that are already related in the various domains within design itself.</td>
</tr>
<tr>
<td>Metadisciplinarity</td>
<td>This mode connects history/theory and practice so as to overcome specialization; it seeks to develop an overarching framework that differs from disciplinarity in that it does not address single problems.</td>
<td>An understanding is demonstrated that shows an effort to overcome disciplinarity by using methods to construct overarching frameworks to connect practices and their histories to new problems.</td>
</tr>
<tr>
<td>Alterdisciplinarity</td>
<td>Globalisation and the proliferation of the digital results in connections that are no longer &quot;amid&quot; systems, cannot be measured &quot;across systems,&quot; and do not encompass a &quot;whole&quot; system. Instead, the digital has generated an &quot;other&quot; dimension so that we might now need to consider &quot;alter-disciplinarity.&quot;</td>
<td>An understanding is demonstrated that shows an ability to make connections that generate new methods to identify &quot;other&quot; dimensions of design activity and thought.</td>
</tr>
<tr>
<td>Undisciplinarity</td>
<td>Practice shifts from being &quot;discipline-based&quot; to &quot;issue- or project-based.&quot; &quot;Undisciplined&quot; research straddles the ground and relationships between different idioms of distinct disciplinary practices. Here a multitude of disciplines &quot;engage in a pile-up of jumbled ideas and perspectives. Undisciplinarity is as much a way of doing work as it is a departure from ways of doing work.&quot; It is an approach to creating and circulating culture that can go its own way without worrying about what histories of disciplines say is &quot;proper&quot; work. In other words, it is &quot;undisciplined.&quot;</td>
<td>An understanding is demonstrated that purposely blurs distinctions and has shifted from being &quot;discipline-based&quot; to &quot;issue- or project-based;&quot; an ability to mesh together jumbled ideas and methods from a number of different, distinct disciplinary practices that can be brought together to create new unexpected ways of working and new projects. Displays an &quot;anything goes&quot; mindset that is not inhibited by well-confirmed theories or established working practices.</td>
</tr>
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**Figure 2: Extended table of the disciplinary framework from Bremner and Rodgers (2013)**

### Conclusion

This research aimed to determine the transformational impact of Design practice on the innovation culture of a cross-section of organisations not used to the contribution of Design, to determine if this concurs with the existing disciplinary discourse on the role of design in society. The interpretation is that the cases provide evidence for a new interpretation of the role of design. The cases included a UK industry based KTP project with a subsidiary of a global corporate manufacturer, and three successive doctoral case studies with VCS, charities. All of these organisations had the aim of introducing design-led innovation capability to the organisation.

Case study analysis helped to derive a range of organisational features that were found to be required for the Design approach to move from an organisational level to a strategic then policy level, to effect transformational change in the organisations. A meta-analysis of these features indicated that the most significant in relation to the discourse about disciplinarity and the evolving role of Design in organisations were:

- **Trust:** which builds confidence and respect and furthers influence
- **Effective communication of design-led innovation processes and outcomes**
• The importance of interaction between disciplines facilitated through a Design approach.

Bremner and Rodgers (2013) argued that the boundaries of the historic disciplines of design have been superseded by a boundless space/time, which they called “alterplinarity.” That this explains the crises of professionalism in design, global financialization, and the rapid adoption of digital technologies. Their critique sees Design having to transform itself from a globalized state of culture.

The consideration of this research it to reject the discursive and categorical construction, even the fetishisation of disciplinary boundaries in the context of a global state, in terms of its relevance to the evolution of Design practice in organisational contexts. Consequently, this means that we cannot describe our approach as inter- multi- or undisciplinary, even though we draw on concepts, theoretical arguments and empirical studies written from existing disciplinary perspectives. Instead, we could describe our shared approach as post-disciplinary in its current intellectual implication. Our evidence seems to point to the growing value of Design as a ‘functional’ discipline within organisational structures. Hence, to Design’s capacity as a ‘para-discipline’; acting between, beside and beyond existing disciplinary categorisations. This concept is not entirely new, for example it was a conclusion of the Design for Service AHRC Workshop, where Kimbell and Seidel (2008) referred to Design as the inter-discipline. The authors suggest that the term para-discipline may be a more accurate, systematic interpretation from practice. To conclude, the observation of Richard Buchanan is apposite:

“Design does not have a subject matter of its own – it exists in practice only in relation to the requirements of given projects. The path of progress for the field is not defined by the next great unsolved design problem. Design is ‘integrative’ in that, by its lack of specific subject matter, it has the potential to connect many disciplines” (Buchanan, 2002).

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It is generally acknowledged that small and medium sized enterprises (SME’s) contribute significantly to a country’s economic performance. It is also generally acknowledged that it can be problematic to provide effective, public sector research, development and innovation support for SME’s given their size and diversity. It is also considered that vertical cooperation with customers and suppliers is more effective in new product development (NPD) for SME’s than horizontal co-operation with research institutions and government agencies. This paper discusses how higher education institutions (HEI’s) engaged in design research, can effectively support SME’s in NPD by actively participating in the design process whilst simultaneously working with SME’s to facilitate the development of knowledge networks local to specific SME’s, by acting as an intermediary. A number of design support schemes and specific SME, NPD projects undertaken by the author are used to advocate a participatory intermediation role for HEI’s in supporting NPD for SME’s.

keywords: SME’s; NPD; HEI; participatory

Introduction
Chiva and Alegre state:

Companies that manage design effectively and efficiently attain better performance than those that do not. Therefore, good design does not emerge by chance or by simply by investing in design but rather as a result of a managed process. (Chiva & Alegre, 2009, p. 424)

This statement is applicable to both large enterprises (LE’s) and SME’s alike, however it is generally acknowledges that where an SME is not of a size whereby it can readily invest in
design or a design management capability, that they are likely to be at a disadvantage in the early stages of the NPD process (Ford, 2016).

It is generally accepted that with increased availability and mobility of knowledge workers and increased access to a vast array of external suppliers via internet sources etc., that traditional innovation systems have been undermined and that innovation is taking place more and more outside of a single firm (Chesbrough, 2003).

In spite of increasing interest in open innovation networks, most studies on its effects have been centred on LE’s (Lee et al., 2010), indeed discussions on open innovation in SME’s appear to have been excluded from mainstream research (West et al., 2006). Simply open innovation can be more readily observed in LE’s as SME’s generally have a lesser ability to access external resource and have fewer technological assets to exchange than larger firms (Narula, 2004); for the LE this would be considered vertically integrated, operating from ‘a comforting, landscape of abundant knowledge’ as Chesbrough refers to it (2003 p. XXV).

However, in the current, fast changing global market, SME’s exert a strong influence on the economy of many countries (Zeng et al., 2010); the ability for SME’s to innovate and develop new products and processes are a primary source for economic growth and technological progress (Bruque and Moyano, 2007).

In the UK alone, figures show that (including sole traders) SME’s account for 99% of business, 55% of non-governmental employment and 51% of turnover (SBS, 2001). In 2015, this was estimated at a gross value of £1.754 billion (Rhodes, 2015), the manufacturing element accounting for £280 billion (Rhodes, 2015).

The innovation agenda for SME’s cannot therefore be ignored, however there appears to have been very few studies of innovation models that are specialised for SME’s (Lee et al., 2010), particularly as there is evidence of tremendous growth in the use of external networks by firms of all sizes (Hagedoorn, 2002).

In keeping with Chiva and Alegre’s comment on the benefits of effective design management in NPD, Hewitt-Dundas (2006) makes the observation that where SME’s have access to and seek external innovation partnerships in order to stimulate capacity for innovation, the results are positive in terms of NPD, and that a lack of innovative partnerships actually had a negative impact on innovation. Cumbers et al., (2003) identify that there are advantages to be gained from localised networks which are of particular importance to SME’s when offsetting the size-related advantages of larger firms. The impact of innovation networks on SME’s cannot therefore be ignored; indeed it would appear that the nature of innovation networks is critical in fostering innovation. For example, it has been noted, where relationships with customers, suppliers, service providers, etc., are vertically orientated, the results of these collaborations appear to yield a greater level of innovative output when compared to competitors who do not collaborate externally (Cooke et al., 2000; Kaufman and Todtling, 1999; Diez, 2002; Doloreux, 2004), very much in keeping with Chesbrough’s thinking on open innovation.

In 2002 Fischer and Varga undertook a postal survey producing data on innovation and inter-firm relationships and found that networking activities with these SME’s were indeed primarily based on vertical relationships (customer, supplier and producer service provider
networks) rather than on horizontal linkages (producer networks, industry-university linkages).

The nature of such networks is pivotal in how SME’s operate; external collaborations being more likely and required, in order to bring about innovation (given an SME’s size). As Bruno Latour describes in his discussions on Actor-Network Theory (ANT), these networks go far beyond a technical meaning, indeed he states:

*An actor-network may lack all the characteristics of a technical network – it may be local, it may have no compulsory paths, no strategically positioned nodes.* (Latour, 1996, p. 369)

In Latour’s terms these networks are complex, actors within these networks extending to the non-human and the non-individual (Latour, 1996); as Law describes (2009), these networks embrace both the material and the semiotic. This cannot be divorced from design and the NPD process, indeed Albena Yaneva (2009) effectively relates such actor-networks to the design of products and environments. So does this have implications on NPD for SME’s and the actors within the sphere of their activity (including designers) and the management of this by them or those acting on their behalf?

Pekkarinen and Harmakorpi (2006) note the often heterogeneous nature of innovation networks which may include actors from universities’ technology centres and development organisations, indeed Bulinger et al. (2004) and Becker and Dietz (2004) suggest that collaborations between universities, researcher institutes, suppliers and customers had a positive effect on innovation and the development of new knowledge. However there is some evidence that firms, including SME’s, are rarely interacting with universities and contract research organisations (Cooke et al., 2000).

**Vertical or Horizontal**

There appears to be a dynamic here between vertical and or horizontal innovation networks and the relationship with a variety of actors and SME’s and in particular what would appear to be horizontal relationships with HEI’s.

Zeng et al., (2010) make a compelling argument when they compare the findings of Cooke et al. (2000), Whitley (2002), Doloreux (2004) and Nieto and Santamaria (2007) and identify that there are significant differences in impact based on different types of network accessed by innovation firms. They make the point that vertical co-operation/collaboration with customers, suppliers, producers, etc., plays a more distinct role in innovation for SME’s than horizontal with cooperation with HEI’s, research institutes and government agencies, indeed they suggest that the significance of cooperation with research institutes, HEI’s and intermediaries with supporting SME’s innovation is less than could be expected.

So, where does this place HEI’s in terms of supporting SME’s and in particular HEI’s that undertake design research, and would collaborations in this context be deemed vertical or horizontal?

It is generally understood that research organisations, HEI’s and Technological Institutes have not traditionally focussed on filling out the innovation processes of firms but on providing them with new knowledge including the scientific and the technical (Lundvall. 1992; Drejer and Jørgensen, 2005). In this context relationships with industry might be
described as being horizontal, that is being an organisation that on its own volition generates new knowledge which in turn may or may not become of commercial value to an external party. It would appear however that this has changed in recent years with Governments encouraging institutions, including HEI’s, to undertake research directed at boosting the competitiveness of industry (Tether et al., 2002), but would this be considered as vertical or just another form of horizontal with a different emphasis; that is, independent research inspired by industry needs rather than just independent research? Simply, if such research, whatever the inspiration, is undertaken as a specific element of a project only and undertaken in isolation from other factors relating to the project as a whole, then this may be considered as horizontal. In terms of NPD, a vertical relationship would involve collaboration with clients, suppliers, producers and end users etc., necessitating a more holistic relationship with all concerned in the development of a product. As Miotti and Sachwald (2003) define, such vertical relationships have a more significant impact on both product and process innovation.

Design requires the understanding of a wide range of criteria in order to determine the best balance of compromise in effective NPD (Design being the art of minimising compromise); therefore, generally speaking, design research in the context of NPD necessitates a broad understanding of all the criteria pertinent to the development of a product which is inherently a vertical activity, which in turn raises an interesting question regarding the place and role of design research from an HEI perspective.

As Lee et al., (2010) suggest, open innovation occurs at all stages of a product’s lifecycle, from technological exploration through to full commercialisation. There would therefore appear to be a close correlation between the scope and role for design in NPD and scope for open innovation for SME’s within vertical relationships.

Intermediary or Broker

A considerable amount of literature has been produced relating to innovation and the roles of intermediaries in the NPD process. It was realised early on that ‘change agents’ could exert a powerful influence on the speed of knowledge diffusion and the uptake of new products (Hägerstrand, 1952; Rogers, 1962). As has been discussed, these dynamics are more easy to observe in the large vertically orientated companies than with SME’s, but given the certainty that an ‘open’ approach to innovation with SME’s is beneficial (Zeng et al., 2010), governments have carried out policy initiatives to promote innovation of the small firms sector as a source of radical innovation (Hewitt-Dundas, 2006), indeed a number of policy makers have been established to directly or indirectly assist SME’s undertake product process innovations (Smallbone et al., 2003). But government support hasn’t always been successful, in particular with regard to design support initiatives.

