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## **MANAGING WICKED DESIGN COMMISSIONS**

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### **ABSTRACT**

Design is a core technical and creative activity for innovation. Design consultancy companies make a business out of taking on ill structured development work. Uncertainty is an integral part of this kind of fuzzy front end (FFE) development; the need for information and knowledge is to a large extent unknown and possible difficulties on the way is yet to be encountered.

The objective of this paper is to describe how commissioned FFE work may be managed in order to mitigate uncertainty. The basis for the article is a comparative case study at two design consultancy firms.

One of the companies have structured and standardized their work process in order to reduce uncertainty about what to do in a commission. Simultaneously, the process functions as a guarantee that they will reach an unknown but acceptable output.

The other company initiates their projects by first of all defining product characteristics that are crucial for business success. This product definition then functions as a beacon during the consecutive development; it reduces uncertainty of what output to reach whilst letting the team decide on the unique route for each commission.

*Keywords: uncertainty, ambiguity, FFE, design practice, design management*

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## **1 INTRODUCTION**

Design is a core technical and creative activity for service and industrial innovation (Hobday et al. 2011). It has been conceptualized as making sense of things (Krippendorff 1989) through a process of problem-solving activities (Hobday et al. 2011). Industrial manufacturing firms engage internal or external designers early on in the development work for amongst other things their innovativeness (Carlgren 2009) and ability to live with uncertainty (Hobday et al. 2012).

Design consultancy firms are companies whose employees function as externally engaged designers. The design consultancy firms are selling the undertaking of design and development initiated in the fuzzy front end (FFE) of new product development (NPD). The FFE development begins when an idea is judged worthy to develop further by ideating, exploring and assessing it (Kim and Wilemon 2002). Design consultancy firms as such take on commissions before the content of a project has been clearly explored and defined. They must therefore assure a project outcome that does not exist during the moment of promise, which creates uncertainty.

The activities included in the FFE phase are amongst other: to identify business opportunities, generate ideas, make a product definition and plan the consecutive development project (Khurana and Rosenthal 1998). Initially, in the FFE phase, the individuals lack sufficient knowledge or are unable to discriminate between relevant and irrelevant information due to the undefined output, which creates additional uncertainty. Uncertainty is therefore an integral part of FFE development (Kim and Wilemon 2002), especially so in commissioned FFE work.

Many have pondered problem-solving activities initiated with too little information, such as ill-structured (Simon 1973) or wicked (Rittel and Webber 1973) problems. Descriptive models that explain how uncertainty may change during development work exist (c.f. Engwall 2003). However, how uncertainty is managed and mitigated in practice throughout the design process is still unknown.

### **1.1 Objective & research questions**

The objective of this paper is to describe how design and development work may be managed in order to reduce uncertainty of commissioned FFE work throughout the process. The research question guiding the pursuit of this aim is:

- How is uncertainty in design commissions managed and mitigated?

The objective is underpinned by an empirical, comparative case study of two design consultancy firms. These companies do not set the agenda of which problems to take on, but merely accept or decline commissions. Learning from their way of handling wicked problems could as such increase knowledge on how designers approach great deals of uncertainty in development work.

In the following article ‘development’ refers to new product development (NPD) work. NPD includes both the fuzzy front end as well as the creation of prototypes, calculations, testing, validation and industrialization (Ullman 2003).

## **2 UNCERTAINTY IN DEVELOPMENT WORK**

Development work is always initiated with more or less uncertainty, if nothing is uncertain no development is needed. Uncertainties may exist about the outcomes, about the alternative courses of actions and about the possible payoffs from coupling various actions to outcomes (Gifford et al. 1979). In other words, uncertainty in development work implies that the present state, the desired state and/or the route in-between these two may not be fully defined. The difficulty stems from individuals’ inabilities to predict something accurately (Gifford, Bobbitt et al. 1979). However the uncertainty may have different origins; either the uncertainty is due to lack of information or it is due to ambiguity. The first kind may be counteracted with increased information, whilst the latter requires structures and systems that enable interpretation and the creation of meaning (Engwall 2003).

