



Delft University of Technology

Considering design practice

The underutilized opportunities in collaborative design research projects for learning by design professionals

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CONSIDERING DESIGN PRACTICE

The underutilized opportunities in collaborative design research projects for learning by design professionals

Marieke Zielhuis

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CONSIDERING DESIGN PRACTICE:

**The underutilized opportunities in collaborative design research
projects for learning by design professionals**

Dissertation

for the purpose of obtaining the degree of doctor

at Delft University of Technology

by the authority of the Rector Magnificus,

prof.dr.ir. T.H.J.J. van der Hagen,

chair of the Board for Doctorates

to be defended publicly on

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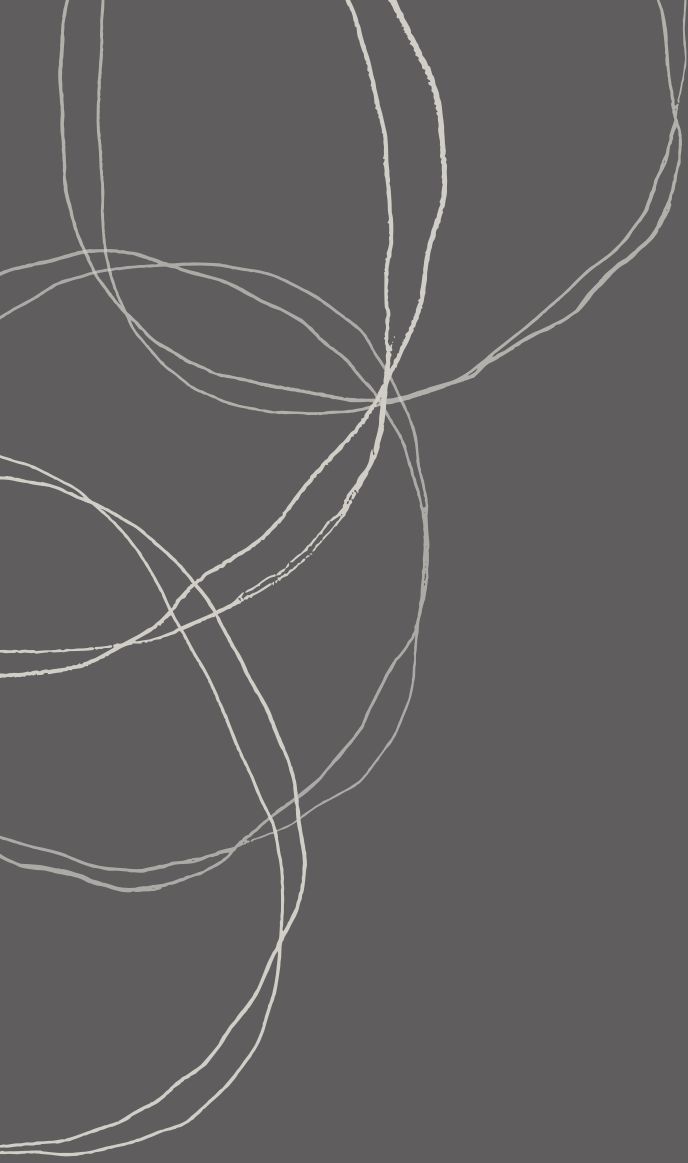
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CHAPTER 1

Introduction of the problem and research focus

"There are lots of great ideas in research which, unfortunately, stay on paper"

(design professional)



1.1 PROBLEM INTRODUCTION

For several years, I worked as a project manager within a Dutch University of Applied Sciences. I did not always find it easy to make the insights from our research projects useful for design professionals in industry. How can we actually help these professionals in their work? How can our research findings help them to develop new products, interactions, and services? Our academic papers are rarely read by these professionals, or at least not regarded by them as very practical for their daily work. We made practical tools such as card sets for them, but these were also not always used. Even the design professionals which we actively involved in these projects often did not use the developed tool. Nevertheless, they indicated that these projects already helped them in their work and they did use the main ideas behind the tool. Projects such as ours seem to hold a potential for design professionals which we do not fully use. Looking for more guidance to unlock this potential, I found that there was not much available.

Difficulties such as these to connect academic design research and designers in practice have been observed more widely in the design field. What is generally referred to as the *research-practice gap*, or *theory-practice gap* formed the starting point for my research. This dissertation aims to strengthen the potential of design research projects in helping design professionals in their work.

1.2 DESIGN PRACTICE, DESIGN RESEARCH, AND THE GAP

Professional design work – *design practice* in this thesis – takes place in design agencies, consultancies, companies, or governmental organizations. These organizations develop strategies, products, services, or interactions as (partial) solutions for the problems we face in society and our daily lives. In the last decades, design became increasingly recognized as a driving factor in innovation as well as an activity in which knowledge is built (Stappers and Van der Lugt, 2006). Studying this design field and developing design knowledge is generally called *design research*.

This thesis studies collaborative design research projects in which partners from various disciplines, including design professionals, collaborate. Many universities engage in such collaborations, which are often funded by funding agencies and aimed at societal impact. Many, though not all, aim to impact design practice.

Impact on design practice is put forward as one of the major quality themes in design research (Cash, Daalhuizen & Hay, 2022). However, many methods, models or toolkits

that result from research are not actually used by designers in their daily practice (e.g., Rogers, 2004). This mismatch is pointed out by various practitioners and scholars (e.g., Beck & Ekbia, 2018; Chakrabarti & Lindemann, 2016). Studies into this *research-practice gap* have provided more understanding of the differences between academia and practice (e.g., Gaver, 2014; Ponn, 2016) or on specific aspects of this gap (e.g., the role of intermediaries, in Norman, 2010b; the uptake of methods, in Daalhuizen, 2014).

So far, not much empirical work has been carried out on the challenges and opportunities that arise when the different worlds of academia and design practice meet. Moreover, the collaboration between actors in design research has hardly been studied yet. This means that practical operational guidance for researchers to deal with this research-practice gap is still scattered and without empirical examples.

Within the projects investigated in this thesis, various communities with different interests meet each other. Dalsgaard, Halskov, and Basballe (2014) introduce the term ‘collaborative design research projects’ to indicate the research practice in which researchers are involved in design trajectories and in which multiple stakeholders, such as end users, public authorities, and design agencies, are involved beyond the design researchers. Figure 1.1 shows the key communities which meet in these projects and for which these projects need to bring results. The left side of the figure depicts the funding practice which supports the research, bringing impact agendas and criteria. Often, these projects are aimed at societal impact in a specific application domain such as healthcare. Various practice or research partners from this domain will be involved as depicted at the right side of the figure. On the top, the academic community of design academics is depicted. The projects which are studied in this thesis are all led by academic researchers from universities or universities of applied sciences. And finally, at the bottom, we find the design professionals, which are one of the audiences and in some cases actively involved in the project.

The phenomenon studied in this thesis is the contribution to the bottom area of design practice, in the context of a project that has to deal with and be held accountable by these other three worlds. A large part of this research is dedicated to developing empirical insights within such projects.

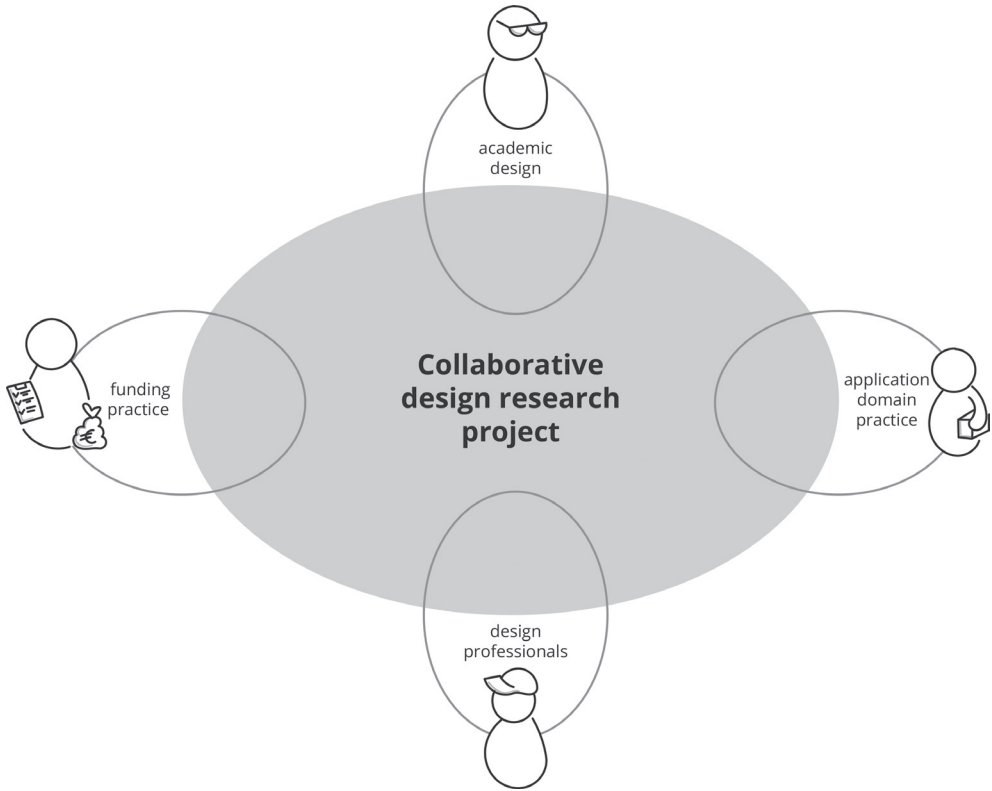


Figure 1.1: Collaborative design research projects in which four worlds meet and have to be addressed. Design practice is only one of these.

1.3 PROJECT BACKGROUND

The empirical work in this thesis is largely conducted in the context of Dutch design research. As in many European countries, design in the Netherlands is growing as a discipline that has both economic impact (Rutten et al., 2021), and a growing scientific credibility (Voûte et al., 2020). In the last ten years the Dutch creative sector and funding agencies have cooperated to create opportunities for design research collaborations between academic design research, design professionals, and other domain professionals. For instance, the call 'Research Through Design' (2014) from funding agency NWO highlighted such designing forms of research. This results in a broad set of collaborative research projects as relevant context for this research.

1.4 RESEARCH QUESTIONS AND GOALS

The goal of this research is to support projects that have the ambition to strengthen design practice and overcome the research-practice gap. By providing insights and practical guidance, this thesis aims to equip these projects to be more effective at having impact on the design profession in practice. This is captured in the central question which drives the research:

Central research question: *How can design research collaborations provide knowledge that design professionals will use in practice?*

This central question is approached by answering several research questions. The first two questions aim to develop a general understanding of design professionals and their ways of learning as well on the relevant challenges within design research projects.

RQ 1) *How are design research collaborations of use for the work of design professionals?*

RQ 2) *What are the barriers and enablers for design research collaborations to be of use in the work of design professionals?*

Building on the key insights on these explorative questions, the following research questions are more focused. These questions further investigate the opportunities in two ways by which design professionals can interact with research projects: when they participate in a research project and when they do not take part in the project.

RQ 3) *How do design professionals learn when they participate in a design research collaboration?*

RQ 4: *How do design professionals learn from research projects in which they did not participate?*

Finally question 5 builds further on these results to offer practical guidance for lead researchers.

RQ 5) *How can project leaders identify concrete opportunities within their projects to support learning by design professionals?*

1.5 CONTRIBUTIONS

The academic contribution of this thesis lies in the empirical evidence from multiple projects and the new perspective which is offered on the knowledge development for design professionals.

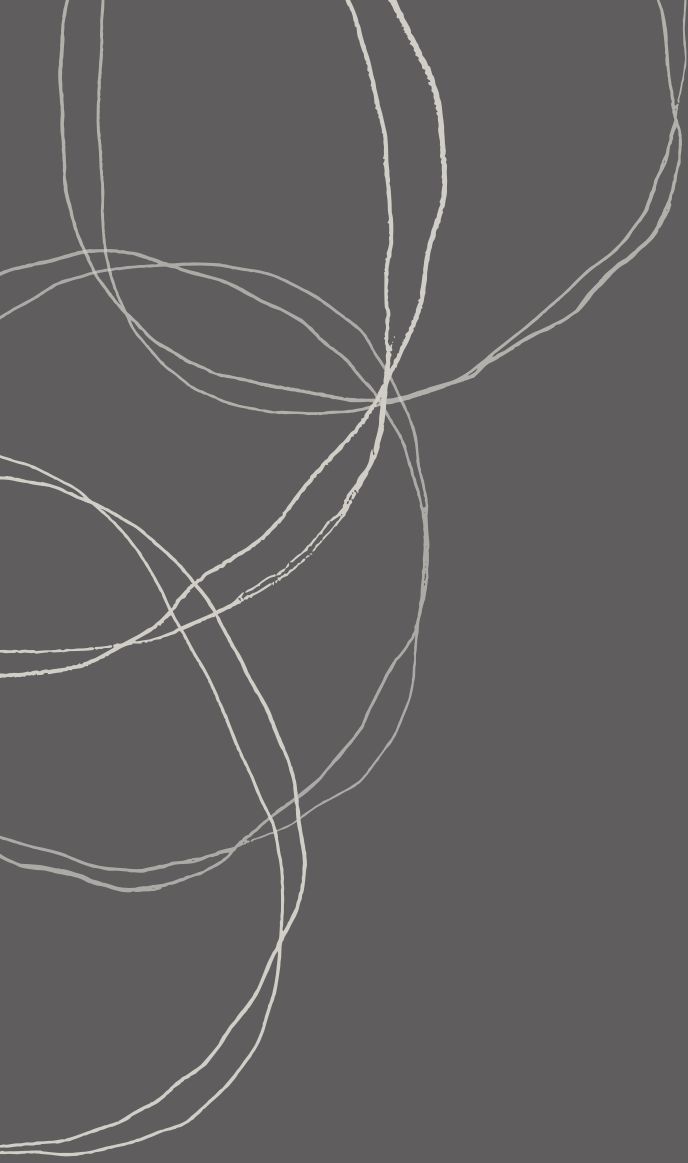
The thesis contributes to practice by offering insights and guidelines to the involved parties in research collaborations. These insights and guidelines can make research projects more effective in contributing new knowledge to design practice. The thesis also offers suggestions for funding parties to better include design practice in the societal impact goals of their new calls.

1.6 READING GUIDE

Chapter 2 describes the overarching research approach for this thesis. **Chapter 3** discusses the relevant literature and presents the central concepts in this thesis. This literature review is partly driven by the empirical findings from the first two explorative studies.

Five empirical studies form the heart of the study. The chapters on most of these empirical studies (chapter 4, 5, 6, 8) are paper based, with only slight adaptations to the original papers. **Chapter 4** presents an interview study among design professionals, to find out how the knowledge that they derived from research projects was of use to them (RQ 1). **Chapter 5** investigates the barriers and enablers in developing useful knowledge for design practice (RQ2). It presents a multiple case study in which ten design research projects were followed over two years. **Chapter 6** studies projects in which design professionals actively take part in research projects. It presents four of such cases and describes how these professionals learn during this process (RQ3). **Chapter 7** studies the efforts by design professionals who were not involved in a project to learn from these projects and how the efforts by researchers to reach out to them are supportive in this (RQ4). It presents the results of a survey among an international group of design researchers and design professionals. **Chapter 8** explores the actionability of the key insights from the previous studies in a use context. It presents two cases in which this is done and shows how supportive materials can be developed to this end (RQ5).

Finally, **chapter 9** discusses the insights and further implications and formulates conclusions. It presents practical guidelines to improve the connection between research and design practice. These are aimed at three groups: design researchers who aim to support design professionals in their work, design professionals who want to get the most out of their collaborations with academia, and funding parties who aim to facilitate this.



CHAPTER 2

Research approach

2



2.1 INTRODUCTION

This chapter describes the overarching research approach of this study which is empirical and qualitative. This approach is operationalized for the various studies, in relation to the research traditions from which is borrowed and with corresponding quality measures. On an even more concrete level, the different roles are distinguished which I take in the various studies.

2.2 FROM EXPLORATIVE TO FOCUSED QUALITATIVE STUDIES

This research aims to investigate how design research collaborations can provide knowledge that design professionals will use in their daily practice. Due to a lack of prior empirical evidence on this topic, the relevant elements in the problem context are not yet distinguished at the start of this project. There is no usable description of the phenomenon, and key elements such as barriers and enablers are not yet identified. Therefore, an overall qualitative and explorative research approach is adopted to inquire into the practices and experiences of design researchers and design professionals and to develop descriptions of the processes that take place and the problems that are encountered.

Figure 2.1 shows the empirical studies in relation to the literature study and the conceptual development throughout the research. The five empirical studies are indicated with their chapter numbers, indicated as studies 5 to 8.

The figure shows that the first two studies 4 and 5, have an explorative nature to determine the key elements for describing the phenomenon. The empirical work in study 4 lays the groundwork for several of the theoretical constructs in this thesis, such as 'actionable knowledge' and the different zones of involvement by design professionals to a research project. The multi-case study 5 explores the main challenges within research projects to contribute to design practice. Combined with study 4, this provides understanding of the key elements in this context for learning by design professionals.

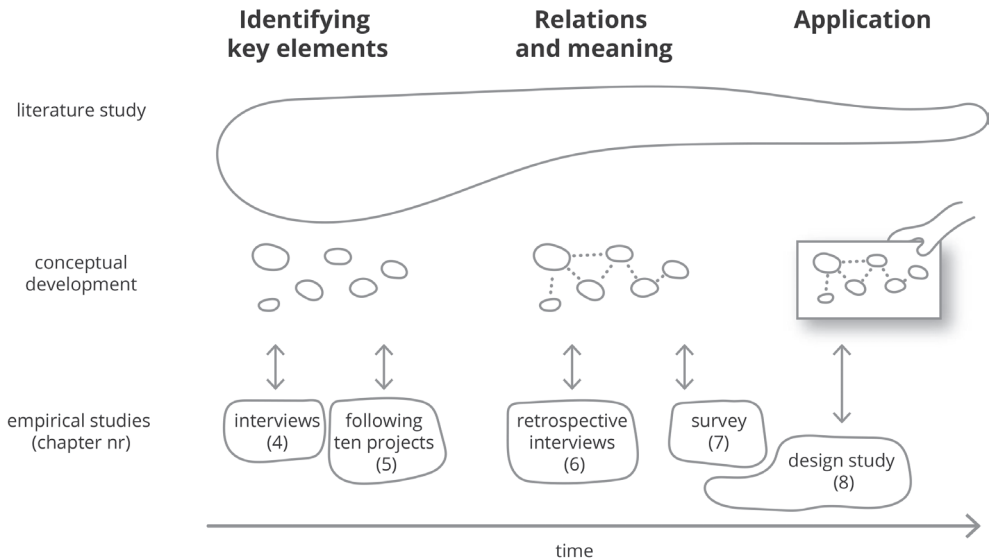


Figure 2.1: The five empirical studies, indicated with their chapter numbers as studies 5-8, in relation to the literature study and the conceptual development throughout the research.

The ensuing studies 6 and 7 are guided by this understanding and zoom in on the elements which the previous chapters distinguished as important, to understand their relationship (see figure 2.1). Study 6 dives more deeply into the specific topic of the learning process that design professionals undertake while taking active part in research projects using the theoretical constructs and categories from the previous chapters. The same constructs are studied in study 7, but this time with design professionals who did not take part in the design research project. This survey probes explicitly into these constructs, for instance by asking questions about knowledge products but also about in-person interactions, as these were found to be of importance. Finally, study 8 explores the key elements from the previous studies by translating them into a tool and evaluating their actionability.

The literature review and the conceptual understanding is presented in chapter 3 as a starting point to guide the reader of this thesis.

2.3 DIFFERENT QUALITATIVE INQUIRIES

The research approach is operationalized in a mixed-method research design in which the overall qualitative inquiries take different forms.

In studies 4 and 5, a multiple case study approach is used (Yin, 1994), because the aim is to explore the key elements and their relationships (Yin, 1994; Eisenhardt, 1989). In both chapters, multiple cases are studied and compared to identify the elements of the phenomenon: how design professionals learn from research projects. Knowledge of these elements and their relations is built within these studies by inductive theory building, following largely the steps of Eisenhardt (1989): getting started, selecting cases, creating instruments, entering the field, analysing data, shaping hypotheses, enfolding literature, reaching closure. Eisenhardt describes this as a highly iterative process of constant moving backwards and forward between steps.

The two studies each take a different approach. The interview study 4 investigates the experiences of several design professionals, in range of experiences with projects. It does so by conducting retrospective interviews which are analysed qualitatively. Study 5 takes a set of research projects within a single program as starting point. It observes these projects over time to capture the barriers and enablers which unfold during the projects.

As study 6 zooms in on learning by design professionals as a process, it adopts a process study approach (Langley, Smallman, Tsoukas, & Van De Ven, 2013). Four cases stand central in which design professionals learned from research projects by taking active part in them. To study those learning experiences, it takes a retrospective angle. The design professionals are interviewed with the use of prompts. For each learning process, a timeline is drawn during the interview. In the analysis, this study relies more heavily on visual mapping (figure 2.2).



Figure 2.2: Joint analysis session on the wall in study 6, using large visual timelines.

Chapter 7 reports on a survey study using a questionnaire to gain data from a larger group of respondents and to validate the key findings of the earlier studies. The key findings come from the predominantly national context and are now investigated in an international context. The questionnaire combines several Likert-type questions on the key identified parameters with open questions. The qualitative analysis is supported by descriptive and comparative statistics.

