



Scenarios for Coupling Design Thinking with Systematic Engineering Design in NPD

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This study addresses the external consultant-client interface and suggests different scenarios for coupling the design activities of both parties. More specifically, it investigates scenarios for coupling the user-centred perspective of design thinking with systematic engineering design processes via the consultant-client relationship. Having interviewed eight innovation consultants and lecturers working with design thinking, a scheme for differentiation of coupling-scenarios is proposed. The scheme considers different *types of process-couplings* (partial and complete substitution of the client's design activities) and *modes of interaction* (the client's active or passive involvement in solution generation). Implications for design practice are discussed. Our findings furthermore suggest four dominant issues that affect successful (external) consultant-client relationships: both parties are aware of design process models used when preparing and implementing design projects, negotiate the solution space when writing the design brief, manage expectations especially with respect to envisaged outcomes, and allow for unplanned and potentially unknown solutions.

INTRODUCTION

Innovation is necessary to stay competitive and grow in today's global product development environment [e.g. Moultrie, 2007; Blessing, Yates 1999; Cooper, Kleinschmidt 1986]. It is an environment characterised by a web of dynamic political, economic, social and technical challenges, and ever-changing consumer aspirations and user needs. These challenges show no sign of slowing down. They affect design processes in all types of design and industry sectors, irrespective of whether the product or system designed is a machine, a consumer good, software, a building, electronics, or service. Given these challenges, companies which

do not yet possess capabilities in product innovation have to develop resources in-house or find other ways to compensate for the lack. If in-house development is not an option, an alternative for enhancing capabilities in innovation is through collaboration with design and innovation consultancies. It offers the chance to innovate whilst remaining focused on core competencies [e.g. Utterback, Vedin, 2006]. Buying in required design capabilities to enhance innovation can range from, for example, market research and product planning (with exploration of (lead) user needs, analysis of market segments, and ideation of possible products) to concept development.

Literature

A growing body of literature on involving external actors in the innovation process and researching the external actor-client relationship has developed around the concept of open innovation [Chesbrough 2003] and the use of external sources of knowledge [see e.g. Laursen, Salter 2006]. For a review of academic studies see Lichtenthaler [2011] and for case studies on implementation of open innovation in industry, see Mortara, Napp [2010]. Studies highlight the potential for product innovation and overall competitive advantage through inclusion of the user perspective. Studies in management have also addressed the consultant-client relationship to explore the interaction between the innovation consultant and client [for an overview see O'Mahoney, 2010]. In design management and focusing on the client-perspective, Behrends, Reymen et al. [2011], for example, report that the intensity of the involvement of external designers in a client's design process has an effect on the occurrence of iterations in the process. Greater intensity leads to a greater occurrence of convergent design phases [Behrends, Reymen et al. 2011]. What these studies have in common, regardless of whether they focus on user involvement (open innovation) or on the involvement of design consultants, is the emphasis on the 'external' actor as an integral part of finding solutions and not as solely a source for requirement definition [e.g. Reichwald, Piller 2006]. Whilst the value that consultants can add to a business has long attracted management attention [e.g. Argyris, 1970; Schein, 1988], interest in the actual consultancy process in general is relatively new [Fincham, 1999]. In the design management literature, the nature of consultant-client relationship in general with emphasis on the perspective of the innovation consultant in particular seems to be underexplored.

Research focus

This paper takes first steps towards addressing the above-mentioned gap, describes scenarios and researches implications for coupling design thinking with systematic engineering design processes in New Product Development (NPD). More specifically, it investigates what is current practice at the interface between design consultancies, working with an IDEO-inspired design thinking approach [Brown, Katz 2009; Plattner et al. 2009], and their clients, who are mainly NPD-companies used to following systematic engineering design processes. Incorporating design thinking through external actors into the NPD-process of a client-company enables user-centred innovation also for clients who have no capabilities in doing

so alone. This paper takes a design process perspective when describing multiple scenarios of how design consultancies and clients might be coupled. We use the term coupling in this paper in its broadest sense as linking two ‘parts’, e.g. through communication but do not distinguish directly between tight and loose couplings [e.g. Weick, 1976]. The paper is guided by the following research questions:

- *Which scenarios for coupling design thinking with ‘conventional’ systematic engineering design processes are observed in industry practice?*
- *What are implications of the observed scenarios for the consultancy and the client?*
- *What issues affect the consultant-client relationship?*

The remainder is structured as follows. The next section introduces our interviewees and gives a snapshot of reported projects. This is followed by a discussion of findings for each research question. A summary and ideas for future work conclude the paper.