A UK, Department of Trade and Industry (DTI) report on a Government design support scheme in operation in the mid -80’s (the Funded Consultancy Scheme) came to the conclusion that this initiative had fallen short of the Design Council’s (the Government sponsored funding body) central objective – to ensure that design became ‘an integral part of corporate strategy and incorporated at all stages of product development’ (DTI Assessment Unit, 1988, para. 9). Later the researchers Roy and Potter were also critical that only a quarter of the 5000 funded projects remained unexecuted or ended with
disappointing commercial results (Roy & Potter 1990). Ford and Woudhuysen (2015) made the following observations:

*With manufacturer SMEs, then, publicly funded initiatives that include product design long ago met problems in embedding design, the communications that surround the design process, and the managing of design. So while the state can act as a broker of and a funder for the direct practice of design, introducing manufacturer SMEs to design consultants and paying for at least some of their work, these functions alone don’t guarantee success in NPD – and, still less, the absorption of design into a manufacturer SME’s overall culture. (Ford and Woudhuysen, 2015, p. 66)*

So it can be seen that the role of the intermediary and the broker is complicated with potential to be successful and less than successful; nevertheless research suggests that open innovation is of considerable value to SME’s and that intermediated networks can be an effective model in aiding collaboration (Lee et al., (2010) and therefore innovation. Hargadon and Sutton (1997) from their study of the consultancy IDEO stress that brokering is more than just a linking role, but helps transform the ideas and knowledge being transferred, that it can be active in the process, even generating new knowledge. Indeed this hails back to the works of Nonaka and Takeuchi (1995) and the interplay of both tacit knowledge, held by individuals, and formal, explicit knowledge. In particular when there is interplay between the tacit and the explicit and vice versa, firms can benefit from this ‘knowledge spiral’ and acquire ‘organisational’ knowledge; therefore when carefully managed, this process can embed new knowledge within and SME (Ford, Wouydhuyysen. 2012), leaving a legacy. Howells (2006) makes the point that:

*Intermediaries are, therefore, not only providing immediate, ‘one-off’ intermediary services to their clients, but are also seeking to offer longer term, ‘relational’ innovation capabilities to them as well’, and that “these collaborations can last for periods of years, not months. (Howells, 2006, p. 724)*

Indeed Howell’s study suggests that intermediaries can provide a much more varied and holistic role for clients in the innovation process than has generally been acknowledged and actually “create new possibilities and within a system.

Howells also makes the observation that intermediaries often remain specialised around a specific activity but that the range of services and expertise expands over time. This notion of time affecting intermediary SME relationships is important as it implies the need for a more intimate role between intermediary, broker and SME.

Nieto and Santamaria (2007), referring to Hoecht and Trott (2006) state the innovation capacity of a firm is largely dependent on cumulative knowledge built up over many years of experience, and that Powell et al. (1996) state that network experience should be considered as an incremental learning process in two ways, firstly in terms of the technical learning of innovations and secondly, in terms of the management of collaborations. Cohen and Levinthal (1990) use the term “absorptive capacity” in a process orientated
context, to determine how fit a company is to innovate, suggesting that this ability is increased where there has been prior experience of the innovation process. Levitt and March (1988) make the observation that firms repeatedly engaged in an activity learn from these experiences and in so doing accumulate knowledge. As Nieto and Santamaria state:

All of the above leads us to argue that firms with experience of collaboration acquired through long-standing relationships are likely to enjoy better alliances, which in turn could have positive implications for innovation outputs. (Nieto and Santamaria, 2007, p. 369)

In Summary
To summarise, an argument has been made for the need for SME’s to engage in open innovation, possibly through knowledge networks (including those relating to ANT), possibly with the assistance of intermediaries, in order to gain market advantage. Indications are that vertical relationships with suppliers, sub-contractors, clients and end users are likely to be more effective in NPD for SME’s than just a horizontal relationship with research organisations and HEI’s undertaking technology based and similar research. The notion that design thinking and the design process can be readily aligned to a vertical approach to NPD and that the role of an intermediary, who is actively engaged in the process (not just facilitating links), can help an SME absorb and accumulate knowledge, either through direct influence or the through establishing and managing knowledge (organisational knowledge) networks, has been discussed.

The issue of time has also been discussed and the merits of long term relationships in the building of knowledge and to provide time for the embedding of that knowledge. The question has been asked, where does this place HEI’s in terms of supporting SME’s and in particular HEI’s that undertake design research, and would collaborations in this context be deemed vertical or horizontal? In this context, this paper presents the work of the Design Unit (RG), a design research group, operating out of De Montfort University (Leicester, UK) as an example of how:

- Vertically orientated design research and innovation can be embedded into the NPD strategies of SME’s
- An intermediary can act as an effective knowledge broker in the NPD cycle and in the management of knowledge networks and also play various ‘actors roles’ within the process
- Embed organisational knowledge within an SME as a lasting legacy of the NPD process
- Time is significant in relationships with SME’s

The findings in this paper are therefore observational, based on a number of Design Unit (RG) projects undertaken in recent years and in particular observations on the relationships with related actors and networks. In particular this has afforded an opportunity to observe interplay of both actively designing in and actively managing the design process; what might be considered a Design or Design Management relationship with SME’s.
The author of this paper therefore acknowledges a close relationship to the findings, but nevertheless hopes that these observations make for valid insights.

Briefly, in the next section, the paper will consider:

- The nature of the Design Unit (RG)
- The RG developed knowledge networks
- Short case studies illustrating network links
- Impact

The Design Unit (RG)

RG is a design research group now in its 25th year which has undertaken a wide variety of design research projects for SME’s, large enterprises (LE’s), local government and other research bodies. RG is therefore in a position to undertake and perform design innovation, manage projects and forming a research perspective, reflect on these undertakings.

Projects have ranged considerably in scope but generally about 80% (either directly or indirectly) of RG’s activity revolves around product design research interventions for private sector SME’s and LE’s. In recent years RG has seen significant growth activity funded by research councils.

Prior to 2004 RG had responded solely to private sector inquiries, briefs and specifications being supplied by these companies (owners, directors, project managers etc.). Generally speaking RG was being used as a conventional design consultancy or consultants in design research and forecasting. In essence and by default RG was operating as a collaborator within a vertical structure of NPD on behalf of the SME’s and LE’s they collaborate with.

From 2004 to 2012 RG managed to lever funding from regional development agencies (RDA’s) to design, establish and run regional, design support schemes (see Ford, Woudhuysen, 2012 for more detail), briefly, these are described as follows:

**Scheme 1**

Funded by the East Midland Development Agency (EMDA), Scheme 1 ran from 2003 until 2007. 180 companies were approached, 52 possible projects were identified and 16 were subsequently funded. RG did not undertake any product development tasks themselves but managed the projects, devised project briefs (with the client companies) and identified/sourced other collaborators into the individual teams and vertical NPD structures.

Overall 8 product design agencies, 2 engineering groups, 2 electronics developers, 2 prototyping houses and 2 trade plastic moulders were enlisted into the schemes and allocated to specific projects.

Generally speaking the core design stages of each project were fully funded by EMDA and all projects were developed from concept through to manufacture resulting in 12 products making it through to manufacture. Project durations were mixed ranging from 18 months to 6 years in two instances.

**Scheme 2**

Funded by the Manufacturing Advisory Service (MAS), Scheme 2 ran from 2008 until 2009. 65 companies were approached, 13 were subsequently funded. In this case RG undertook 6 of the projects with other actors being assigned to the remaining projects. Again RG
manged the projects, devised project briefs (with the client companies) and identified/sourced other collaborators into the individual teams and vertical NPD structures.

Overall 5 product design agencies (4 the same as with scheme 1 and 1 new agency), 1 engineering group, 2 prototyping houses (same as for scheme 1) and 1 (different to the 2 in scheme 1) electronics developer were enlisted into the schemes and allocated to specific projects. In addition 2 government funded regional innovation support agencies, 1 intellectual property group, 1 trade plastics moulder (different to scheme 1) and 1 trade toolmaker were co-opted into the scheme.

On this scheme the core design stages of each project were 50% funded by the MAS and again all projects were developed from concept through to manufacture resulting in 11 products making it through to manufacture. Project durations were again mixed ranging from 18 months to 4 years.

**Scheme 3**

Funded by the European Regional Development Fund (ERDF), Scheme 3 ran from 2009 until 2012. 110 companies were approached and funded to varying degrees. In this case RG undertook about 60% of the projects with other actors being assigned to the remaining projects. RG once more managed the projects, devised project briefs (with the client companies) and identified/sourced other collaborators into the individual teams and vertical NPD structures.

Overall 6 product design agencies (2 being different from schemes 1 and 2), 1 engineering group and 1 electronics developer (not additional to schemes 1 and 2), 3 prototyping houses (2 the same as for schemes 1 and 2 and 1 additional) were enlisted into the schemes and allocated to specific projects. In addition 2 government funded regional innovation support agencies (the same as scheme 2), 1 intellectual property group, 1 trade plastics moulder and 1 trade toolmaker were co-opted into the scheme (the same as for schemes 1 and 2).

On this scheme the core design stages of each project were fully funded by ERDF, but generally 65% of the projects were given a modest level of support with the remaining 35% being developed once more from concept through to manufacture, resulting in about 50 products making it through to manufacture in one form or another (the majority being from the 35%). Once again project durations were mixed ranging from 1 to 3 years.

**The RG Development of Knowledge Networks**

Overall, these schemes represent a substantial amount of design activity over a 9 year period; 140 projects with a significant number making it through to manufacture. A general observation is that that project supports of this type can result in protracted project lead times for SME’s.

“A deduction from this is that SME’s quite simply need more time and consistent M/I support (the ‘heavyweight manager’) throughout these, often protracted periods, to achieve a successful outcomes in NPD” (Ford, 2016, p. 10)
It is also interesting to note the number of players engaged in this period, (note, the actors listed in schemes 1 to 3 are the primary participants, in reality there were also a considerable number of minor players) these are as follows:

- Product design consultants: 11
- Engineering consultants: 3
- Electronics developers: 2
- Trade moulder: 2
- Trade toolmaker: 1
- Government innovation support bodies: 2
- Intellectual property specialists: 2
- Prototyping agencies: 3

The common denominator in these relationship’s though is RG, not only is it performing an intermediation role (Lee et al., 2010), but is actively participating in undertaking specific tasks in the NPD process (Howells, 2006).

**Short Case Studies**

To demonstrate the dynamic of these knowledge networks further, this section presents four short case studies relating to specific projects/client relationships RG have undertaken/engaged with in the past 5 years. In particular they will attempt to define (simply) the network of key players in each project scenario over a period of time. Finally these networks will be overlaid one against the other to illustrate the dynamic between projects. Figure 1 provides a key to the actors in the case studies.

![Figure 1 Key to Actors in the Case Studies](image)

**Case Study 1 – Medical Device Company (MDC)**

MDC was founded in 2004 when they set out to become a distributer of medical technology for critical care, operating theatres and other applications.

As this brought MDC into close proximity to clinical services, they were able to identify when leading clinicians had ideas and developments for new products in their infancy and could see opportunities for NPD from which they could generate their own products resulting from these collaborations.
Their first venture into NPD was the development of a Xenon re-breathing circuit, a product that manages the delivery of Xenon gas and the removal of CO2 to and from extremely premature babies to help minimise the risk of potential brain damage.

RG was recommended to MDC for design assistance by a government run medical device support group (MDS) in 2011; the project being to design and develop this circuit in consultation with MDC’s clinicians. RG worked with MDC to produce a patented design (P1) concept and 200 prototypes using a rapid prototyping (RP).

Electronics systems used in the monitoring of Xenon, O2 and CO2 in the system was also critical in the development; RG was able to direct MDC to an appropriate electronics collaborator (EC). Within 18 months the prototypes were on clinical trial, the results of which have been very encouraging to date; trials are still ongoing.

Based on this success, in 2013 MDC established its own in-house design team (MDC-IH) product development and regulatory activities have subsequently, largely been developed by this team including their own neonate nCPAP device (to help premature babies on a ventilator). Following the development of the infant Xenon re-breathing circuit; MDC have continued to involve the RG with the development of an adult Xenon re-breathing unit securing a substantial Small Business Research Innovation grant to achieve this (Grant 1).

MDC have subsequently ‘floated’ on the stock market and entered into a joint venture to develop the adult Xenon device with a USA based investment group (IG). See figure 2.

*Case Study 2 – Retail Display System (RDS)*

RDC are a 90 person SME who manufacture for the retail display industry, their clients include Wickes, Chanel, Lancome etc., essentially they manufacture check-out desks and concession displays. The retail display industry faces fast product turnarounds with stores being refitted every 18 months to 2 years. As most of the materials used in the construction of these products are based on painted or laminated medium density fiber board (MDF), the majority of these materials will find their way into landfill at end of life – the paint and bonded laminate fundamentally contaminating the base material.

These materials are also heavy, making for a significant tonnage of material going into landfill on an annual basis. This project was therefore to develop a light weight construction approach for retail display systems that does not require painting or laminating of substrate materials.