The practice of designing is a process of assigning meaning to something (Krippendorff 1989). This description implies that when design is first undertaken, the starting point is not making sense – the problem is ill-structured or wicked (Rittel and Webber 1973; Simon 1973). During this FFE phase characterized by uncertainty (Kim and Wilemon 2002), many critical decisions that restrict the design problem are made (Ullman 2003).

## 2.1 Classification of uncertainties in development projects

In previous research the concept of ‘uncertainty’ in development projects has amongst other things been described based on its embedded characteristics; such as uncertainties about estimates, objectives and priorities etc. (c.f. Ward and Chapman 2003). Others have defined it on the basis of its predictability and impact; such as foreseeable and unforeseeable uncertainties as well as chaos (c.f. De Meyer et al. 2002). Yet others have detailed ‘uncertainty’ on the basis of its origin; such as technical or market uncertainty (Sicotte and Bourgault 2008). These different ways of categorizing uncertainty may be paired with one another; the classifications are as such not mutually exclusive.

Foreseen uncertainties may be predicted as possible threats whilst the effects thereof are less known, these often result in thorough risk management and contingency planning (De Meyer et al. 2002).

The unforeseen uncertainties, on the other hand, are not identified in advance. This is either due to an inability to perceive the event in advance or due to that the possible effects are underestimated. The projects are initiated with relatively stable assumptions and clear goals. However as the project continues the unforeseen uncertainties requires a more flexible and adaptive management style (De Meyer et al. 2002).

## 2.2 Transformation of uncertainties during development work

Uncertainties in development work may change or be changed during the work process (Duimering et al. 2006). A useful explanatory model for how uncertainties may be transformed is based on two dimensions; product and process uncertainty. Furthermore the dimensions are scaled from low to high uncertainty. Low uncertainty is due to lack of information and can as such be mitigated with increased information intake. High uncertainty, on the other hand, is due to ambiguity of goals, estimates and knowledge. This type of uncertainty may only be dealt with through trying to understand, identify and define problems over the course of time (Engwall 2003).

By combining high and low with product and process uncertainties a matrix consisting of four conditions is created, see Figure 1 (Engwall 2003). The uncertainty is relative to the involved actors knowledge and experiences. Development work under uncertainties is not about implementing ideas but rather is a knowledge-generating journey. During the design or development work the actors’ knowledge and experiences evolve, which is why the development project moves through the matrix over time (Engwall 2003).

		Process uncertainty	
		Low	High
Product uncertainty	Low	Known process Known product	Unknown process Known product
	High	Known process Unknown product	Unknown process Unknown product

Figure 1. Explanatory model for uncertainty in development projects (Engwall 2003).

In the lower right corner a development project may be initiated with both an unknown goal (product) and an unclear way to get there (process). In such an ambiguous situation the development team does not know what to do, for whom and why. Nor do they know what activities to undertake and who should ideally be involved (Engwall 2003).

When the development continues through a knowledge-generating journey the team learns from their actions and uncertainty is gradually reduced. For development work in the lower, left square the process is fairly known: the team knows which activities to undertake, whilst the output (product) from the process activities is still ambiguous. Development activities taking place in an environment corresponding to the upper, right square means that a team is working with the output defined in overarching terms, whilst the process activities on how to detail and specify the output is unknown. A successful development project should end up in the top left corner. Reaching that part of the matrix

implies that a development team has managed to reduce the many ambiguities so that the process activities and the output product is known (Engwall 2003).

The FFE phase of development is characterized by non-routine and dynamic work with an objective to reduce ambiguity (Kim & Wilemon 2002). Therefore FFE work never appears in the upper left square, which is why this kind of uncertainty is given little attention in the remaining article, in line with the delimitation to focus on the FFE phase. The other three squares do contain ambiguous uncertainty however, which is elaborated further below.

## **2.3 Ambiguous uncertainty**

The most pressing issue of ambiguous uncertainty is that the unknown is unknown. Ambiguity is due to lack of knowledge and cannot be offset with increased information (c.f. Ward and Chapman 2003). Development projects subject to chaos are initiated with much uncertainty, both concerning what to do and how to do it. During the process much new knowledge is created that may change the direction of the consecutive development. These chaotic projects must be managed by a leader with a high level of autonomy and ability to change continuously depending on consolidated ideas and new learning (De Meyer et al. 2002).