INTERVIEWING INDUSTRIAL DESIGNERS AND LECTURERS

Collaborating with a design consultancy affects the design process of any company. There are similarities to open innovation where a NPD-company also works with external stakeholders and ‘opens up’ its most important value creation processes – the design process.

Study design

We conducted eight interviews (see *Table 1*) to identify typical scenarios of such collaborations, implications for the participating parties, and key issues affecting successful partnerships.

Table 1: Overview of interviewees from design practice and academia

	Affiliation	Educational background	Practice	Country
Consultants	Ingomar&Ingomar – consulting	Mechanical engineering; Industrial design; Design research	> 15	US
	VIA Design	Industrial design; d.school Potsdam alumni	> 20	DK
	Tiefenschärfe	Economics; Political Science; d.school Potsdam alumni	> 5	DE
	Dark Horse Innovation	Mechanical engineering	> 5	DE
Lecturers	d.school Potsdam	Fine Arts	>20	DE
	d.school Potsdam	Computer Science	>10	DE
	Copenhagen Business School	Graphic design; Industrial design	> 20	DK
	Copenhagen Business School	Industrial design	> 5	DK

Interviews focus on the consultant-side of the consultant-client relationship. In addition to design consultants, university lecturers offering courses in design thinking were interviewed.

The university lecturers were chosen as they supervise student projects. These projects tackle real-life design problems and are executed with industry partners. University lecturers have a potentially great influence on the future design practice of their students and might therefore be considered in a position similar to representatives of a design consultancy. Our interviews cover four different design consultancies and two universities located in three different countries. The interviewees' expertise ranged from young entrepreneurs to very experienced design consultants. All interviews were semi-structured to allow for comparability between the two interviewers, were conducted face-to-face or over the telephone and lasted between 60 and 90 minutes.

Design projects

We asked our interviewees to refer their answers whenever possible to the same reference project. This posed challenges, especially for the university lecturers as they mostly act as supervisors rather than actively involved designers. Reported projects included a number of design disciplines and refer to large as well as small and medium-sized clients. Some cases were executed during previous engagements in other consultancies. Due to confidentiality reasons, clients in the projects described will not be named. Out of the many examples given during interview, four projects consultants mainly referred to will be described in brief (an overview is given in *Table 2*).

Table 2: Overview of selected design projects

	Industrial	Service design	Interaction	Event design
Content	new models for consumer good	alternative service concept	interacting in a prison	stand at fair use renewable
Goal	improve functionality	to support product planning	increase positive experiences	to interest youth
Size of client	large	large	large	medium
Type of client	private	private	public	public
Role of contact person	R&D	Marketing	Board and all stakeholders	Director of public relations
Duration	6 months	3 months	1.5 years	3 months
Main result	design prototype	product idea user information	activities newsletters	experiments with materials
Success	profitable design awards	follow-up project roll-out service	reduced crime roll-out	strong use and interest

Selected projects range from industrial design, to service design, to interaction design, and event design and cover clients from industry as well as governmental institutions. The industrial design project was motivated by the launch of a new product through a competitor. Our consultancy interviewed was hired to propose a modern design for a vacuum cleaner that attracts customers as well as improves the functionality of the product. The service design project was initiated in order to propose an alternative service concept for a logistics company. A main aspect of this project was the analysis of consumer behaviour in densely populated areas. The interaction design project was driven by the need to improve interaction

between guards and inmates of a prison in order to support the rehabilitation of the inmates and to improve the sometimes threatening atmosphere. The event design project was initiated by a public special interest group in order to design a stand at a fair that allows the younger audience to experience different ways of using renewable primary products.

