

A multi-context design approach for a portable ultrasound device

Wouter C. Kersten¹, Jan Carel Diehl¹, Marcel R.M. Crul¹, Jo M.L. Van Engelen¹²,

¹*Faculty of Industrial Design Engineering, Delft University of Technology*
w.c.kersten@tudelft.nl

²*Faculty of Business Administration, University of Groningen*

Abstract

The world is complex. Amongst others, this means that many elements are interconnected. When designing solutions, this complexity is often seen as cumbersome, resulting in (over) simplification of the issue at hand. This leads to solutions that are optimised for one specific context. Especially when these solutions are aimed at tackling large scale development issues, redoing the process every time when a new context is entered is very resource intensive.

A multi-context design approach that was recently developed, takes another premise: if multiformity of a design challenge is acknowledged from the start, this encourages to intentionally bring together insights from multiple contexts. This collective intelligence results in design solutions with higher quality that also allow for quicker scaling and adaptation to multiple contexts thereby achieving more impact against lower overall costs.

The first intended result, higher quality, has been tested in various set ups. The most elaborated experiment was conducted with junior designers for a medical company. The main question was: “*To which extent does a multi-context approach result in higher quality of design concepts?*” Starting from the same issue (maternal health care, a portable ultrasound device), three groups developed concept directions for solutions, with differences in the sources of insights that were provided. All assessments that were performed point in the same direction, being that the results from the multi-context group were more creative and relevant. Several lessons were obtained about the execution, which are translated into recommendations for more and better experiments and actual use in industry settings.

Keywords: *context variation, multiform analysis, complexity, impact*

1. Introduction: complexity and design challenges

1.1 A complex world

The world is getting increasingly complex. Explained as concisely as possible this means that our society consists of a *diverse multitude* of different parts, many of which are *interrelated* in ways that we cannot always see, oversee, understand and predict (Sargut and McGrath, 2012). A relevant question then becomes how we address this reality. For the purpose of this paper we focus on the question how, in the face of complexity, we might best address problems that occur in (very) different contexts. We are particularly interested in large scale development

issues that affect millions or even billions of people world wide like maternal health care, sanitation, safe drinking water.

The currently dominant way of business thinking with regards to contexts emphasizes contextual intelligence (e.g. Khanna, 2014), which stipulates that because of cultural differences providing solutions needs to be done with utmost care for the specific details of an individual context.

Not taking cultural differences seriously by focusing on efficiency, i.e., implementing the same solution everywhere, is likely to miss the mark. Cultural sensitivity therefore has merit. However, in a complex society this cultural sensitivity is no longer sufficient either. Whereas contexts vary, it should be acknowledged that they are part of the same global system as well. Before we analyse how we could do this from section 2 onwards, we first take a brief look at how paradigms from the industrial design domain consider complexity, if they do at all.

1.2 Design paradigms and complexity

Much of the current thinking that deals with the role of designers in society is allegedly covered by an approach referred to as design thinking (e.g., Buchanan, 1992; Cross, 2001; Brown, 2008). The term is explained in quite diverse ways, for example by elements like empathy, creativity, rationality (Buchanan, 1992), but also as “collaborative integrative thinking, creative resolution [...], involving end-users perspectives and thinking outside existing alternatives” (Dunne and Martin, 2006).

Some claim that addressing complexity is the absolute core of design thinking (Dorst, 2011) or specifically refer to dealing with complex or wicked problems (Buchanan, 1992). Other authors take a more modest view by stating that designers should be suitable for dealing with complexity but currently are not always living up to that promise (Sevaldson, 2009).

In terms of the process of problem solving, recognizing complexity implies that much attention is necessary for end users, i.e., the most direct beneficiaries, of solutions. In that respect design thinking builds on waves of participatory innovation and design, for which we find the origins in Scandinavia. One major challenge in such dynamic participation arenas is how to create a shared understanding, as experienced by Buur and Matthews (2008). On the other hand it is brought forward that diversity of framing should not be managed away too early either because it can be helpful in the design process (Dorst, 2006). What seems to be largely underemphasized is the notion of *using* interconnections between contexts, on purpose. In management discourses, dealing with complexity has been discussed for example by Stacey (1996) in terms of “fighting complexity with complexity”. What might this mean when applied to the design discipline?