Ambiguity may be classified into four kinds (March and Olsen 1976/1979): (1) *ambiguity of intention* due to inconsistent or ill-defined objectives, (2) *ambiguity of understanding* due to unclear technologies and organizational environments, (3) *ambiguity of history* due to multiple interpretations of what happened, why it happened and whether it had to happen in order to evaluate and learn from previous events, and (4) *ambiguity of organization* due to changing patterns of participation (March and Olsen 1976/1979). All, or a combination of these categories may appear in the early phases of development work when both what to do and how to do it is unknown.

### **2.3.1 Wicked problems**

Design tasks are by nature ill structured; neither are there any definite criteria that potential solutions may be benchmarked against in order to test the proposition, nor is the problem space defined (Simon 1973). The prime challenge with a problem (the difference between a present and a desired state) is the actual problem definition itself. Once the present and the desired states have been identified, as well as how to get from one to the other, much of the problem has been solved (Rittel and Webber 1973; Simon 1973). *Wicked* problems however, have no clarifying traits; “the formulation of a wicked problem *is* the problem!” (Rittel and Webber 1973: 161). As such wicked problems are by nature ambiguous.

Wicked problems have ten distinctive characteristics. (1) The wicked problem may not be formulated definitively (Rittel and Webber 1973). Instead every attempt at a problem formulation correspond to a problem solution (Buchanan 1992). (2) Wicked problems have no stopping rule; the problem is not ultimately solved but the problem solver runs out of resources; such as time, money, etc. (3) Solutions to wicked problems are not absolute; neither is right or wrong, just good or bad. (4) A solution of a wicked problem may not be tested, instead an implemented solution generate consequences over time. (5) There is no trial-and-error for wicked problems; every tested solution has consequences. (6) Wicked problems do not have an enumerable set of solutions. (7) Each and every wicked problem is unique. (8) Every wicked problem is a symptom of another higher-level problem. (9) The choice of explanation of a wicked problem determines the nature of the problem’s resolution. (10) The wicked problem solver has no right to be wrong, they are liable for the consequences of the actions they trigger (Rittel and Webber 1973).

## **3 METHODOLOGY**

The basis for the article is a comparative case study. Through observations and interviews the objective has been to explore how design commissions may be managed and organized. The collection of empirical data has been executed at two design consultancy firms with different specializations; one focusing on service design and the other on product design and development.

Following an abductive approach the empirical explorations have been iterated with studies of related theoretical fields in order to arrive at the core aspects of the studied phenomenon (Alvesson and Sköldbberg 2009). As common in qualitative case studies, the data collection has combined different materials and methods, such as; archives, interviews and participatory observations of formal and informal meetings (Eisenhardt 1989).

#### 4.1 Research design

The main source for empirical insights has been participatory observations and interviews inspired by ethnography (Garsten 2003): The author has spent approximately three days a week during 3-4 months at each of the companies, resulting in a total of seven months. During the data collection the researcher was granted full access to the premises during office hours. She had a personal desk in the open-plan office space and as such attended the everyday discussions. The researcher was both invited to attend certain meetings and had the possibility to initiate participation in other meetings, seminars and workshops. The participatory observations were documented by taking notes, audio-recording, as well as taking photographs.

In addition to the observations, semi-structured interviews were undertaken with respondents at each of the companies at the ends of the data collection periods. Doing the observations before the interviews brings about the advantage that the researcher is familiar with the language, expressions and organizational culture during the interviews. Therefore the interview questions can be formulated in a language closer to the respondents' vocabularies (Kvale and Brinkman 2009). Furthermore basic questions on how the work is performed could be excluded since the researcher was already familiar with the companies' work practices.

The interviews have been undertaken with employees and managers at different positions, in order to cover as many views as possible. The ones that were not included did either not have time to participate or did not engage directly in the companies' design commissions. The collection of empirical material is summarized in *Table 1*.