The final empirical study 8 evaluates the key findings in a use context: the findings are translated into a tool to support practical guidance for lead researchers. The study draws on generative techniques which emerge from the design discipline (Sanders, 2000). A 'make toolkit' (Sanders and Stappers, 2012) is developed which enables the participants (researchers) to make sense of their project and to contextualize the results from our research to their specific contexts.

The methods for data collection and analysis are different within each study and are explained in more detail in each chapter. Recurring is the use of qualitative data collection methods such as document study, focus groups, and interviews, and qualitative analysis methods (Saldana, 2016; Sanders & Stappers, 2012). This results in data as project documents (i.e., project proposals, reports, or publications), observations, and interview data.

2.4 QUALITY CRITERIA

In these studies, measures are taken to establish quality on the three criteria for qualitative research as described by Malterud (2001): relevance, validity, and reflexivity.

The concept *relevance* refers to whether findings from one study are relevant to other settings (Easterby-Smith et al., 1999). A similar concept is proposed as *applicability* by Prochner and Godin (2022), which they describe as the usability of knowledge outside the current research project. This concept reflects the underlying value of wanting to improve practice. Zimmerman et al., (2007, p. 500) argue for "*research contributions to lead to, or support, a preferred state of the world*". They add that researchers should take care to substantiate why the improved state is preferred. Andriessen (2014) argues that particularly universities of applied sciences strive to combine rigor and relevance. For all the findings in this thesis, the context is described in which the insights were built. Finally, study 8 is dedicated to exploring the insights when brought into practice and making them actionable.

For the various studies, suitable quality criteria for *validity* are used in line with the specific type of study. In studies 4, 5, and 6, quality criteria are used regarding validity for case

study research. Gibbert et al. (2008) use *internal validity*, *construct validity*, *external validity*, and *reliability* to assess the quality of case study research, drawing together several sources (e.g., Cook and Campbell, 1979; Eisenhardt, 1989; Yin, 1994). To attain *internal validity* and provide a satisfactory logical reasoning, the case studies in this thesis include a continuous process of going back and forth between data, existing literature, and emerging theoretical constructs within each study (following Eisenhardt, 1989) and over the various studies (see figure 2.1). To attain *construct validity*, several measures are taken for triangulation. Where possible, multiple data sources are used, as well as a diversity of methods. Where possible, multiple researchers are involved in the analysis of data. This happens most prominently in study 5, which was part of a larger research project. To attain *external validity*, cross-case analysis is conducted over four (study 6), eight (study 4), and ten case studies (study 5) which are theoretically sampled. This provides a good basis for analytical generalization, as, according to Eisenhardt (1989), a number between 4 to 10 cases usually works well. Additionally, for each study, the rationale for the case study selection is provided, and sufficient details of the case context are described. To attain *reliability*, the analysis process is thoroughly documented, for a large part by using qualitative analysis software. Throughout the process, I use a reflective journal (Hubbs & Brand, 2005) in line with quality criteria as put forward in Grounded Theory (Corbin & Strauss, 1990). The reflective journal serves as a document to make explicit how things happen over time. I used the journal at several points to look back at interpretations and decisions I made and retrace or reverse some steps.

In the survey study 7, a mixed-methods approach is used (Creswell, 2003) which combines qualitative and quantitative analysis. As there was no standardized research instrument available for this topic, a questionnaire is constructed around the core concepts. Care is taken to ensure proper instrument length, item format, item discrimination, item clarity, order of items, and item effectiveness. This includes a process of pretesting with several individuals. Following Bryman, Becker, and Sempip (2008), different quality criteria are applied for the qualitative and for the quantitative analysis. The qualitative part draws on the criteria for qualitative research mentioned above. For the quantitative part, several additional quality measures are taken in this study for the internal validity. In line with Bryman et al. (2008), this includes close-ended questioning, the use of a repeatable method in the set-up, and the use of appropriate statistics in the analysis, with a mix of descriptive statistics and the non-parametric Mann-Whitney U test (Wilcoxon, 1945).

Study 8 draws on the quality criteria for qualitative research as described above. Additionally, this study incorporates measures to support *reflexivity* on my own actions,

as I also take an active intervening role in this study by making design choices and facilitating the situations I analyse. Olmos-Vega et al. (2023) describe *reflexivity* as a way to embrace and value researchers' subjectivity. They define reflexivity as a set of continuous, collaborative, and multifaceted practices through which researchers self-consciously critique, appraise, and evaluate how their subjectivity and context influence the research processes. In study 8, I take several measures up front to mitigate subjectivity, such as allowing the participants to use the tool without leading them explicitly. Additionally, I incorporate the view of the others who were present (i.e., by interviewing them) and I report on the limitations in this regard. Throughout the other studies, I incorporate *reflexivity* by providing transparency in my writing about my background, position and attitude as a researcher. For instance, I started the introduction with the origin of this research project from my work as research project manager. I make it clear that I am positioned at a University of Applied Sciences, in which practical impact and collaboration with the practice field is highly valued. This research may have been done differently by a researcher who operates in a different context. Being transparent about the different roles I take as a researcher is another measure taken. The overview of roles in table 2.1 is illustrative for this.

2.5 RESEARCH ROLES

Especially within qualitative research, it is important to be transparent about the role of the researcher. Sleeswijk Visser (2018), for example, describes a range of (partly overlapping) roles of researchers and designers who collaborate in research projects which generate knowledge through design activities (Research through Design). According to Stappers and Sleeswijk Visser (2014), roles of designers can take place on different meta-levels. They also note how these various roles inform each other. In this thesis, I use *roles* to indicate the mandated responsibilities which are associated with typical activities and geared towards typical end results. In this, 'mandated' points at the accountability, which is connected to a role, which goes further than a more general responsibility (Zwikael and Meredith, 2018). During this project, I am active in various roles. These roles are listed in table 1, as well as the main focus, the activities within these roles, and their outcomes.

As each study has a different character, there is a different role combination for me in each study, with field researcher and theorizer as my most prominent roles. Table 1 shows that in all studies, I take these two roles. The two roles complement and inform each other: being involved in all the field work is very useful for the development of conceptual understanding and vice versa. Overall, periods of field work during and around

interviews and focus groups easily takes turns with periods of analysing the materials. Furthermore, this PhD project (except study 5) is not embedded in a larger project. This means that the case study management and organization tasks are all performed by me, while I am also the lead researcher. The organizational worries which are connected to deadlines (e.g., organizing meetings, finding cases) sometimes threaten to distract from building the necessary understanding to further direct this field work and which requires slowing down and zooming out. My background as project manager helped me to keep these two sides balanced.

My Researcher roles	Focus	Mandates	(Intended) outcomes
Theorizer (all studies)	Understanding the phenomenon	Studying literature, developing models, generalizing, analysing	Theory and models about knowledge development, learning, and actionable knowledge
Field researcher (all studies)	Observing the field	Collecting data, interviewing	Empirical data: insights from actual projects, experiences by researchers and professionals
Tool developer (study 8)	Developing supportive materials for the problem context (i.e. research projects)	Developing practical guidance, translating insights to practical tips and tangible tools	Practical guidelines which help researchers and design professionals in their collaboration. Tangible tools, based on these guidelines.
Facilitator (study 8)	Facilitating project actors to improve their contribution to design practice	Bringing insights and tools to problem contexts and problem actors, in workshops and project meetings	Problem actors (researchers and design professionals) apply insights to strengthen their research projects and contribute to design professionals
Project manager (all but study 5)	Organizing my project to reach the intended outcome	Organizing practicalities, managing deadlines, setting up interviews etc.	Project goals of this PhD are achieved within the constraints

Table 2.1: My roles in the empirical studies 5-8 on different meta-levels, building on Stappers and Sleeswijk Visser (2014).

Study 8 takes a different angle than the other empirical studies. In this study, I designed a tool to help lead researchers in setting up or optimizing a learning structure for design professionals in their design research projects. This tool consists of supportive materials and facilitation. The first prototype was evaluated in two cases. As a researcher, I took a designer role (development of the tool), a facilitator role (guiding the participants in the prototype exploration), and a researcher role (analysis of these two try-outs).



CHAPTER 3

Literature review: how design professionals learn from research projects

The content of this chapter is partly derived from the theory sections in Zielhuis et al. (2022a,b) and Zielhuis et al. (under review, a,b)

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3.1 INTRODUCTION

To identify relevant concepts within the current literature in light of the research question, this chapter starts in section 3.2 with a review of the knowledge needs within design practice and the way design professionals go about to acquire new knowledge. An understanding is built about *actionable knowledge*: knowledge that helps these professionals to get things accomplished in their practice. Furthermore, three different *zones* of involvement are identified of design professionals with research. These zones are further discussed in section 3.3 and put forward as a more appropriate metaphor to indicate what lies between research and practice than the metaphor of a *gap*. Building on the insights about these zones, section 3.4 discusses the current perspectives of these zones and proposes a new perspective of learning in these zones. This perspective of learning in these zones is further elaborated in 3.5 and 3.6. The chapter concludes in 3.7 with the key concepts which are used to steer the empirical studies in chapters 4 to 8.

3.2 HOW DESIGN PROFESSIONALS LEARN

Design practitioners and their ways to acquire new knowledge

Starting point for this thesis is the need within design practice for new knowledge. *Design practice* is used here to indicate the professional design work that is done in industry, outside of academia. This work is done in design agencies, consultancies, companies, or governmental organizations. The design practitioners included in this thesis mostly work as product designer, service designer, strategic designer, or interaction designer.

Many professionals work in design industry, but not all of them design. This thesis addresses the knowledge needs by those who actually apply their design expertise, mostly describing their position as designer, design consultant, or similar. It does not include the work by, for instance, human resources managers or accountants in the design industry.

The work of these designers or design consultants not only consists of designing, sketching and prototyping activities, but of numerous activities to organize the design work and manage the complex stakeholder networks they work in. Dorst (2008) argues that this especially goes for more senior designers. Building on the work by Dreyfus and Dreyfus (1980), Lawson and Dorst (2005) distinguish seven levels of expertise for design professionals, from naïve to visionary (table 3.1).

Levels	Characterization of problem solving	Scope of work
6 Visionary	Opening up of the field and learning from other fields	Design practice as a field
5 Master	Strengthening the field, describing new approaches	↑
4 Proficient	Pattern-based: intuitive problem solving and responding	↑
3 Competent	Strategy-based: creating design situations and opportunities	The conditions of a project
2 Advanced beginner	Situated-based: problem solving not only by hard rules, but also situational	↑
1 Novice	Rule-based: applying techniques and rules (students)	↑
0 Naïve	Series of one-off choices (ordinary people, starting students)	A project

Table 3.1. Seven levels of design expertise, corresponding types of problem solving, and scope of design work (summary of Lawson & Dorst, 2005; Dorst, 2008).

Dorst notes that in the top three levels (proficient designers, masters, and visionaries), we find professionals with many years of experience, whose daily work contains very little actual design work. With an increasing level of expertise, the professionals move from a rule-based to a more pattern-based way of problem solving, and from a project scope to the advancement of the design field.

These top three levels of senior design professionals – proficient, master, and visionary – are central in this research, not novice (or future) designers. This demarcation has several reasons: 1) senior researchers overall engage more actively in collaborations with researchers, 2) seniors bring much practice knowledge and experience to reflect on, and 3) the educational aspects of initial design educations (i.e., building the lower levels of expertise) are already much researched. Nonetheless, some insights about senior researchers can still have relevance for novice designers.

A large portion of these senior professionals work in the creative industry, for instance in design agencies. The creative industry is characterized as overall small-scale enterprises, with many design professionals working in relatively small companies such design agencies¹. Beyond the creative industry, many design professionals work in non-design organizations, such as large business or in public organizations².

With a growing understanding of the complexity of societal problems (Norman, 2010a), design practice has also become increasingly complex. Design has moved from product design to social transformations (De Lille & Overdiek, 2021; Van der Bijl-Brouwer & Malcolm, 2020) and designers have to deal with a complex field of stakeholders (Sleeswijk

¹ For instance, in the Netherlands, the average company within the creative industry is 1,8 job, compared to an average of 5 jobs for companies in general in the Netherlands (Rutten et al., 2022).

² In the Netherlands, 40-60% of design professionals worked outside the creative industry in 2021 (Rutten et al., 2021), in the UK this was even 77% of the design professionals in 2020 (Design Council, 2022).

Visser, 2018). Design professionals take roles, tasks and responsibilities in dealing with societal problems such as globalization, digitization, and the environmental crisis. This role is increasingly acknowledged. For example, in the Netherlands, the government emphasized this role in their coalition agreement in 2021³. This also means that their role evolves, as they become a connector between diverse stakeholders and a facilitator of co-creation (Manzini, 2015; Rygh, 2019). To take on such a role, the design profession needs to build new knowledge (Manzini, 2015).

Design education provides a first knowledge base for future design professionals. That said, not all design professionals are educated in design⁴. After their initial education, they also learn much and constantly develop their skills and knowledge about a range of topics. For instance, some of them seek to improve on approaches such as strategic design, others on a specific topic, such as interface design for mobile apps, as this is a new area they intend to step into. As indicated earlier, particularly senior design professionals also seek knowledge that helps them create the conditions for doing design, such as assigning roles in collaborations, and developing ways to deal with a complex field of stakeholders (Dorst, 2008). Adding to that is the need they feel to account for their way of working with clients.

Designers turn to various sources to gain such new knowledge. As all professionals, they learn a lot on the job when carrying out their projects. They also read books, papers, and social media, and attend training, masterclasses, and workshops. Many designers collect design artefacts and images from projects by other designers and store these in personal archives for future inspiration, as indicated by for instance Herring et al. (2009) and Mougnot et al. (2008). In mature disciplines such as UX design, a shared language and a selection of methods is available, whereas in a new area such as systemic design much is still unclear. Some design disciplines, such as service design, have strong communities in which knowledge exchange is organized. Such communities enable them to exchange with peers in meetings, network events and conferences.

Collaborative research projects are one of these sources of new knowledge for design professionals. These professionals use not only insights from the design discipline, but from various research disciplines, such as behavioural or organizational sciences. Figure 3.1 depicts the abovementioned sources of new knowledge for design professionals in five main

³ <https://www.government.nl/documents/publications/2022/01/10/2021-2025-coalition-agreement>

⁴ For instance, 69% of designers surveyed by the Design Council had a design education (Design Council, 2022)

categories: 1) their day-to-day job (centre), 2) other design practices (left), 3), design education (bottom), 4) other disciplines (right), and 5) academic design research projects (top).

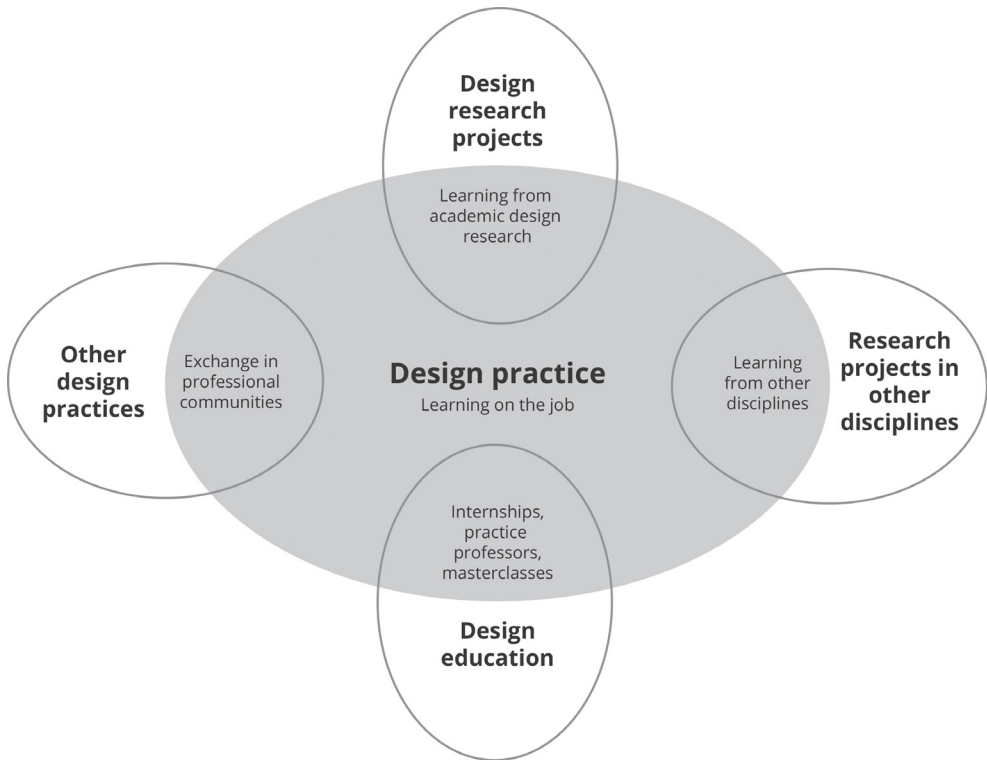


Figure 3.1. Design professionals integrate knowledge from various sources: 1) their own experience in their day-to-day job (centre), and what they learn from 2) other design practices (left), 3), design education (bottom), 4) other sciences (right), and 5) academic design research projects (top).

Design research projects as a source of knowledge for practice

Let us take a further look at these academic design research projects as one of the knowledge sources for design professionals. 'Design research' is often used to indicate, in the words of Telenko, Sosa, and Woods (2016) 'scholarly inquiry that seeks to advance design by studying and improving it in systematic and scientific ways'. The resulting knowledge contributions serve to advance the design discipline. Next to systematic ways of inquiry, explorative ways of inquiry also contribute to the design discipline. Since design itself is an intermediary to improve something, design research projects often involve other disciplines, for instance the healthcare discipline. This also means that academic research projects which include design often serve more than one discipline.

In this thesis, object of study are large design research projects in which partners collaborate from research, design practice, and often an application domain, led by researchers from universities or universities of applied sciences. Following Dalsgaard, Halskov, and Basballe (2014), we indicate these as *collaborative design research projects*. Many universities engage in such collaborative research projects, supported by funding agencies and aiming for societal impact. Although there are also research endeavours within companies which are also often indicated as design research⁵, these are beyond the scope of this thesis.

Design research comes in many flavours and goes by different names (see Stappers & Giaccardi, 2017, p. 20). The intertwining of design and research is operationalized in these different flavours in many different ways⁶. The strand of research in which the design process has an important role as knowledge generating activity – and is even part of the research method – is mostly referred to as *Research through Design (RtD)* (e.g., Stappers & Giaccardi, 2017, Zimmerman, Forlizzi, & Evenson, 2007). Research through design is a relatively young discipline with origins in the disciplines of arts, design and architecture, and has particularly shown strong developments in the discipline of Human Computer Interaction. As the field is relatively young, there is little consensus on how RtD is conducted, but designing and creating prototypes always play a central role. As the practices of research and practice meet in this approach, the case studies included in this thesis centre on this type of research – not always explicitly labelled as Research through Design – in which design plays a central role in the knowledge generation process.

The notion of the research-practice gap draws attention to design professionals as *unconnected* to these research projects for various reasons, for instance because they are not aware of new research output or lack the time to read academic papers (Grieb and Quandt, 2016; Lindemann, 2016). In their model to map research contributions, Kok and Schuit (2012) make a more fine-grained distinction of the links between a project and beneficiaries. They make a distinction between the smaller group of recipients who were actively involved as investigator in the project, a group of otherwise linked actors (e.g., involved as interviewee, as consulted group, or in a workshop) and a group of those that learns by engaging with the resulting knowledge products (also indicated as 'utilisation at a distance'). They argue that these groups learn in different ways from research projects.

⁵ This especially concerns user research activities. Stappers and Giaccardi (2017, p.14) describe such research *for* design as a third way in which 'design research' is used, building on Frayling's (1993) distinction of research *for*, *through*, and *into* design.

⁶ Stappers and Giaccardi (2007, p. 9-13) discuss a range of different relations between design and research. As ways in which design can be part of research, they distinguish design activities to provide stimuli for research from design activities as a way of inquiry.

For the interaction between design research projects and design practice, we recognize similar ways in which design professionals can connect to the insights from research projects (figure 3.2). Moving from outside to inside these projects, we distinguish three zones of involvement. They can interact with a project when they (zone 3) read the resulting papers or use the knowledge products of a project in other ways. Or they (zone 2) interact in-person with academic researchers to connect to research findings. They attend the conferences or use researchers in their network to access otherwise hard-to-reach academic papers or they consult researchers as experts within their own projects. Some, especially more experienced designers, (zone 1) go for more extensive collaboration, by taking an active part in projects with academics. For instance, a design professional specialized in design for healthcare joins a research project about designing for children with cancer. Already experienced in dealing with the hospital environment, this professional conducts user research within the project. As a result, the professional learns *more* about this specific area of child oncology and its jargon, stakeholders and issues. In such collaborations, professionals not only join to contribute to societal challenges with their specific expertise and skill, but also to deepen their own understanding on certain topics, to explore new fields, and to build up cases.