2. Towards a multi-context design approach

2.1 From a sequential to a discursive process

In order to start to make better use of the interconnections in society, the starting point is to realize that any problem encountered in one location is also encountered elsewhere, even if nuances vary. We previously mentioned “contexts”; which is virtually impossible to define. Some practical distinctions are: different cities, regions, countries, but also differences between urban and rural, different segments and even different socio-cultural classes. In such different contexts there will be differences in climate, language, legal boundaries. culture, demographics and habits to name a few and one does need to obtain and use contextual intelligence to have an understanding of these. However, then using the differences as excuse for keeping the contexts separate means we are ignoring the highly interconnected nature of society. Instead, we should better consider these contexts in conjunction. In that way so-called *shared insights* would be developed that would less likely materialize, if at all, in case of

separated or sequential processes. By on purpose *seeking the complexity* of the issue at hand by intentionally allowing multiple interpretations and by also reflecting on possible interrelations between these interpretations and their underlying facts and insights, *new insights* see the light that would have remained hidden otherwise. Adoption of a wide diversity of views can be recognized in the concept of co-design, of which many variations exist (Sanders and Stappers, 2008). Explicitly considering multiple contexts in conjunction is however not common.

Outside the design domain, the relevance of this way of thinking was identified by some anthropologists who have started to use multi-sited ethnography (e.g., Hine, 2007; Marcus, 2009) and design (e.g. Lindtner, Anderson and Dourisch 2011). This includes considerations for *interplay* between different sites (contexts), as opposed to just *considering their existence*. The latter was so far lead to just using other contexts as free-of-obligation inspiration, or multi-context implementations (typically using a ‘universal’ solution). It might be time for designers to take next steps in addressing global issues with contextual variations.

This way of looking at contemporary design challenges would represent a new step in the learning process how to face complex, multi-contextual, issues. It acknowledges the relevance of seeking complexity in the design process instead of avoiding it. Building collective intelligence is a crucial element to create a better understanding of any issue, and therefore will create a richer solution space. The insights created in this space result in design concepts that are based on richer understanding, which, as a logical consequence, is likely to lead to better solutions. The intensive interaction in this *shared solution space* will therefore enable creation of solutions that allow for faster adaptation to more contexts. This is why it should appeal to organizations that tackle issues that affect many people and occur in many places

Recently a design approach was developed and tested that works as outlined above (Kersten et al, 2015); it is called Context Variation by Design, CVD in short. In this current paper we focus on a key theme from that paper, i.e., the level of creativity in a shared solution space. Valid questions regarding effects on the speed of adaptation in practice, consequences for the costs and the role of designers in all stages will not be addressed in this paper.

2.2 Relation with the Nordic Approach

The NordDesign conference puts the “Nordic Approach” at centre stage. This approach celebrates the close and informal cooperation and co-creation between industry, academia and education as an important advantage in global competition. Laakso and Ekman (2014).

Secondly, the Nordic approach in general refers to the desire to develop the potential of each person to the fullest. In design terms this leads to the ‘guideline’ that good design helps humans to thrive. In this vision good design puts humans, human values and dignity at the centre, instead of considerations like efficiency. In terms of pursuing growth, we need to strive for ways that make life more meaningful (Next Scandinavia, 2015).

2.3 Main research question

The main flow of premises of the approach that was introduced in section 2.1 can be summarized as: 1) using an intentional multi-contextual approach results in higher quality of (base) solutions, 2) which can be adapted and scaled to multiple contexts 3) quicker, and 4) against lower overall costs. While the latter two points might seem to refer to efficiency as important consideration this is in fact not the case: eventual savings on overall costs and time are natural consequences, not the main goal of the approach.

One way to test the validity of the flow of premises refers to the first step: investigate by means of experiment whether the approach does result in higher quality initial solutions.