RDC were introduced to RG through the scheme 3 Europe funded design support project being managed by RG. This scheme funded initial concept work leading to a patent (P2)
application (granted in 2015) for a novel, method of retail display construction (based on a tensioning system) that was indeed light, strong and did not require significant bonding and painting.

Innovate UK funding was obtained (Grant 2) to develop the product further to full sized working prototypes for evaluation by Wickes and Chanel. A rapid prototyping house (RP) was used to produce a number of components for the prototype. Tooling company (T1) and plastics moulding company (M1) were used to manufacture injection moulded sets of the tensioning system.

To determine the carbon footprint of the new system, collaboration was developed with specialists in life cycle analysis (LCA). The system is currently undergoing functional testing with Chanel and Wickes. See figure 3.

![Figure 3 Case Study 2 – Actors/Knowledge Network. Source: The Author](image)

**Case Study 3 – Using 100% Recycled Plastic in Digital Phones (DP)**

DP is a large UK based multinational operator of telecommunication networks. As part of their corporate sustainability initiatives DP needed to determine how to design and manufacture plastic products from the outset when having to use 100% recycled material.

DP approached RG to determine these parameters based on actually designing and then injection moulding a prototype for a new digital phone design. Initial investigation revealed opportunities for sustainability gains beyond just using 100% recycled material; this required developing semi-working electronics to incorporate within the mouldings. This necessitated collaboration with an electronics collaborator (EC), in addition to collaborations with toolmaker (T1) and plastics moulder (M1).

A number of working prototypes were produced which were subsequently destruction tested at testing house (TE1) and then environmentally (rapid ageing) evaluated at testing house (TE2). Again, as with case study 2, a life cycle analysis of the new design proposal was undertaken by LCA. See figure 4.
Case Study 4 – Air Redistribution Medical Bed (AMB)

AMB manufacture air redistribution mattresses that help prevent the occurrence of pressure sores for patients who, due to illness, are confined to bed for long periods of time. These mattresses are controlled by a bed side mounted compressor linked to a manifold and valve system that sequentially inflate and deflate to create undulations under the patient. AMB have been manufacturing these systems for a while, but generally the casework designs for the compressor and manifold are old and very expensive to manufacture. In addition the need to replace these caseworks with more cost effective solutions, there was also a requirement to innovate a new CPR coupling that could easily deflate the mattress in the unfortunate event of heart attack.

AMB was introduced to RG by the medical device support network (MDS) as part of RG’s scheme 3 design support initiative. This resulted in RG undertaking a modest amount of concept design work for AMB under that scheme. During this time it became clear that the entire range of mattress compressor manifold systems and CPR valves needed redesigning, this was a significant amount of work; it was also clear that AMB’s managing director was too thinly stretched to have the time to project manage these new designs.

Ultimately this led to a body of design research support beyond the scope of scheme 3. AMB managed to obtain a substantial Regional Growth Fund (RGF) grant for this activity (Grant 3). In addition a 2 year Innovate UK, Knowledge Transfer Partnership (KTP) (Grant 4) to develop and embed a design and NPD resource within AMB.

Full design, prototype and production development was undertaken for a number of compressor/manifold cases and patented (P3) CPR valve systems requiring collaborations with two plastic moulding companies (M1 and M2) and toolmaking companies (T1 and T2) in addition to collaborating with an electronics collaborator (EC). See figure 5.

The KTP associate (KA) has now been fully employed at AMB and is working on the next generation of products.

In Combination

Figure 6 combines figures 2 to 5 (although simple) to highlight/map the influence of RG on all four projects over the four year period, again proving to be a common denominator, being both an active contributor and an intermediary between actors.
Figure 6    Spread of Actors/Knowledge Networks Over Time for the Four Projects. Source: The Author

Evidence for Impact
As implied in the RG section, the style of this method of intervention would appear to be highly successful with a 75 - 80% success rate of products finding their way through to manufacture (Ford, 2016). In 2005 Lord Sainsbury commended RG’s scheme 1 project for achieving a 14:1 return on public sector investment (Sainsbury, 2005) through the development of new markets for UK design and manufacturing companies. In addition, following a 2014 Research Excellence Framework (REF) review of HEI’s research outputs including impact case studies, the Design Unit’s Design Supporting Business case study was considered as making an outstanding impact on SME’s in the Region, generating millions of pounds of increased revenue in addition to job creation (DMU Research Repository, 2014).

Observations and Conclusions
It can be seen from these case studies that a design research group such as RG can assist SME’s in being effective in NPD by acting and influencing at a number of different levels
and by exerting this influence over substantial periods of time. In these cases, RG has not only played the role of the design and development actor, leading to the generation of intellectual property and commercially viable products, but has assisted SME’s in establishing effective project briefs, developed networks (and actors) that overlap across a range of projects and worked with SME’s to manage the design and NPD process effectively.

Figure 7 illustrates how a group such as RG can place itself vertically in the NPD process working with the SME and their knowledge/supplier networks, generating IP and new knowledge in the process, as opposed to generating IP on the periphery (a horizontal relationship); this form of support being both of active participation in the process and with intermediation between actors across the process.

We can see here that over a period of time (Hoecht and Trott, 2006; Powell et al., 1996) a wide ranging (Chesbrough, 2003), heterogeneous group (Zeng et al., 2010; Pekkarinen and Harmakorpi. 2006) of actors has been repeatedly engaged (Nieto and Santamaria, 2007) in a series of related, local (Zeng et al., 2010) knowledge networks. The common denominator in all these relationships is RG, performing this intermediation role (Lee et al., 2010), and undertaking specific tasks in the NPD process (Howells, 2006). Operating out of an HEI, a group such as RG can be well placed to fulfil these roles over these periods of time and is in a position to engage in actor-networks effectively, not necessarily managing them (counter to ANT) but establishing threads of influence through them (see figure 7) to the mutual benefit of all the actors engaged. In these cases RG has had the opportunity to make tacit knowledge explicit to the SME’s involved, providing confidence to invest in their own design provision thus the embedding of organisational knowledge. Being able to simultaneously provide both design and design management expertise, a group such as RG can find itself in a unique position while working with an SME, to balance
the multitude criteria and actors in the NPD process making for successful outcomes at a number of different levels.

References


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Section 1.e
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To Create More Vivid Experience: Information Generation and Dissemination by Display Design in Urban Planning Halls

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This article focuses on the study of display design, with respect to its information generation and dissemination from the perspective of its audience experience. It takes as an example the information generation and dissemination by display designs in urban planning halls and analyzes them in three respects: attractiveness, intelligibility, and adequacy of information generation. It then develops the information experience-building strategy based on the emotional elements, judgment elements, and compound elements that constitute the experience. The study aims to form a feasible path to improving the audience experience of urban planning halls effectively, in terms of the provision of information, in order to enhance the attractiveness of its display design and make the public more willing to go to urban planning halls.

Keywords: experience; urban planning halls; display design; information

Introduction
Information is about how matter exists and the state in which matter displays itself (Wu, 2005). The design of information display is a link between exhibits and people, and the information needs to be sorted, processed, and transmitted to the audience according to the particular certain space and medium. The term ‘display design’ refers to the comprehensive activity of information dissemination, that is, the work carried out with regard to conveying the information intended by the expresser of it and making it understood by the audience (Shi, Ma, & Dong, 2005). As a location to analyze the generation and dissemination of display information from the perspective of the
audience’s experience, the planning hall serves as a real and vivid exemplar and is thus a useful place to conduct research. In addition, the information presented in the planning hall relates to the city, so the information about dynamic and complex urban development and professional planning can only be used to display information after being re-organized and optimized. The majority of us live and work in cities, so a city’s planning and development are closely related to our lives. Thus, as a research subject, the urban planning hall has significance in both a theoretical and a practical sense.

**Analysis of and Reflection on the Dilemma of the Urban Planning Hall during Rapid Urbanization**

**Current Development of the Planning Hall**

Driven by more than 30 years’ of reform and opening up, China’s urbanization has made important progress. According to the National Bureau of Statistics, China’s urbanization rate had reached 56.1% by late 2015 (Zhao, 2016). Along with the developing urbanization process, the promotion and display of urban planning and construction have increasingly gained the attention of society. The years around 2000 saw the rapid growth of the urban planning exhibition hall, a new type of professional venue, alongside urbanization. The urban planning hall is also known as the urban exhibition hall, urban planning hall, exhibition hall, etc. It is described in Ren’s Urban Culture and Urban Planning Design as having the important task of showing the public the guiding ideology, research findings, preparation process, planning blueprints, demonstration models, scientific indicators, implementation effects, and practical experiences of urban planning, enabling people to perceive closely what the plans are, what effects they will have on the city in which they live, and how life in the future compares with that in the past and the present, in such a way as to promote understanding of the plans and to encourage people to follow and take part in urban planning (Ren, 2012).

**Analysis of the Dilemma of the Urban Planning Hall**

First, thanks to the internet and to convenient and highly developed transportation, people may quickly and easily access the relevant information without having to go to the planning hall. Second, the vast range of cultural, leisure, and entertainment venues that have cropped up in recent years means that the public has an increased number of options, reducing the relative attractiveness of a trip to the planning hall. Another factor that cannot be ignored is the convergence trend, brought about by rapid urbanization, which has led to the unification of display design in many planning halls. This homogenization makes the visit tedious. The relatively short development history of this type of planning hall also adds to the natural shortage of management and operational experience in this respect, resulting in a lack of highlights in public education and social activities.

The above compound factors have resulted in limited public willingness to visit planning halls or recognize them as places to visit, which affects the halls’ role in serving the community.
**Experience-Oriented Coping Strategy**

Creating an experience is an effective strategy in response to a society stuffed with homogenization and the best way to create value, argues B. Joseph Pine in his famous book *The Experience Economy* (Pine & Gilmore, 2016). Pine refers to the experience economy as the fourth economic form, after the agricultural economy, industrial economy, and service economy, as shown in Table 1. The museum exhibition design has undergone a revolution from the spaces for displaying objects to the environments for visitors experience (Falk & Dierking, 2000). As Kirchberg argued, the most important thing might be that the museum experience has a much larger effect on the visitor than one might have thought (Kirchberg & Trondle 2015). In this context, display design, like other industries that make up this society, needs to adjust the coping strategies designed to meet the demand of social development. Display design is gradually transforming from a material-oriented design, centering on exhibits, which emphasizes formality, satisfies the function, and pays great attention to logic, etc., to a paradigm that is people oriented and which creates a positive experience.

### Table 1  Differences in Output between Different Economies (Pine)

<table>
<thead>
<tr>
<th>Economic output</th>
<th>Economic form</th>
<th>Economic functions</th>
<th>The nature of economic output</th>
<th>Main attributes</th>
<th>Supply mode</th>
<th>Seller</th>
<th>Buyer</th>
<th>Demand factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary products</td>
<td>Agricultural economy</td>
<td>Extract</td>
<td>Interchange-able</td>
<td>Nature</td>
<td>Bulk storage</td>
<td>bulk storage</td>
<td>Market</td>
<td>Features</td>
</tr>
<tr>
<td>Product</td>
<td>Industrial economy</td>
<td>Manufacture</td>
<td>Tangible</td>
<td>Standardization</td>
<td>Post production inventory</td>
<td>Manufacturer</td>
<td>User</td>
<td>Function</td>
</tr>
<tr>
<td>Service</td>
<td>Service economy</td>
<td>Deliver</td>
<td>Intangible</td>
<td>Customization</td>
<td>Delivery on demand</td>
<td>Supplier</td>
<td>Custome r</td>
<td>Interest</td>
</tr>
<tr>
<td>Experience</td>
<td>Experience economy</td>
<td>Build</td>
<td>Recallable</td>
<td>Individualization</td>
<td>Periodic presentation</td>
<td>Builder</td>
<td>Custome r</td>
<td>Feeling</td>
</tr>
</tbody>
</table>

The display design of a planning hall promotes a city’s planning and development and provides a kind of general education, mainly to show audiences the miniature model, data, text, graphics, and video images that reflect the city’s construction. There are generally no exhibits and works of art here that easily arouse people’s esthetic tastes or move them in the way that traditional museums or art galleries do. An experience-oriented design strategy may display the information of the planning hall in a way that meets the audience’s psychological and emotional needs, creating a more vivid information experience, giving the audience a unique, personalized experience, improving the attractiveness of the urban planning hall, and increasing its social influence.
Experience-Oriented Display Information: Generation Principles

On the basis of Pine’s description of the experiential economy, display design information should have personalized attributes that will give the audience a pleasant experience and bring them valuable memories. Organizing the display information of an urban planning hall requires orderly discovery, organization, and dissemination, rather than a simple list and straightforward narration. Such information may provide the audience with a better experience, but only after having been carefully generated and organized. The principles for the generation of display information in an experience-oriented urban planning hall would balance the information's various factors, incorporate cultural uniqueness, give expression to emotion, and provide an interpretation that is readily understandable. As Figure 1 shows, cultural uniqueness emphasizes the differentiated strategy of display design in a planning hall, mainly composed of cultural elements, cultural temperament, and cultural origin, which create the unique taste and image of the planning hall. The understandability of the interpretation, from a cognitive perspective, requires specific modes of information organization and structure, including dramatized narrative, simplification, and symbolization. The principle of emotional expression means that information generated should be interesting and pleasant while also leading visitors to reflect on the information.