*Table 1. Research design for the collection of empirical data*

	<b>Transformator Design Group</b>	<b>Oxyma Innovation AB</b>
How?	Comparative case study inspired by ethnography	
	3,5 months	3,5 months
a) Observations	Three days per week; 15 individuals employed in the organization were continuously observed, as well as external parties, commissioners & end-consumers.	Three days per week; 13 individuals employed in the organization were continuously observed, as well as commissioners & sub-contractors.
b) Interviews	9 semi-structured interviews, an average of 1½ hour/interview	11 semi-structured interviews, an average of 1½ hour/interview
c) Meetings	Approx. 10 internal meetings (á 2hours), 3 external meetings with commissioners (á 2hours), 4 seminars (á 2hours), 8 end-consumer interviews (á 30 minutes), and 8 workshops (half or whole day)	Approximately 15 internal meetings (á 2hours), 1 external meeting with commissioner.
d) Documentation	Project related documentation, project related mail correspondence, work process descriptions and documents describing the company	
f) Other	Partaking in informal meetings, lunches, coffee breaks etc.	

#### 4.2 Empirical setting

The selection of case companies was based on the intention to study two "successful" design consultancy firms, in order to grasp the best practice of how to manage design commissions. The selection of successful organizations was based on a few criteria. Firstly, assuming that it is difficult to establish whether a young organization is economically successful or even sustainable, both of the studied companies have existed for more than seven years. Secondly, both of the companies are growing in number and size of commissions, number of employees as well as increasing annual turnover, which may be seen as an indication of that they are successful in their markets. The selected companies are summarized in *Table 2*.

The service design firm called *Transformator Design Group* is considered to be the leading service design firm in Sweden. Transformator mainly execute their commissions as in-house projects; all consultancy work is undertaken in the firm's own facilities and the firm's employees are in charge of the project planning, management and execution.

Table 2. The empirical setting

	<b>Transformer Design Group</b>	<b>Oxyma Innovation AB</b>
Year of establishment	1998	2004
Number of employees (2012)	~25	~30
Education of employees	Mainly industrial design	Mainly mechanical engineering, but also industrial design
Why successful?	<ul style="list-style-type: none"> <li>• Increasing annual turnover</li> <li>• Continuously recruiting</li> <li>• Generally considered among designers as leading in its field in Sweden</li> </ul>	<ul style="list-style-type: none"> <li>• Increasing annual turnover</li> <li>• Continuously recruiting</li> <li>• Nominated to and won several design awards</li> </ul>
Commissioners	Service providers in areas such as banking, insurance & healthcare	Industrial companies with products in large-scale production
Commissions	Service design, i.e. <ul style="list-style-type: none"> <li>• Improved customer experiences in grocery stores</li> <li>• Pre-packaging of the most common banking services to retail customers</li> </ul>	Design & product realization, i.e. <ul style="list-style-type: none"> <li>• Industrial design of a portable gas grill</li> <li>• Industrial design and development of an ergonomic torque wrench</li> </ul>
Contracts executed as	In-house projects	In-house projects or Staffing projects

The product design and development firm called *Oxyma Innovation* has been nominated to, and won, several design awards in Sweden. During the data collection period Oxyma executed some of their commissions as in-house projects and some as staffing projects. The in-house projects were undertaken in a similar manner to those at Transformer: the consultants were based in the company's facilities and worked with their commissions from there. During the staffing projects the consultants mostly worked in projects managed by the commissioners in the clients' own facilities.

## 4 FINDINGS

The two design consultancy firms sell the undertaking of design and development work in order to structure and suggest solutions to their clients' problems in existing offers or their need for new offers. Clients hire them for their ability to interpret end-consumers and reframe problems as well as for their creativity (Carlgren 2009). One of the studied companies design services, whilst the other design and develop products. As such they have a fundamental difference in output of the design process. However, a comparison is still valid and interesting since both companies manage great deals of uncertainty: for instance the designers initiate each new commission with restricted knowledge about the content and output of the project.

These kinds of consultancy firms take on design and development projects with defined time limits and resource constraints. Designing services is about adapting service processes to fit with the end-consumers' needs and wants, through creative solutions. Designing products is about shaping and building physical forms to mitigate technical constraints and accommodating consumer needs.

### 5.1 Managing design commissions at Transformer Design Group

Industrial designers mainly populate the first organization and the service design practice hence resembled industrial design processes to a large extent. The process for how they execute their design projects is not formally defined in a written document. Instead they use an illustrative process image that clarifies what knowledge or insights they should produce in each step.