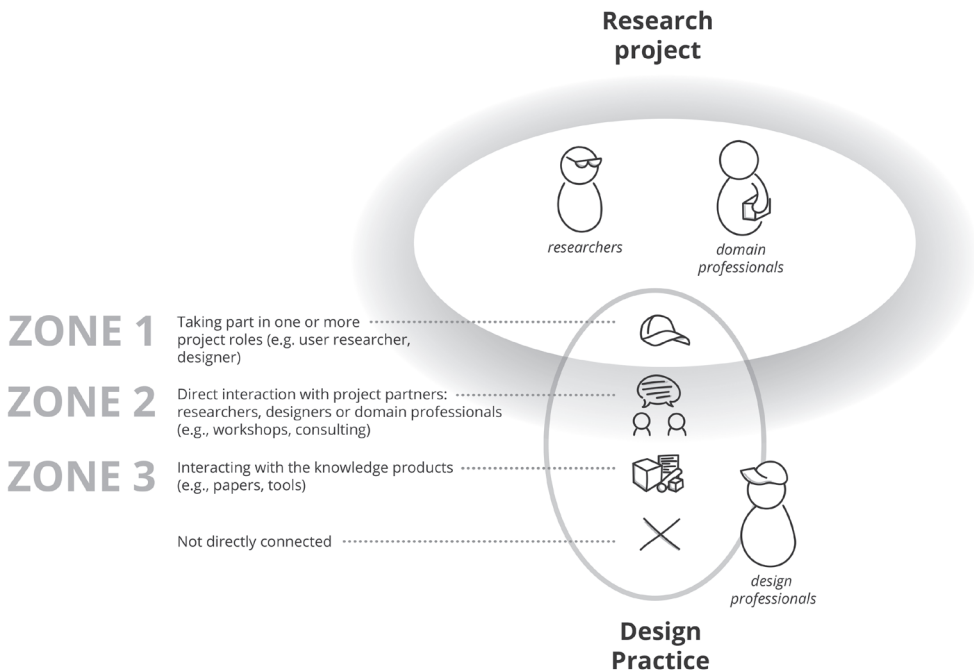


Figure 3.2: Design professionals can connect to the insights from research projects in three zones of involvement: 1) actively taking part in one or more roles, 2) interacting with project actors, and 3) interacting with resulting knowledge products.

Actionable knowledge

From this involvement in design research collaborations, as well as their other knowledge sources, design professionals derive knowledge which they can put to use. This is not the same as all that is new or interesting for them. A design professional can derive a new model about for instance design for behavioural change from research, but still not know how to use it in their practice or conclude that the method is too time-consuming for practice.

Knowledge that actually helps to get things accomplished in practical situations is described as *actionable knowledge* or *working knowledge* by Markauskaite and Goodyear (2017) and it is personal knowledge of the knower (in this case, a design professional). According to Markauskaite and Goodyear (2017), actionable knowledge can encompass up to five closely connected aspects. It is not only a matter of 1) knowledge which underpins this action with understanding (e.g., grasping a certain model), and which is also indicated as *know-that* (Ohlsson, 1995). It also includes 2) knowledge which directly supports action (e.g., being able to apply certain practical techniques), which is also indicated as problem-solving knowledge or *know-how*. Markauskaite and Goodyear also distinguish 3) social knowledge, such as understanding power relations, 4) material knowledge, such as being able to make use of the properties of a certain material, and 5) somatic knowledge, such as drawing abilities.

This overview indicates that some aspects of actionable knowledge are embodied or tacit. Polanyi (1966) introduced the idea of tacit knowledge as the ability to do something without necessarily being able to articulate it or even be aware of all its dimensions, for instance being able to ride a bicycle. Some tacit knowledge can be explicated when called upon, some only after deep reflection, and some is difficult to explicate. Actionable knowledge of design professionals is thus more than what can be captured in knowledge products such as papers or tools. These are often described as ‘containers’ of knowledge, as they convey for instance theory and guidelines. These types of outside-our-heads knowledge are indicated by Bereiter (2002) as *conceptual artefacts*. When these are viewed as ‘containers’ of knowledge, this suggests that knowledge is *carried by* them. Some knowledge cannot just be ‘carried’, but something extra is required to get the knowledge across to the audience, either in annotation, interpretation, or explanation (e.g., when prototypes are annotated, such as Gaver & Bowers, 2012). Others argue that knowledge can also be seen as ‘embedded’ in artefacts, stating that for instance prototypes or designs can be effective even without additional annotation.

Bereiter (2002) argues that the notion of conceptual artefacts (or knowledge products) is not enough to fully grasp how knowledge production in research projects works, and that we also need to address the concept of *personal knowledge*. Eraut (2000) defines this as the cognitive resource which a person brings to a situation that enables them to think and perform. As the range of actionable knowledge above already showed, personal knowledge is more than a box of knowledge in the head. This is acknowledged in literature about design cognition (e.g., Cross, 1999), drawing for instance on insights about *embodied knowledge* (e.g., Van Dijk, 2013). Orlikowski (2002) argues that we cannot talk of knowing as separated from the 'doer' and the 'doing'. Especially *experiential knowledge*, knowledge as gained through one's own experience, is seen as crucial in design practice (Cross, 1999). This means that *learning* – the process of developing personal knowledge – requires an integration of prior knowledge and experiences by the learner.

Thus, to find out how design professionals develop actionable knowledge in light of research projects, we need to take their personal knowledge as well as the conceptual artefacts on which they draw into account. This actionable knowledge is always contextual, because it is connected to the doer and the doing. Problematic in this, as argued by Andriessen (2008), is that knowledge 'as carried by stuff' is a dominant metaphor within many domains which has consequences in the solutions people seek when they try to improve knowledge transfer. Even when they are aware of embodied aspects of design knowledge, researchers might still resort to dissemination approaches in which they try to transfer knowledge from their own 'box in the head' to the design professional's 'box in the head'. To avoid this trap, this research avoids terms such as *knowledge transfer* and rather talks about *learning*, which will be further elaborated on in section 3.4.

Take-aways

The design profession evolves and design professionals need new knowledge to keep up. This thesis investigates how they develop *actionable knowledge*: knowledge that helps them to get things accomplished in their practice. Each design professional integrates the knowledge they gain from research projects with knowledge they gained from other sources, such as their initial education, their everyday practice, professional education activities, and professional communities. Research projects are a source of knowledge to which especially senior design professionals connect by three zones of involvement:

Zone 1: actively taking part in a project,

Zone 2: direct contact with people from the project, and

Zone 3: interacting with knowledge products.

This thesis studies all three zones for *collaborative design research projects*: design research collaborations between research and practice partners which address societal issues. These collaborations provide opportunities where research and practice can meet. Especially in research projects in which design plays a central role in the knowledge generation process, also known as *Research through Design*, these practices come together.

3.3 THE INTERACTION ZONES BETWEEN RESEARCH AND PRACTICE

We will now take a closer look at the boundary zones between research and practice and how they are currently described and problematized. This will help to identify the key elements to further study these three boundary zones.

Many design academics have a drive to have impact on design practice (e.g., Zimmerman, Forlizzi, & Evenson, 2007). Impact on design practice is even put forward as a quality theme in design research (Cash, Daalhuizen & Hay, 2022). Several funding programmes, e.g. the GO-CI programme in the Netherlands, require societal impact towards design practice. Although this impact aim is asked for in calls, written in proposals, and even desired by researchers, many authors describe how researchers fall short in achieving this (Dorst, 2008; Rogers, 2004; Ponn, 2016; Stolterman, 2008; Velt et al., 2020).

Such a lack of uptake of research findings in practice space is not unique for the field of design, but a matter of concern in many disciplines, such as in medicine (Drolet & Lorenzi, 2011), education (McKenny and Schunn, 2018, Neal et al., 2015), or management (Van

Aken, 2021). This is indicated in multiple disciplines as the *research-practice gap* and is commonly regarded as undesirable. The lack of uptake by practice is seen as unavoidable to a certain extent, due to inherent differences between academia and practice. The term research-practice gap is not only used to indicate a lack of uptake of research findings by practitioners in their work, but also to indicate the difference between the academic and practice worlds.

However, the framing of a 'research-practice gap', or the related 'theory-practice gap' is problematic in various ways for researchers or practitioners who aim to come to solutions. As argued by Beck and Ekbja (2018), 'a possible consequence of this framing – given its emphasis on disconnects, fissures, and the like – is that existing connections between theory and practice go largely unexamined'. They propose to rather focus on already existing theory-practice relationships. Section 3.2 pointed at several connections between design research projects and design professionals. Dalsgaard, Halskov, and Basballe (2014) talk of *boundary zones* in collaborative projects where different social worlds meet. Along the same lines, we used the metaphor of a *zone* with connections between research projects and design practice to replace the metaphor of the gap.

A second problem with the way the research-practice gap has been framed is that it often leaves ambiguous which gap is indicated. The research-practice gap is almost never clearly defined but rather described and used as umbrella term to cover various different gaps. As design research projects often aim to serve multiple practices, it is not at once obvious whether the gap with the application domain practice or design practice is indicated. In relation to design practice, a gap was identified decades ago (e.g., Butler, 1985). Since then, many authors (e.g., Dorst, 2008; Goodman, Stolterman, & Wakkary, 2011; Rogers, 2004; Stolterman, 2008) have indicated that design theory or methods from research projects are not much used in practice. In this, a more general gap between academia – as 'the ivory tower' – and practice is signalled as well as more specific gaps between research projects and design practice contexts.

What is more, the term 'research-practice gap' is also used to indicate a gap between education and practice. This is also often indicated as the *theory-practice gap*⁷. For instance, in nursing, Brown (2019) defines the theory-practice gap as 'a deficit that nurses experience in integrating theoretical concepts in the clinical environment'. In environmental research, Cooke et al. (2021) define this gap as 'the disconnect between the

⁷Theory-practice gap is not used exclusively to indicate the gap between education and practice. For instance, Beck and Ekbja (2018) use this term to address the lack of uptake of design theory in practice, without focusing particularly on education.

knowledge which is generated through scientific research and the needs, expectations, and the practices by knowledge users for decision-making and practice'. In engineering, Trevelyan (2010) defines this problem as a 'misalignment between education and practice'. In the design discipline, solutions are also sought in the direction of education. Voûte et al. (2020) discuss various developments to sustain the exchange between practice, education, and academia. They describe how academic research feeds into the education program and how students are a channel to practice. Design education provides a way to bring knowledge from research into curricula of design schools to educate future professionals. In their overview of impact by research on design practice, Chakrabarti and Lindemann (2016) show how such interactions between research, education and practice can take many shapes and can be observed on different levels, involving people, products, and partnerships. For instance, Lindemann (2016) describes a range of interactions involving master students, doctoral students, and practice professors. As indicated in 3.1, the educational aspects of building design expertise are already much addressed. To move forward, the way in which design expertise is built in the more senior levels needs to be addressed.

To do this, we need to be more precise on the *zones* between research and practice and to gain more insight on what already goes on in these zones. As this thesis aims to study the three zones between collaborative design research projects and design practice(s), the next section zooms in on related problems which have already been identified in previous studies. These problems will help to identify the key elements in these zones that can hinder or promote design professionals' learning.

Dealing with multiple design audiences

Design practice is often not the number one audience in design research projects. Projects are set in an application domain such as health practice and address societal challenges such as social, environmental, economic, or cultural issues (e.g., Rodgers, Mazzarella & Conerney, 2020). They are aimed at developing solutions for problems within the application domain (e.g., new digital solutions to support the communication of people with dementia and their relatives) as well as at producing insights which can be used beyond this specific problem topic (e.g., how to design for people with dementia).

This is in line with most funding opportunities, as funding agencies increasingly emphasize the importance of transfer and impact of research results. The European Commission's Horizon 2020 program is an example of this. Many researchers are aimed at achieving such practical impact. Prochner and Godin (2022) reason that an ambition to have impact on practice arises from a pragmatist paradigm, which aims to produce knowledge that improves practice.

The impact on design practice has to be seen within this context of aims for practical relevance within an application domain. Figure 1.1 showed the different worlds which meet in collaborative design research projects: the academic design community, an application domain, the funders, and design practice. Dalsgaard, Halskov, and Basballe (2014), following Strauss (1978) call these different communities which meet in collaborations *social worlds*. Combining the interests of these different worlds can be challenging for those who lead such collaborations. Van Turnhout and Smits (2021) argue in a similar way that the knowledge build up by design research is pluriform as it contributes to multiple communities. They argue that although this pluriform nature makes these project rich and unique, it also poses challenges for programmatic research planning.

Especially the interests of design academics and professional designers can be difficult to combine. Many researchers see this distinction as a trade-off between two opposites, where rigour (methodical thoroughness) comes at the expense of relevance (utility for practice), in line with Bush's (1945) distinction between basic and applied sciences. Others follow Stokes (1997) who distinguishes a strand of research that combines an 'eye for generalization' with an 'eye for application'. Beck and Stolterman (2016) observe that researchers often try to embrace the aims of both scientists and practitioners and aim for multiple goals in a single project. This combination comes with some challenges. Cash (2020) observes that having an impact on the design research academic community, and thus having an 'eye for generalization' is hard enough for researchers.

Moreover, the multiple design audiences do not form the homogenous groups that figure 3.1 suggests. Design practice, section 3.2 already indicated, is differentiated in levels of expertise and in fields. Novices require different support than expert designers (Dorst, 2008), and different fields require different types of knowledge. Similarly, design academics are differentiated as to their field and level of expertise. The same goes for beneficiaries in the application domain or the funders.

Using effective formats

All these different audiences require different types of presentation. Various authors (Dong and Maton, 2014; Zimmerman, Forlizzi & Evenson, 2007) indicate that knowledge products from design research ranges from abstract (academic papers, dissertations) to concrete (demonstrators, artefacts). Specifically in RtD, design artefacts are seen as an important deliverable and a way to communicate results (Gaver, 2012). Zimmerman, Forlizzi, & Evenson (2007) describe design artifacts as the ‘currency of design communication’. Koskinen et al. (2011, p. 95) describe how in some types of research projects, ‘exhibiting prototypes, photographs, and video are as important as writing books and articles’. According to Höök and Löwgren (2012), design research also produces outcomes in a middle abstraction level between abstract theory and particular artefacts (figure 3.3). The field is building a growing repertoire of for instance guidelines, strong concepts, and annotated portfolios (Gaver & Bowers, 2012; Löwgren, 2013). Sleswijk Visser (2018) illustrates how a single project can produce the entire spectrum from concrete (implementable solutions) to abstract (theory).

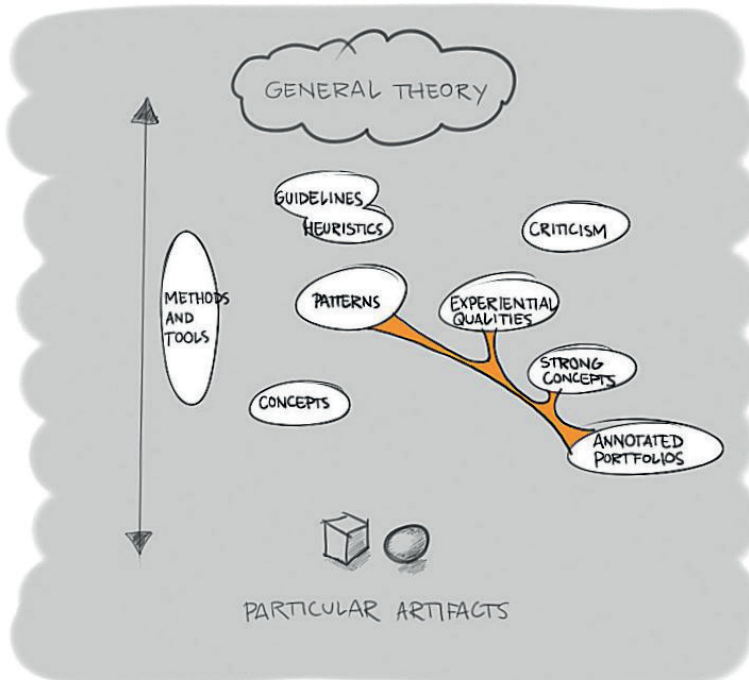


Figure 3.3: Various forms of intermediate-level knowledge between theory and artefacts (illustration by Löwgren, 2013).

Despite this growing repertoire of output formats, it is still challenging to find suitable and actionable formats to capture and communicate knowledge from design research to a design practice audience. Löwgren (2013) describes various forms of intermediate-level knowledge as ‘bricks in the bridge between design practice and academic research’. On the other hand, Velt, Benford, & Reeves (2020) point out that both academia as practice produce and use forms of knowledge that sit at every level in the intermediate-level knowledge space, implying that the solution in reaching practice is not found by aiming for a certain level of abstraction.

Even more problematic is that not all knowledge can be captured in papers, tools, design artefacts or other forms of knowledge products. Especially *experiential knowledge*, as developed by project partners, is difficult to share the beyond the involved partners. Various forms of intermediate knowledge are seen as ways to capture and communicate some of the tacit and experiential knowledge, but they cannot convey all.

Finally, as mentioned before, ‘design professionals’ do not form a homogenous group in levels of expertise, available sources and different fields. Researchers lack guidance to oversee and address these different needs.

Channels beyond knowledge products

Beyond the formats of the knowledge products, there is a growing attention for other channels between design research and design practice. Currently, much attention goes to channels to reach those which were not involved with knowledge products (indicated as zone 3 in figure 3.2). Knowledge can not only be shared via papers, tools or artefacts, but also via project participants (Telenko et al., 2016) in zone 2. Ponn (2016) provides several examples of ways in which method knowledge moves via people from research to practice, such as students who move to practice or researchers who consult to practice. Ju, Aquino Shluzas, and Leifer (2016) even describe people as “the ultimate vehicles by which research is converted to practice”.

A specific identified problem is how experiential knowledge can be shared beyond the involved partners. Design cognition literature stresses that experiential knowledge is crucial for design practice (Cross, 1999). Some authors, such as Friedman (2000), emphasize that researchers should strive to articulate this type of knowledge towards explicit knowledge (thus: zone 3). Gaver (2014) proposes that researchers can convey some of their tacit personal knowledge in shareable conceptual artefacts such as annotated portfolios. Indicated as ‘participatory communication’, Sleeswijk Visser, Van

der Lugt, and Stappers (2007) describe a way to support particularly the communication of user insights by enhancing empathy, by providing inspiration, and by supporting engagement.

There are in-person ways to share more. Nonaka and Takeuchi (1995) provide some ways to share some tacit knowledge 'tacit to tacit', face-to-face exchange and by shared experiences between individuals, for instance by working together in brainstorming or workshops. Sanders and Stappers (2012) indicate a range of different ways to elicit and share latent, implicit and explicit knowledge. As much attention goes to the knowledge products, researchers currently lack guidance to oversee how such in-person interactions can play a part in their projects. This makes it difficult to identify actions to improve the contribution to design practice.

Shaping the involvement of design professionals

Co-creating with design professionals is put forward as a way to make a project more relevant for design practice. However, there is little guidance on how to operationalize this involvement (zone 1 in figure 3.2). This goes both ways. The contribution by these professionals *to* a project and its application area is not much explicated, nor is the way they benefit *from* the research.

As pointed out by Sleeswijk Visser (2018), the roles in design research collaborations are not much explicated or studied at all. This is not just the case within the field of design. Zwikael and Meredith (2018) conducted a literature review about the project roles that are distinguished and labelled within the field of project management. They identified and clustered the roles within a project's funding entity (e.g. funder, project owner, steering committee) as well as the performing entity (i.e. the organization which does the actual work). Within the performing entity, they identified as much as five roles: project manager, project team, sponsor, project management office, and program manager. What stands out, is that the specific details of the actual 'project team' – the ones who carry out the project – are deemed industry specific and thus not further specified. We cautiously conclude that those who are mostly interested in project roles are project managers and that they are particularly interested in the roles *surrounding* the project team. As a result, the field of project management does not supply much guidance about the learning opportunities by content-driven project roles in the project team.

Sleeswijk Visser (2018) studied different roles of researchers and designers in a Research through Design project to provide guidance on how to organize collaboration,

documentation and knowledge generation. There are various approaches to conducting RtD, but little guidance on how to organise collaboration with a multidisciplinary team rather than individual researcher. In Research through Design projects, particularly the design activities and research activities inform each other. Involved designers might join research activities and researchers might be involved in design activities. For example, a design professional designed a prototype (designer role) based on insights from a study in which he acted as an observer (research role), and joined the analysis of the evaluation of the prototype (research role). As a result, the interplay between research and design is sometimes fuzzy and complex and activities of design and research partly overlap. The described set of roles includes several organizational and practical ones (e.g., manager), but also distinguishes several content-oriented roles for the project team (e.g., theorizer, designer). These roles were used to map the activities by the researchers, designers, or domain professionals in the project. Sleeswijk Visser notes that various individuals took more than one role and that the role arrangement developed over time. Being clear about role arrangements was found to be very important in this project. Specifically for agile teams, Barke and Prechelt (2019) even note that role clarity deficiencies can wreck a team.

The roles which the design professionals take in such collaborations are not explicitly studied yet, but within research papers we recognize a variety of roles:

1. as respondent and object of study (e.g., Goodman, Stolterman & Wakkary, 2011),
2. as participating expert to interpret observations (e.g., Keller, 2005),
3. as a 'reality check' to bring business-sense to academics (Eggen & Hekkert, 2015),
4. as designers-doing-research in parts of a larger project (Sleeswijk Visser, 2018), or
5. as reflective professional, applying new service design techniques and reflecting on this (Enninga et al., 2013).