![Figure 1 Planning hall display information generation principles model](image)

**Cultural Uniqueness Principle**

Uniqueness provides an important prerequisite for the identification of information as well as the basis for information differentiation. Only uniqueness can attract attention. Attention is the inevitable result of information processing with a limited capacity. The
number of objects we perceive in the world is far greater than the capacity of perceptual and cognitive processing of human observers. Therefore, in order to deal with the torrent of information, human beings can only selectively pay attention to some of the clues, while ignoring others (Solso, 2005).

Display space is not a standardized duplicate product, and uniqueness constitutes its charm in attracting people. The regional culture where a planning hall is located can form the unique quality required to display the design information of the planning hall. The urban planning hall, as an important place to reflect the planned construction of a city, will be affected by the regional culture of its location to some degree and will require that culture to be reflected. Tracing the understanding and application of the local regional culture, as well as the artistic reproduction of local customs, would be an effective way to shape distinctive information uniquely. The qualities of a regional culture with fresh features will better reflect the esthetic connotations and thematic interpretation of the display space. Figure 2 shows the design of an exhibition area in Huailai Planning Hall. It has a three-dimensional device with borrowed elements from the Octagon House, a famous local monument in Huailai. The information elements embedded in this Octagon House not only enrich the spatial effect of the exhibition area but also provide a unique cultural feature overall.

The information in this environment will be given a certain regional color, attribute, and meaning. For this purpose, the information generation of the display design for the urban planning hall calls for the rediscovery and application of the local traditional culture's image and spirit, to arm the display design of every urban planning hall with its own cultural origins and fresh attributes through the visual presentation and spiritual metaphor of the regional culture in the display space.

![Figure 2](image_url)

**Figure 2** Step 1 is to collect and classify relevant regional and cultural elements. Step 2 is to select a feasible element based on the first stage. Step 3 is to conduct a creative and visual design of the identified element.
**Interpretation Understandability Principle**

- **Information simplification.**
  The design of a planning hall needs to take into account the space of the display and the time limit of the audience. In addition, the content of the information has to be refined and summarized, so that the audience can quickly grasp the information displayed. The following two methods can be utilized: the headlining of information and flat information delivery. Headlining of information. The urban planning hall is a public open space. It should be considered that the general audience tends to visit once, spends little time on each visit, and cannot afford to spend too much energy studying the content displayed in detail. This requires that the information be refined and generalized. Headlining is an effective way of generalizing information to allow the audience to obtain the concentrated essence of visual information in a short time. It is important to note that this display method avoids the use of professional terms and uses generalized language to enable the audience to understand and accept the information more easily and quickly. Flat information delivery. This is based on an audience's linear visiting behavior. The hall is a space that audiences move through when visiting. The delivery of information as the audience proceeds through the hall enables the audiences to access the information dissemination points rapidly and sensitively. A complex, multi-layered structure should be avoided when organizing information to reduce the friction during information retrieval and increase information friendliness. In terms of the logical relating of information, significance should be attached to the relevance of the information and the efficiency of information dissemination. Furthermore, the audience's demand for mobile information needs to be satisfied and the differentiation and superiority of spatial information cognition needs to be maximally demonstrated.

- **Information symbolization.**
  Symbols may represent certain types of information and have become an effective means for cognition and communication between people (Xu, 2008). In cognitive psychology, information processing takes cognition to mean the processing of information in a system, with that process involving the collection, storage, recording, conversion, extraction, and transmission of the information. The information is stored in the form of symbols, and the way it is encoded and stored will greatly affect whether the information will be easily used in the future (Galltti, 2005). In the process of display design, information identification, coding, and dissemination are also focused on audience awareness.

  The important goal of design is to create symbology. The information displayed in an urban planning hall will require symbolized encoding and conversion because many professional planning terms and items of information are difficult for a general audience to understand. It is necessary for this information to be modified in such a way that the public can understand and accept it.

  With regard to the specific application of information symbols, it is important that the symbols used are instantly recognizable by the public at large and therefore should be those established by common usage, rather than symbols created by the subjective imagination of the designer. Experience-oriented information symbolization requires that information symbolization be considered in the current social context, allowing for
recognition of accepted symbols while combining with the current cognitive and esthetic goals, as well as with the actual environment of the urban planning hall. While reflecting authenticity and professionalism, this approach can improve the interestingness, esthetics, and readability of symbols to satisfy the cognitive requirements of non-professional audiences.

- Dramatized narration.

With regard to the individual information display, the next step is to have the audience interpret and understand the information, so selecting the appropriate narrative approach to the information may improve the audience’s cognitive experience. Dramatized narration and information exchange are very natural and rich approaches. A good story is often rich in plots, providing a stable carrier for the narration, on which experience can be built and experienced from multiple perspectives (Wurman, 2001). Dramatization is used for information generation in the planning hall to combine all the fragmented information into a coherent whole and can also link the audience’s understanding of the process by which the information is generated. Thus, the story is not only about the transfer of information but also about the active mechanism of making contact with different kinds of people (Quesenbery & Brooks, 2014).

The dramatized narrative is used to expand the display of information, the script being constructed with time and space as the background of the staging and information as the actor. It should be noted here that, for the visitors as the audience, listening to a story is not a one-way reception process. The visitors will create their own ideas in their own understanding of the story while listening and will think of their own life experience to establish imaginary links. By using the narrative approach to explaining the motivation or purpose of planning, the display information generated is presented in story form. The story’s narrativity may be used to trigger the imagination of the visitors, help them break through an intuitive leap of linear logic, and stimulate new imaginative thoughts to fill gaps in understanding.

*Emotional expression principle.*

Emotion forms our experience. It is a process that directs decision making, controls the attention, and strengthens some memories while weakening others (Gorp & Adams, 2014). Experience-oriented display information needs to take into consideration the psychological and emotional needs of the audience. When visiting the planning hall, the audience may easily become fatigued by the progress of time and physical exhaustion, gradually losing interest in the display information. Only display information that engages visitors emotionally can continue to arouse their interest, attract their attention, stimulate their perceptive desire, and leave a profound and beautiful memory.

- Pleasure.

To most visitors, the trip to an exhibition hall means having a pleasant time. The visit should provide a comfortable experience and enable visitors to receive the displayed information in a pleasant state.
Museums are visited for various reasons: they offer the chance to experience new things, they provide a learning opportunity, and they are interesting, entertaining, exciting, and relaxing places where friends can come together (Black, 2011). Generating interest is an important aspect of the display information, since it is a precondition of producing pleasure in the visitor; interesting information directly stimulates reception, which helps to maintain audience attention. In terms of creativity, performance techniques such as cartoons, humor, caricature, implied meaning, lyrics, etc., can be applied. With regard to visual design, such elements as shape, color, structure, texture, etc., can be utilized to make its character more novel and interesting.

Compared with other media, the display space of an urban planning hall has the advantages of greater space and a greater variety of media integration resources, which may be used effectively to create different forms of information generation in order to meet the audience’s needs.

- Leading to reflection.

Norman (2005) divides design into three levels: sensory, behavioral, and reflective. In general, instinctive design focuses on intuition, behavior design cares about pleasure of use and efficiency, and reflective design concerns rationality and intellectuality. Norman believes that the level of reflection places a higher demand on design and that only in the level of reflection will the highest capacity of consciousness, emotion, mood, and cognition exist. Only from here can the full potential impact of thinking and emotion be experienced. Interpretation, understanding, and reasoning all depend on reflective capacity (Norman, 2005). Falk thinks the museum visitor experience is constructed within the mind of the visitor and expressed in the form of visitor satisfaction and memories (Falk, 2016). The display information not only needs to provide a unique character at the instinct level, giving audiences more efficient information organization at the level of behavior, but also needs to satisfy the audience’s deeper psychological experience at the level of reflection. Furthermore, it allows for a certain social, profound, and philosophical significance, so as to stimulate the audience to conduct greater in-depth thinking and to retain a long-term memory of the display information.

To Create a More Vivid Information Experience: Communication Techniques to Display Design Information in a Planning Hall

Information can be delivered to audiences through a variety of media, and contemporary society provides a wealth of technical choices and resources for information dissemination. The adoption of the appropriate method of dissemination on the basis of the audience’s perspective constitutes an effective way of improving the experience. In this strategy, the first step is to determine the key factors affecting the experience and then to optimize the design. Jinwoo Kim, a design scholar, believes that three elements have a major impact on the experience, namely, an emotional element, a judgment element, and a composite element (Kim, 2015).

Although an experience is a holistic event that cannot be simply broken down into elements, it may be classified and modified by intervention and operation in terms of the experience-affecting factors to produce a specific impact on the expected experience.
Improving the Emotional Experience

It is believed in cognitive psychology theory that feeling is mostly the initial reaction of the five senses—vision, hearing, taste, smell, and touch—to the physical world (Solso, 2005). Kim argues that the emotional element is significantly affected by a sense of existence. That is, the strength of the sense of existence has a direct impact on the emotional element of the experience, while the sense of existence itself is mainly influenced by external sensory stimulation (Kim, 2015). Moreover, narrative, concreteness, and media richness provide effective ways to improve the experience.

From the perspective of display design, emotional experience is the instinctive response of the audience to the first stage of the context stimulus, such as color, lighting, morphology, sound, etc. Then, in line with the logic of information processing, the audience will respond instinctively to the stimulus; for example, a red display environment may be more likely to make people feel excited, while blue may make them rational, and so on.

The planning hall is a space that invites audiences to enter. Digital virtual or physical scenery can be applied, as well as other features, to design an immersive information display space to give the audience a multi-channel stimulus, and to take the audience into the intended narrative context. In the concrete context created by the rich media resources and technology available, the audience experiences the dissemination of the information. Figures 3 and 4 present one example of an entrance space design for a planning hall. There is an attempt to integrate a water element into the design theme of the planning hall. No detailed display information can be found here; it is more of an attempt to create an atmosphere or mood. Once the visitor enters the exhibition hall, a sensor responds and the lighting goes dark. An LED screen above lights up and plays a video, accompanied by music. A dynamic device around the wall simulates sparkling water, and through a set of mechanical devices, a sense of wind can be produced. This will allow the audience to have an integrated, multi-channel experience through the senses of vision, hearing, and touch. In this way, the visitor can be quickly acclimatized to the required visit state, that is, taken from the real world into the experience space.

Enhancing the Judgment Experience

The term “judgment experience” refers to the act of evaluating or judging, it is mainly reflected in function satisfaction and pleasure of use brought by the design (Kim, 2015). In the specific case of information dissemination of a planning hall, it means the audience’s judgment of the efficiency, quality, and pleasure of the information experience, which can
be optimized and enhanced by means of technical integration and participatory interaction. One of the directions in technology development is enhancement of the efficiency of tools. The advantages brought by technology integration can improve the efficiency of an audience’s information experience. The integration and coordination of technologies can be used breakthrough to eliminate the material obstacles to display information dissemination. Images, texts, videos, sounds, and objects can be combined organically with the help of innovation and the integration of technologies to increase the efficiency of information dissemination. A good example would be a sand table, principally used to show urban planning, that is organically integrated with intelligent lighting, images, sounds, and other different media. This enables the audience to have a more intuitive and faster understanding of the concepts, methods, and results of planning. Multi-channel integration renders the information displayed more stereoscopic, vivid, effective, and focused, providing the audience with an experience that is more efficient and pleasurable. Participatory interaction improves the quality and pleasure of an experience. Thanks to the highly developed internet and convenient mobile terminals, people are accustomed to actively controlling the choice and communication of information in a timely and convenient manner. Active choice is the distinctive feature of contemporary information interaction. In terms of information selection and value expectation, the experimenter achieves satisfaction and the pleasure of information interaction from the process of information dissemination. In this social context, when developing an information display, an interactive participatory experience is now both the norm and a requirement. This new behavioral trend must be recognized and satisfied in the information dissemination of a planning hall. The interactiveness of the information needs to be increased to meet the needs of the audience’s experience. Figure 5 shows a touch-query display system. The technical advantage of such a system is that it allows information that cannot be conveyed in the physical space to be stored and displayed in a digital way, which expands the capacity of information displayed virtually. Here, audiences can conduct in-depth inquiry, searching quickly and easily for the information of interest. This system not only allows for queries but can also sometimes set a number of theme-related questions and answers or interactive games, enhancing the knowledge and pleasure derived from the display. Figure 6 shows an interactive ride experience display system. In this system, musical effects and information feedback appear differently, in line with the audience’s changing pace, bringing the participant the experience of creating and controlling the information. During the interactive experience, the audience is drawn further into the context of the display information, leading to two-way information communication, producing information resonance, improving the cognitive effect, broadening the audience’s horizons, promoting thinking and imagination, enhancing memories of the disseminated information, and raising the quality of the information experience.
Harmony of the Composite Experience

The composite experience refer to the unity and coordination of various experiential elements, including human, goods, and environment. Coordination is the benchmark of the composite experience. The display information of a planning hall can be summarized as the time-space relationship and the relationship between the elements.