Transformer's clients approach the design consultants with either a problem in an existing service, a problem in a certain consumer segment or a challenge in a future market. All commissions that Transformer take on follow one out of two predefined design processes. Their most common kind of process they label "Action research" projects. The other kind of process is called "Discovery" and is a

prolonged version of the early phases of “Action research”. The empirical basis in this paper is founded mainly on observing “Action research” projects.

The commissions are initiated with a pin-point during which the problem or challenge to be solved is approached and discussed by several of the client’s internal stakeholders. The project team members bring with them their insights from the meeting, which then functions as the base for a semi-structured questionnaire in the next step. Then they interview end-consumers (the client’s customers) and gather insights about the needs, wants and demands of the users that will eventually buy the service that is being designed.

From the end-consumer interviews the project team cluster their insights and generate ideas on preliminary solutions to the defined problems. These preliminary solutions are then evaluated by the end-consumers during a second round of end-consumer interactions. The loop of end-consumer interaction, discussing insights, designing and testing solutions is iterated for a varying number of times. The amount of iterations depends on the commissioner as well as on when the project team sense that they have reached a saturation of the end-consumer responses.

Eventually the design team has come to a solution that is hopefully well received amongst end-consumers. This solution will then be presented to the client. The commissions have a set time frame from the start; hence the project is terminated at a predefined point in time.

The CEO at Transformator is very clear on that they only take on commissions that may be fitted into their predetermined design processes. The employees embrace the formalized processes. A reason given is that they then may focus their efforts to create on the content of the projects rather than reinventing the design process for each new undertaking. Furthermore they believe that new employees adopt the work procedures more quickly with a formalized design process at hand.

Throughout the design process the output is ill-defined. The teams’ main task is to assemble knowledge about and understanding for the end-consumers in order to create a suitable output. In other words the output uncertainty is being transformed from ambiguous to being conceptually defined.

## **5.2 Managing design commissions at Oxyma Innovation AB**

The product design firm was initially established with a goal to offer an alternative way of how to undertake product design projects. The two founders had learnt from their own previous experiences that business orientation often gets lost on the way during development project execution and that consultants often solve the “wrong” problem. Therefore they developed their own product development approach in which the starting point is to define the business opportunity.

For the purpose of orientation the approach consists of a number of commonly included activities during project executions. The activities are not defined in a specific order. However both employees and managers view these activities as guidelines rather than as prescribed standards for what to do. This means that the project group is more than welcome to settle on somewhat different activities, if they find that it is needed in the commissions.

The project teams consist of a mixture of professions and skills, depending on the technical needs of the specific project. The industrial design work is considered to constitute approximately 5-10% of the development work. Also the work force consisted of that same proportion of industrial designers.

In the cases when the commissioner allows it, the design and development work is initiated with making a definition of the product’s characteristics. Although the client might have an idea of what kind of product that should be developed, the team must make an analysis of the market and identify possible business opportunities. Exactly how this is done varies between the projects but do contain similar activities.

The product definition contains all properties that are crucial for meeting the identified corresponding business opportunity. The product definition then functions as a guidance throughout the consecutive design and development: all collected information, all identified potential problems and all prospective solutions are benchmarked with the product definition.

The testing and industrialization activities are also performed with the product definition in mind. If a product is to be directed towards a specific segment of a market, then that poses challenges on test results and industrialization efforts. During testing and industrialization the product is refined and improved in detail.

By benchmarking with the product definition Oxyma ensures that the right information and knowledge is collected and used. Furthermore the benchmarking ensures that the correct problem (that the client wants them to solve) could and is being solved, according to the executive vice president. Creative

work is considered a necessary part of the projects' process and progress. Creativity is talked about as problem solving within constraints and they claim that creative ideas are favored by restrictions in what may be developed.

## 5 DISCUSSION AND CONCLUSIONS

The initial phases of design and development work contain much uncertainty: the need for information and knowledge is to a large extent unknown, possible difficulties on the way is yet to be encountered and whether expectations from commissioners and end-consumers can be met or not is still unclear. This paper has illustrated two ways in which design consultancy firms manage and mitigate uncertainty.