Moving from the top to the bottom of this list, the above list reflects an increasing level of involvement as in the ladder of participation by Arnstein (1969). Arnstein's ladder, which starts from non-participation and moves to actual control, is often used to indicate the participation of practice partners in research projects. The first three roles at the top of the list suggest that the design professionals are involved in zone 2 and are only brought in at certain moments during the research. The two more active roles at the bottom of the list suggest that the design professionals are involved in a larger part of the project, which we indicate as involvement zone 1. We assume that these active roles will provide more opportunities for them to learn. What the list by Sleeswijk Visser show in more detail is that the project roles are also differentiated in *content*: a theorizer does

something else than a designer. In short, we expect that the different roles and related activities can offer different learning opportunities.

The above four problem areas provide us with the main ingredients in the boundary zones between research projects and design practice(s). Figure 3.4 brings these ingredients together as (a) the different audiences with various worldviews and interests, (b) the knowledge products in which knowledge is made explicit, (c) the different in-person channels by which knowledge is shared, and (d) the roles in which design professionals are involved in research projects. This overview will help us to study the different perspectives which researchers have taken on the boundary zones and will show that some of these aspects are rather under-addressed.

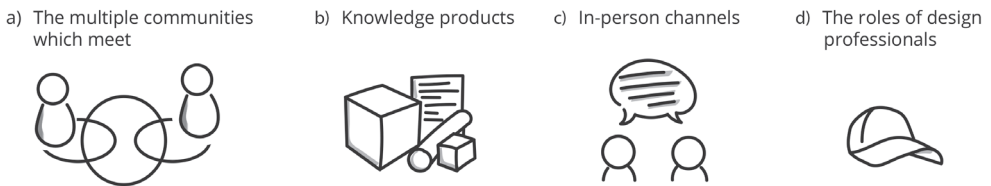


Figure 3.4: The four ingredients in the three zones between collaborative design research projects and design practice, which can be used to identify barriers and enablers.

Take-aways

Academic design researchers often aim to impact design practice, but do not always manage to do this. This is often indicated as the *research-practice gap*. Zooming in on the problems which are associated with this gap, we do not find an empty gap between design research projects and design practice, but rather several *zones* in which already much is going on. Several challenges are identified in these zones, which offer the main ingredients to map the zone:

- Design professionals are not the number one audience in these projects. **Ingredient:** the various audiences or communities which meet.
- The growing repertoire in available output formats has not yet solved the problems in reaching design practice. **Ingredient:** knowledge products.
- There is relatively little attention for in-person ways of interaction to convey experiential knowledge. **Ingredient:** in-person interactions.
- Although project roles have influence on project partners' opportunities to learn, they are not studied much at all in design research. **Ingredient:** roles by design professionals.

3.4 THE DIFFERENT PERSPECTIVES TO CROSS THE ZONES

In current literature, we find four perspectives on how to best cross the gap – or rather, the boundary zones. Each perspective lays a different emphasis on the ingredients as described above. Figure 3.5 maps these four perspectives and their focus on the boundary zones between research projects and design practice. It shows that these perspectives predominantly emphasize the *knowledge products* and do not provide a full perspective on the boundary zones. We use a single case project ('The Behavioural Lenses') as recurring example to illustrate each perspective. This example shows that different perspectives can surface at different moments within a single case project. After these four perspectives, we propose a new perspective: that of learning (perspective nr. 5 in the figure).

A communication problem

Various authors approach the lack of success in helping design practice as a communication problem between two different communities. Daalhuizen (2014) lists various communication problems to explain the lack of uptake of design methods in practice: many methods have a non-appealing form (Araujo et al., 1996), are too complicated (Subrahmanian et al., 1997), and lack the vocabulary of designers (Frost, 1999). Many researchers have realized by now that the fairly straightforward frame of *knowledge transfer* falls short, as it fails to acknowledge and appreciate the differences between research and practice and the knowledge that resides in the practice context.

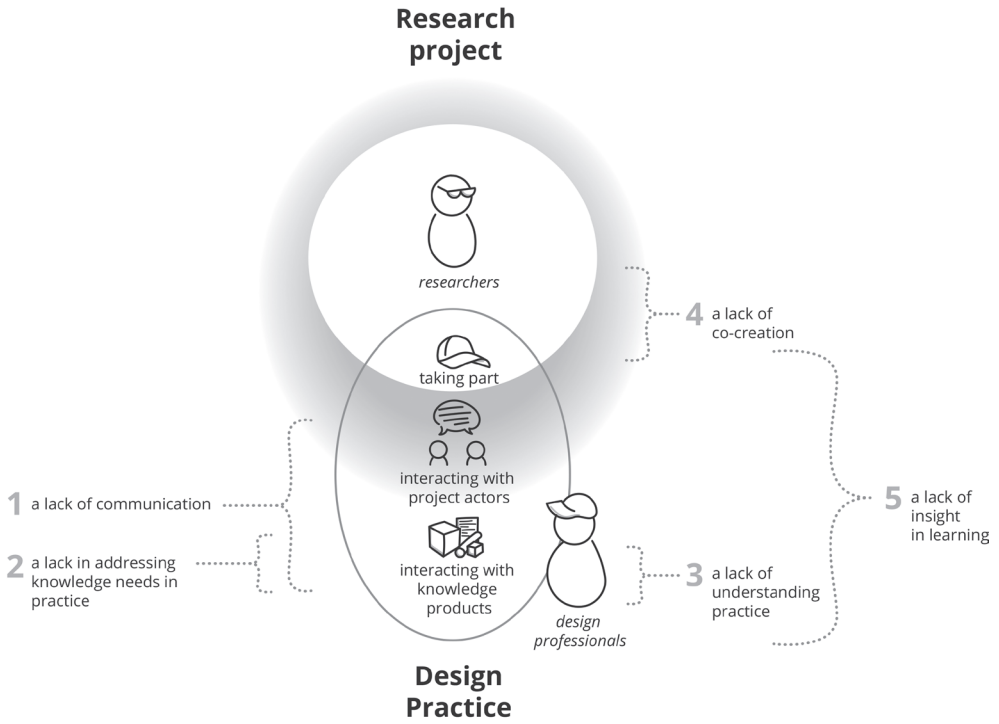


Figure 3.5: Four current perspectives to cross the boundary zones between research projects and design practice, and a suggestion for a fifth.

Various authors suggest that these problems should be addressed not by *transferring* but rather *translating* research findings to practice and creating new forms of knowledge (Drolet & Lorenzi, 2011). For example, Hermsen, Renes and Frost (2014) describe how they translated their research findings about designing for behavioural change to a theoretical model: the Persuasive by Design model (figure 3.6). The paper describes how they designed the layout and presentation of the model for use by design professionals by using colours and layers to highlight important elements.

In the field of HCI, Colusso and Munson (2019) and Velt, Benford, and Reeves (2020) distinguish various translational activities on the boundary between academia and design practice. The study by Velt et al. proposes that such translation activities do not necessarily be conducted or led by academics.

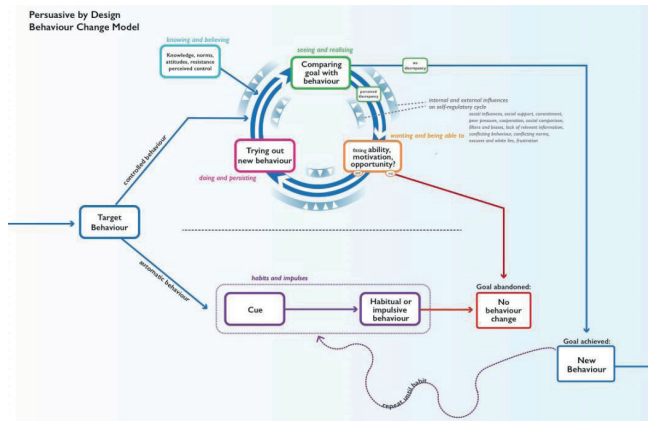


Figure 3.6: 'Persuasive by Design', the behavioural change model as translated by Hermesen, Renes & Frost (2014) for a design professional audience.

Although this perspective focuses predominantly on *knowledge products*, Velt et al. (2020) also note that *people* play an important part in this communication. Norman (2010b) proposes that there should be translational developers to act as intermediary between the different mindsets and interests of academia and practice. In the educational domain, Neal, Neal, Kornbluh, Mills, and Lawlor (2015) argue in a similar way that an increased communication between researchers and educational practitioners is necessary, and that *translators* are needed between them.

Within this *communication* perspective, various researchers refer to *boundary crossing*, which Akkerman & Bakker (2011) define as ongoing, two-way actions and interactions between contexts. A boundary crossing perspective highlights the potential that resides on the boundary (e.g. Velt al, 2020). Especially the potential of *boundary objects*, and (less prominent) *boundary brokers* is emphasized in this. The term *boundary brokers* is used to indicate the people, such as the intermediaries proposed by Norman (2010b) or Neal et al. (2015), who do the translating and crossing between the communities. Sin (2008 p. 8) describes knowledge brokers between research and practice as "individuals or organizations that bridge the evidence and policy/practice divide".

The products of these translations are often put forward as *boundary objects*. Star and Griesemer (1989) define a *boundary object* as "an entity that can inhabit several intersecting worlds and satisfy the informational requirements in each of them, which is at the same time conceptually rigid enough to form a shared point of reference and a platform for negotiation". For instance, when a certain model is drawn on the whiteboard during a meeting and is used

as reference by different participant throughout the meeting, this model serves as boundary object. Similarly, when academics and design professionals work on a specific tool together and can use this as reference within their respective practices, this is also a boundary object. Especially the notion of boundary objects has been taken on within design research. The development of and interaction with artefacts plays an important role in design research, especially in RtD. Boon et al. (2020) note that, within Research through Design, artefacts such as prototypes or demonstrators seem to have multiple roles as boundary objects as they play a role between various domains (Bertelsen, 1998). Not only artefacts such as prototypes are put forward as boundary objects. For instance, Daalhuizen (2014, p. 154) discusses methods as potential boundary objects between different people in social settings.

A lack in addressing knowledge needs

The lack of success in helping design practice is also seen as a lack in properly addressing the knowledge needs of practice. To support design practice and design education, many researchers aim to develop knowledge products that *prescribe* such as guidelines and methods. The idea behind guidelines is that these are more practical in use than theories, as they give clear direction. This tendency to want to prescribe is not exclusive for the design domain. For instance, in management science, Van Aken (2021) advocates the development of prescriptive knowledge as one of the ways to be relevant for practice. However, the lack of uptake of methods by design practice has led academic design researchers to question this prescriptive function. Stolterman (2008, 2021) proposes that designers can be ‘prepared-for-action but not guided-in-action’ by detailed prescriptions. Daalhuizen (2014) found that although methods are often not used as the intended prescriptive set of instructions, they do function as mental tools for designers to frame a problem or to provide reference frame when looking back at past activities. Fricke (1999) and Bender and Blessing (2004) report that flexible method usage actually leads to better performance than strictly following methodological guidelines.

In this light, several authors (e.g., Dorst, 2008; Van Turnhout et al. 2019) have stressed that design practice needs more than prescriptive knowledge, such as *explanatory* and *evaluative* knowledge. Dorst (2008) argues that the rule-based methods and tools that research often produces are not aligned to the pattern-based way of working of especially experienced design professionals. He proposes that many academic design researchers are too eager to prescribe and fail to provide explanation. Rogers (2004) shows that design research in the field of HCI is making the move from mainly offering informative, predictive and prescriptive knowledge towards developing more analytic and generative approaches. Sanders (2000)

describes generative tools as tools that inspire creative activity. The work by Rutkowska et al. (2019) zooms in on this generative function. They define a set of qualities (e.g., inspiring, multi-layered, playful) for the output of user research, and propose corresponding guidelines to engage business partners to take action on these insights in the service innovation industry⁸. Roy and Warren (2019) argue that the many card decks which are produced by researchers as well as design professionals are aimed to fulfil such a generative function.

The earlier introduced 'Persuasive by Design' model by Hermsen et al. (2014) about designing for behavioural change was developed into a card deck to allow design professionals to work with the model more easily. Figure 3.7 shows the resulting card deck: The Behavioural Lenses (Hermsen & Renes, 2014; Hermsen, Renes & Frost, 2014)⁹. With this tool, design professionals are supported in the application of insights from behavioural sciences in their designs. This card set is intended as generative and flexible as well as explanatory and analytic. It is flexible and generative because users can pick and choose between the cards and use the prompt questions to inspire action. It is explanatory because the cards reflect a range of behavioural change insights. Hermsen and colleagues describe how, to provide even more explanatory background, they also developed a book, to which the card also refers. The card set serves an analytic purpose because it can be used to analyse a current situation in terms of behavioural drivers and determinants.



Figure 3.7: Example of translation for design practice: the card set 'The Behavioural Lenses' (Hermsen & Renes, 2015).

⁸ Such a generative function of knowledge products is often tied to a use of the term 'actionable knowledge' to indicate knowledge products which serve such a generative function, and thus seen as 'useful'. This is not quite the same as actionable knowledge as viewed as thesis, as personal knowledge of a design professional.

⁹ The researchers eventually developed more tools beyond this card deck. A broad range of tools and materials can be found in the online repository at: <https://osf.io/6frsy/>

The increased attention to the needs of practice is not exclusive for the design domain. Hiatt, Green, & Ottoson (2009) describe how healthcare researchers have moved from a 'diffusion' perspective which is basically a matter of sending knowledge and letting go, towards a perspective which has more eye for the needs of practice.

A lack of understanding design practice

So far, contribution to practice is depicted as a fairly linear process, in which results from research flow towards practice, as described by Bush (1945): from basic research, through applied research, to application in practice. Several authors, such as Goodman et al. (2011) propose that the problem is that researchers lack an understanding of the day-to-day experience within design practice. The key point of critique on research projects from this perspective is that academics do not take the complexity of everyday context into account (e.g., Kreimeyer, 2016) and even disregard the approaches which work in practice. Cantamessa (2003) notes a lack in evaluation and implementation in everyday practice. Beck and Ekbia (2018) add that design professionals often lack the time to carry out the detailed analyses that come with some methods or approaches.

In the example case of the Behavioural Lenses Project, the researchers found that the model and tool were not that easy to integrate in the daily practice of design professionals. Van Essen, Hermsen, & Renes (2016) further investigated how they could 'embed theories and evidence from behavioural sciences in a design method in such a way that it does not hinder creativity, but offers a theory-driven anchor to creative drifting'. They produced a behaviour change design process model which linked to the Double Diamond model (figure 3.8)

One of the things they found was that such an application would not necessarily translate to the more agile and iterative processes, such as Scrum, which are increasingly preferred within design practice over more classic serial approaches. Ploos van Amstel et al. (2017) describe a further development step to integrate the model into more agile ways of working within the practice context.

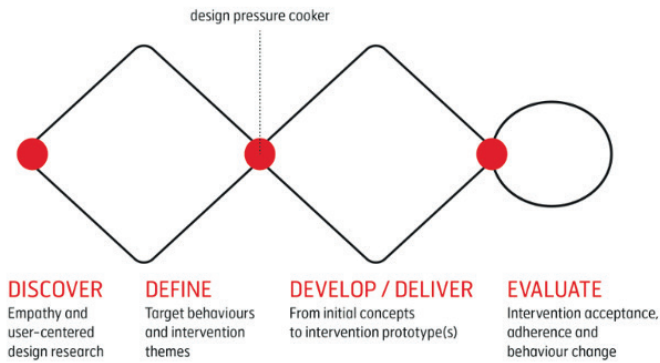


Figure 3.8: The behaviour change design process model as linked to the Double Diamond model (Van Essen, Hermsen, & Renes (2016): an example of an effort to build on a better understanding of design practice.

From such a need to better understand design practice, various authors argue for more research *into* design practice. Several studies have taken this approach, for instance studying best practices (e.g., Tempelman et al., 2015, Bongard-Blanchy et al., 2015). Other follow similar lines in explicitly studying the topics of interests within design practice in order to provide direction for academic research. For instance, Smits and Van Turnhout (2023) offer a research agenda for the graphical user interfaces of recommender systems (e.g., news feeds, journey planners), which they base on a study into practitioners' needs. Kou and Gray (2019) studied online interactions by UX professionals, to identify the vocabulary these professionals use to communicate knowledge and to feed this vocabulary into academic research.

This increased attention for the complexities of design practice has resulted in more insight in the differences between the research and practice context. Researchers aim to produce generalizable knowledge, while design professionals aim to produce solutions to concrete problems (Nelson & Stolterman, 2012; Velt et al., 2020). Gaver (2014) describes this as different measures of success: scientific truth versus practical utility. A similar distinction is drawn by Sanders (2005) between the research attitudes of scientific researchers versus (applied) design researchers. Ponn (2016) distinguishes similar differences, such as different objects in focus (method or product), or different ways of working (a top-down versus a bottom-up perspective). Lindemann (2016) adds that while academics aim for revolution and significant improvement, practitioners work towards evolution and step-by-step adaptations.

A lack in co-creation with practice

Others go even further. In the field of management, Van de Ven & Johnson (2006) propose that the research-practice gap is a knowledge production problem, and the solution should be found in the *process*. Collaboration with practitioners is put forward in this light as necessary to improve the relevance and usability of research results. Sharma & Bansal (2019) argue for an ongoing dialogue between design practice and research to ensure mutual understanding between research and practice. Mohrman, Gibson, and Mohrman (2001) provide examples of situations in which practitioners can collaborate, such as jointly interpreting data.

The example of The Behavioural Lenses also shows that the project took such a co-creative perspective to involve design practice. Hermsen et al. (2016) describe that the project team consisted of ‘*service designers, design researchers from theory and praxis, behavioural scientists and visual designers*’. Zielhuis and Wallinga (2015) describe in the project end report how design professionals were actively involved in the project team.



Figure 3.9: Researchers and design professionals in a co-creation session towards *The Behavioural Lenses* (Zielhuis & Wallinga, 2015).

Similar ideas are put forward in other disciplines, and described as *collaborative research* (Starkey & Madan, 2001) or *Mode 2* research (Gibbons et al., 1994; Kelemen & Bansal, 2002). For instance, collaboration with practice is put forward in information technology (Mathiassen, 2002) and innovation studies (Wallin et al., 2014) as a way to bridge the gap. Along the same lines, Gray, Siegel, & Stolterman (2014) propose for the field of design that a tighter coupling of research and practice helps researchers to better understand and build on practice (the “bubble-up” of ideas from practice), and at the same time “trickle-down” into practice.

Studying collaborative design research projects, Van Oorschot et al. (2022) note that these are not necessarily oriented towards practical impact. This means that merely working with practitioners is not enough. In fact, Akkerman, Admiraal, and Simons (2012) note that it requires effort to make use of the diversity of collaborators while working together. They explicitly apply a boundary crossing perspective to such collaborations and note that boundaries can be great resources for learning, as they can trigger efforts — by individuals, groups, or larger systems — to cross boundaries (Engeström, 1987; Wenger, 1998). Studies which investigate the position of designers within collaborations, such as by Stompff and Smulders (2013), rather lay the emphasis on the boundary crossing which is leveraged *by* the designers as brokers between other disciplines. However, the learning potential within design research collaborations *for the design professionals themselves* has not been studied yet.

A new perspective: learning

The previous perspectives all reflect a dominant view on knowledge development as the production of papers, tools, and other knowledge products. We propose that this captures the knowledge development by design professionals only partly, as it only addresses zone 3 in figure 3.4. To capture the knowledge development in the other two zones, when design professionals interact with researchers (zone 2), or with an active role in the project (zone 1), we lack a suiting perspective. Therefore, this thesis takes a different angle to capture all three zones: that of *learning* by design professionals.

Currently, *learning* by design professionals from research projects is mostly addressed via the route of design education in the design schools, aimed at novices and advanced beginners (see table 3.1). Learning is not explicitly put forward as a perspective to study the boundary between research projects and senior design professionals. Of course, there are trainings or masterclasses directed at design professionals around research projects. In our example, the project around the Behavioural Lenses, the authors note that they needed to “craft a proper introduction and background explanation” (Hermsen et al., 2014). They shared this knowledge with design professionals in training programs and workshops (e.g., Hermen et al., 2014; 2019). A similar example is described by Smeenk et al. (in press), where a training is developed around a developed tool. What still lacks is insight in the learning process in workshops, meetings, etc. that are not explicitly training sessions.

Some guidance is offered from the more general field of research impact studies, in which the attention grows for the learning during the research by professionals. Greven

and Andriessen (2019) argue that a research project also impacts practice by enabling the involved partners to learn by participating during the process, not only from the papers and tools that are produced. Van Beest (2021) points out that an emerging stream of research impact literature emphasizes the value which is created in the interactions between researchers and various stakeholders, already during the project. For instance, Kok and Schuit (2012) study the contributions to practice as a result of the actions by multiple actors, and Spaapen and Van Drooge (2011) describe so-called *productive interactions*: mechanisms through which research activities lead to socially relevant application. In both approaches, more attention goes to the range of contributions of interactions *during or even before* the research process between a range of actors, and not just to the dissemination at the end of the project. What these interactions imply – but do not state explicitly – is that learning takes place.

In this thesis, three zones of learning by design professionals are distinguished: when they take active part in the project (zone 1 in figure 3.2), when they interact with project actors (zone 2), and when they interact with the resulting knowledge products (zone 3). For all zones of involvement, we conceptualize the development of actionable knowledge by these professionals as *learning*.