What unites the four projects selected is the fact that all projects were initiated by the client and judged as successful – last but not least as the consultant-client relationship turned into a long-term one. A further commonality of these examples is that the results of the projects were strongly affected by the type and mode of coupling between the consultants and the clients, even though coupling scenarios differed.

FINDINGS: COUPLING PROCESSES AND ACTORS

Our findings encompass configuration options for coupling design processes and modes of interaction between the consultant and the client.

Types of process-coupling

This paper describes opportunities for coupling a design thinking (DT) approach [Plattner et al. 2009] with the design methodology proposed by Pahl and Beitz [2007]. Both approaches start with an initial problem statement or with the identification of a need. Pahl and Beitz' methodology for systematic engineering design covers the whole design process from product planning and task clarification, to conceptual design, and detail design as a full description of the product, including parts lists, detailed drawings for manufacture and the like. The design thinking approach ends with the development of a prototype (see *Figure 1*).

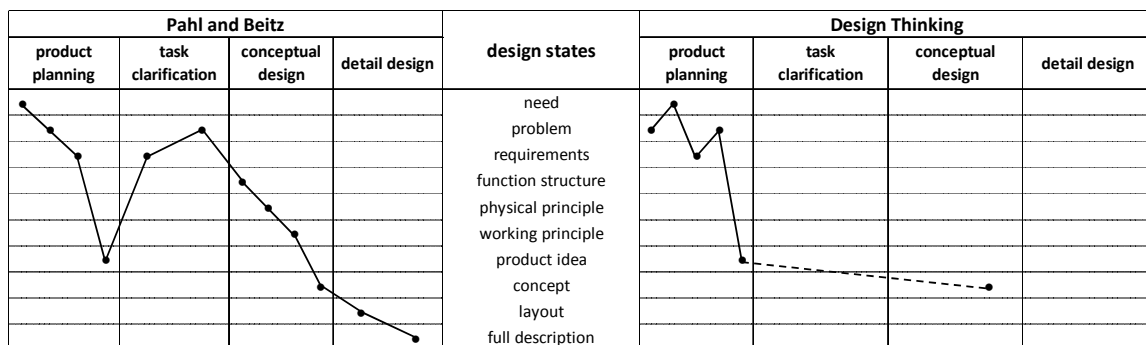


Figure 1: Sequence of realised design states [Gericke et al. 2010]

The graphs shown in *Figure 1* indicate the sequence of realised design states (from left to right; iterations are not represented) as described in literature (for Pahl and Beitz) and observed during a case-study of design thinking projects at the d.school Potsdam, preceding the interview study reported in this paper. Depending on the problem addressed, the final deliverables of the student projects were categorised as a product idea or concept (indicated by the dotted line in *Figure 1*) [see also Gericke et al. 2010].

This led to the idea that coupling both approaches might be beneficial for product development projects which are characterised by complex problems, in which users are

involved and innovative solutions need to be developed. Combining both approaches offers the chance to combine the user-centred perspective of the design thinking approach in the beginning of the project (more design-oriented phases) with the methods proposed for systematic variation, selection and optimisation during later phases of the project (more engineering-oriented) [Gericke et al. 2010]. We might conclude from this study that in design practice, different types of coupling the design thinking approach with a company’s design process are constrained by the required maturity of the delivered solution and design thinking might not take us to a detailed design. In order to find out whether these statements derived from student projects are supported by findings from design practice, our interview study set out to analyse examples of successful consultant-client relationships.

Perhaps as expected, interview results point to two types of how design processes can be coupled: One, what we call partial substitution, in which parts or some phases of the client’s design process are completed by the consultant and another one, what we call complete substitution, in which the client’s design activities are fully undertaken by the consultant.