With regard to the time narrative of the display information of a planning hall, the context-matching and coordination of the history of the past, the reality of the moment, and the near future need to be taken into consideration. The time narrative calls for a combination of cultural value, social structure, and historical context under the present circumstances to carry out illation and innovation. In terms of information dissemination, balances need to be achieved on the proportion of display space, the content of the transition and transition, the way audiences behave and their habits, etc. For example, in practice, sometimes, in order to display as much information as possible, too much display information is presented in the available space, and the audience’s need to breaks is ignored, placing the audience in danger of being overwhelmed by the amount of information. With regard to circulation planning, great significance has to be attached to the audience’s reading habits, and the visit should be planned in a clockwise stream as far as possible to unify the order of the visit and the reading of the display.

In addition, the balance of relations among exhibits, information, space, audience, and other core elements needs to be unified to serve the common goal: the audience’s experience. At the peripheral level, there is a need to coordinate the environment, architecture, space, and display relationships. In terms of the internal display techniques and adoption of technologies, the element of human experience needs to be attended to in a comprehensive manner. Under some circumstances, the extensive application of new technology and new equipment in pursuit of novel effects will leave audiences confused about the visit and its operation, thus affecting the mood of the visit. There are other times when the atmosphere and effect of the space are overemphasized while the purpose of information dissemination is overlooked. As a result, the audience cannot understand the information and ideas displayed. Coordinating these contradictions entails thinking about how to deal with and handle them harmoniously.

There is no doubt that emotional, judgment, and composite elements that affect any experience are unavoidable, and sometimes their cross application, as well as their coordination and integration, is needed to improve the audience’s experience. The
advantages and limitations of various experiences should be analyzed and differentiated to provide a more appropriate selection strategy for information dissemination. Only with overall unity and coordination can we provide audiences with a better visitor experience.

Figure 7  Information generation and dissemination model.

Conclusion
Changing times bring new trends and requirements. In today’s China, every city is building its own planning hall. No doubt these facilities, built with huge investments of money, just like many other, similar museums, will face social service requirements and challenges upon completion and will ultimately be subject to testing by audiences. Whether an urban planning hall attracts an audience may, to some extent, be an important factor in determining how successful it will be. The urban planning hall is a relatively new type of exhibition hall that not only inherits history but also dynamically reflects the present society. In the society’s move toward the experience economy, information generation and dissemination of display design will conform to the needs of the society, changing from material-oriented displays to people-oriented experiences.

In terms of generating display design information, this means applying design principles that can create a more vivid visiting experience for the audience, constructing the information to be generated in such a way as to enable the audience to obtain a more vivid experience, and using the region’s unique culture in the planning hall to shape the uniqueness of the information conveyed. It is also important to engage the audience emotionally through the information presented in order to avoid tedium, while also ensuring the vividness of the information generated and pleasure brought to the audience. In light of the audience's diverse experiences and the planning hall’s visiting hours, the information may be organized through dramatization, symbolization, and simplification to allow the audience to grasp it faster and more effectively. The generation
of display design information for an urban planning hall provides the basis for the dissemination of the information. The means of dissemination are the conditions through which the information is presented to the audience. Design techniques for the construction of an experience-based environment may present information in a more relevant immersive space, so that the audience is given a positive information experience in a simulated scene. For a technical approach, new media and new technologies may be used for integration, fusion, and innovation, allowing the audience to have two-way interaction and reconstruction with the displayed information, in a way that improves the efficiency and quality of the audience’s information experience, thereby creating a more vivid urban planning hall visitor experience and attracting more citizens to the venue.

References

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Design processes for OBM firms in the NPD process

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For production-oriented companies such as original brand manufacturers (OBMs), management of the NPD cycle is essential to how their business functions. However, because these companies focus on R&D activities, engineering and manufacturing goods, they often see design as a small fragment of their product development cycle rather than as an integral part of the process. This paper investigates current design processes, identifying how each process is run by different businesses. Literature reviews and in-depth interviews are undertaken with key NPD project personnel from OBM firms and international brands, to evaluate firms’ current problems operating the existing processes. The findings show an overview of how the design process is carried out by various functional groups in OBM consumer electronics companies and international brands respectively. It is anticipated that contributions to this research will guide OBM firms’ activities in each process of design, and help to improve managing overall design practices.

keywords: design process, design in NPD process, OBM, product design

Introduction

Designers and non-designers in any organisation each have their own approach to the challenges faced by a company, and both have a particular set of skills, influences and responsibilities which affect how they approach design problem-solving. These differences influence the processes and methods which each party employs to approach the development of new products and services. For production-oriented companies, managers overseeing the development process are often primarily concerned with the elimination of defects and controlling production quality, rather than questioning what the most appropriate design should be. Each phase is therefore executed in the most
straightforward, logical, cost-effective and least time-consuming way. As a result, these production-oriented firms do not take full advantage of design, and truncate their product development cycles by minimising the design process, which tends to make it less rigorous.

This research investigates the existing design processes during new product development (NPD) in academia, professional organisations, international companies and OBM electronics firms. A design process can be perceived as a generic procedure to create a design, or as a sequence of activities and disciplines which occur while performing a design task (Clarkson and Eckert eds., 2010). In this research context, the perspective on the design process will be focused on the activities of each process of design and disciplines engaged in the design process. Design processes have been discussed by academics as the broader procedure of design or structure and graphical notation of the process, rather than focusing on providing insights into specific stages or activities at the practical level (Bobbe, Krzywinski, and Woelfel, 2016). It is therefore important to examine current processes to identify how each process is operated by companies which have different business backgrounds or levels of experience in design.

The existing design processes developed by academia have allowed professional organisations to efficiently and strategically follow the design procedure (Clarkson and Eckert eds., 2010). However, some researchers have shown that OBM firms continue to resist adopting design as a strategic tool and an effective process which allows the firms to achieve design goals ranging from problem definition, research, the understanding of customers and markets, ideas generation, design, prototyping, and evaluation to implementation (Brown, 2008; Hsu, 2009; Guo, 2010; Yan, Chiang & Chien, 2014). Other studies identified that those firms’ lack experience in design and internal resources to support executing design implementation could be a major factor which bring challenges and causes NPD project failure (Lewis & Brown, 1999; Anon, 2005; Berends, Reymen, Stultiëns & Peutz, 2011). Hobday (1995) and Wong (1999) note that only a few exceptional OEM firms have managed to transform into an OBM system, while the rest have struggled to generate new product innovations, build brand values or establish their own distribution channels (Kim and Nelson, 2000; Yan et al., 2014). To effectively move upstream to OBM design becomes an increasingly relevant factor, by consistently pursuing quality and continuously generating differentiating factors for the technologies, products, and branding (Tsai & Hung 2006; Lee, Kwak & Song, 2011). Since the role of design may result in new business practice, it would be beneficial to explore new approaches to performing design activities more efficiently and effectively in OBM firms. This study evaluates current design processes in OBM consumer electronics companies and seeks effective steps for companies working with external design agencies.

The importance of the study becomes evident when OBM consumer electronic companies are able to avoid common design problems during NPD. The study focuses on investigating the actual conditions of NPD design processes, examining how the design process can be more practical for OBM companies to use so that they can successfully achieve their goals. It is expected that this research will contribute to guiding both OBM firms and external design agencies to the generic procedure of design activities, to help improve overall design outcomes. The study aims to help OBM firms improve speed and efficiency, and reduce design management risks during the NPD process.
Only a limited number of in-depth interview researches has been completed on how OBM firms manage a design process which is integrated with their former product development process. Previous researchers have identified that it takes time for an OBM firm to make design integral to the organisation and that it may face challenges when inviting external professionals to develop design (Anon, 2005; Bolton, 2009; Lee, 2013). However, few studies have been conducted about design processes which manufacturers can use easily and effective ways to collaborate between OBM firms and design agencies.

Methods
This exploratory research uses literature reviews, in-depth interviews and case studies. Literature reviews concentrated mainly on acquiring in-depth knowledge about design in existing design processes from academia, professional organisations, international brands and OBM firms. To obtain a realistic view, in-depth interviews were undertaken with key NPD project personnel from international brands and OBM consumer electronic firms, to explore their current problems in operating the existing processes. It evaluates the suitability of existing design processes, examining whether their unfamiliarity with design processes makes it harder for OBM firms to use those processes adeptly during the NPD process. The paper also discusses co-operation between external design experts and OBM firms while considering their ability to manage the increasing complexity of design problems and the more practical level of the design processes which can help an organisation implement design effectively and efficiently.

Exploratory interviews with international brands and OBM consumer electronic firms were conducted to capture an overview of design procedures during the NPD process. To investigate a general view of design processes, this study explored three case studies of international brands and three OBM consumer electronic firms (see Table 1). In this research context, the term OBM (Original Brand Manufacturer) refers to a company that retails its own branded products which are either the entire products or component parts produced by a second company (Kim and Nelson, 2000; Bolton, 2009). The OBM-based business develops and sells the products under its own brand name. Transition to an OBM system also means that the company is responsible for the entire process: from production and development, supply chain and delivery to marketing (Bolton, 2009; Kim and Nelson, 2000).

These international brands share a similar attribute in that they are (1) consumer electronic manufacturing companies which are highly competitive in both design and innovation, (2) have an in-house team of designers and engineers and (3) have designed for over ten years to produce their own-branded products and succeed on the global market.

However, OBM consumer electronic firms share a common attribute in that they are (1) consumer electronic manufacturing firms which have transformed from OEM/ODM to OBM during the last ten years, (2) have no in-house design team or a team of fewer than five, and (3) have less experience working with external design agencies during the NPD process. In this research context, consumer electronic products refer to electric or digital products for daily use and other products, ranging from brown and white goods to mobile communication devices and office automation products. The in-depth interviews aimed to
understand a general view of what is currently happening in the companies and to identify frequent patterns and common deviations during the design processes.

Table 1: Case study descriptions

<table>
<thead>
<tr>
<th>Case study</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>A multinational corporation based in South Korea which manufactures a wide range of consumer electronic products and is regarded as a successful business model which transformed its business from OEM to OBM in the mid-1980s.</td>
</tr>
<tr>
<td>brand A</td>
<td></td>
</tr>
<tr>
<td>International</td>
<td>A company established in 1917, which formerly manufactured optical glass and microscopes and became a leading Japanese brand specialising in optics and imaging products, including imaging lenses, SLR cameras, digital SLR cameras, compact digital cameras, and waterproof film cameras.</td>
</tr>
<tr>
<td>brand B</td>
<td></td>
</tr>
<tr>
<td>International</td>
<td>A multinational electronic company based in South Korea which set up in business in 1958 and became the first company to manufacture electronic goods, such as radios, TVs, refrigerators, and washing machines etc. The company, initially OEM-based, transformed itself into an OBM. The company employs six hundred in-house designers in its headquarters and in facilities located globally.</td>
</tr>
<tr>
<td>brand C</td>
<td></td>
</tr>
<tr>
<td>OBM A</td>
<td>A South Korea based firm which has manufactured a broad range of multifunction printers, imaging products and office solutions since the 1960s. The company started its business by an OEM and ODM company subcontracted to the leading brands of Japan and the US and has recently moved upstream to become an OBM. The firm has no internal design division yet, currently relying on an external design agency.</td>
</tr>
<tr>
<td>OBM B</td>
<td>A South Korean manufacturer and supplier founded in 1973, widely known for its air treatment appliances including air purifiers and dehumidifiers and water products such as water coolers, water filters and filtration systems for home and the office environments. The business practice started from OEM/ODM for Electrolux and Samsung. The firm has five in-house product and graphic designers.</td>
</tr>
<tr>
<td>OBM C</td>
<td>A manufacturer of consumer appliances with headquarters and manufacturing facilities in South Korea; the firm manufactures a range of home appliances including air washers, ionic water purifiers, refrigerators and air conditioners.</td>
</tr>
</tbody>
</table>

Semi-structured in-depth face-to-face interviews were completed lasting approximately 50-60 minutes. The interviews were recorded and transcribed with participants’ consent. Transcripts were then analysed to discover future opportunities. The interviews explore the participants’ experience and specific events. Prior to each interview, data and information were gathered to understand each participant company. The literature review of academic design processes gathered retrospective data to develop an understanding of
the foundation of the design process. In order to compare and analyse different processes, it reviewed international companies’ design processes prior to their becoming OBM firms. The key reason which emerged is that international companies have a longer track-record of design and highly skilled in-house design teams. An OBM firm’s ultimate goal is to adopt and operate design processes like those of international companies, so it was necessary to review international brands’ current design processes to identify the broader processes which may be similar or distinct from those in OBM firms. In reviewing and analysing design processes for OBM firms, the aim was to clarify the distinctive attributes and weaker points in OBM firms, which can be further developed in future research.

An overview of design processes in the academic field

In academic researches and exploration of design processes, across a range of different products, generic product design has many similarities (Bobbe et al., 2016). Although analysis of design processes can include graphical notation, the shape of the design processes (i.e. diamond, V, U, circle etc.), iterative vs. linear notation, this study focuses on the number of stages and activities in each stage of the design process (Bobbe et al., 2016). Academically, the definition of design means problem-solving (Cooper and Press, 1995; Wallace and Clarkson, 1999), and thus developing design processes serves to provide a methodology of problem definition, research, concept generation, evaluation and implementation.