Take-aways

The current perspectives on the boundary between research projects and design practice all address some of the ingredients in the boundary zone, but they leave some ingredients unaddressed. The four current perspectives frame the gap as:

- a communication problem, which calls for translation of knowledge products to practice
- a lack in addressing knowledge needs, which calls for knowledge products with knowledge functions ranging from descriptive to prescriptive knowledge
- a lack of understanding by academics, which calls for research into design practice
- a knowledge production problem, which calls for co-creation with practice

These perspectives reflect a view of knowledge development as the production of papers, tools and other conceptual artefacts. All of these perspectives have contributed to our insight on contributing to design practice, but these insights are mostly restricted to the interaction by design professionals with knowledge products. However, insight is lacking about the aspects of knowledge development which concern *personal knowledge*. Therefore, this thesis adds an additional perspective of *learning*, which is studied in the three zones of involvement.

3.5 LEARNING BY TAKING PART

This section zooms in on the learning process by design professionals when they actively take part in research projects, in what we identified as zone 1 involvement.

Individual learning is not on the forefront

By taking part themselves, the design professionals can learn from their own experiences in these projects. In the field of participatory design, learning by collaborating stakeholders in a design process is even valued as a key part of the process (Calvo, 2019). This is indicated as mutual learning. However, Calvo also points out that such mutual learning is rather taken for granted and not studied much.

In a similar way, individual learning is mostly a by-product in collaborative design research projects. Unlike in formal learning such as training or masterclasses, people involved in projects often do not think of themselves as learners. Learning by individuals is often not part of the stated project aims and therefore not explicitly supported. The learning which takes place is rather a process of *non-formal learning* (Eraut, 2000), also described as *informal learning* (Tynjälä et al., 2003). Eraut argues that this involves a combination of *deliberative* (i.e., *intentional*), *reactive* and *implicit* learning. There can be some deliberative learning, taking place in time specifically set aside for that purpose such as in planned training sessions in the dissemination phase. But there will also be much reactive learning in which the learner is aware of learning. This learning takes place almost spontaneously and further intentional reflection is needed to articulate what is learned. In implicit learning there is neither a specific intention to learn at that moment nor awareness of learning at the time.

Although explicit reflection on the learning by involved design professionals will often not be planned in a project, reflection is an important part of learning. Many scholars, both within and beyond the design domain, point at the importance of reflection on experiences for learning (e.g., Goodman, Stolterman, and Wakkary 2011; Stolterman 2008, often referring to Schön (1983). Without explicit reflection, the learning outcomes will stay implicit or tacit. Eraut (2000) emphasizes that learning is not only directed at the experience at hand, but also includes an integration with the prior knowledge and experiences of the learner. To further support the learning by design professionals in collaborative research projects, we need to identify and offer explicit opportunities for reflection in which these professionals can synthesize their prior knowledge.

Learning is social and connected

The reflective process is not only a process in an individuals' mind, as indicated by for instance Schön (1983). Largely building on the work of Vygotsky (1978) and the tradition of Cultural Historical Activity Theory (CHAT), scholars in the educational field have conceptualized learning as social and connected.

Learning can be supported by exchanges and dialogue with others (Goodyear, Carvalho, and Yeoman, 2021; Griffiths and Guile, 2003). Calvo et al. (2022) show that learning by research participants can be supported by in-person exchange. How such interaction works out for the learning process by design professionals in these projects is not yet studied. Figure 3.10 depicts a design professional collaborating with a project partner.



Figure 3.10: Learning is social: research partners interacting during a research collaboration.

Learning can also be supported by the exchange with boundary artefacts (Star, 1989; Star & Griesemer, 1989) which fulfil a bridging function between the learning context and the learner's daily application context. In Research through Design (RtD) literature, the interaction with artefacts is put forward as an important way to communicate knowledge which cannot be fully captured in words (Höök and Löwgren 2012; Löwgren 2013), but also – in making and reflecting on these artefacts – as a way to develop knowledge (Stappers and Giaccardi 2017; Wensveen and Matthews 2015). Since the collaborative research projects in this thesis either self-identify as RtD projects, or are identified by the authors as such, the creation of and discussion about artefacts bear a potential for learning. However, what is not studied yet, is how such interaction with artefacts helps the individual learning process of the design professional during research projects.

Learning activities can be studied (and improved)

Since learning is often a by-product in collaborative work, it is hard to study or make explicit. Goodyear et al. (2021) argue to study not so much the processes in peoples' heads, but rather *what they do* that makes them learn: their *learning activities*. They argue that studying these activities helps to understand and improve the conditions in which these activities can happen – in our case, the conditions in which design professionals learn during collaborative research projects.

Section 3.3 discussed the activities of design professionals in research projects and connected these to their project roles. We suggest that the different roles and related activities can offer different learning opportunities for the design professionals. From the perspective of learning as a social process, it matters whether the professional is involved in joint activities with other design professionals, researchers, domain professionals or students.

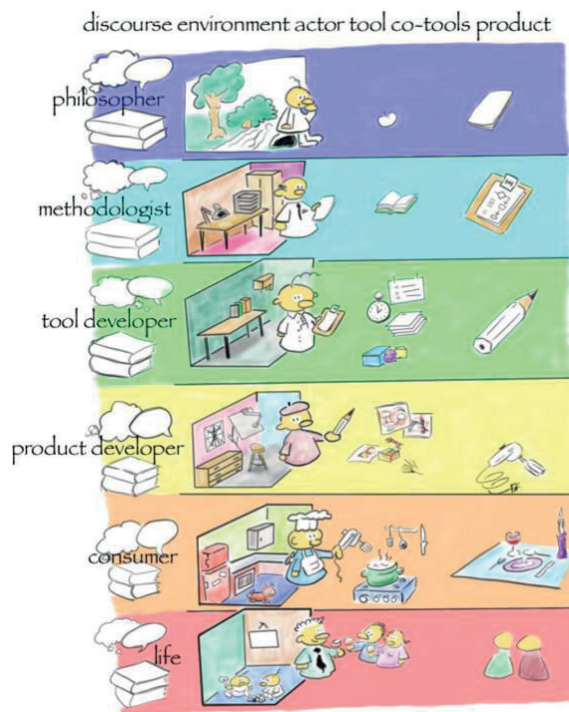


Figure 3.11: Six meta levels within design research which distinguish different roles (Stappers & Sleeswijk Visser, 2014).

It also matters whether the professional can learn by being involved in more than one role. Stappers and Sleeswijk Visser (2014) argue that an individual can be active on multiple meta levels in design research. Figure 3.11 shows how they distinguish different abstraction levels in which actors play different roles, in a different environment and discourse, towards different end results, and with different tools. These levels are interlinked: what is considered the output (ends) is a tool (means) at the level below. To illustrate, the paper gives the example of the ‘tool developer’ who develops a pencil which the ‘designer’ can use in their work. This way, reflection not only happens *on* a level but also in the interaction *between* these levels. A further study of these roles could help to identify learning opportunities for design professionals.

If the learning situations for design professionals are better understood, a supportive structure within research collaborations can be developed. Although learning cannot be forced, supportive conditions can be created (Goodyear et al., 2021). A learning situation is a combination of the socio-cultural setting and the physical/digital setting in which learners perform their tasks (Carvalho and Goodyear, 2018; Bouw, Zitter, & De Bruijn, 2021). Similarly, we presume that the learning situation for design professionals can be studied and improved on the opportunity for exchanges and project roles as well as the opportunity to engage with artefacts.

Take-aways

Learning by individuals is not on the forefront in collaborative design research projects, which means that much learning will be reactive or implicit for the design professionals who take active part in these projects. Currently, we lack insight in the opportunities of design professionals for the necessary explicit reflection on their practice, and in the way the interaction with people or artefacts supports this process. These opportunities can be further investigated in light of the project roles which these professionals take.

3.6 LEARNING BY INTERACTING FROM OUTSIDE THE PROJECT

Only a limited number of design professionals can actively collaborate within a research project. The majority of the designers in practice will have to learn from an outside position. In this section, we discuss their learning as a result from zone 2 (interacting with project actors) and zone 3 involvement (interacting with knowledge products). This is discussed from a boundary crossing perspective (Engeström, 1987; Wenger, 1998).

Similar as for the learning within the project, we aim to understand the *learning situations* for design professionals who were not involved.

More than boundary objects or brokers

In the various perspectives on crossing the boundary zones as described in section 3.4, the exchange with design professionals outside a project is discussed in terms of *boundary brokers* (e.g., Norman, 2010b; Sin, 2008) to indicate people who do the boundary crossing, and *boundary objects* (Star, 1989) to indicate knowledge products which do the boundary crossing.

3

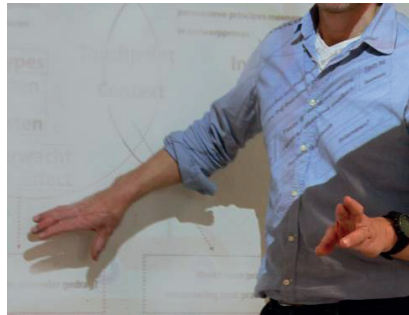


Figure 3.12: Training as example of in-person activity by which design professionals learn from research projects.



Figure 3.13: Workshops as examples of in-person activities by which design professionals learn from research projects.

However, especially the learning in zone 2 seems to take more than these boundary objects or boundary brokers. In the overview provided by Chakrabarti and Lindemann

(2016), a broad range of learning activities are sketched for design professionals. For instance, Ponn (2016) describes activities such as consulting and workshops. Such activities are in some cases organized within the project by a researcher or project lead, such as in trainings (figure 3.12), workshops (figure 3.13), or masterclasses. There are also activities which are rather the initiative of the professional, such as when a researcher is invited to consult within a project. This means that we need to investigate the boundary crossing not only by studying boundary objects and brokers. We also need to include this range of in-person activities between research collaborations and design practice. In terms of Carvalho and Goodyear (2018), this concerns the *social design* of the learning situation.

The examples also indicate that actions and initiative come from both sides of the research-practice boundary. In terms of Carvalho and Goodyear (2018), this means that researchers are not always in the lead of the *set design* (tools, resources, etc.), nor the *social design* (teams, individuals, etc.) of a learning situation. But they can create opportunities and make use of opportunities.

From an educational science perspective, Akkerman and Bakker (2011) propose a framework to study learning on a boundary. Based on an extensive literature study, their framework offers insight into the various mechanisms which take place at boundaries and on the relevant activities in which they show. With this framework, boundary brokers and objects as well as in-person activities can be studied with more nuance. The framework offers guidance to describe the phenomenon of knowledge generation of design professionals through collaboration in design research projects.

Learning mechanisms on the research-practice boundary

Table 3.2 shows the four learning mechanisms which Akkerman and Bakker distinguished on boundaries and which they present as *identification*, *coordination*, *reflection*, and *transformation*. These processes are all driven by the dialectic between the different contexts. The four processes can be used to analyse activities by actors on either side of the boundary, and boundary objects that play a role in this. They are already used successfully in vocational education to identify the specific learning potential at the boundary between school and workplace (e.g., Bakker et al., 2106). This is particularly studied for *hybrid learning environments* (Zitter & Hovee, 2012) in which formal, school-based learning is closely connected to workplace experience and in which the former mostly supports formal and the latter non-formal (Eraut, 2000) learning.

Each of these four learning mechanisms highlights a different aspect of the learning potential on the boundary. Akkerman and Bakker note that these four mechanisms do not always occur, and that there is not necessarily an ideal order to them. Akkerman and Bruining (2016) observe these four mechanisms on different levels: on an organizational level (e.g., between research institutions and industry partners), an inter-personal level (between individuals in different practices), and even an intra-personal level (for instance, when a professional works in academia as well as industry). As this thesis investigates the learning by design professionals, the inter-personal level is the most relevant. Table 3.2 distinguishes the two mechanisms with a focus on reflection and dialogue, and the two mechanisms with a focus on action and practice. We start with the two reflective mechanisms.

Identification is the process in which actors on either side of a boundary get a renewed insight into their own and the other's identity. The learning potential resides in a renewed sense making of different practices and identities. This comes with efforts to find out the differences between either side of the boundary. An example is the study by Ashforth et al. (2000) about the challenge of individuals to switch between work and home. These identification efforts are not so much aimed at overcoming boundaries, but at emphasizing and recognizing a boundary to create more clarity. Applied to the boundary between design research and design practice (right column in table), *identification* happens for instance in zone 1, as design professionals better understand their own ways of doing by having to articulate them to others in the project. The issue identified in section 3.4 that the differences between design research and design practice are not sufficiently addressed can be seen as lack of *identification*.

Reflection is a highly dialogical process in which both sides learn in exchange with each other. It involves a reflection on the different ways of working on either side of the boundary. This goes further than the mere *identification* of differences and involves the formulation of distinct perspectives. This comes with efforts to explicate one's own understanding and knowledge of a particular issue ('perspective making'), but also of looking at oneself through the eyes of other worlds ('perspective taking'). An example is the study by Williams and Wake (2007), about their experience as college teachers visiting workplaces with their students. These visits made them aware of the differences between genres in both college and work cultures. Applied to the boundary between design research and design practice, *reflection* happens for instance when design professionals come to new insights about a certain method for their practice by engaging with project actors in training sessions (zone 2), or by collaborating closely with them (zone 1).

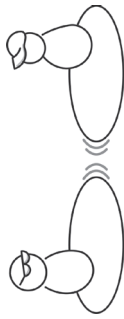

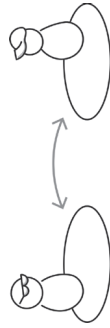
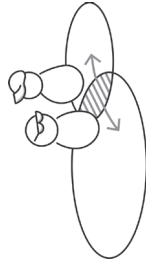
Learning mechanisms on the boundary	Characteristics	Examples for design professionals in relation to design research projects
<p>Identification of the own identity and that of the other</p> 	<ul style="list-style-type: none"> • Othering, reconstructing the boundary • Gaining insight in how practices differ • Accepting differences 	<p>Within research collaborations, identification happens for instance when design professionals better understand their own ways of doing by having to articulate them to others in the project (zone 1). For researchers, this is about becoming aware of the differences between themselves and design professionals.</p>
<p>Reflection on the different ways of working on either side of the boundary</p> 	<ul style="list-style-type: none"> • Defining and exchanging perspectives • Developing your own perspective (perspective making) and taking others' perspective (perspective taking) 	<p>For instance, when design professionals learn by being in dialogue with researchers or other project actors in workshops or training (zone 2), or by collaborating closely with them (zone 1).</p>
<p>Coordination of distributed work</p> 	<ul style="list-style-type: none"> • Dealing with a boundary by each going their own way as much as possible • Translating and communicating, aimed at efficiency in distributed work 	<p>When design professionals interact with knowledge products such as tools which researchers developed for practice (zone 3). Or when design professionals are only involved to a research collaboration to perform isolated tasks (zone 2/3).</p>
<p>Transformation of previous ways of working</p> 	<ul style="list-style-type: none"> • Joint work at the boundary • Driven by mutual needs and a shared problem space • Creation of new or hybrid forms 	<p>Collaborative projects between research and design practice are examples of transformation, if there is much joint work and they actually start from practice needs (zone 1).</p>

Table 3.2: The four learning mechanisms of boundary crossing (Akkerman & Bakker, 2011), their corresponding characteristics, and examples between design research projects and design practice.

The mechanism described as *coordination* is the process in which both sides coordinate any necessary exchange which allows either side to mostly go their own way. It is aimed at overcoming the boundary as efficiently as possible. Both sides inform each other, but with a minimum of contact and without much dialogue. To this end, much effort goes to translations and efficiency in distributed work. An example is the study by Fisher and Atkinson-Grosjean (2002) about liaison officers who were charged to translate research results into concrete commercial applications. Applied to the boundary between design research and design practice, *coordination* happens when knowledge products such as tools are the organized ways in which researchers connect to practice (zone 3), or when the work within a research collaboration is divided between groups which operate apart (zone 1).

The fourth mechanism, *transformation*, describes what happens when people on either side of a boundary transform their previous ways of working and start from a shared problem space. This often results from confrontation and requires continuous work on the boundary. Akkerman and Bakker note that although transformation requires a process of co-creation, it does not necessarily follow from co-creation. Transformation efforts bring about a real-world change in practices on either side of the boundary, or even create new in-between practices. This is in line with insights in the field of innovation management from Carlile (2004), that some knowledge cannot easily be transferred or translated to another practice without joint effort and thus requires transformation. Educational researchers as Wenger (1998), and Brown, Collins, and Duguid (1998) describe *communities of practice* as examples of such transformation, and of the new practices that can result on the boundary. Applied to the boundary between design research and design practice, *transformation* happens when the collaboration between research and practice partners leads to new and joint result, for instance in platforms or innovation labs (such as discussed by Ponn, 2016).

Regarding *boundary objects* (Star, 1989), Akkerman and Bakker note that these are often intended in light of *coordination*, to maximize efficiency and minimize joint work. For instance, toolkits and methods are produced with the aim of being easily picked up by design professionals. However, Akkerman and Bakker also show that boundary objects can be of value for the processes of *identification* and *reflection* (drawing on, e.g., Kynigos & Psycharis, 2009) and for *transformation* (e.g., Macpherson & Jones, 2008).

In this light, we see many current approaches of crossing the research-practice gap as efforts of *coordination* with much focus on knowledge products to bridge the boundary

zone and only limited attention for in-person exchanges. When there is attention for in-person exchange, this may still be limited to the people who can act as intermediary between research and practice as broker (e.g., Norman, 2010b) and not on the exchanges as such.

We hypothesize that design researchers tend to focus on the two more practical mechanisms: *coordination* by producing knowledge products and *transformation* by inviting design professionals in a project. In this, they may under-address the reflective mechanisms and the in-person exchange which is necessary to leverage the learning potential on the boundary.

Take-aways

From a boundary crossing perspective, we can better understand the learning by design professionals in the three different zones of involvement with research projects. Current approaches of crossing the boundary zone predominantly discuss appropriate channels and output formats, which means that they see boundary crossing as the work by *boundary objects*. In light of the four learning boundary crossing mechanisms, these efforts seem to be driven by the mechanism of *coordination*. There are also in-person interactions between the design professionals and the project actors which stay rather unaddressed (zone 2). Some attention for *brokers*, but not for other ways of exchange. This leaves learning opportunities unaddressed. The four learning mechanisms offer a framework to study the learning opportunities by brokers and object as well the learning opportunities in in-person exchange.

3.7 KEY CONCEPTS

This chapter reviewed the literature on how design professionals develop their knowledge and make this actionable for their practice. It argued that research projects are one of the sources of this new knowledge, but that current contributions from such collaborations do not always help design professionals in learning. Particularly research-practice collaborations provide opportunities where research and practice can meet. Based on this review as well as the empirical work – which developed hand-in-hand –, the following concepts emerge as central in this thesis.

1 Learning. This chapter argued to use a lens of *learning* to analyse research-practice collaborations, with the learning process by design professionals as the phenomenon of

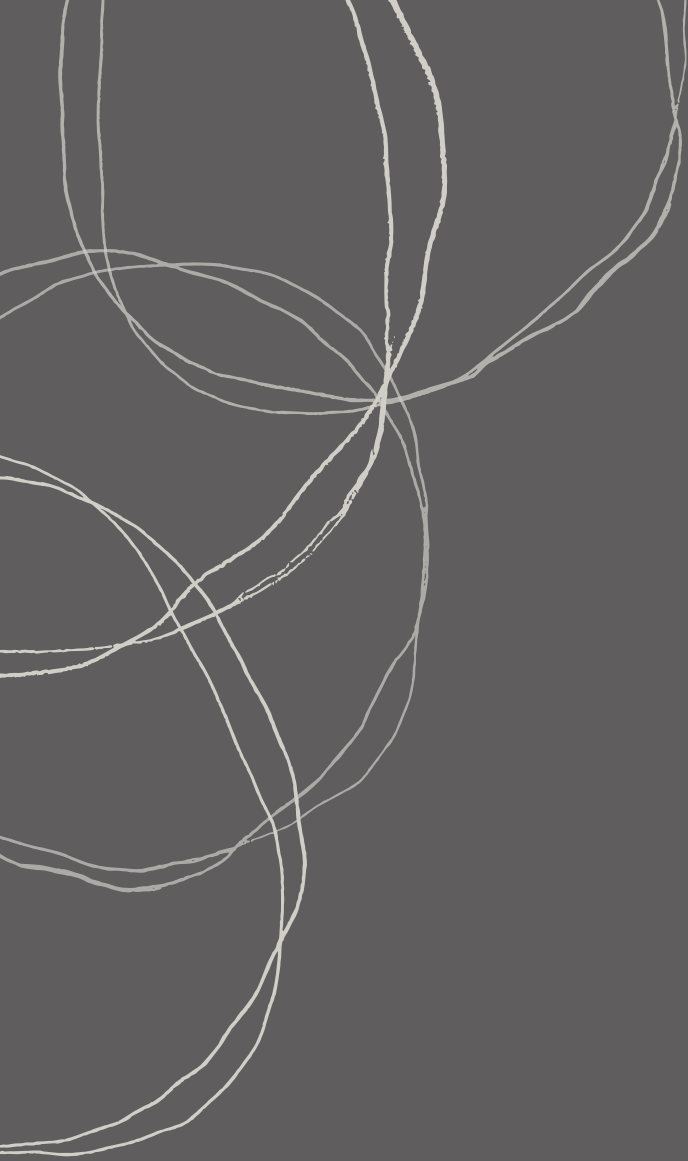
study. Following Eraut (2000), we understand this as a process of *non-formal learning* in which the learners integrate new insights or experiences with their prior knowledge and which partly goes unaware. We build on Akkerman & Bakker (2011) to study the learning potential from a *boundary crossing* perspective.