Partial substitution of the client’s design process

In the reported cases, the design consultancies were mostly involved right from the start or sometimes even before a specific project was launched. Most often, consultants were tasked with the goal to propose ideas for new products and services. This type of coupling can be described as a partial substitution of the client’s design process by the design thinking process. In the cases reported, the deliverable from the design thinking project was often a product idea, a solution concept or a first layout of the final solution. This would depend on the type of product. Most of the reported projects resulted in the proposal of a product idea and in case of less complex design problems, a concept (see *Figure 2*; partial substitution – a). One project resulted in the development of a layout of the final solution (see

Figure 2; partial substitution – b). Distinguishing between design states implies an increase in knowledge about the solution. The distinction between product idea and concept was difficult in some cases as the degree of complexity of some solutions was rather low.

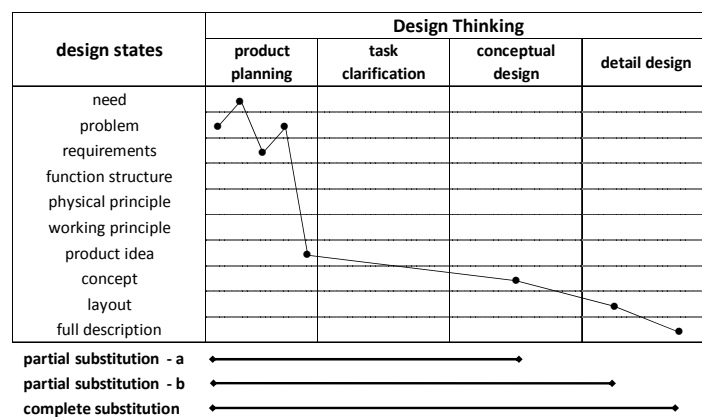


Figure 2: Types of process coupling

Complete substitution of the client’s design process

Another type of coupling between design consultancies and clients can be described as complete substitution, where product development was wholly performed by the consultancy. This type of coupling was reported for consultant-client partnerships where the client did not possess own design capabilities. Projects characterised as such resulted in a deliverable that was ready for implementation (see

Figure 2). Detailing of the product idea that resulted in a full description of the deliverable was done by iterating the later stages of the design thinking process, which was, as and when needed, supported by additional and sometimes additional external experts. *Table 3* summarises findings from types of design process-couplings seen.

Table 3: Description of observed types of design process-coupling

	Partial substitution	Complete substitution
Size of client	<ul style="list-style-type: none"> rather large companies 	<ul style="list-style-type: none"> rather small and medium sized companies
Design capabilities client	<ul style="list-style-type: none"> company is capable 	<ul style="list-style-type: none"> design/innovation resources or capabilities are limited
Intent of collaboration	<ul style="list-style-type: none"> to get new ideas to get new impulses for own work to have a competitive advantage to learn about users to maintain image as innovative company to try a new approach to get insights into the DT approach 	<ul style="list-style-type: none"> to get new ideas to have a competitive advantage to compensate lacking design resources/capabilities of the client
Scope of the design challenge	<ul style="list-style-type: none"> open solution space 	<ul style="list-style-type: none"> related to client’s own portfolio
Deliverable	<ul style="list-style-type: none"> new ideas are paramount 	<ul style="list-style-type: none"> implemented solution

Modes of coupling: The consultant-client interaction

A further factor that influences collaboration between a design consultancy and a client is the mode of coupling, i.e. the mode of interaction between both partners. Interview results point to two configurations: a somewhat passive coupling and a more active coupling between a consultancy’s design thinking team and their clients.

In consultant-client partnerships categorised as passive coupling, the consultancies’ design thinking teams developed the solution on their own and contacted their clients only in order to get further information or for reviewing results. In active couplings, the consultancies’ teams were supplemented with designers from the client. Intensity of the collaboration varied during the project. Designers from the client-side collaborated closely, e.g. through regular workshops and contributed to the final solution.