Given the many different interpretations of quality we decided to approach this question from an angle that energizes designers, i.e., creativity. This does pose a challenge in terms of

objectivity but this need not be blocking. It has for example been argued by Hofstee (1985), that creativity by definition revolves around change and the subjective, fallible human process is even key to that. We discuss this in depth in the next section.

Based on the above, the main research question for the experiment was: “*To which extent does a multi-context approach result in higher quality of design concepts?*” The next sections will discuss the set-up of the experiment (3), the findings (4), discussion (5), ending with conclusions (6) and recommendations for further research (7).

3. Testing the premise empirically

3.1 Measuring creativity

As mentioned, the decision to approximate quality by creativity is not the final point in the thought process. The topic of measuring creativity (in design) can fill volumes of research. We will here focus on the statement in section 2.3 that human assessment is fallible, but in the case of assessing creativity not a real problem. We could even go further and state that opening up the *discussion* why something is considered creative, or more creative than something else, enhances our understanding of the concept, more so than relying on seemingly objective numbers. As much was identified when Ball (2010) stated that designers have an intuitive notion of creativity that may even collide with a wish to describe it in universally accepted metrics. There even is debate whether the level of creativity should be derived from results (outcome) or process. Furthermore we aimed to end the experiment at the level of concept directions (see section 3.3), which implies that metrics referring to concrete concepts or beyond were not relevant for now. As a general conclusion from the literature review we found that any method that is used to measure creativity draws as many opponents as supporters. See Ball (2010 for an overview).

3.2 Brief case description

The experiment was conducted in a project regarding an ultrasound device initially intended to be used by lower level health care workers in Africa where large regions have limited maternal health care infrastructure. The company working on this concept, the principal, did have two epiphanies: 1) besides this primary market there is also a growing home market in developed countries for ‘fun echos’ for which (a version of) the device could be interesting and 2) serving that context in parallel might create interesting options for the pricing or business model. This was the perfect starting point for an experiment referring to multi-context solution spaces as opposed to mono-context settings. The research in the (semi) professional market in Africa focused on both rural and urban Ghana (actually two sub-contexts), and for the European consumer market the focus was on the Netherlands.

Because of the early stage of development, information sensitivity and the many uncertainties on how the strategy will evolve, details about the product will be limited in this paper.

3.3 Experiment set-up

The experiment was part of a regular design process, with an external lead designer. In this process, the step towards concept directions was turned into an experiment. To assess and compare the results of using shared insights we used two control groups, resulting in:

- A. Group that received shared insights that had been created before the experiment in the shared solution space, i.e., rich insights that were created by letting insights from both contexts interact; this group was specifically reminded of the multi-context scope.

- B. Group focusing on African context (more specifically: Ghana), with detailed information about that context, and statement that the principal was explicitly interested in introducing the product in the European consumer market as well
- C. Vice versa, group focusing on the European consumer context, but with the statement that the principal is explicitly interested in the African medical market as well.

The design challenge was the same: develop concept directions for this product/service, taking into account the desire of the principal to introduce it in these different contexts.

The sessions lasted three hours and used the same general set-up: *Introduction* (short intro, “touch and feel” early prototype), *Understanding the problem* (re-read insight cards, containing information about the respective contexts), *Live the context* (role play in pairs, reflecting two stakeholders), *Moving forward* (formulate How Could You solve-statements, then discussing these plenary), *Pair up* (translate discussion into one concept direction and fill in a fixed format: drawing, brief description, assumptions, advantages and concerns). The lead designer was present to answer questions while not steering the participants in any direction. With three pairs per session, the total result was nine concept directions.

The starting conditions for the groups were made as equal as possible, with the exception of the intentional differences (input and priming). This refers to the groups receiving insights from one of the two contexts (B, C) or the shared insights (A). A mono context insight from Ghana for example was that the mothers had more trust in the current machine than in people but not everyone was convinced of the safety of ultrasound. In the Netherlands some mothers-to-be were not certain about the actual safety (concerns about ‘radiation’). Staying with that theme, a Shared insight was the importance of creating trust in this technology, which can however be done in different ways in the different contexts. One more example: in Ghana the mothers hardly looked at the screen and were also not interested, in the Netherlands they certainly were but the baby had to be recognizable. A shared insight was that the importance of the image quality was clearly different for both contexts. These examples show that shared insights can refer to differences or similarities, but more relevantly they create a wider understanding of the requirements in the various contexts, as input for design implications.