2 Actionable knowledge. The learning process results in *actionable knowledge*, which we understand (Markauskaite & Goodyear, 2017) as personal learning outcomes which design professionals can put to use in their work. We study this with an awareness that actionable knowledge is a result of integration with prior knowledge. Design professionals do not only learn from design research projects, but also from other knowledge sources. To study how design professionals develop actionable knowledge in research projects, we need to take their personal knowledge as well as the conceptual artefacts on which they draw into account.

3 Boundary zones. This thesis follows the argument by Beck and Ekbia (2018) to leave behind the frame of the *research-practice gap* and instead investigates the places where research and practice already meet. In collaborative projects, different social worlds (companies, projects, etc) meet and bring their goals and ambitions which play a bigger or smaller part in the project. Following Dalsgaard, Halskov, and Basballe (2014) we indicate the places where these worlds meet as *boundary zones*. This thesis zooms in on the boundary zones between research projects and design practice(s), while taking into account that the other worlds also bring barriers or enablers, such as funding conditions. We propose that these boundary zones can be distinguished in three *zones of involvement*, in which learning by design professionals has a different character:

- Zone 1: taking part in the research
- Zone 2: when design professionals did not take part in a project and learn by in direct interaction with project actors such as researchers, partaking design professionals, or domain professionals
- Zone 3: when design professionals did not take part in a project and learn by or with knowledge products

The empirical studies in the following chapters are steered by these concepts. The next chapter starts with the design professionals and their experiences of *actionable knowledge* from design research projects, in light of research question 1.



CHAPTER 4

Actionable knowledge for design practice: What does the practice tell us

The chapter is an adaptation of Zielhuis, M., Sleeswijk Visser, F., Andriessen, D., and Stappers, P. J. (2022). "What Makes Design Research more Useful for Design Professionals? An Exploration of the Research-Practice Gap". *International Journal of Design Research*. 22 (2): 105-122.





4.1 INTRODUCTION

This study presents a series of interviews with design professionals with experience in collaborating with academia and studied how the knowledge from those projects was of use to them. What did design professionals learn from projects in which they had an active role? And what did they learn from attending the closing symposium of a project and acquiring the book out of interest for the methods that were used? This study aims to answer the following research question:

How are design research collaborations of use for the work of design professionals?

In this, we study the personal knowledge that they attained in a research process, as well as the knowledge products that resulted from these projects. We considered the format of these knowledge products: e.g., did they come as a report, a template fill-in tool, a card set? And we studied their function: e.g., did they have a describing or prescribing nature?

4.2 METHOD

Selected cases

This study focuses on Dutch design professionals and how funded design research projects in the Netherlands were of use to them. As in many European countries (e.g., Design Council, 2018), design in the Netherlands is growing as a discipline that has both economic impact (Rutten et al., 2019), and a growing scientific credibility (Voûte et al., 2020). In the last ten years the Dutch creative sector and funding agencies have cooperated to create opportunities for design research collaborations between academic design research and design professionals, providing a relevant context for our research goal. For this explorative study, we conducted qualitative semi-structured interviews with eight design professionals that we acquired by purposive sampling. Figure 1 lists the design domain the respondents work in, their position, their design experience in years, and the size of the agencies. In the results we refer to the respondents by the numbers D1 to D8. Four respondents have previously collaborated in projects with the first author, the other four were reached by snowballing from those four. The resulting sample is a varied set of participants that all have a minimum of ten years of experience as a design professional. All participants work in agencies that are based in the Netherlands, two of which have a worldwide scope. All but D5 have ample experience as partner in research projects and are able to report from their experiences within one to three recent projects.

This includes partner roles as co-researcher or designer, or as a member of an advisory board. D5 has prior experience with research in a former employment at a university of applied science. All respondents could draw from recent experience of using end results of research projects, e.g., by reading a paper, trying out a tool, and attending a seminar.

Three main topics were covered during the interviews: situations of applying knowledge from research projects, the type of involvement of the respondents in these research projects, and the characteristics of the knowledge that they used. Example questions are listed in table 2.

	Design domain	Position	Years of experience within design practice	Size of agency in number of employees
D1	Service design	General manager	15	10-15
D2	Product design	Senior industrial design engineer	20	10-15
D3	Service design	Partner/ service design consultant	30	10-15
D4	Service design	Head of design	25	>50
D5	Experience design	Self employed	10	1
D6	Service design	Strategy director / design researcher	25	10-15
D7	Service design	Design researcher	10	10-15
D8	Product design	Senior designer/ project lead	20	25-30

Table 4.1 Overview of respondents D1 to D8, listing the design domain they work in, their position, their design experience in years, and an indication of the size of the agencies.

Topics	Examples of prompting questions
Use of knowledge	Can you describe a situation in which you were really helped by what you learned from a research project? What were you trying to achieve? How did this knowledge help you?
Involvement in research projects	Can you tell me about your experience as a partner in this research project? What other ways do you use to learn new things?
Characteristics of knowledge (personal knowledge, conceptual artefacts)	What did you learn from this project, and what did it bring? Can you describe what you actually used? Did you use the card set, the model, the guidelines etc?

Table 4.2 The topics and examples of questions in the interviews with eight design professionals.

Data collection and analysis

The manner in which we asked them to elaborate on the situations of applying knowledge was based on the Critical Incident Technique (Flanagan, 1954). We asked the respondents to describe situations in which they were really helped by what they learned from research.

The author conducted all interviews. The duration of the interviews ranged between one hour and an hour and a half. Three interviews were held face to face, the others were done by telephone. All interviews were audio-recorded and transcribed. We first coded all interviews using a coding scheme constructed with the previously introduced elements: use (what did the respondents describe to use knowledge for), type of involvement, personal knowledge (what did they personally learn), and format and function of knowledge products. Open and axial coding followed to answer the research questions.

4.3 RESULTS

Three content categories

The respondents gave various examples of knowledge that was useful to them. The analysis resulted in three categories: knowledge about the design approach, about the application domain, and about project organization (see figure 4.1). Each category is substantiated by examples from a majority of the respondents (respectively six, seven, and five from the eight respondents). Some knowledge is used in a short-term context of a specific design project, and other knowledge more on the long run.

Knowledge about designing is about designerly approaches, methods, mindset and skills. Respondent D4 describes this as mostly learned on the job: *'I think that ninety percent of the service design domain develops during our projects'*. The respondents hardly look for new knowledge about designing amidst the worries of a design project. Mostly they draw from their own repertoire, or as D7 describes: *'I use the expertise of my colleagues'*. They see learning about new design approaches or techniques as long-term professionalizing. Eventually, they aim to be able to offer more to their clients, as respondent D8 describes: *'We hardly look for new methods. When we do, it is mostly at lectures or masterclasses. I see this as professionalizing, not as something I need right now.'*

Knowledge about the application domain is about the problem context and background. For instance, a model in a scientific paper about the energy transition helped in a specific energy related project to structure and process relevant information. Models are used by the respondents to structure their user research, to set up an interview guide, or to structure the output of the analysis. The respondents also extend their vocabulary or skills in working with a specific user group, as D1 describes: *'Investing in a research project like that helped us to acquire the vocabulary of medical professionals'*. Respondent D4 learned the right phrasing in addressing elderly people in a project. Joining a research project also enables them to build a relevant case and network that help them enter a new domain.

Knowledge about project organization covers ways to manage the design process and the meta-process around it. Respondent D6 describes: *'We work a lot in agile environments where you have to respond quickly, and constantly be in touch with your clients. This is a totally different way of working than a few years ago in terms of process, collaboration, and your role as partner.'* Several respondents also describe the need to explain and justify their approaches to clients, which is even more complicated in a rapidly changing environment. Respondent D6: *'You have to develop new practices'*. Respondent D7 explains how they more and more need to closely involve clients actively in various steps of the process. Respondent D6 benefited from a research project in which the approaches of several service design agencies were studied: *'I loved those meetings where all partners reflected together, studying one another's methods, but also studying the process: how these projects evolve, how they collaborate with multiple stakeholders. Normally, you do not helicopter on this meta-level'*.

Actively involved, in interaction, and not involved design professionals

The respondents obtained this useful knowledge by various ways of involvement to research projects, which we grouped in three types: actively involved, in interaction with project actors, and audience. Each category is substantiated by examples from a majority of the respondents (respectively seven, five, and all).

All but one respondent describe projects in which they were actively involved. They appreciate if they are able to really co-create with academics to contribute to the development of the field, but D3 adds: *'There are not many research projects in which design professionals are really part of the intellectual process'*. Active involvement can produce useful learnings in all three content categories described above. Knowledge about project organization is exclusively reported as the result of such active involvement.

Involvement by engaging with project actors occurred as taking part in an advisory board or as a consultant (D3), or being involved 'at some strategic moments' (D2). Some involve researchers and their knowledge in their work (D2, D8). Sometimes they join a project meeting in which a colleague is actively involved (D2) or discuss with a colleague who is doing the research (D4). *'I like to be able to have an influence as creative professional, by giving feedback and by pointing out what is interesting and important for creative professionals'* (D3).

All respondents describe examples of using knowledge from projects in which they were not involved. They learn from such projects as audience by reading papers or buying the tool.

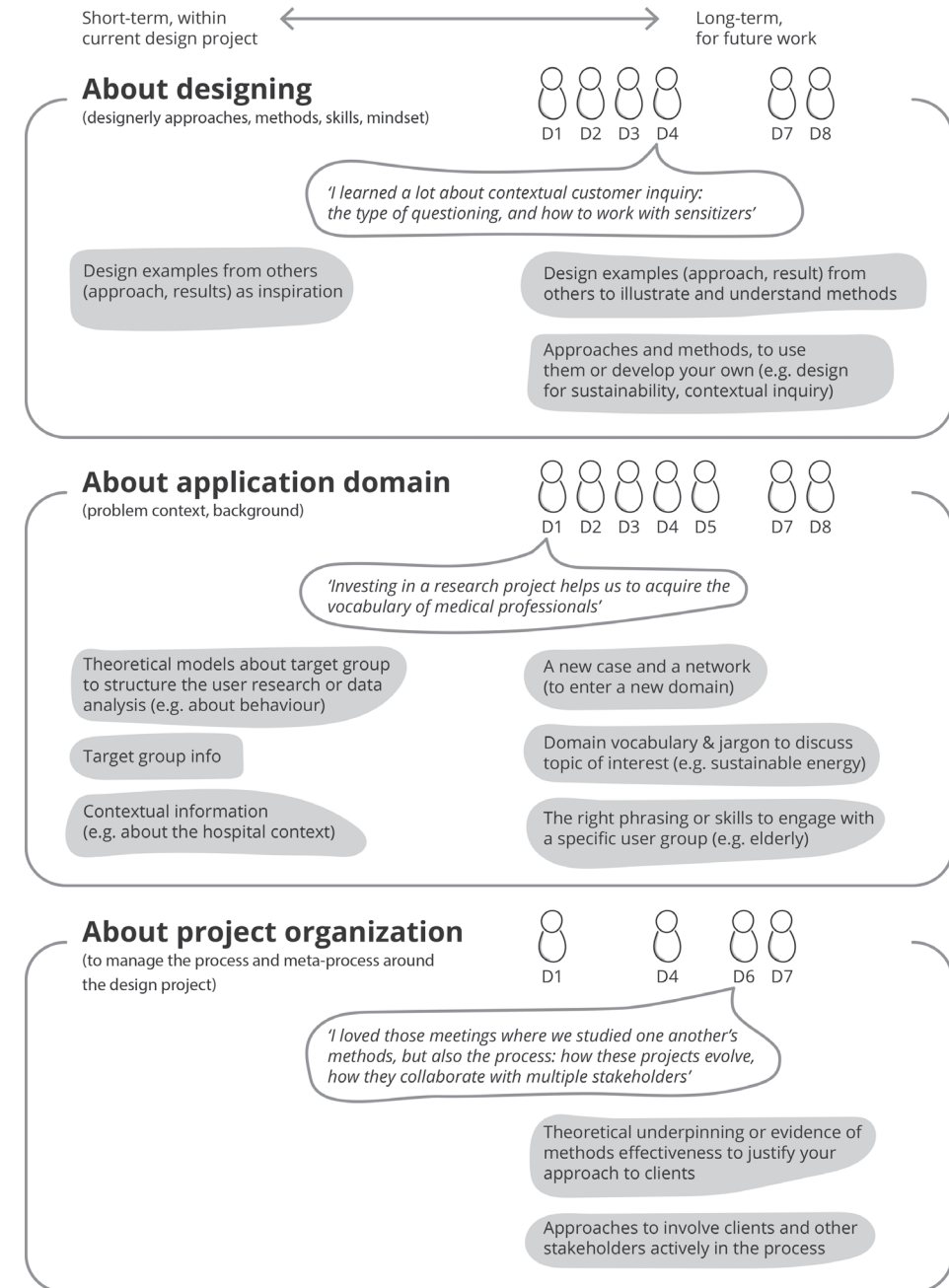


Figure 4.1: Examples of useful knowledge from research projects provided by the interviewed design professionals (respondents D1 to D8). The examples fall in three content categories: knowledge about designing, about the application domain, and about project organization. The grey blocks all indicate sub-categories found within the three categories.

Developing personal knowledge

As an active project member, the respondents develop personal knowledge which involves not only explicit understanding but also implicit understanding, intuition and skill. This can be hard to pinpoint, as respondent D5 describes: *'Sometimes I have internalized things so much that I do not recall what it was I read or heard'*. The professionals extend their vocabulary or skills in working with a specific user group, and learn to work with new methods, like respondent D4 indicates: *'It has become a standard part of my internalized body of knowledge'*. Respondent D2 describes that if you conduct research yourself, you get more out of it than when someone else provides you with results: *'Participating in a research project works best to make something your own. [...] We use these new methods because we feel ownership. And we had some opportunity to work with them and master them'*. Complex matters, such as designing for behavioural change, are hard to take in just by reading books as respondent D1 states: *'If I would have just read the book it would not have sunk in.'* Respondent D4 adds that to use complex theory, you also have to build up skills. *'This is so complex; you really need to conduct multiple projects and build up skills to fully deploy the value of this tool'*.

Sometimes they pick up things that were not part of the explicit project goals. Respondent D4 describes to have learned more about conducting contextual customer inquiry, which was a means in the project and not an objective: *'I learned about the type of questioning and how to use sensitizers to activate people to generate more data [...] I picked up this methodological knowledge because I was an active member.'*

Respondent D3 suggests that some personal knowledge is transferred 'tacit to tacit': *'I feel that a lot of connections were made between the researchers and the agencies. Apart from the explicit outcomes, the forming of such a community allows knowledge to find its way to practice in a less explicit way'*. D4 suggests to provide even more opportunity for learning and building skills, as *'just let people learn along the way, so that they internalize it in a different way than by reading a book or listening to a trainer'*.

Knowledge products

Many examples of useful knowledge mentioned by the respondents involve conceptual artefacts such as models, tools or guidelines. When the respondents are not involved in a project, conceptual artefacts as knowledge products are an important way of learning from a project. But also when they are actively involved and developed personal knowledge, they use conceptual artefacts in certain ways.

In projects where respondents took an active part they were happy that the research outcomes became tangible and visual in a physical tool such as a card set. They used the tool to explain the results to their colleagues (who were not involved), and to show it to their clients. But they soon stopped using it. Respondent D2 describes this process as follows: *'I am glad that we did not just put the results on a website but made a tangible card set that you can put on the table. That way it is very visual, making it [the model] easy to explain to clients. [...] At first we used the card set to explain things to each other. But it is quite big and contains so much information. And the people who use the theory do not need the card set anymore. They use the five elements that form the core. I think this is because they master it now'*. This is in line with the experience of D3: *'The card set was used in the beginning, but not after that. It is a way to capture something though and get something across'*. He adds: *'Those methods, tools or fill-in templates often do not fit very well with what you do. But the knowledge on which they are based is often useful'*. The tools were tailored for use and incorporated in the respondents' own way of working. Respondent D1 describes how a particular tool was not used, as *'the whole design suggested completeness, but if you looked into it, it turned out not to be complete enough for us to dare to use it in projects. But I did not mind that we did not use these instruments in the end, because we developed other instruments that we do use.'* The agency developed their own way of working, based on the same theory. *'It does not work to just give us a finished tool. We will change it anyway.'* Several respondents describe how they prefer a tool that accommodates them to make their own version. D7 describes: *'I really like researchers to come up with a version that is not quite finished. So that we can contribute as designers, from the perspective of applying this, to look at the model and theory again and see how we can improve it.'*

When the respondents were not actively involved, but engaging with project actors, they were often not in the position to develop actionable outcomes themselves within the project. But they describe how –from this position - they sometimes urged researchers to make the knowledge products more actionable and manageable. For instance, the persona method (Grudin & Pruitt, 2002) is mentioned several times as a way to capture knowledge about a target group in a manageable and actionable way (D2 and D8). Respondent D8 said: *'If they would have given us these personas of elderly people. That would have helped us to create better products for the future.'*

The respondents stress the importance of studying design cases conducted by other design professionals: *'Exploring and strengthening my profession is also about experiencing, studying and discussing the work of others.'* (D5). Not only the solutions are studied, but also – especially – the approach that others used: *'How did they translate the model to*

results? What obstacles did they encounter, what have they tried? (D7). And very important, what kind of result comes out, as respondent D8 describes: *'That is the first thing I look for: how can it lead to a new interesting perspective and to a different result'*. As respondent D1 said: *'I don't think that academic researchers realize that inspiration is so important in these projects.'*

To learn from projects in which they are not involved, the respondents engage with the knowledge products or conceptual artefacts via books and scientific papers. Visually oriented designers tend to search for figures, graphs, and models. D5 points out that scientific papers are more difficult to come by as they are often behind a paywall. Personal contacts with academic researchers are used to provide access to these papers (D1). Respondent D8 notes that taking the time to learn something new, beyond the scope of your current project, is often done away from the daily troubles of projects: *'While working on a project, you do not stop to think of learning something new. So learning something new takes place at other moments, away from the office. In the train, in the evening, in the weekend, at a lecture or a training day.'*

Knowledge functions

Prescriptive knowledge, such as guidelines or methods, is not used in the prescribed way. For instance, respondent D1 used a method for giga-mapping and found out that they should have taken the guidelines with regard to the required size more serious: *'We realized in our evaluation: oh yes, we really should have paid attention to this. We thought: two by two [meters] is also big. But it turned out it wasn't big enough!'* She explains that this relates to how they use prescriptive knowledge such as guidelines: *'We don't use it as a guideline. We use it more as a suggestion: you might do it like this.[...] You don't have to understand all the finer points, that will follow in practice.'*

The knowledge function intended by the researchers does not always match the actual function in practice. Indeed, the respondents are often not aware of an intended knowledge function. Respondent D7 describes the use of a card set, but used the main elements of the model to map the assumptions of the client about their target group behaviour in five categories. She adds: *'Was this type of use intended? Actually, I do not know. Before, I used a different model, but I prefer this one.'*

The respondents also use explanatory and evaluative knowledge, like respondent D3 who wants to understand how peoples' behaviour can be influenced. In this, respondents D1, D2 and D5 report a difference in what researchers consider a well-grounded result

versus what they find useful themselves, as D2 adds: *'I understand that you want to substantiate everything from a researchers' perspective, but to help us you could make things clearer and easier to apply;* (D2). Respondent D1 states: *'In practice, it matters whether we are able to work with it.'* It also helps if explanatory or evaluating knowledge is supported by visual models or an illustrative tool. As D1 describes: *'It really worked for me to see how you could translate a scientific theory like that to instruments that you can use.'* Respondent D1 indicates that her colleagues, who conduct most of the actual design work, need less explanatory background than she does: *'They just want to use a tool and do not need all the theory. I am involved in business development, in showing others that we really know what we are doing. They just have to show that we are doing it really well.'*

4.4 DISCUSSION AND PRACTICE IMPLICATIONS

Discussion

Figure 4.2 presents our main results. We discuss the results and conclude this section with practice implications.

The content that design professionals found to be useful ('useful content' in fig. 4.2) can be distinguished in three categories. Design professionals learn about designing (designerly approaches, methods, mindset and skills), about the application domain (problem context and background) and about project organization (ways to manage the design process and the meta-process around it).

These categories resemble those indicated by Dorst (2008). He proposes that design research should also support the meta-activities of design professionals, such as how they put together a design team or negotiate a contract, not just on design processes and on the content of design problems. Kou and Gray (2019) point at a similar 'beyond the cubicle' category as topic of interest in online Q&A activities in the UX domain. Our results reflect this interest for knowledge about meta-activities, and what is more: they indicate that research projects can contribute in this.