It is important to point out that the projects at Transformator corresponds to only a subset of the commissions at Oxyma in terms of scope and time consumption. The service design projects at Transformator are completed when they have created a design brief, which in simplified terms contains the designed service concept and how that corresponds to the end-consumers' needs. This resembles Oxyma's product definition, perhaps merged with development of conceptual solutions. The additional development phase of Oxyma's commissions correspond to a continued NPD process such as; creating prototypes, calculating, testing, validating and industrializing (Ullman, 2003). Despite the differences both of the cases demonstrate how FFE work may be structured and managed in order to reduce ambiguity.

At Transformator, the commissions are *premised on certain specified inputs*, i.e. the issues that the design project should be focused on. Transformator's commissions are in this way defined by the clients' problems with their current services and their need for new services. The commissions are simultaneously initiated with great uncertainty about the output also referred to as *product* (Engwall 2003); they do not make efforts to reduce the solution space content wise, as such causing ambiguity of intention (March and Olsen 1976/1979).

Instead the team is provided with a structure that enables them to get a sense of certainty that they will reach a suitable output. They have a predefined process that is known prior to development, which helps mitigating ambiguity of organization (March and Olsen 1976/1979); the team knows what to do and who is participating in the work. As such all their commissions are initiated with low process uncertainty and the project is about mitigating the uncertainty related to the ambiguous output.

At the other firm, Oxyma, the projects are initially subject to chaos (De Meyer et al. 2002). There is both ambiguity of intention, understanding and organization (March and Olsen 1976/1979); the team does not know which business opportunity to tap, they do not have perfect information of which technologies to apply, nor do they know which suppliers and sub-contractors to engage.

Initially they lay a foundation for the continued development by making the so-called product definition. How the product definition is done depends on each commission's unique characteristics, but do contain similar elements between different customer projects; they define a visionary product, hence mitigating the uncertainty related to intention. The product definition is partly based on a business opportunity analysis in which product-to-be characteristics that are critical for business success are defined, by that reducing ambiguity of organization.

On those occasions when Oxyma is commissioned in a project with much unknown technology they do a primary development project. During this predevelopment phase they clarify any technical ambiguities in advance, before starting the main product development project hence mitigating ambiguity of technological understanding. In other words, Oxyma dedicate the first part of their commissions to problem setting, hence reducing the many ambiguities (March and Olsen 1976/1979) into manageable tame problems (Rittel and Webber 1973), see the filled vertical arrow in Figure 2.

A comparison between the design processes at Oxyma and Transformator reveals two different patterns of how uncertainty develops during project execution. At Transformator the project group's task is to develop the commission from the unknown to a known content by following the predefined process, represented by a dashed arrow in Figure 2. The product uncertainty is gradually reduced by continuously identifying and developing knowledge about the end-users' demands and needs about the output-to-be. The increasing knowledge and understanding for the output demands also facilitate the creation of potential solutions. Although the exact activities are not defined in detail in advance, the project groups essentially have a shared understanding of which activities to include, and in what order, throughout the design process. The employees seem to perceive a sense of certainty in having an established process to follow.



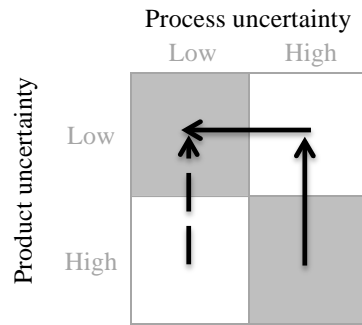


Figure 2 Illustration of uncertainty mitigation at Transformer Design Group (dashed arrow) and Oxyrna Innovation (filled arrows). Matrix extended from Engwall (2003).

At Oxyrna the development team's task is to detail the product characteristics through problem solving activities of any technical, functional and design issues that may arise on the way. The objective is to reduce the process uncertainty (Engwall 2003) according to the horizontal arrow in Figure 2. This is done by gradually choosing which activities to undertake depending on the current status of the development in the project.

Throughout this endeavor the product definition functions as a guideline for *what is to be achieved* during the development work. They consider the product definition central to ensure that the project results meet the clients' expectations. A suitable metaphor is to compare the product definition with a beacon; it functions as a guiding light in the dark that facilitates navigation but do not prescribe which route to take.

## 6.1 Conclusions

This paper is based on a comparative case study with the objective to describe how design and development work may be managed in order to reduce uncertainty in commissioned problem solving. By setting goals and managing either the *process* of work or *product* (outcome) of commissions the studied organizations seem to master to mitigate ambiguous uncertainty.