In terms of group composition, each group contained four junior designers with explicit industrial design background and two with other but for this design challenge relevant background (e.g. architecture, socio-cultural studies); each group also contained one to two persons with specific context knowledge.

The junior designers were not aware of the experiment: they had volunteered for the sessions based on the understanding that they were to support the lead designer in generating concept directions, without knowing what the result was going to be judged on. This lowered the risk of ‘gaming’ (i.e., directing the effort based on known criteria instead of going with the flow of the process). All groups were reminded at least once of the multi-context scope.

3.4 Assessment and data collection methods

Based on the ambiguous results of the literature review and in line with the multiformity of the design challenge, we also made the assessment process multiform. A combination of assessments was used, acknowledging the possibility of different views and experiences of different stakeholders. Each assessment in itself might have limited value, but if overall patterns would emerge, these do shed more light on the validity of the premise.

The following types of assessors and assessments with their own focus were distinguished:

1. Evaluation by each junior designer individually regarding the results (creativity): all designers were asked open questions about the other concepts, mainly about identifying surprising elements and elements that they would have liked to have thought of.

2. Evaluation by each junior designer regarding the process: they were asked open questions about the sessions. Their answers might reveal differences in the group dynamics.
3. Assessment of the quality (creativity, richness) of the results by design experts: three senior design experts were asked to judge the richness of the concept directions. This term can be interpreted in different ways, which was done on purpose, as is discussed in section 4.3. The senior experts were told as little as possible about the experiment to minimize the chance that they would unconsciously favour certain concepts.
4. Assessment of the quality (relevance) of the results by the lead designer, who was asked to reflect on, and grade, all the concept directions, based on relevance for next steps.

4. Findings

The data were collected according to the four methods as described in 3.4. The findings are presented in this section. The implications are discussed in sections 5 and 6. One remark to keep in mind for the entire section is that the intention of this experiment was not to collect a large number of objectively measurable data that would allow thorough statistical analysis. Rather, by collecting and evaluating a diversity of data, we aimed to be able to discern patterns that would allow some conclusions, and direction for next steps.

4.1 Results – creativity (junior designers)

As explained in section 3.4, all eighteen junior designers were asked to reflect on all other concepts, with emphasis on surprising elements and elements that they would have liked to have thought of themselves. They were not told about the differences between the sessions.

We then scored all their remarks by assigning them the label positive (+), neutral (0) or negative (-). By tallying all remarks we got an overview of the perceived creativity of the results of each session. The results are shown in Table 1 below.

To give some feeling for the different outcomes we share one idea from each session. Note that the eventual product(s) in the market might be completely different. One concept in session A focused on use in the European market, followed by a donation to the professional African market, with a story included. In session B one concept focused on easy reparability and detection of malfunction. In session C one concept focused on the personal experience and the option to collect echoes from different weeks in an on-line diary. These representative examples clarify that while all ideas have some ‘panache’, the one from session A most concretely uses the possible benefits of a multi-context setting.

Table 1: Results of peer-assessment of creativity

Metric Session type	Positive remarks (1)	Neutral remarks (2)	Negative remarks (3)	Pos -/ Neg
Concepts from session with shared insights as input (A)	14	4	2	12
	15	2	5	10
	12	1	3	9
Average	13,7	2,3	3,3	10,3
Concepts from session with Africa focus (B)	10	3	2	8
	7	2	4	3
	8	1	2	6
Average	8,3	2,0	2,7	6,7
Concepts from session with European focus (C)	8	6	7	1
	6	4	6	0
	13	5	10	3
Average	9,0	5,0	7,7	1,3

This overview shows that all concepts drew both positive and negative remarks, reflecting the many possible different views anyone might have. The overall picture of this peer-assessment does display a preference for the concepts created in session A (based on the shared insights). In terms of general feedback, one remark was that ideas that lean more towards the European context contain a variety of technical and other extra features; the ideas that tilt more to the African market focus more on sustainability aspects. The junior designers considered the differences between the concepts surprising since all were tackling the same issue. Another interesting observation was the range of opinions on the “surprising elements” and “aspects that you would like to have thought of”. One junior designer thought there were very little to no surprising and ‘envy-invoking’ elements, at the other end of the scale another designer thought virtually all concepts had (very) interesting elements incorporated in them.