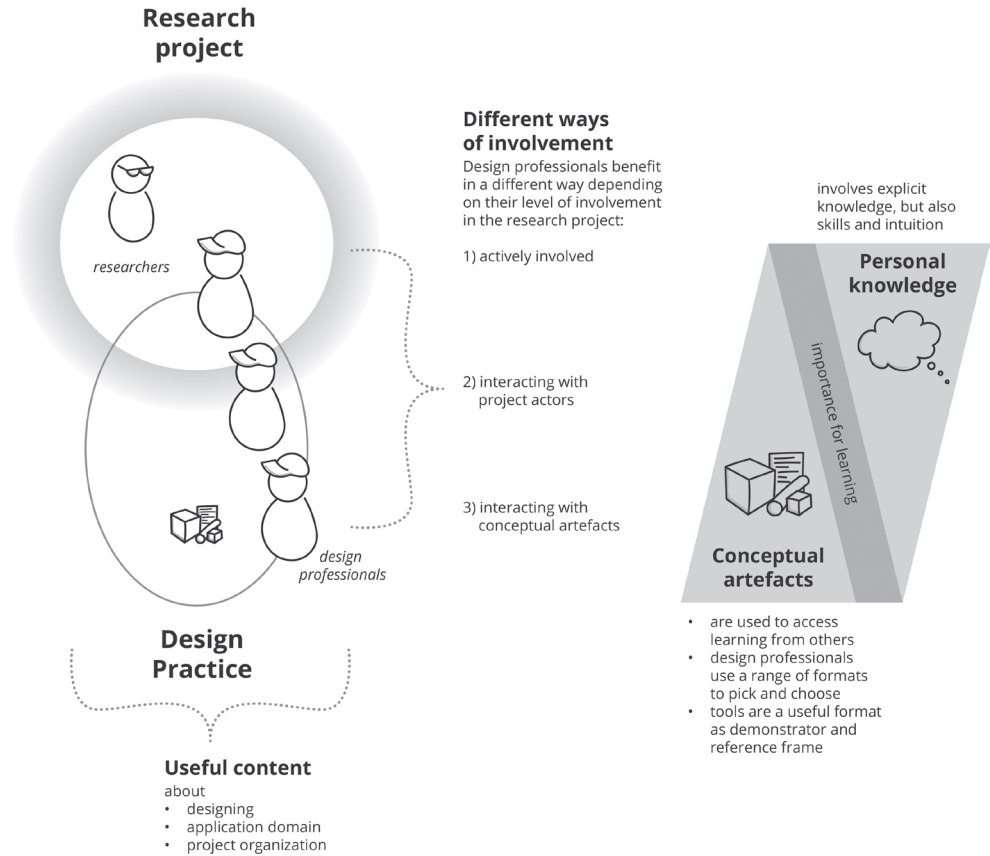


Figure 4.2: How design research collaborations are of use for the work of experienced design professionals: in three categories of useful content, in three levels of involvement, and with different importance of the development of (less explicit) personal knowledge and conceptual artefacts.

The results illustrate how design professionals benefit differently from a project depending on their level of involvement to it. For each zone of involvement, the development of personal knowledge and conceptual artefacts play a different role. As an active member, design professionals learn things they cannot take from papers or books. They acquire personal knowledge such as experiences, deeper understanding of design methods, improved design skills, and extended domain vocabulary. As non-involved audience, they rely on the models, methods, tools and examples which Bereiter (2002) calls conceptual artefacts, which are captured in knowledge products. When they were not involved, but interact with project members, e.g., by joining a workshop, they benefit by elements of both ways. They acquire some personal knowledge during their interaction with the research process. However, they also use output such as personas or other tools to be

informed from activities in which they were not involved. As the involvement of design professionals in funded research projects is often limited due to funding restrictions, this combination will often be the case.

The three content categories seem to be different in the way they are tied to the development of personal knowledge or the learning by conceptual artefacts. Design cognition literature stresses the importance of personal knowledge when it comes to knowledge about designing, e.g., describing how especially experienced design professionals rely on intuition (e.g., Cross, 2004; Lawson & Dorst, 2009). In line with that, our respondents describe how methods or models need to be internalized and become part of the professionals' own repertoire before they are used. This might be the reason why it is hard for respondents to recall how certain personal knowledge was acquired and to trace the source. In what way did a research project contribute to their personal knowledge about designing? How did a method in a paper contribute to this? They might learn things on a very tacit level without being aware of it. This would make it harder for researchers to recognize and acknowledge these tacit learnings of the design professionals. It might also make it hard to share these learnings to inform the collaborative knowledge development process. Sleeswijk Visser (2018) reports that generated knowledge is not always captured and shared effectively among research actors. She proposes an explicit structuring of roles to safeguard both the capturing and the sharing.

The respondents talked most easily about what they learned about the application domain and how they used this knowledge in practice. It could be that this type of knowledge is very top-of-mind for design professionals amidst the everyday troubles of a design project. Dorst (2008) indicated that design research displays a growing interest for the content of design problems. However, the results also suggest that this type of knowledge does not always make it to output that can be shared with other design professionals (e.g., conceptual artefacts such as personas), as this is often of less interest for other research partners such as domain professionals.

The respondents link their interest in knowledge about project organization to their role in a complex and rapidly changing environment. In this, we recognize the complex environment described by Norman (2010a) and the collaborating and orchestrating role that design professionals need to take according to, e.g., Sleeswijk Visser (2018). This third type of knowledge, about project organization, is only mentioned by design professionals who design services. Perhaps because service solutions often consist of people, relations and organizations as 'materials' of the solutions, requiring design professionals to 'really

take clients on the path of change' (respondent D4). We also note that the respondents apparently learned about this type of knowledge from their own experiences in a research project or those of other practice partners in similar projects. This suggests that this type of knowledge can typically be elicited *from* the experience of practice, especially in a relatively young and developing field which has had less opportunity to consolidate its ways of working. It might be that the relevance of this type of knowledge about meta-processes is not recognized by both researchers and design professionals, as suggested by Dorst (2008), nor the way that it is developed. It is often not part of the stated research purpose or even the motivation for the design professional to join the project, but apparently proves to be of value to them along the way.

Conceptual artefacts in knowledge products are an important means to deal with knowledge outcomes of a project for design professionals who were not involved. But they are also used by design professionals who were actively involved in the project themselves. They use pieces of knowledge that describe or prescribe, such as models, guidelines, and methods, but also that explain or evaluate. Some prefer more background or theory than others, depending on their professional role or personal interest. These findings underline the call for explanatory and evaluative knowledge (e.g., Rogers, 2004; Van Turnhout et al., 2019) as well as illustrate the value of informative, predictive and prescriptive knowledge. Also, in line with studies into design practice (e.g., Herring et al., 2009), the respondents stressed the importance of using examples such as solutions and design cases. The results indicate that design professionals prefer a combination of the above in a range of formats, in which for instance a theory is supported by a visual model and demonstrated in a design case.

In line with the earlier presented literature, our results also indicate that prescriptive tools are not used as prescribed. Once design professionals sufficiently understand the idea behind a tool, they will hardly use it at all. However, a prescriptive tool still seems a recognizable format that works for design professionals. It has a value as a demonstrator: a visual and tangible tool to share the underlying ideas with others, such as clients or co-workers. Moreover: design professionals use such tools as inspiration for their own versions. This corresponds to how Daalhuizen (2014) proposes that design methods serve as 'mental tools': as inspiration and reference frame. It seems that a method card set resonates with design professionals in a similar way that a product does, by tapping into one of the designerly ways of knowing that Cross (2001) indicates: gaining knowledge by interacting with and reflecting upon the use of an artefact. They read it like a chef reads someone else's recipe as inspiration for his own dishes (but will definitely not make the same recipe).

Practice implications and future research

These findings suggest several practical implications and opportunities for future research. We propose four ways that may help academic researchers to make the knowledge outcomes of their research projects more useful for design practice (figure 4.3).

First, consider the design practice audience of your research project and use the three content categories to explore their needs. What motivated your design practice partners to join your project? And what do they find useful along the way? Do they want to get acquainted to a certain method, or to learn about a specific application domain? And how can other design professionals also benefit from your project?

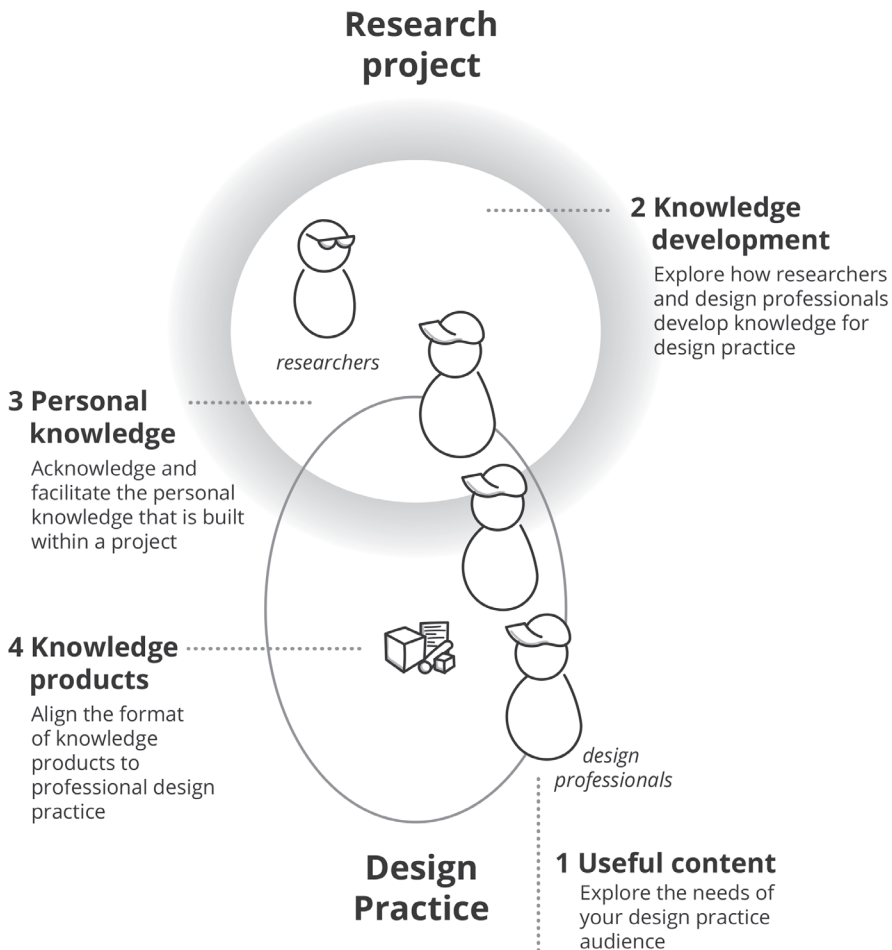


Figure 4.3: Four suggestions for academic researchers to make their research projects more useful for design professionals.

Second, apply this understanding of useful knowledge for design practice in order to explore how researchers and design professionals develop these different types of content within a project.

Third, acknowledge and facilitate the personal knowledge that is built within a project. Some of this might be shared with others beyond the project, e.g., explicated in knowledge products such as papers or tools, or conveyed in training and workshops. Consider if you can facilitate more opportunity for learning and building skills.

And finally, align the format of knowledge products to professional design practice. Aim for a tool that demonstrates the use of the research findings, rather than a practice-ready tool. Provide design professionals with the range of forms that they seem to prefer. In the chef's analogy, this range of forms includes not only other chef's recipes, but also their dishes, the science behind certain baking processes, the account of their experiences, their ideas and their failures.

These guidelines provide several opportunities for future research that are not limited to the Dutch research landscape, but have a more general appeal.

4.5 CONCLUSION

We set out to investigate how knowledge outcomes from design research collaborations are of use for experienced design professionals. We studied this by interviewing experienced design professionals who have participated in state sponsored research collaborations.

We conclude that design professionals learn in three zones of involvement:

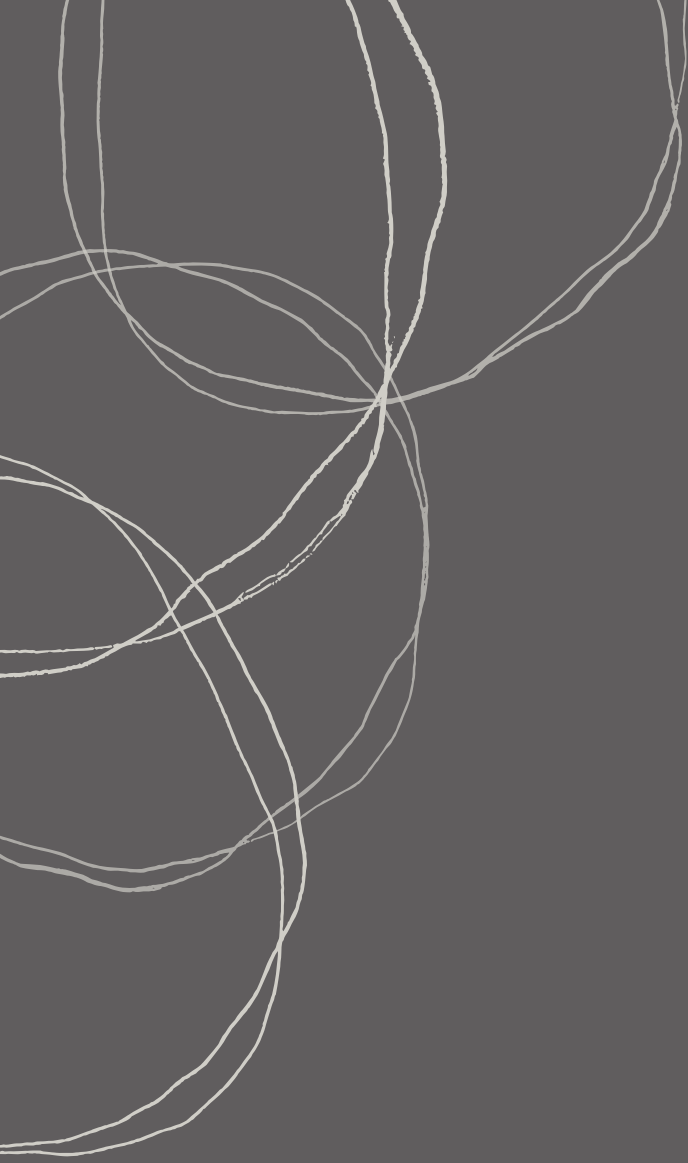
1. by taking active part in the research,
2. by engaging with project actors, and
3. by engaging with knowledge products.

All three require explicit attention during the project and not only at the project end. They use tools, papers and books, but they also learn from their own experiences in research projects. The three zones of involvement offer different learning opportunities in this. Prescribing tools turn out to be useful formats, but they serve as demonstrator and reference frame, not as a recipe. The useful topics they learn about are:

1. designing,
2. the application domain,
3. project organization.

Based on these insights, we suggest four ways for academic researchers to make their project more useful for design practice: explore the needs of your design practice audience, explore how researchers and design professionals develop these different types of content, pay attention to the personal knowledge that is built within a project, and align the format of knowledge products to professional design practice.

The contribution of this study lies in the inclusion of the design professionals' perspective on the collaborations of academic researchers and design practice. We confined this study to Dutch design professionals and what they took out of state sponsored projects. Although the scope of this study is limited and localized, we believe that the results are of interest for a broader international community of academic researchers and design professionals who want their collaborate in design research projects and gain learning from that as a design professional.



CHAPTER 5

What is in the way? A multi-case study

The chapter is an adaptation of Zielhuis, M., Sleswijk Visser, F., Andriessen, D., Stappers, P.J. (2022). Making design research relevant for design practice: What is in the way. *Design Studies*, 78: 101063





5.1 INTRODUCTION

The previous study provided more understanding of what useful knowledge for design professionals entails. Based on this understanding, this chapter now investigates the support (or lack thereof) that is provided for this in design research projects. Informed by the challenges as presented by the literature review in chapter 3, it explores the main challenges in an empirical study.

The chapter presents a multi-case study of the way researchers view impact on design practice and what they do to achieve this in their projects. We studied ten public-funded design research projects in which impact on design practice was asked for by the grant giver and the need is felt by researchers to inform design practice. We addressed the following research question:

What are the barriers and enablers for design research collaborations to be of use in the work of design professionals?

We study the explicated goals towards design practice, the ways in which research partners talked about these goals, and through what actions they tried to achieve them. Tables 2-5 in section 5.3 offer a comprehensive overview of the views and approaches we found in the projects. We organized these in four more detailed challenges. Section 5.4 discusses these findings and offers suggestions for future design research projects.

5.2 METHOD

Selected cases

We approach this question in a multi-case study on ten projects that are funded in a Dutch research program on developing e-health applications to support the day-to-day functioning of people as they grow older. The set of projects was selected because (1) they list design practice explicitly as audience, among other audiences such as researchers and domain (healthcare) professionals, (2) they can all be characterized as design research, and (3) they allow us to study the topics as raised in section 5.1 by offering a variety in channels, in formats to present knowledge, in different audiences and in ways to involve (or not involve) design professionals.

For example, one of the projects studies the use of sounds to increase the wellbeing of people with dementia, another studies persuasive technology to support them at

articulating their needs. The program calls for (fundamental) knowledge development, but also explicitly for a contribution to practice in both healthcare and design. The program requires multidisciplinary partnerships between research organizations and practice partners in the fields of design and of healthcare and wellbeing. The projects typically include several design researchers, researchers from the healthcare domain, engineering academics, various healthcare organizations and related professionals (e.g. managers and caretakers in a home for elderly), and in some cases a design agency. They also involve caregivers and representatives from the target group in small-sized co-design activities or in large surveys. In combining the ways of working of the different disciplines, the projects adopt various approaches which they characterize as Research through Design, human-centred design or design science. Prototypes are used in two ways (see Stappers & Giaccardi, 2017, p.77): in several projects, prototypes are developed and studied in lab or home context to study aspects of a phenomenon (e.g. dementia), in others projects two or three iterations lead towards a final tested prototype, which will be further developed to eventual implementation (beyond the project scope).

Data collection and analysis

The selected cases were studied between 2018 – 2021 in interviews and by a review of project documentation such as the project proposal and progress reports (Appendix A lists the sources, table 5.1 gives a summary). At the time of the last interviews, most projects still had several months to go (because of COVID-19, many were extended). The study addressed the way impact on design practice was addressed along the way. Other aspects, such as project deliverables to the problem domain, were not included.

Respondent groups	Individuals	Amount of interviews
Researchers	17	20 (2x, 7 interviews pairs and 3 individually)
Design professionals	4	4 (1x)
Funding experts	4	2 (1x in pairs)
Program manager	1	1 (1x)
Total	26	27

Document type	Amount of docs
Project proposals	10
Program call	1
Progress reports	20 (2x per project)
Total	31

Table 5.1: Summary of the data sources (more detailed overview in appendix A).

For each project, the first author and two colleagues conducted 2:1 or 2:2 interviews with the main researcher, who was often seconded by another researcher from the project. Before each interview, project documents were analysed and two visual maps were prepared: (1) an actor-map depicting the main actors, and (2) a timeline depicting activities, e.g., literature research, contextual user research, lab research, design, prototyping, testing and analysing. Both maps were used as prompts in the interviews with the researchers. Both interviewees and interviewers could point at them and annotate them (see figure 5.1), e.g., to add or move actors, or draw on the timeline. The interviews with the researchers covered: the research approach (using the timeline), actor involvement (using the actor map), goals and results, and underlying motivations. We asked for any contributions they saw towards design practice, how they viewed this and what was challenging.

Four project consortia included professionals from creative agencies: senior designers who predominantly work for the health sector (see appendix A). These design practice actors were separately interviewed in 1:1 interviews by the first author. We asked them to reflect on their motivation to join, their involvement in the project and how they benefited, and on the contribution to a broader design practice audience.

We also interviewed four experts in the Dutch design research funding landscape, to explore how the barriers relate to the broader research funding context. We interviewed two funding advisors at a university and two professionals who promote and manage R&D collaborations in creative industries. We asked for their observations about how researchers develop knowledge that is relevant for design professionals and used the main topics that we derived from literature in a semi-structured format.

We interviewed the program manager about the background of this specific call and analysed the program call to study how development of knowledge for design practice was incorporated.

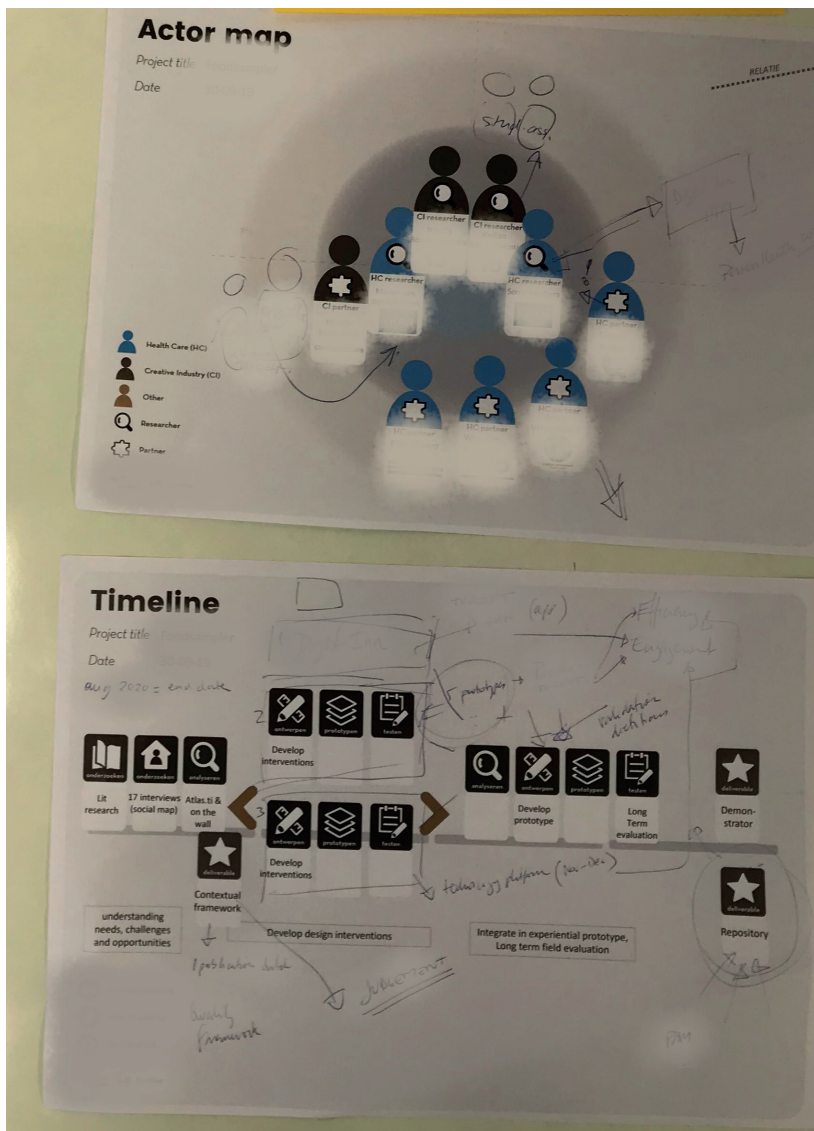


Figure 5.1. Example (anonymized) of an actor map and timeline, used in the interview with the researchers in one of the projects and showing the researchers' comments and adjustments.