While design processes have periodically been well-defined from the early twentieth century to the present day, they follow a similar methodology or pattern which begins with defining problems, and goes on to solve problems (Hasenkamp, Adler, Carlsson & Arvidsson, 2007; Howard, Culley, & Dekoninck, 2008; Childs, Downie & Katz, 2001). Depending on the different disciplines focusing on the process stages, some models have been developed up to the design implementation stage, others only up to the design finalisation stage. It may therefore be surmised that the implementation of design is related to post-design activities, although in the academic field this may not be regarded as the most critical factor. However, in a context where the design process has a strong connection to industrial use, academic design processes are still impractical for companies to adopt, where it is not necessary to go through every stage of the process (Hollins and Shinkins, 2006).

The model Jones introduced in his book Design Methods (1970) is regarded as an example of modern design process which brought objectivity and rationality to the discipline of design (Holston, 2011). Jones saw that less practical traditional design processes often failed to resolve complex problems. Jones’s design process model has three stages: (1) divergence, (2) transformation, and (3) convergence. The main focus in the divergence stage is to extend the boundaries of design problems so that designers may explore and understand several dimensions of a problem. Creative action occurs in the transformation stage, turning complicated problems into a simple strong idea. The main goal of the convergence stage is to focus on a solution and reduce uncertainties until the best possible design is identified (Jones, 1992; Holston, 2011). The strength of Jones’s model is that it can be used for any circumstances requiring the generation of design ideas; its
drawback is that it may be too generalised and concise to share with non-design skilled groups.

Pahl and Beitz’s design process model (1984), which is regarded as an engineering method for the conceptual design of a new product, has five stages: ‘Planning and Clarifying the Task’, ‘Developing the principle solution’, ‘Developing the construction structure’, ‘Defining the construction structure’ and ‘Preparing production’ (Hasenkamp et al., 2007). This process is one of the models which include the implementation stage because of its connection to product and engineering-oriented processes. The term ‘concept’ in Ullman’s process model (1997) is defined as “an idea that is sufficiently developed to evaluate the physical principles that govern its behaviour.” This phase focuses on two specific design activities which generate, evaluate and improve concepts (Pugh, 1991).

Cooper and Press (1995) explored a five-stage design process model which includes ‘Define problem’, ‘Understand Problem’, ‘Think about problem’, ‘Develop idea’ and ‘Detail design and test’ (Figure 1). The five stages indicate how they develop their thinking and shape their ideas. Cooper and Press (1995) define this model as an internal creative design process, which is more oriented to the designer’s inner perspective rather than the context specific.

![Diagram](https://via.placeholder.com/150)

*Figure 1: The internal creative process of design (Cooper and Mike, 1995; The Design Council, 2007)*

Walker (1990) introduces a four-stage external productive design process (Figure 2), based on the core four broad phases and design activities which designers perform (Copper and Mike, 1995; The Design Council, 2007). Unlike other processes, this model has clearly specified design activity objectives at each stage. Hollins and Hollins’ design model expands Walker’s four-stage design process model into a ‘Total Design’ (Figure 3), which progresses from market research to production level and environmental monitoring (Cooper and Mike, 1995).
Figure 2: External productive process of design by Walker, 1989 (Cooper and Mike, 1995)
The Design Council researched Western European and United States leading companies’ common design activities, where design is used as a strategic tool and business method for their products and services (The Design Council, 2007). The design process model in Figure 4 shows a double-diamond shape which incorporates the need for widening and constraining during the design process. The model illustrates the iterative nature of the design process, repeating the process of divergence and convergence. It shows a similar pattern to John’s model which is a generalised concise process to be shared with non-design skilled groups.
Erat and Kavadias (2008) noted that existing product development systems became slower and inadequate due to rapid changes in the industrial system or environment. These changes include various aspects including engineering technology, software, or industry practice etc., (Unger and Eppinger, 2011).

The literature review revealed that design processes in academia are developed into academic debates and generated to support designers, business professionals, engineers in the organisation in improving the effectiveness of practical design work through using, tailoring and managing the process to meet particular aims. However, it is difficult to generalise about a range of design processes because they provide recapitulative tasks or broadly-defined design activities. It is, however, useful for designers who are familiar with design activities and where paths and requirements are specifically defined. Although the core of the design process structures is similar, there is no indication of the duration of the process, the scope or the participants. An organisation with non-designers and novices may it find challenging to apply academic models to achieve design goals effectively and efficiently.

**Design processes in business**

The priority needs of design in business are to generate profit and gain competitive advantage. Effective use of design and management of its process can thus contribute positively to business performance (Berends et al., 2010). To maintain a competitive advantage, organisations try to attain in the areas of innovation, speed to market, risk management, and an effective work process (Holston, 2011; Westcott et al., 2013).

A design project often requires aligning people from different industry backgrounds, gathering information, and thinking creatively. The role of the design process is to function as a blueprint for the project team, and enable a designer to reach the design solution which enables the organisation to achieve a specific goal (Holston, 2011; Preddy, 2011; Westcott et al., 2013). A design process enables an organisation to understand which roles to hire and how to identify skill gaps, to achieve its goal successfully (Holston, 2011; Preddy, 2011). It will both guide designers through the generic procedure of design.
activities and help improve overall design quality. Best (2006) states that a design process is the specific series of events, actions or methods by which a set of procedures is followed in order to achieve an intended purpose, goal or outcome.

Design processes in business are set in the middle of new product development (NPD) process, so it is important to examine what the design process itself is like, how the design process starts, and when it happens and ends throughout the entire NPD process.

**Design processes from international brands during the NPD process**
Collective design processes have been explored and developed both in academia and in the business environment. As companies have realised that design is a key factor in differentiation in the market, by creating added value to products and services, professionals have continuously modified and adapted design processes to improve quality and efficiency in their organisations (Kanno & Shibata, 2013).

Processes allow organisations to understand workflow, information, communication and project control, enabling them to deal with problems more quickly, increase quality, minimize failure, and ultimately create value for the customers (Holston, 2011). Activities in each design process stage are also extensively employed from problem definition, research, understanding customers and markets, ideas generation, design, prototyping and evaluation to implementation (Brown, 2008).

In the business environment, it is common to have a well-defined linear process format, which enables the organisation to control outcomes by managing uncertainties and risks (Cooper & Press, 1995; Best, 2006; The Design Council, 2008; Preddy, 2011). It can identify more efficiently where duplication of effort exists and find areas which are being overlooked (Bruce & Morris, 1994). Organisations often have no absolute design process model, though this varies according to the product type, product lifecycle, organisation culture, the project budget etc., (Bobbe et al., 2016).

While Company A has several design processes, Figure 5 shows one of the standardised models. In a large organisation a design process is influenced by several different factors: the product life-cycle, manufacturing methods and the personnel involved at a particular stage of the process. In Company A’s case, the three different types of design processes focus on the consideration of development duration and market release of new products. The model in Figure 5 is used for developing new products to be launched within two to three years. Within the entire NPD process, the design process is usually eight to twelve months, so the internal design team or product planning team spends only a moderate time preparing and planning the project scenario (Table 2). The project scenario comprises a project overview, problem definition, the project goal, objectives, a business overview, a target audience review, competition and competitive positioning, the schedule etc., The design process takes place over about a year, so the internal design team prioritises conducting the target consumer research and extensive market and commercial analysis.

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*Table 2: A summary of the disciplines and teams of international brands which involve in the NPD process*

<table>
<thead>
<tr>
<th>Stages</th>
<th>Cases</th>
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<tbody>
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<td>Company A</td>
<td>Company B</td>
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<td>Company C</td>
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<table>
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<tr>
<th></th>
<th>Planning</th>
<th>Create T/F team</th>
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<tbody>
<tr>
<td></td>
<td>Product Planning or Design</td>
<td>Product Planning or In-house Design</td>
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<td>Initial design dev.</td>
<td>Design</td>
<td>Design</td>
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<tr>
<td>Design embodiment</td>
<td>Design</td>
<td>Design</td>
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<tr>
<td>Prototype</td>
<td>Design</td>
<td>Design, R&amp;D</td>
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<td>Quality control test</td>
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<tr>
<td>Production planning</td>
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<tr>
<td>Functional/mechanical test</td>
<td>Design, R&amp;D</td>
<td>Design, R&amp;D</td>
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<tr>
<td>Mass production/launch</td>
<td>Design, R&amp;D</td>
<td>Design, R&amp;D</td>
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<tr>
<td>Marketing, advertising</td>
<td>Product Planning, MKT, Sales</td>
<td>Product Planning, MKT, Sales</td>
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<td>Packaging design</td>
<td>Design</td>
<td>MKT, Design</td>
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<td>MKT, Design</td>
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The process model in Figure 6 shows a similar procedure to Company A’s design process model, however the second stage of the process in which the T/F team is created is unique to Company B. The only difference between the models in Figures 5 and 6 is the various disciplines involved at the early stage, which means that the general NPD approach may be different. The personnel who have completed the first stage will become responsible for leading an NPD project and create a T/F team appropriate for the development of the new product. The T/F team is typically a multi-disciplinary team encompassing product planning, product design, marketing and sales, R&D engineers, system engineering, manufacturing and production control, quality control etc., (Ishihara, 2016). Once the project plan is clearly defined and shared with multidisciplinary teams, the design team carries on the next phase to visualise the business plan in a more clear and tangible form. In the third and fourth phases, the internal design team leading the phases becomes a touch-point to communicate with other members.

Company B considers the two early stages as pre-project stages and the most important, time-consuming stages. The first and second stages require sufficient communication to support all team members to understand the process from the earliest phase to production level. Depending on the initial team, the overall NPD approach achieves change and a different result. A few years ago, this company started to reshape the current process model, inviting external design consultancies at the outset of the two stages of the process. Having an external design team more actively involved in the early stages allows the internal organisation to break out of the silo and prevents the internal team from exclusively defining creativity. The remaining stages of the process will be carried out by internal teams or by a combination of in-house and external design teams.
In Figure 7 Company C’s two distinctive approaches reflect customers’ point of views: (1) a customer-following approach and (2) a customer-leading approach. A customer-following approach reflects customer needs in the product concept brief stage, whereas a customer-leading approach depends entirely on insights into customers’ latent needs. Company C’s process model (Figure 7) has some similar procedures to Company A’s, because the major purpose of both process models is to implement a design to production level.
In the early stage of the process, either the product planning team or the internal design team plays a pivotal role in defining the new product requirements. The major role is to conduct market and consumer researches, and analyse and discover new insights. However, the company starts to take advantage of a design team at a more integral and strategic level, encouraging the design team to engage with every stage of development from start to finish. It aims to improve the actual design process by allowing a design team to involve a broad spectrum of NPD processes to consistently seek different objectives and needs at each stage, rather than operate as generic procedures.

**Design processes from OBM consumer electronic companies during the NPD process**

Transformation to the OBM business model indicates that a firm has made the break from subcontract manufacturing and is now producing and selling products with its own brand name through its own distribution channels (Lee, 2013). It enables OBM firms to reach out to a global audience, lead higher sales volume and ultimately drive greater growth and expansion. In order to compete with international brands, it is imperative for OBM firms to enhance NPD productivity to obtain sustainable competitive advantage in the market (Holston, 2011; Chang, Kim & Joo, 2013). However, due to the nature of OBM firms, a NPD project is often highly constrained by budgets and time. Furthermore, the organisation’s R&D and engineering oriented culture adds its own constraints to the process for product quality and safety. It drives each process to develop rigorous verification and validation, eventually making the overall design process less flexible and effective.

**Table 3: A summary of the disciplines and teams of OBM firms involved in the NPD process**
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<th>Cases</th>
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<td>OBM A</td>
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<td>OBM B</td>
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<td>OBM C</td>
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<td>Planning</td>
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<td>Product planning</td>
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<td>Product planning</td>
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<td>Create T/F team</td>
<td>R&amp;D</td>
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<td>Product planning or Design</td>
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<td>Product planning or R&amp;D</td>
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<td>External design agency</td>
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<td>In-house or external design agency</td>
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<td>Design embodiment</td>
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<td>In-house or external design agency</td>
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<td>Prototype sample 1, 2</td>
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<td>R&amp;D, In-house design</td>
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<td>R&amp;D, In-house design</td>
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<td>Mechanical engineering</td>
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<td>specification</td>
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<td>Product dev. planning</td>
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<td>Marketing, Ads</td>
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<td>Packaging design</td>
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Furthermore, for OBM firms where the role of R&D engineers is predominant during the NPD process (Table 3), product quality, verification, safety and validation are also fundamental drivers in the design process. Clarkson and Eckert eds. (2010) discovered that current design processes used by OBM firms are similar to the engineering design process and the product development process. To ensure business survival and growth, the firm needs to expand its scope of experience and knowledge from a manufacturing and R&D engineering base to design and brand management which deliver differentiation and increase value augmentation (Yan et al., 2011; Lee, 2013).
The early stages of the design process in Figure 8 are completed by the R&D engineers by developing mechanical engineering specification (Table 3). After the first and second stages in Figure 8, OBM A invites an external design consultancy to design a new product. It is debatable whether starting to perform design activities after defining new product specifications is the most effective way to achieve successful NPD. The designers’ major skill lies in understanding customer needs and rapidly capturing market trends and translating them into a tangible form (Clarkson et al., 2010). However, in OBM A’s case, this limits its full potential. In the fact that the core attributes of a manufacturing-orientated company are speed, efficiency and predictability, from the initial concept right through to production. Stringent control of production costs is critical to business success. Companies are therefore often unwilling to bring in an external design agency until after their own team has defined a specific measurable problem which their own team cannot resolve internally. It narrows the designer’s scope limiting their skills to making the most of existing issues rather than approaching a problem in an open and engaged way. This happens to both OBMs B and C, where the entire NPD process is driven by a R&D team (Figures 9 and 10).