4.2 Results - process (junior designers)

One of the main evaluation questions was what type of information the junior designers felt was lacking to take on the design challenge. There was no notable difference in the answers of the participants from the different sessions. Most designers would have liked to have a little more information about the (current) possibilities of the early prototype, the use-situation (pregnancy) and basic data about the contexts. The total picture that emerged from the feedback was that the information that each group received was by and large sufficient, and lack of specific context information was not consciously felt as blocking the process.

Another interesting finding when comparing the answers was that designers from group A considered their plenary discussions more interesting and relevant than the concept directions themselves; this was not mentioned by other groups. An interesting difference was the assessment of the quality of the eventual concepts. From the shared insight session (A) the feedback indicated that the concepts were quite shallow in their final form, while from other sessions feedback was given that the concepts were quite well worked out. Another notable feedback from one group that was only made aware of the multi-context intention, stated that their final results “... somehow had not taken into account the second context very well”.

4.3 Results – richness (senior designers)

In their evaluation session each of the three senior designers first scored all concepts individually on a scale from 1 to 10. The experts had on purpose not been informed about the differences between sessions, nor how many there were. There also was no fixed definition for the evaluation criterion of “richness”, neither a discussion on a shared definition. This was done on purpose as is briefly explained below the table. After the designers finished their individual scoring, the scores were discussed. The quantitative results of the expert assessment are shown in Table 2 below.

Table 2: Results of senior design expert assessment, three concepts per session

Session type Metric	Shared insights (A)	Two contexts, more info on African one (B)	Two contexts, more info on European one (C)
Scores of each expert per concept (avg)	6, 7, 6 (6,3)	4, 6, 6.5 (5,5)	5, 4, 5 (4,7)
	4, 7, 4 (5,0)	4, 4, 4 (4,0)	7, 5, 5 (5,7)
	8, 6, 5.5 (6,5)	6, 4, 5.5 (5,2)	6, 5, 3 (4,7)
Overall avg	6,0	4,9	5,0
Score range delta	1, 3, 2.5 (2,2)	2.5, 0, 2 (1,5)	1, 2, 2 (1,7)

Based on these results we can add a few observations: the concept directions of session A score higher across the board. The assessment is not unanimous however as the score differences vary considerably (high score range delta).

Based on the expert discussion after the individual scoring a few additional observations are shared here. One point of discussion was the use of different interpretations of the term “richness”. As explained, this was done on purpose. This experience was intended to provide *practice based* input to make the interpretation inter subjective, i.e., get towards a shared understanding on this term, for future cases. Interpretations used by the experts included “If a concept direction seems usable beyond one specific context it scores higher”, “If a concept is more holistic (i.e., pays attention to more than just the product) it scores higher” and “If a concept refers to a ‘deeper thought’ (e.g. removing fear), it scores higher”. As it turned out the experts admitted that some sense of feasibility (i.e. relevance) did play a role but not a major one. That was in line with the focus of the intention of the experiment.

On procedural level, they mentioned that the clarity of the explanation on the form including the drawing does influence the opinion. Unclear explanations are likely to have a dampening effect on the score. As a final point it turned out that they considered the results from session A to be more multiform (e.g. included a business model), as opposed to product-focused.

4.4 Results - overall relevance (lead designer)

As another proxy for quality, the lead designer was asked to objectively assess the relevance of the results of all concepts for her own thought process, resulting in the following grades for each of the concept directions and sessions: 7,0 average for session A (7, 6, 8), 6,3 for the other two sessions (exactly the same scores: 6, 8, 5 for concepts from both sessions).