There is no one best way. Strengths and weaknesses of each mode depend on the context of the particular design project. A main issue that influenced the decision on which mode to

choose is related to the open-mindedness of the client to ideas that were not invented by their own designers. This might be more or less relevant, depending on the goal of the collaboration. Collaborations in which co-creation of the solution during an on-going project is the goal, active coupling might be beneficial as the proposed solutions enjoy higher mutual acceptance. Collaborations aiming to provide new ideas and insights into consumer needs might benefit from passive coupling, as the design thinking (DT) team might be less affected by restrictions and fixations imposed by the client’s designers. An overview of additional benefits and challenges of the different modes of couplings are given in *Table 4*.

Table 4: Comparison of coupling modes

	Passive coupling	Active coupling
Description	<ul style="list-style-type: none"> • Consultancy’s DT-team develops the solutions on its own • Designers from the client-side are not involved in design activities 	<ul style="list-style-type: none"> • Co-creation of solution • DT-team is composed of designers from both the client and the consultancy. (Alternatively, designers from the client-side are only involved during workshops)
Benefits	<ul style="list-style-type: none"> • DT-team will not be affected by restrictions and fixations within the client-company • DT-team is familiar with the approach 	<ul style="list-style-type: none"> • Easier acceptance and uptake of the proposed solution • Face-to-face communication might save time and makes iterations faster
Challenges	<ul style="list-style-type: none"> • Deliverable might suffer acceptance problems by on client-side (“not invented here”- syndrome) 	<ul style="list-style-type: none"> • Client might focus on own contribution relative to contribution from consultant • Might narrow the solution space because of client’s design fixation

Scenarios for coupling

Considering both types of process-coupling and the coupling modes allows for a description of scenarios for connecting design activities of both consultants and clients. Cases reported by the interviewees did not cover all possible combinations of the identified types and modes (see *Figure 3*). All configuration options appear feasible but in design practice, demarcation lines between the different scenarios characterised by coupling-types and -modes are blurred.

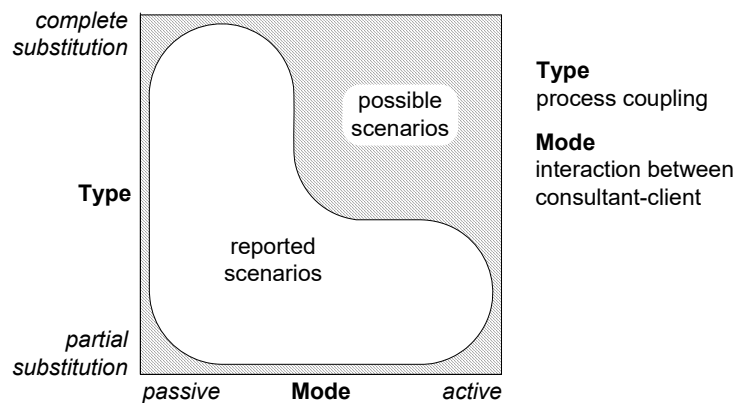


Figure 3: Scenarios for coupling

DISCUSSING IMPLICATIONS OF COUPLING-SCENARIOS

A good fit between the design process of a design consultancy and the design process of a client will improve the outcome of the collaboration and will avoid wasting resources [Browning 2003]. The choice of a suitable coupling-scenario can compensate for the absence of design capabilities, required expert knowledge and skills in the client-company and can determine efficiency of such a collaboration.

Interpreting our findings within the context of the projects, we suggest that there are major influences on the course and the outcome of the consultant-client relationship. These influences or determinants concern the client and the consultant (design capability, size, and goals) and the product (complexity, type of product/branch).

One determinant for the decision to which extent design activities are substituted by a design consultancy is the design capability of the client. It is obvious that if a client-company has no own design capabilities, it cannot contribute to the design process, thus the design consultancy has to substitute that completely. But even if the client possesses good design capabilities a comprehensive substitution (compare scenario ‘partial substitution – b’ in

Figure 2) might be sensible, if the client wants to engage in a market sector where they have currently no expertise or if the product development process is driven by different expert knowledge or skills (for example industrial design skills).

Influence of the design capability on the choice of a suitable scenario seems to explain the observed tendency that a complete substitution was only reported for collaborations with small companies. Collaborations with large companies were usually characterised by partial substitution aiming to support the early phases of the product development process, namely the need finding and product planning/conceptualisation phases.