Figure 8: OBM A’s design process model in the NPD process

OBMs B and C have in-house design teams whereas OBM A depends entirely on external design agencies (Table 3). OBM A faces three current design challenges:

1. The internal NPD task force team lacks professional design skills and does not understand the design process
2. The firm has no design experience of designing and producing its own product
3. The organisation lacks resources for managing the design process
4. The design process is highly constrained by cost and time

Some of these challenges are still relevant to OBMs B and C, despite already having enough resources and design experience.
Design processes require management at several levels and the organisation needs to be managed strategically (Clarkson et al., 2010). Former studies, however, have argued that when a non-design skilled organisation co-operates with external design experts, many barriers need to be resolved to achieve successful results (Bruce & Morris, 1994; Bruce, Cooper & Vazquez, 1999; Lewis & Brown, 1999). Researchers also found variable quality of outcomes between the companies with design experiences and those which did not already have them (Bruce et al., 1999). A company without personnel responsible for the
design process may achieve a poor-quality design outcome (Cooper & Mike, 1995; Bruce et al., 1999; Lewis & Brown, 1999; Berends et al., 2011).

This research outlines the difference between design processes in academia, international brands and OBM firms, showing how the process can be achieved. It demonstrates that the existing design processes follow the basic design process framework from academia, comprising a sequence of activities from problem definition, research, understanding customers and markets, ideas generation, design, prototyping, and evaluation to implementation. Depending on the different disciplines focusing on the process stages, some models have been developed up to the design implementation stage, whereas others end at the design finalisation stage. Furthermore, different disciplines with different roles seek different objectives, so the design process can be driven either by the process of design thinking and its implementation or by engineering and manufacturing technology. While companies with a strong in-house design team (Table 2) adopt similar design processes from academia (Figures 1 to 4), OBM firms relying on external design agencies to carry out design activities (Table 3) were less likely to adopt design processes and more dominated by engineering and production based processes (Figure 8 to 10).

The major differences between international brands and OBM firms are the involvement of cross-functional teams in design process. Some researchers have argued that allowing the effective implementation of cross-functional teams is critical to new product success (Kim & Kang, 2008). For OBM firms to achieve effective implementation of the design process, rigorous management is required of the different teams’ involvement and appropriate objectives must be clearly stated at each stage. Collaboration between internal cross-functional teams and external teams from the early stage NPD process allows both parties to play a vital role in generating new ideas and the formation of an appropriate design strategy. External design consultancies are able to examine an OBM firm’s market, competitors, existing products and consider the customer’s perspective. This insight helps a company conceive the type of products and services they should be developing, to set a focused and appropriate scope of the work. It is therefore crucial for external design agencies to step in early in the process, to understand how the company's strategy was developed and find unanticipated ways to represent their strength and value.

Conclusions and the need for further research
The aim of this study is to understand the design process operated by international companies and OBM firms during the NPD process. Academic research on design processes helps to build an understanding of basic design processes; however, all models follow the recapitulative design framework which results in models which are difficult to generalise. While some models from international brands adhere to the fundamental design process notion, some variables may be based on the organisation’s specific conditions: product lifecycle, manufacturing methods and personnel involved at particular stages of the process and etc.

This research indicates that it is essential for companies to improve their understanding of the design process in order to commission work effectively from an external design agency. For most OBM firms, overconfidence in their R&D capabilities and novel manufacturing expertise can be particularly damaging to their NPD process. If companies do not manage a full design process, they will continue to produce mediocre products.
which make little impact in their market. Companies must take full advantage of designers’ skills, from unlocking insights to challenging consumers’ future behaviours, in order to create truly innovative products which deliver real commercial benefits. This study contributes to the literature by adding findings in process in the practical context of manufacturing-oriented companies to collaborating with either internal design team or external design agencies. The study found that still manufacturing-oriented companies (based in Asia) relying on to the traditional design development processes which mechanical engineering specification occurs before the design process, constraining possible design outcomes.

This study has found some limitations and makes future research suggestions. The small sample sizes limits the research to generalised findings. However, the case study approach collected data by conducting in-depth interviews, which enabled an understanding of intricate issues. The next step is to continue to conduct in-depth interviews with OBM firms and gather further information about their current design processes. The primary goal is to identify current design processes and define the role of the in-house design team during the NPD process. If the firms rely on external design agencies to collaborate with internal NPD project teams, further study of design processes should include design agencies which are experienced in working with both international companies and OBM firms. Design agencies’ successful and failed experiences of collaborating with client companies would provide a clearer understanding of where OBM firms need to make improvements or implement countermeasures in their design processes, and identify the ideal role of each functional group in the NPD process.

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A study of practice based design research models from knowledge integration perspective

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The transformation of China's design innovation industry has highlighted the importance of design research. The design research process in practice can be regarded as the process of knowledge production. The design 3.0 mode based on knowledge production MODE2 has been shown in the Chinese design innovation industry. On this cognition, this paper establishes a map with two dimensions of how knowledge integration occurs in practice based design research, which are the design knowledge transfer and contextual transformation of design knowledge. We use this map to carry out the analysis of design research cases. Through the analysis, we define four typical practice based design research models from the viewpoint of knowledge integration. This method and the proposed model can provide a theoretical basis and a path for better management design research projects.

keywords: Practice based design research, Knowledge integration, Knowledge transfer, Contextual transformation of design knowledge

Introduction

At the macro level, the "Made in China 2025" plan pushes the Chinese manufacturing industry to a new stage of development. In this government-leading plan, there are the basic principles of innovation-driven included, and innovation-driven core initiatives are collaborative innovation, open innovation and platform innovation (Ji, 2015). This policy requires design innovation to be more open and transferred to platform innovation and not rigidly adhere to a single system. The trend toward customized manufacturing,
service-oriented manufacturing and intelligent manufacturing in the "Made in China 2025" plan gives design innovation a broader perspective and stage (Ji, 2015; Zhilei, 2016). In addition, with the development of information industry and Internet thinking, design innovation field has emerged intelligent, user-driven, cross-border innovation and other new trends (Mingzhi, 2015). At the meso level, the design innovation model of the enterprise is also being upgraded and evolved. More and more enterprises are evolving toward the "design oriented " model. In this model, design is an internal core culture and external core competencies (Liu, 2014). At the micro level, designers work area and knowledge structure are also undergoing tremendous changes, many Chinese designers in their own areas of work using untraditional knowledge and cross-discipline knowledge (Cai & Li, 2016).

In the broader context of design change in macro, meso and micro level, the design landscape has become broader and the value of design has become more plentiful (Westcott et al., 2013), and design issues have become more dynamic and complex (Dorst, 2015). This circumstance is calling for the emergence of new design knowledge. Design research is the process of producing design knowledge, which is the process of generating explicit, discussable, transferable, possible to accumulate knowledge (Manzini, 2009). In the design practice, design knowledge is generated in the process of the design research through action. This type of design research is generated, implemented in the field, process and result-oriented, dynamic and in the context. Scholar Sevaldson defines this type of design research as a practical design research in action (Sevaldson, 2010). Similarly, we named this type of research as practice based design research. According to Sevaldson's definition, the knowledge generated by practice based design research must be generated in the context of the application, and the mode of knowledge production conforms to the characteristics of MODE2 (Gibbons et al., 1994). Knowledge production MODE2 gives an insight into the design research from the perspective of knowledge production.

Knowledge production MODE2 model is relative to MODE1, the core view includes the knowledge generated in the application environment rather than the academic environment; knowledge is interdisciplinary rather than rely on a single discipline; knowledge with reflection and social accountability rather than self-isolation and other attributes (Hessels et al., 2008). Combined with the attribute of MODE2, we propose that the design knowledge has entered the era of 3.0. It is believed that in the era of design 3.0, design knowledge should be oriented to the integration of design ecosystem and platform, showing the state of interdisciplinary knowledge integration. Based on this view, we conducted a design survey and interviews to verify that the knowledge characteristics of the design 3.0 era are emerging in the Chinese design industry (Jun & Honghai, 2016), design research is moving towards a knowledge-based integration model.

Built on the conclusion of the previous study, we continue to dig deeper into the knowledge integration in design research projects. We would like to explore how the integration of knowledge occurs in the Chinese design research practice. In the process of integration, whether there are different models exist? In-depth interviews and case studies were conducted in this study. We concentrated on the details of knowledge production in the practice based design research and discussed the design research models based on knowledge production. This paper is organized as followed, the first part
is the research dimensions of knowledge production in practice based design research that based on the conclusion of the literature review and the in-depth interviews with the design research project managers; the second part is the findings of different research models based on the knowledge production dimensions; the third part is the discussion of the value of this study.

**Literature review**

When we observe the phenomenon of design innovation from the viewpoint of knowledge production, we must clearly state the difference between design research and design practice in design innovation. It is difficult to distinguish between design research and design practice if we observe them from the perspective of goals, processes, or participants. Because in most design projects, research and practice would be mixed together in the process and the performers are often in the same team. If the analysis from the perspective of knowledge production, the distinction could be more clearly. IIT scholar Charles Owen put forward the concept of knowledge building-knowledge using, which is defined in the analysis and synthesis level, there is knowledge building and knowledge using process. We can use this model to understand that design research is the process of knowledge producing and design practice is the process of knowledge using(Owen, 2007). Ezio Manzini also stated that design research is the process of producing design knowledge, which is the process of generating explicit, discussable, transferable, possible to accumulate knowledge(Manzini, 2009). Based on these discourses, we explored the literature of design knowledge and could have an opportunity to build the framework of our study of design research from knowledge production perspective.

In its 1996 report "Knowledge-based economy", the OECD mentioned that the object of knowledge production can be divided into four categories, namely, know-what, know-why, know-how, and know-who. The value of this definition of the OECD is providing a foundation for the classification of knowledge; it also points out that know what and know why are information; and know-how and know who are tacit knowledge. From this point of view, knowledge production in design can clarify some of the original fuzzy design concepts, for example, knowledge about human knowledge, design knowledge, and design process knowledge(Cross, 1997; María & Narváez, 2000; Van Aken, 2005; Lintao, 2004); some researchers were also based on this model to build the designer's knowledge system and design research methodology(Whitney, 2015). This perspective helps design researchers to define the type of design knowledge from the point of view of the design object or the design research object.

From another aspect, the research on knowledge level is concerned with the evolutionary path of knowledge. Typical research is the characteristic of the novice, the advanced and the expert's knowledge from the designer's experience level(Dorst & Reymen, 2004). Müller's previous work has developed a hierarchical model of design knowledge: physical level (design artefacts) /neuronal level (design intuition) /symbolic level (design rational) /model level (design theories)(Müller & Thoring, 2010). The contribution of this paper is to summarize and classify the design knowledge in previous studies, and discover four levels of design knowledge. This study also found the transformation mechanism between the four levels, and pointed out that the neuronal level is the tacit knowledge and the
symbolic layer is the explicit knowledge. The significance of the study of the knowledge hierarchy is the fact that it can discover the ways of expression, communication and management applied at different levels of knowledge.

Some research focus on the production, diffusion, and transfer mechanisms of design knowledge. BERTOLA and Teixeria divide the design knowledge into three domains: users’ community, organization and network, and point out the specific categories and diffusion patterns of different levels of design knowledge, that is, knowledge integrator and knowledge broker model under different contexts (Bertola & Teixeira, 2003); In the latest discussion, Ezio Manzini proposed the concept of distributed knowledge production (Manzini & Coad, 2015). In Roger Martin’s opinion, the model of knowledge production in business innovation is Mystery/Heuristic/Algorithm, which he calls the knowledge funnel (Martin, 2009). In this type of study, the researchers observed the evolution of design knowledge in the design practice, and define the path and mode.

Reuse of design knowledge is also a frequent topic in the field of design knowledge production. The precedent design is very important for design research and design innovation. Eilouti proposed a model of reuse of design knowledge and seven patterns of precedent-based design (Eilouti, 2009). Design knowledge reuse research will be from a practical point of view of the design knowledge classification and indexing (Ahmed, 2005; Reed, Scanlan, Wills, & Halliday, 2011; Zheng, Shouqian, & Yunhe, 2009). This is of great help to understand the existence of design knowledge in design practice.