From this we can see that the scores for assessed relevance of the results are higher than the richness as assessed by the experts (see 4.3), possibly because the lead designer could find use in specific elements without needing to embrace a whole concept direction.

5. Discussion

This section briefly discusses the strength of the results related to the limitations. Because of its exploratory nature, the experiment had a number of limitations. A practical one was the fact that groups might have benefited from accidental individual creative superiority. This was mitigated by sub-division within the groups, so an accidental ‘over-creative’ person would only have substantial effect on one concept, which would not explain significant differences on group-level. Lastly, the assessments were mostly qualitative, meaning to an extent subjective. By quantifying the quality of the main assessments (see 4.1 and 4.3) this disadvantage was mitigated as well.

Keeping these remarks in mind, the results do allow for interesting conclusions. The intention to combine and triangulate different types of assessment to discover whether a pattern would emerge did pay off. The nature of that pattern is discussed more elaborately in section 6; the main conclusion is that the overall pattern supports the premise: a multiform and multi-context approach leads to more creative (and relevant) concepts.

We realize that it is too early to make conclusive statements about the value of the approach. Nevertheless, on top of the results of all assessments pointing in the same direction, i.e., emergence of a pattern, the feedback by especially the designers themselves also mentions the intangible feeling of relevance of the approach. Put differently: they could “feel” the value of intentionally working with information from multiple contexts, even if it made the design challenge more complex. This reaction is consistent with reactions of (junior) designers in other projects. This raises the question what type and level of guidance leaves sufficient room for creativity without letting (junior) designers drown in ambiguity.

6. Conclusions

In this section we draw the main conclusions based on interpreting the outcomes of the experiment seen through the lens of the main research question.

The first main conclusion is that the assessments together show a dominant pattern: the concepts from the shared insights session (A) were evaluated more positively by all assessors. Especially the peer-assessment, which allowed ample room for both positive and less positive remarks, provides a strong indication. The range of opinions regarding the results does raise the question whether the assessment should be made more comparable between designers or whether we should cherish the diversity of opinion, i.e. an open evaluation.

In terms of the process, we can draw one main conclusion for next experiments: more information about exact goals can actually distract if the time is not ripe yet as it closes off options to explore. Richness of discussion in early stages benefits from a level of ambiguity about importance and relevance of certain requirements: it helps to create a lively discussion, which seems to have the potential to invoke more creative thoughts.

A related conclusion refers to how to get the most out of a rich process. The group working with shared insights as input (A) remarked that the process was appreciated more than the output. This indicates that to capture the benefits of a rich process, insights might need to be allowed to sink in rather than pressuring designers to move to next design steps.

The expert assessment supports the notion that the conditions created for session A were most conducive for creative outcomes. The assessment of the lead designer supports the notion that “more creative” can also be “more relevant”. Furthermore, the remarks of groups B and C that they had somehow not looked at the other context enough seems to imply that just being made aware of the relevance of another context is not sufficient to let designers acknowledge the multiformity of a design challenge.

Summarized in terms of the research question: the overall pattern of this experiment supports the premise because all results point in the same direction. I.e., the concepts that are based on shared insights and explicitly aimed at more contexts are more creative and more relevant to the lead designer. More experiments and use in practice might result in higher quality, both in terms of actual outcome (designs) as well as in a methodological sense.

With relation to the Nordic approach we conclude that the *explicit inclusion* of beneficiaries from multiple contexts seems to have a positive effect on the creativity and relevance of the design while just being aware of this multi-context scope resulted in concepts that were less suitable for different types of beneficiaries. In other words, the approach has a positive influence on “letting humans thrive”, both in terms of the designers as well as the end-users.

7. Recommendations for further research

Based on these results we find there is sufficient reason to continue with applying and further developing the approach. We like to provide suggestions for lines of research and recommend some improvements for new editions of the same type of experiment

We suggest three lines of research: 1) Obtain insights on type of guidance required for designers. This might vary depending on their level of experience; 2) Expand the experiment so the relation between the use of the approach and the actual success of a product can be assessed. This requires a longer commitment by stakeholders; 3) Investigate more in depth whether this approach consistently leads to more inclusive and/ or human centred solutions.