Another determinant for the extent to which a design consultancy can substitute design activities is the existence of the required expert knowledge and skills on the consultancy side. As reported by some interviewees, the consultancies hired external experts in order to complement the design thinking team if required. The flexible organisational structures of the rather small design consultancies allowed integration of external experts even in the later iterations when the basic idea was already developed and the design activities focussed on a further refinement of that idea.

Yet another determinant for the suitability of the portrayed scenarios seems to be the product respectively the nature of the design task. A complete substitution of the design process, what differs from observations in a previous case study [Gericke et al. 2010], was only reported for service design or products with a rather low complexity. This suggests that design thinking can be used in order to develop solutions beyond the product idea or concept level (see

Figure 2). However, it also suggests that a complete substitution is not possible in all cases. An explanation might be that more complex products seem to usually require more diverse

expert knowledge and more manpower. Even if the design consultancy might be able to build a team with the required expertise it seems questionable whether the iterative design thinking approach is the most appropriate in that case. The reported design thinking projects involved a rather small number of designers which allowed intensive face-to-face communication. The question remains whether this can be upheld when the team grows in size. In such cases, consultancies working with design thinking might contribute best during the early phases of product development, with concept refinement and detail design being perhaps out of scope.

ISSUES THAT AFFECT THE CONSULTANT-CLIENT RELATIONSHIP

Four for us unexpected issues were emphasised in interview. Related and in no particular order, consultants found themselves what one might call ‘being guided by process models’, ‘negotiating the solution space’, ‘managing expectations’, and ‘daring the unknown’.

Being guided by design process models: design thinking useful myth

We were surprised by the fact that both design consultants and university lecturers had a process model in mind which they followed when executing their design projects. Interestingly, it seemed that most of the design consultants focused on the process models or a slight modification of the ones they were taught.

The four interviewees from the d.school Potsdam and d.school alumni followed the design process model as proposed by Plattner et al. [2009]. The two interviewees from the Copenhagen Business School referred to using the UK Design Council’s Double Diamond [Design Council 2007] in their teaching and consulting, one interviewee referred to Andreasen and Hein’s Integrated Product Design process model [Andreasen, Hein 1987], and one hand-drawn a design thinking process model he was using. All interviewees were familiar with the IDEO-inspired design thinking approach.

Confirming Norman’s ‘design thinking: useful myth’ [Norman, 2010], most interviewees mentioned that they had been using design thinking characteristics throughout their industrial design practice, even if they did not call it design thinking when they started. Some speculated that giving it a label probably accelerated the trend to focus on the user – the trend of co-creation and treating the client as an actively involved partner in the project.

Negotiating the solution space: Stage-gate vs flexible process

Design thinking emphasises the need for and benefit from design iterations and differs from how most companies are used to manage their own design processes, which is often inspired by a stage-gate approach with defined stages and deliverables [e.g. Cooper 1990]. A lot of times, clients had problems accepting the iterative nature of the design thinking approach and ambiguity resulting from the open solution space. Especially large companies asked for concrete and tangible solutions early on. Accommodating and using this tension, industrial designers found themselves continuously communicating, negotiating, creating and re-defining the solution space.

Managing expectations: The design brief

Managing the client's expectations with respect to the solution is one of the most crucial aspects for a successful consultant-client relationship. It contributes towards client satisfaction and re-assurance that the right problem had been invested in.

Consultancies interviewed were confronted with two different situations, which, when confused, lead to difficulties in executing the design project. In the first situation, the client had clear ideas for expected deliverables. The initial focus in the design brief would often forestall possible solutions and perhaps neglect central user-needs. It would often perhaps solve the problem right but not the right problem. Intensive negotiation of the initial design brief was therefore required in order to widen the solution space, e.g. by re-defining the system boundary and loosening requirements and restrictions imposed by the client. Contrary to the first, in the second situation, the client had only vague ideas or rudimentary understanding of the problem but the feeling that there might be potential for a good product or service. This situation required careful preparation of the design brief to develop shared understanding of the problem and user-needs to be addressed and satisfied. In both situations, giving priority to managing expectations and capturing them in the design brief was highly recommended (see also [Petersen, Phillips 2011]). Industrial designers interviewed also highlighted that managing expectations and formulating the initial design brief were easier and less time consuming during follow-up projects as clients were then already familiar with the design thinking approach.