The design management researcher’s perspective is more biased towards the knowledge generation and application pattern in the design project practice. SATO and other scholars pay attention to the knowledge in user research, especially the transfer of user’s knowledge and management methods (Teeravarunyou & Sato, 2001; Fei, Xing, & Zhijian, 2009), Some scholars are concerned about the knowledge sharing mechanism among different stakeholders in the design management process. (Follett & Marra, 2012; Jung, Evans, & Cruickshank, 2013). Design management researchers define the knowledge of design management from the perspective of strategy, tactics, and operation (Kim, Nam, & Borja de Mozota, 2016).

**Literature Summary**

It can be seen from the analysis of the literature that the research on knowledge in the design field has shifted from the classification, hierarchy to the application, management and quality control of microcosmic design knowledge, but this kind of research still falls short, in particular, the research based on industrial practice is still not enough. However, the basic research on design knowledge in the literature has been very deep and rich. When we discuss the pattern of knowledge integration in design research, we could find two implicit clues from the previous design knowledge literature, namely, design knowledge transfers and the contextual transformation of design knowledge. From these two basic dimensions, we can establish a research framework to carry out our empirical study.

- **Dimension 1: Design knowledge transfer**

The design knowledge transfer mainly includes the following several situations. The transfer of design knowledge from different stages, typically between Owen’s knowledge building and knowledge using; and the transfer of design knowledge from different
objects, such as user knowledge to design objects or design process. From the perspective of practice based design research projects, knowledge transfers often occur with the design research process promotion or iteration.

- **Dimension 2: Contextual transformation of design knowledge**

As can be observed in from the literature, knowledge integration path is another dimension of the context transformation, including knowledge from general knowledge to specific knowledge; from research scenarios to design scenarios; from academic scenarios to application scenarios and so on.

**Method**

Utilizing the research dimension proposed in the literature analysis, we conducted case studies and interviews with design researchers. The study begins with interviews with design project managers and analyses the design research cases in China’s design industry using the analytical models summarized in the interviews. In this phase of the study, four organizations were interviewed and seven design study case studies were discussed. During the interview, the manager of the design project gave us a detailed introduction to the background, process and final design output of the entire design research project, and we also discussed the transfer and contexture transformation of the design knowledge. Different design research projects in the transfer of design knowledge and transformation has a very big difference. Table 1 is the brief description of seven case studies.

**Table 1  Case studies list.**

<table>
<thead>
<tr>
<th>Case Areas</th>
<th>Research objectives</th>
<th>A brief description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case1</td>
<td>Furniture and lifestyle</td>
<td>Brand repositioning</td>
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<td></td>
<td></td>
<td>Rebuild brand value based on changes of customer groups</td>
</tr>
<tr>
<td>Case2</td>
<td>Kitchen appliances</td>
<td>New Products Development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Product categories and product strategy innovation based on Chinese cooking context.</td>
</tr>
<tr>
<td>Case3</td>
<td>Intellectual Products</td>
<td>New Products Innovative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Product categories and product strategy innovation on kids’ education.</td>
</tr>
<tr>
<td>Case4</td>
<td>Household appliances</td>
<td>New Products Innovations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New product for the new class emerging in China’s urbanization wave.</td>
</tr>
<tr>
<td>Case5</td>
<td>Environment home appliances</td>
<td>New Products and Services development</td>
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<td></td>
<td></td>
<td>Marketing design strategy of foreign Brand entering China market</td>
</tr>
<tr>
<td>Case6</td>
<td>Smartphone</td>
<td>New Product Design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Product Branding realization and innovation based on industry chain management</td>
</tr>
</tbody>
</table>
**Design knowledge transfer in design research projects**

During the interview and case studies, we found the current situation of China's design research projects are very complex and involves a number of areas. In a brand rebuilding design project (completed by DMR lab, Tsinghua University), design researchers need to deal with user values, social trends, brand communication and other issues; and in another project conducted by the same research institutions, researchers have to deal with culture trends, business models and other aspects of research; The design research projects of manufacturing-based NPD have become more complicating too. The East innovation industrial design company's Chinese kitchen innovation projects deal with user behaviour, technology trends, market and industrial transformation and other issues; A e-commerce company’s intelligent product innovation project is more sophisticated, design researchers need to deal with business model, user behaviour, user experience, technology and supply chain integration and other issues. Based on the conclusion of the interview, we find that the range of knowledge transfer of design research in Chinese design industry is very wide, from user to technology to culture, which involves almost the entire business process. These different issues knowledge in are transferred in the design research project and integrated in the research results.

**Contextual transformation of design knowledge in design research projects**

During the interview and case studies, we can learn the diversity of design research projects context. One of the major characteristics of China's design innovation environment is the complexity of the design context. From the perspective of consumers and users, China's regional diversity is plenty and social strata are numerous; from the perspective of economy developing, China's current level of industrialization is uneven, in the industrial phase of 1.0 to 4.0 parallel(Ji, 2015). The complexity of the competitive environment for corporate strategy is also rapidly changing. The complexity of these scenarios will also directly affect the design of research projects.

**Key findings**

After the analysis of interview and case studies, we could build a map to illustrate the practice based design research in China from knowledge production perspective. Firstly, according to the classification of the knowledge found in the case, we can build knowledge transfer model of design research from the four aspects of know-what, know-who, know-how and know-why, that is to say, which type of knowledge needs to be integrated in the research result. Know-what research goal is to provide the design value, know-who’s research objective is whom the design for, know-how research goal is the path and process of design implementation, know-why research goal is the design innovation motivation. From the design study case analysis, we can find know-what research aimed to knowledge of brand and product & service; know-who research aimed to knowledge of user segmentation and user experience; know-how research aimed to knowledge of marketing and technology; know-why research aimed to knowledge of industrial resource
and culture. In this way, we will establish a design research model with eight types of knowledge.

The second point of view is knowledge contextual transformation. From our result of interview and case studies, we can find knowledge transforms from universal to specific level. The general level of knowledge refers to the current social, industry-level trends. Such as the rise of new consumer classes in Chinese society or the development of Internet channels, or new research on user’s emotional or cognitive perspectives. The second level is application level knowledge, which focuses on the development of a specific field and the characteristics of the enterprise itself; for example, for a new study of consumer culture, or a specific sub-cultural groups, or a significant technological breakthrough in an industry. The last aspect is the clinical level knowledge, focus on a particular design innovation project, at this level of knowledge is mainly reflected in the design project for the characteristics and context; for example, use behaviour research for a particular design project, or a processing technology research to achieve a design effect, or a single product brand positioning.

With these two dimensions, a map of practice based design research can be established, which includes eight categories of design knowledge and three levels of knowledge context. Every category has three level knowledge of industry, enterprise and project context. Using this map, we can describe the details of the process of knowledge integration in the design research project. Mostly, a single design research project does not require the transfer of all types of the knowledge in this map, so we can define different design research models according to the knowledge integration map (Figure 1).
Figure 1: Knowledge integration map

Four Modes of design research

When we review the case studies using this knowledge integration map, we can reorganize the knowledge type and research method of every case.

Table 2: Reorganize the design research case.

<table>
<thead>
<tr>
<th>Knowledge transfer categories</th>
<th>Knowledge transform levels</th>
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</thead>
<tbody>
<tr>
<td>Case1 Value system; Identity; Consumer Cluster; Symbolization</td>
<td>From enterprise to project context</td>
</tr>
<tr>
<td>Case2 New Product type; Product family; Product</td>
<td>From industry to enterprise, then to project context</td>
</tr>
<tr>
<td>Case3 New Product type; Product family; Product</td>
<td>From industry to enterprise, then to project context</td>
</tr>
<tr>
<td>Case4 Product; Consumer Cluster; Pain &amp; Desire; Development platform</td>
<td>From enterprise to project context</td>
</tr>
<tr>
<td>Case5 Consumer Cluster; Culture; Business ecology; Positioning; Value system</td>
<td>From industry to enterprise, then to project context</td>
</tr>
<tr>
<td>Case6 Manufacturing; Capacity; Symbolization; Identity; Usability</td>
<td>Only project context</td>
</tr>
<tr>
<td>Case7 Business ecology; Industrial ecology; New technology application; Development platform; Usability; Pain &amp; Desire; Product</td>
<td>From industry to enterprise, then to project context</td>
</tr>
</tbody>
</table>

Summarized from our case study, we have found diverse design research models based on the knowledge integration map. In these types of design research models, we can define four typical models and other models could be seen as the intermediate states of these four types.

- **Model 1**: focus on a single knowledge type in project context level.
  
  Research for product or service incremental innovation, such as the optimization of a function of a product or a user experience to enhance the users’ pain point. Research for branding or marketing strategy design is the same model.

- **Model 2**: a single knowledge type from industry to project context.
  
  The typical design research project of this model is to define the new product category, new brand building or new user segmentation definition, etc.
• Model 3: multi-type knowledge in project context level
Research for defining new product development with brand, marketing strategy, this research model is suited for overall innovation.

• Model 4: multi-type knowledge from industry to project context.
Research for seeking new product and service opportunities in a new business model, this research model is suited for breakthrough innovation. This design research model needs to break from multiple perspectives with huge risks (Figure 2).

![Figure 2 Four typical practical based design research models](image)

Discussion
The knowledge integration map and four models of design research could provide a new perspective to manage and analyse practice based design research. The values of our results in this study are as followed.

Firstly, in essence, four design research models explain the relationship between design practice and design research, which means that design research needs to define the research framework according to the requirements of design innovation practice. In the interview, we learned that determine the framework of the research is a critical problem that researchers and managers encountered in the design research projects. Based on the previous knowledge structure, design researchers need to clear research objectives or outputs to develop research plans. But the current research projects in most cases, the research goal is ambiguous, so researchers always conducted a trial-and-error research. However, based on the knowledge integration map presented in this paper, there is no requirement to know clear goal in advance, and the researcher only needs to know which knowledge is uncertain, and it is possible to produce innovative knowledge in that type. Researchers should make clear the dimension of the knowledge category firstly, then clarify whether the design project is a breakthrough or incremental innovation. As a result, the entire research program can be carried out. By defining the framework of the design research in such way, it is possible to avoid too much research in the process without value, but also to avoid the key research are not carried out.

Secondly, this model can help design and research managers to control the quality of design research. Design research quality control is the design research management of critical issue. In the interview, the design research managers have repeatedly talked about...
how to design research in the process of project quality monitoring and adjustment, the current practice mostly rely on experienced designers or clients to control the assessment, but this method are too dependent on the evaluation of human factors, prone to bias. Based on the knowledge integration map of design research, the managers of design research can establish and review indicators according to the knowledge system, and establish evaluation matrix from two dimensions of the model, which can make the evaluation of the whole project more comprehensive and fair.

Thirdly, this model can help to establish the practice based design research project evaluation indicators. Design research project evaluation is also the pain of the researchers. When a design research project results output to the designer or design decision-makers, how to assess the project’s contribution to design creativity or decision-making? Using the final design results’ market performance to assess is clearly not comprehensive, but also unfair, because there are too many factors that affect the success of a design innovation. According to our model, we can establish different evaluation criteria than results. In this map, we can trace back the output of a design research to integrate what knowledge categories, and then observe whether the knowledge is consistent with the initial design innovation goals. Such an evaluation can clarify whether a design study's conclusions are comprehensive or biased. Using such indicators in conjunction with other assessment methods, the final assessment conclusions will be as fair as possible and valuable.

Lastly, our research result could help design research knowledge management. Whether for a new design project, or iteration of the previous project, a completed design research project’s knowledge legacy can be reused. If we only retain the conclusions of the design research project, which could not provide much value for the new project. And the most primitive information is difficult to reuse. During the interview, we also talked to the project manager about these issues. Based on our proposed design knowledge integration map, the design researcher can classify the process data of a design research project. Under such a unified framework, the same or similar research processes of different projects can be carried out comparison or accumulation.

**Conclusion**

Through the research on the case of Chinese enterprise design innovation project, we find that the design research based on knowledge integration is becoming more and more important under the situation of China's design transformation. Its importance is reflected in the design innovation can provide creative sources, project development support and to help decision-making. But in reality, we also found that the design of Chinese enterprises is still in the relatively early stage of the research. They simply transplant foreign design processes and methods to domestic projects, the practice proved that the effect is not satisfied. The reason is that China's design innovation environment is more complex, the development of the industry is not balanced, the regional market is also very different, the social class is complex and rapid changing. In such a sophisticated design environment, design research needs to establish an appropriate framework. The result of this paper is the beginning of such research. Through the excavation of the knowledge integration process in the design research project, the paper analyses the different characteristics and finally obtains four design research models. This study reveals a central feature of design
research projects, namely, design research is the production process of new knowledge. This production process is closely linked to design innovation and corresponds to, from this perspective, the design study will be more clearly understand what the essence of design research, which can design research projects for the planning, quality control and evaluation of the contribution. Of course, the current study is only an attempt. When the researchers put forward a model, it is the beginning of a series of studies, we can rely on this model to define different types of design innovation and design research. But what is the difference of these types in the operational level? At the micro level of knowledge integration, different stakeholders contribute different knowledge or experience, what happens in the integration process? Faced with these problems, we have carried out a new research, and expect more researchers to participate in the study of this topic.

References


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Erik Bohemia is the Programme Director in the Institute for Design Innovation at Loughborough University London. He is interested in Design as a cultural practice and the material effects of design.

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