For executing next versions of the same experiment we have four recommendations: 1) To make assessments more comparable, work with an inter-subjective definition of the concept of “richness”, based on interpretations of the senior designers complemented by literature review; 2) Sufficient time should be provided to enable designers to adequately capture their ideas in writing and drawing; 3) Information that would add value for assessors is the possibility to explain what the next step in the (thought) process would be; 4) Lead designers might consider to focus more on capturing the discussion than getting actual concept directions as output. The former appears to have much value in itself.

Acknowledgements

This paper has been written in cooperation with Susanne van Gils during her graduation project for Delft Imaging Systems. We furthermore like to thank the junior designers who participated in the sessions and the senior experts for their cooperation and contribution. This experiment is part of a larger research line; the results as presented and discussed here are likely to be used in future journal papers.

References

- Ball, P. (2010). *Assessing Creativity in Design: Emerging Themes for Engineering*. The higher education academy.
- Brown, T. (2008). Design Thinking. *Harvard Business Review*, 86 (8). 84-92
- Buchanan, R. (1992). Wicked Problems in Design Thinking. *Design Issues*, 8 (2). 5-21.
- Buur, J. & Matthews, B. (2008). Participatory Innovation. *International Journal of Innovation Management*, 12 (3). 255–273.
- Cross, N. (2001). Designerly ways of knowing: design discipline versus design science. *Design Issues*, 17(3). 49–55.
- Dunne, D. & Martin, R. (2006). Design Thinking and How It Will Change Management Education: An Interview and Discussion. *Academy of Management Learning & Education*, 5 (4). 512–523.
- Dorst, K. (2006). Understanding design. 175 reflections on being a designer. 2nd edition. BIS Publishers. Amsterdam.
- Dorst, K. (2011). The core of ‘design thinking’ and its application. *Design studies*, 32 (6). 321-332.
- Hine, C. (2007). Multi-sited Ethnography as a Middle Range Methodology for Contemporary STS. *Science, Technology and Human Values*, Vol. 32 (6). 652-671
- Hofstee, W.K.B. (1985). Liever klinisch. Grenzen aan het objectiviteitsbeginsel bij beoordeling en selectie. *Nederlands Tijdschrift voor de Psychologie*, Vol. 40, 459-473.
- Kersten, W.C., Crul, M.R.M., Diehl, J.C., Ven Engelen, J.M.L. (2015). Context Variation by Design. Working Paper, version 4.0. Delft
- Khanna, T. (2014). Contextual Intelligence. *Harvard Business Review*, 92 (9). 58-68.
- Laakso, M. & Ekman, K. (2014). Preface. Proceedings of NordDesign 2014 conference, Aalto Design Factory. Aalto.
- Lindtner, S., Anderson, K & Dourisch, P. (2011). Multi-Sited Design: An Approach Towards Addressing Design-Use Relations in Transnational Processes. *Position Paper for the CHI 2011 Workshop on “Transnational HCI. Humans, Computers and Interactions in Transnational Context”*.
- Marcus, G. E. (2009). Multi-sited Ethnography: Notes and Queries. In: M Falzon. (ed), *Chapter 10: Multi-sited Ethnography. Theory, Praxis and Locality in Contemporary Research*. Ashgate.
- Next Scandinavia. (2015). Meaningful growth. Retrieved from: <http://www.nextscandinavia.com/ideologies/the-nordic-ideology/>
- Sanders, E.B.N. & Stappers, P.J. (2008). Co-creation and the new landscapes of design. *Codesign*, 4 (1). 5-18.
- Sargut, G. & McGrath, R.G. (2012). Learning to live with complexity. *Harvard Business Review OnPoint*, summer 2012. 44-50.
- Sevaldson, B. (2009). Why should we and how can we make the design process more complex? A new look at the systems approach in design. In: *M. Lieberg (ed), Shaping Futures*. (pp. 274-281). Oslo School of Architecture and Design.
- Stacey, R. D. (1996). *Complexity and creativity in organizations*. Berrett-Koehler Publishers. San Francisco, CA.