One of the companies have structured and standardized their work process in order to reduce uncertainty about what to do in a commission. Simultaneously, the process functions as a guarantee that they will reach an acceptable output.

The other company initiates their projects by first of all defining product characteristics that are crucial for business success. This product definition then functions as a beacon during the consecutive development. It reduces uncertainty of what output to reach whilst letting the team decide on the unique route for each commission.

Designers have been declared to be good at taking on wicked or ill-structured problems since they are claimed to be good at living with uncertainty (Hobday et al. 2012). However, as this paper has illustrated, the designers do not merely embrace the ill-structured or wicked problems. Instead they either reduce the solution space of an ill-structured commission, or decide upon a route from the present state of being to an unknown desired state. As such they manage to mitigate much of the ambiguous uncertainty in the wicked design commission.

## REFERENCES

- Alvesson, Mats and Sköldböck, Kaj (2009) *Reflexive Methodology - New Vistas for Qualitative Research*. 2 edn.; London: SAGE Publications Ltd.
- Buchanan, Richard (1992) Wicked Problems in Design Thinking, *Design Issues*, 8 (2), 5-21.
- Carlgrén, Lisa (2009) Early Involvement of Industrial Designers in Product Development - Exploring Motives and Challenges, Licentiate thesis (Chalmers University of Technology).
- De Meyer, A., Loch, C. H., and Pich, M. T. (2002) Managing project uncertainty: From variation to chaos, *MIT Sloan Management Review*, 43 (2), 60-67.
- Duimering, P. Robert, et al. (2006) The Effects of Research Ambiguity on Project Task Structure in New Product Development, *Knowledge and Process Management*, 13 (4), 239-51.

- Eisenhardt, K. M. (1989) Building Theories from Case-Study Research, *Academy of Management Review*, 14 (4), 532-50.
- Engwall, Mats (ed.), (2003), *Produktutveckling bortom kunskapens gränser - Mot en osäkerhetens grammatik* (Lund: Studentlitteratur).
- Garsten, Christina (2003) 'Etnografi', in Bengt Gustavsson (ed.), *Kunskapande metoder inom samhällsvetenskapen* (Lund: Studentlitteratur).
- Gifford, W. E., Bobbitt, H. R., and Slocum, J. W. (1979) Message Characteristics and Perceptions of Uncertainty by Organizational Decision Makers, *Academy of Management Journal*, 22 (3), 458-81.
- Hobday, M., Boddington, A., and Grantham, A. (2011), 'An Innovation Perspective on Design: Part 1', *Design Issues*, 27 (4), 5-15.
- Hobday, M., Boddington, A. and Grantham, A. (2012) An Innovation Perspective on Design: Part 2, *Design Issues*, 28 (1), 18-29.
- Kim, J. and Wilemon, D. (2002) Focusing the fuzzy front-end in new product development, *R & D Management*, 32 (4), 269-279.
- Krippendorff, K. (1989) On the Essential Contexts of Artifacts or on the Proposition that "Design Is Making Sense (of Things)", *Design Issues*, 5 (2), 9-39.
- Kvale, S. and Brinkman, S. (2009) *Den kvalitativa forskningsintervjun*, 2 edn.; Lund: Studentlitteratur.
- March, J. G. and Olsen, J. P. (1976/1979), *Ambiguity and Choice in Organizations*, 2<sup>nd</sup> edn.; Bergen, Norway: Universitetsforlaget.
- Rittel, H. W. J. and Webber, M. M. (1973), Dilemmas in a General Theory of Planning, *Policy Sciences*, 4 (2), 155-69.
- Sicotte, H. and Bourgault, M. (2008) Dimensions of uncertainty and their moderating effect on new product development project performance, *R & D Management*, 38 (5), 468-79.
- Simon, H. A. (1973) The Structure of Ill Structured Problems, *Artificial Intelligence*, 4, 181-201.
- Ullman, D. G. (2003) *The Mechanical Design Process*, 3rd edn.: McGraw-Hill.
- Ward, S. and Chapman, C. (2003) Transforming project risk management into project uncertainty management, *International Journal of Project Management*, 21, 97-105.