Daring the unknown: Is a bird in the hand worth two in the bush?

Irrespective of the coupling types and coupling modes chosen, interviewees pointed to the importance of the client's mindset with respect to the design thinking approach. According to the design and innovation consultants interviewed, design thinking is highly iterative and requires the willingness to try something new. Something, the client might not be able to predict or control but something that might offer the potential to exceed expectations. In this context, one of the designers pinpointed the situation by using the English proverb 'a bird in the hand is worth two in the bush'. Often, one of the participating parties tends towards thinking that it is better to accept or be content with what one has than trying to get more and thus risk losing everything. If this is the case and the innovation envelope is trying to be pushed, it is therefore of paramount importance to agree on a journey of experimentation; as in these cases, only the future will prove whether the chosen approach is right but without embarking on the journey, the unknown yet rewarding destination could never be reached.

SUMMARY AND FUTURE WORK

Summary

A company might be fixed on existing solutions, locked-in a certain way of perceiving and interpreting user needs, or might lack capabilities in designing. Working with a design

consultancy might offer possibilities for developing products which were not thought of before. Working with a design consultancy might also offer possibilities to adapt a company's own design process, for example, by learning from observation and analysis of the design consultancy's practices and/or by getting insights and inspirations from an external pair of eyes.

However, such collaborations are also sensitive, as they require valuable resources and success is not guaranteed. In order to support preparation of a client-consultant partnership, this paper investigated different aspects of such collaborations by interviewing eight industrial designers and lecturers in design thinking. The paper focused on three questions.

Which scenarios for coupling design thinking with 'conventional' systematic engineering design processes are observed in industry practice?

Different scenarios for coupling have been reported by the interviewed design consultants and lecturers. The scenarios can be distinguished by two main aspects: the *type* and the *mode* of coupling. The coupling *type* describes what part of the design process is executed by the design consultancy, i.e. whether the consultancy or the client has the process ownership. For all reported projects the consultants had the ownership at least for the initial part of the design process (*partial substitution*) and for few examples the consultancy had the ownership of the whole process (*complete substitution*). The coupling *mode* describes the way the client is integrated into the consultancy's design activities. Two different modes can be distinguished: *active* and *passive*. An *active* integration means that designers from the client-side are integrated into the team of the design consultancy, i.e. it is both expected and desired that they contribute with own ideas to the final solution. In a *passive* coupling mode, the client is not integrated into the consultancy's team.

What are implications of the observed scenarios for the consultancy and the client?

There is no one best scenario. Suitability depends on the context, in particular on the design capabilities of the consultants and the clients, the goal of the collaboration, and the addressed design task. Each scenario has different strengths and weaknesses which should be considered when preparing such collaborative design projects. Findings in this paper resulted from interviews with design experts who embraced design thinking. We believe that findings also relate to other consultant-client partnerships.

What issues affect the consultant-client relationship?

In addition to the different options for coupling (see e.g. *Figure 3*), this paper highlights four dominant issues that affect both sides of the (external) consultant-client relationship and the outcome thereof: Being aware of explicit or implicit design process models used when preparing and implementing design projects, negotiating the solution space and putting emphasis on writing the design brief, managing expectations especially with respect to envisaged outcomes, and allowing for unknown and possibly even more rewarding solutions.

Future work

This discussion contributed to coupling of design thinking with systematic engineering design processes via the consultant-client relationship. Empirical data was gathered through the eyes of the consultant and with help from academic examples. Future studies will explore the client-side. Further work will extend scenarios, e.g. by exploring situations in which the consultant-side itself is composed of a number of partnerships.

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