Transcripts of the recorded interviews and other project documents formed the materials for analysis. Transcripts, fieldnotes, project documents and the annotated actor maps and timelines were imported in qualitative analysis software and analysed by the first author through open and closed coding. The co-authors were involved in interpretation

sessions between the coding rounds. The challenges suggested by literature (in section 3.3 were used as initial (closed) codes; open codes emerged from the clustering findings during the analysis as we discovered additional challenges and opportunities to remedy them. The analysis led to a clustering of themes, partially driven by the expected issues from literature, partly emerging.

5.3 RESULTS

From the analysis, four main insight clusters emerged of the challenges faced by the lead researcher in structuring the project and engaging with team members and other stakeholders. These challenges are:

- to address design practice as an audience;
- to identify an actual design practice audience;
- to find out what is relevant for design practitioners; and
- to communicate the results effectively.

In the following subsections, we present the results for each challenge in a text, supported by a table listing aspects, evidence, and possible remedies for the challenge. All observations are supported with data from multiple projects. The interviews with the funding advisors and creative industry commissioners especially contribute to aspects 1, 2, 4, 5, 8, and the interview with the program manager and the program call to aspects 1 and 5.

The challenge to address design practice as an audience

Both researchers and funding parties acknowledge that design practitioners play an important role in dealing with societal challenges. In all project proposals, design practice is listed explicitly as an intended audience. However, we found that – even when knowledge for design practice is a stated ambition – design practice comes after the domain audience (such as healthcare professionals) (aspect 1, table 5.2). Even though communicating to design practice is a stated goal, funding and institutional constraints leave little room to allocate time and money to it (aspect 2).

<p>Challenge aspects. How to ...</p> <p>Observations: barriers (-) and enablers (+) for impacting design practice</p>	<p>Illustrative quotes, indicated by source: PM= program manager, R=researcher, DP= participating design professional, FE= funding expert, PP=Project proposal, PC=Program call, PR=progress report contribution to design practice</p> <p>PC: <i>Projects should help both the healthcare and welfare sector and the creative industries take a step forward in the creation of sustainable e-health solutions for a healthy and active old age.</i></p> <p>PP: <i>The gaming industry will lead the way in using virtual agents in the healthcare sector.</i></p> <p>PP: <i>To inspire the creative industry in designing systems, products and related services that are more in line with the changing needs and circumstances of people living with dementia.</i></p> <p>FE: <i>Design practice is often not seen as a target group by funding parties who are primarily aimed at societal challenges.</i></p>	<p>Suggestions for design researchers and funding parties to improve contribution to design practice</p> <p>Address the specific needs of design practice to fulfil this potential.</p> <p>Address design practice as audience in impact goals.</p>
<p>1. regard design practice as an audience</p> <p>+ The potential of design practice towards societal challenges is acknowledged by researchers and funding parties.</p> <p>- Researchers and funding parties see design practice as mainly facilitating (less important).</p> <p>- Researchers are primarily assessed on theoretical impact.</p>	<p>PC: <i>The knowledge should contribute to the knowledge base of the creative industries and life science top sectors.</i></p> <p>PC: <i>The proposal must involve 'fundamental research' performed primarily for the acquisition of new knowledge [...].</i></p> <p>R: <i>We have our academic agenda, but we also stated in the proposal that we would develop practical guidelines for design.</i></p> <p>R: <i>When you don't have someone who is constantly busy to connect research products to practice partners, it will demise at a certain point.</i></p> <p>FE: <i>Researchers ask for funds to finance a book or another form of communication to show how what they have done can be of value for design practice. Unfortunately, these funds are not available.</i></p> <p>FE: <i>Budgets are often meant to make sure that a certain tool will get adopted by the involved practice such as health organizations, not for design practice.</i></p>	<p>Be inspired by different ways of having impact (Telenko et al., 2016).</p> <p>(for funding parties) Provide funding opportunities.</p>
<p>2. find resources to develop knowledge for design practice</p> <p>- Making knowledge explicit and actionable takes time and money, which is difficult within funding and institutional constraints.</p>	<p><i>Table 5.2: The challenge to address design practice as audience in two aspects, supported by observations and illustrative quotes and translated to suggestions.</i></p>	

The challenge to identify an actual design practice audience

The results show that the program call is ambiguous about whom is considered as design practice. The call partly suggests an actual professional design practice and partly a bigger audience of everybody who designs, e.g., as demarcated from the healthcare domain. We see this reflected in several of the projects. Some describe a specific professional design practice audience (e.g. game developing companies), some indicate a broader designing audience that includes academics. Potential differences between these audiences are not always recognized (aspect 3, table 5.3). In addition, some projects focus on specific needs that design professionals have expressed, especially the need for evidence-based knowledge (aspect 4). This makes sense in the healthcare context of this program – and easily aligns with the theoretical impact that academics are supposed to make – but leaves other expressed needs (such as the need for inspiration) unattended.

The challenge to recognize what is relevant for design professionals

The ability of design professionals to bring in the voice and needs of design practice during the project is closely tied to the role they take in the project (aspect 5, table 5.4). Four projects include a design practice partner as an active partner. However, this involvement is mostly aimed at bringing in their specific expertise (such as game development) and not to bring the voice and needs of design practice to the project. Two of these design professionals have a designing and prototyping role, another combines this with a researcher role (conducting user research), and the last conducts user research and joins the data analysis. Most have prior experience in academic research: one with a PhD and two with extensive experience in collaborating with academic research projects. As their role is limited to certain activities, they are also not always in the position to identify content that could be relevant for a broader design practice audience. They do not particularly think of a design practice audience. What is more: it is hard for these partaking design professionals to identify their own learnings during the project, as these are often tacit and not explicitly reflected on (aspect 6). Some learnings, such as knowledge about the application domain, are more explicit and more easily identified as relevant for design practice by both researchers and the participating design professionals. The design professionals find several other useful learnings harder to pin down and more tacit in nature, while these could be very valuable for a wider design practice audience.

The other six projects use other ways to connect to a design practice audience (aspect 5). Designing activities are executed by (design) researchers (sometimes with practice experience) and/or (design) students. In one project, the design practice audience is represented in a panel that provides feedback, in two other projects as a dedicated partner to form a bridge to a broader design practice audience, e.g., by organizing workshops.

<p>Challenge aspects. How to ...</p>	<p>Observations: barriers (-) and enablers (+) for impacting design practice expert, PP=Project proposal, PC=Program call, PR=progress report</p> <p>- Researchers do not see design professionals as having different needs than design academics or other design related professionals.</p>	<p>Illustrative quotes, indicated by source: PM= program manager, R=researcher, DP= participating design professional, FE= funding</p> <p><i>R: Outcomes such as the design process would be for design researchers, or for people who want to develop health prevention strategies.</i></p> <p><i>R: A toolbox with shows design principles and design choices would be not just for designers, because we turn all those other people [health professionals] into co-designers and co-developers.</i></p> <p><i>DP: This project feels very academic to me, I see this more as building up knowledge for follow-up projects than that it helps us now.</i></p> <p><i>PP: We see a growing need in the creative industry for evidence-based technologies which can play part in therapy programs and interventions.</i></p> <p><i>PP: This will help the creative industry to design adequate eHealth-interventions and legitimize underlying design-choices.</i></p> <p><i>DP: This was a chance to develop an evidence-based mechanic that we can seamlessly implement in other games and VR environments that we make [...]. That is the first thing healthcare clients ask for: evidence-base.</i></p> <p><i>DP: They [researchers] were primarily interested in: how to keep users motivated in time. This is more abstract. I see the value, but I can use these insights less straightforward to solve a problem.</i></p>	<p>Suggestions for design researchers and funding parties to improve contribution to design practice</p> <p>Differentiate between designing audiences.</p> <p>Let a dedicated partner help articulate and champion practice needs.</p> <p>Address a wider range of practice needs. Use overviews of useful knowledge for design professionals (Zielhuis et al., 2022b)</p>
<p>3. recognize differences between design audiences</p>			
<p>4. value different needs</p>			

Table 5.3: The challenge to identify an actual design practice audience in two aspects, supported by observations and illustrative quotes and translated to suggestions.

<p>Challenge aspects. How to ...</p> <p>Observations: barriers (-) and enablers (+) for impacting design practice expert, PP=Project proposal, PC=Program call, PR=progress report</p>	<p>Illustrative quotes, indicated by source: PM= program manager, R=researcher, DP= participating design professional, FE= funding improve contribution to design practice</p>	<p>Suggestions for design research partners and funding parties to improve contribution to design practice</p> <p>Match roles not only on contributions to the project, but also towards benefit for actor.</p> <p>See #6</p>
<p>5. organize design professionals' roles to include the practice voice</p> <p>+ Design practice is brought in for their specific expertise (e.g. game development).</p> <p>+ Collaboration with design practice is assumed to be helpful for bringing in the voice of practice</p>	<p><i>PP: The design agency will contribute to conceptualization and development of experiential prototypes.</i></p> <p><i>PC: The program is designed to stimulate activities focused on collaboration between the creative industries and the healthcare sector.</i></p> <p><i>FE: When researchers actively collaborate with design professionals in their research, you can count on more applicable results.</i></p> <p><i>PP: The design agency will bring the company perspective on how to develop knowledge that addresses the needs of the health service development companies.</i></p>	<p>See #3</p>
<p>+ Design practice is represented in the project organization (e.g. feedback panel)</p> <p>- Roles are often instrumental, which limits the ability of partaking design professionals to identify relevant content.</p> <p>- Learnings of design practice partners are not always identified, being partly tacit and not explicitly reflected upon.</p>	<p><i>PP: The valorisation panel provides input and feedback from the perspective of the creative industry as well as from the target group.</i></p> <p><i>PP: Partner [...] has the responsibility to involve the creative industry in the project</i></p> <p><i>DP: I did not think of other designers. I didn't know this was part of the plan.</i></p> <p><i>DP: The number of hours that we can put in, is fairly limited. So the role we can take is relatively small.</i></p> <p><i>DP: Use us for the things that we are good at: structuring things, designing, developing the game mechanics.</i></p> <p><i>DP: We were less involved in the content than normally. We really took the role of making things. It strengthened what I already knew more than that it was shockingly new.</i></p> <p><i>DP: Maybe it's just that I see how they [design researchers] do things and take some of that and use it myself, without being able to point out what it is. What I see from them [the health domain] is more straightforward applicable.</i></p>	<p>Operationalize roles (e.g., Sleeswijk Visser, 2018)</p> <p>Let professionals reflect to make tacit knowledge explicit (Nonaka & Takeuchi, 1995).</p>
<p>6. use the learnings of design professionals to identify relevant content</p>	<p><i>Table 5.4: The challenge to recognize what is relevant for design professionals in two aspects, supported by observations and illustrative quotes and translated to suggestions.</i></p>	

The challenge to communicate results effectively

To make their results actionable (aspect 7, table 5.5), most researchers aim for middle-level knowledge and concrete solutions or demonstrators for design practice. Some take guidance from conventions within their community on how to communicate results to design practice (e.g., formulating design implications). Some seem to target both a practice and an academic audience with the same middle-level type of output that is more tailored to an academic design audience (e.g., guidelines published in an academic journal). Most researchers reach out to practice once they have concrete results to communicate, which is often at the end of the project (aspect 8). This late communication is sometimes problematic for practice partners. Several projects plan transfer by other channels, such as workshops and seminars. Conveying tacit or experiential knowledge beyond the active partners is not actively planned, but these workshops and seminars seem to provide opportunity to do so (aspect 9).

Challenge aspects. How to ...	Observations: barriers (-) and enablers (+) for impacting design practice	Illustrative quotes, indicated by source: PM= program manager, R=researcher, DP= participating design professional, FE= funding expert, PP=Project proposal, PC=Program call, PR=progress report	Suggestions for design research partners and program officers to contribute to design practice
<p>7. produce actionable output</p>	<p>+ Researchers aim for concrete demonstrators and middle-level means such as guidelines, using conventions within a community on how to communicate results to design practice.</p> <p>- Researchers aim to impact the practice audience with output tailored to an academic audience (e.g. academic papers).</p>	<p>R: <i>We have formulated design implications. For our community, that is an accepted way to transfer knowledge that designers can actually use.</i></p> <p>R: <i>We will include design guidelines that form a bridge between insights and practice. The background of these guidelines is also important for a designer.</i></p> <p>R: <i>A project website with interactive design knowledge and conceptual demos to be presented at practitioner's seminars.</i></p> <p>PR: <i>Our research elaborates on existing theoretical frameworks by generating more specific and applicable insights.</i></p> <p>R: <i>I know what to tell to my community, to design researchers, but I'm not that sure how I can tell it to design professionals so it becomes relevant.</i></p> <p>R: <i>The thesis will include design guidelines.</i></p>	<p>Aim for middle-level knowledge (e.g., Hook & Löwgren, 2012; Sleeswijk Visser, 2018). Consider the vocabulary of your design methods (Gray, 2022)</p> <p>Prototype with practice & use practice outlets (Mathiassen, 2002).</p>
<p>8. identify opportunities for sharing</p>	<p>- When researchers decide on going to practice once they have concrete outcomes, sharing happens at the end.</p>	<p>R: <i>Sharing the content is difficult. They wanted to share this article right away, but we said: wait until it is published.</i></p> <p>DP: <i>Four years is long. A lot will happen in the world, which is not incorporated.</i></p> <p>PM: <i>We received some comments from companies: should I wait three years for this knowledge? So we said: try to agree on intermediate results that you could use.</i></p> <p>R: <i>That is something we will have to address towards the end.</i></p> <p>R: <i>Because we have not developed concrete products and design proposals yet, we have not involved the creative sector.</i></p> <p>FE: <i>I think it is essential to involve design professionals much earlier in the process.</i></p>	<p>Consider less linear research impact pathways (e.g., Kok and Schuit, 2012) and involve design practice early on, e.g. in an iterative process such as in Zimmerman (2003).</p>
<p>9. transfer tacit and experiential knowledge</p>	<p>- Researchers do not plan to convey experiential and tacit knowledge beyond partners.</p> <p>+ Design professionals are engaged in workshops or seminars.</p>	<p>DP: <i>If I do co-design sessions, I sometimes sense something. Even if I write a thorough report, some knowledge gets lost if I hand it to someone else. This sounds vague, especially for scientists, but that is just my intuition.</i></p> <p>PP: <i>Dedicated small-sized workshops about these products</i></p>	<p>Use tacit-to-tacit ways of transfer (Nonaka & Takeuchi, 1995), e.g., in workshops.</p> <p>Engage design professionals in workshops (Wallin et al., 2014).</p>

Table 5.5: The challenge of effectively communicating results in three aspects, supported by observations and illustrative quotes and translated to suggestions.

5.4 DISCUSSION AND IMPLICATIONS

The results show that bringing actionable knowledge from a design research project to design practitioners poses several challenges. Table 5.6 pulls together the main findings from the preceding discussion. Four main challenges are identified that all concern the project lead researcher, but also concern more involved parties. Regarding design practice as audience and identifying their specific needs is also challenging for funding organisation in shaping the requirements and restrictions of research calls. The unclarity about which findings would benefit design practitioners concerns all parties: the involved design professional and other team members, but also funding parties in the way a program facilitates the involvement of design practice partners. The challenge to communicate results effectively concerns all team members, as well as the program manager to facilitate this.

The challenge to:	Challenge aspects. How to ...	Main suggestions to improve contribution to design practice	Barrier
Address design practice as an audience (table 2) <i>(for lead researcher + funding parties)</i>	1. regard design practice as an audience 2. find resources to develop knowledge for design practice	Formulate impact goals on practice, engage with design practice in various ways, and (for funding parties) provide funding opportunities.	Design professionals are under-prioritized as audience
Identify an actual design practice audience (table 3) <i>(for lead researcher + funding parties)</i>	3. recognize differences between design audiences 4. value different needs	Distinguish design practice from other audiences (e.g. academics) and articulate the needs of practice.	
Recognize what is relevant for design practitioners (table 4) <i>(for lead researcher + other project members + design practice partners, funding parties)</i>	5. organize the roles of design professionals to bring in the practice voice 6. use the learnings of design professionals to identify relevant content	Shape the roles for participating design professionals also with an eye for their benefit	Design professionals are not regarded as learners
Communicate the results effectively (table 5) <i>(for lead researcher + other project members + program coordinator)</i>	7. produce actionable output 8. identify opportunities for sharing 9. share tacit and experiential knowledge	Reach out to design practice from the start to engage in knowledge exchange and to iterate towards end results.	

Table 5.6: Overview of the four main challenges for various research-involved parties to impact design practice, the different aspects of these challenges, and suggestions to address these challenges.

Addressing design practice as audience

Impact on design practice might be stated as aim (see the introduction), the interests of design practitioners are at a disadvantage. The results reflect the difficulties that were noted in the literature (chapter 3) of combining the interests of academics and design practitioners. This study illustrates how these difficulties partly lie beyond the project, and notably concern the lack of funding opportunities for impacting design practice and according assessment criteria.

Suggestion (for funding parties): provide financial support for impact goals towards design practice. Suggestion (for researchers): formulate impact goals on practice and engage with design practice within and beyond the scope of a project, for instance by working with practice professors, by joining practice exhibitions, or by involving practitioners in student projects (e.g., use the overview in Telenko et al., 2016).

Identifying an actual design practice audience

The three ensuing challenges all reflect that design professionals are not regarded as learners. The first aspect of this is that design researchers do not always distinguish between themselves and design professionals. Although previous literature (e.g., Gaver, 2014) points at academic - practice differences, these are not always acknowledged. Some researchers leave ambiguous whether they mean academics or practitioners when they state their ambition to (in the words of Manzini, 2009) 'produce knowledge useful to those who design'. Perhaps academics identify with design professionals because they themselves have a design education background and they often apply practice methods. However, to deal with any differences, these will have to be acknowledged.

Suggestion: Distinguish design practice from other audiences (e.g. design academics). To articulate the needs of design practice, existing overviews of useful knowledge for design professionals (such as Zielhuis et al., in press) can be used. A project partner can be tasked with articulating and championing the needs of design practice throughout the project.

Recognizing what is relevant for design practitioners

A related challenge is that researchers lack insight in the learning process which takes place within the different involvement zones, and lack insight in the support that this

learning requires. We found that collaboration with design professionals is sought in many different ways. However, their roles are primarily shaped with an eye for the expertise they bring, limiting their ability to contribute a practice eye. This seems partly due to funding restrictions on the number of hours that they can put it in. It also seems to reflect the notion in chapter 3 that both researchers and design professionals have little guidance on how to operationalize design professionals' roles to bring in the practice eye.

Suggestion: Shape the roles for participating design professionals also with an eye for their benefit. These roles need to be further operationalized to support better sharing of knowledge, building for instance on the roles in Sleeswijk Visser (2018). For instance: how can participating design practitioners be supported to articulate their developing knowledge?

Communicating the results effectively

The results reflect the initially indicated challenges by the literature review in chapter 3 on managing different channels and on output formats. Of these channels, ample attention goes to output of papers, guidelines and artefacts and considerations about format. Less attention goes to other ways of knowledge sharing, such as by people. We find that the difference in standards between academics and design professionals that Gaver (2014) indicates, also includes a difference in standards on when knowledge is ready to be shared. Whereas researchers do not share knowledge until all data is analysed and condensed into peer-reviewed papers, designers want emerging insights much earlier as they validate it in practice (does it work?). Earlier interaction might also need to be more two-way and joint effort. As Carlile (2004) argues from a boundary crossing perspective, some knowledge cannot easily be transferred or translated to another practice without joint effort.

Suggestion: Reach out to design practice from the start to engage in knowledge exchange and to iterate towards end results (e.g. in the lines of Zimmerman, 2003). Some guidance is available on suitable formats to communicate results from design research (e.g., Hoök & Löwgren, 2012), on vocabulary in communicating design methods (Gray, 2022) and on tacit-to-tacit ways of sharing e.g., in workshops using prototypes (Wallin et al., 2014).

In our own next studies, we aim to explore the last two challenges and suggestions, which both point at a more joint research-practice effort.

5.5 CONCLUSION

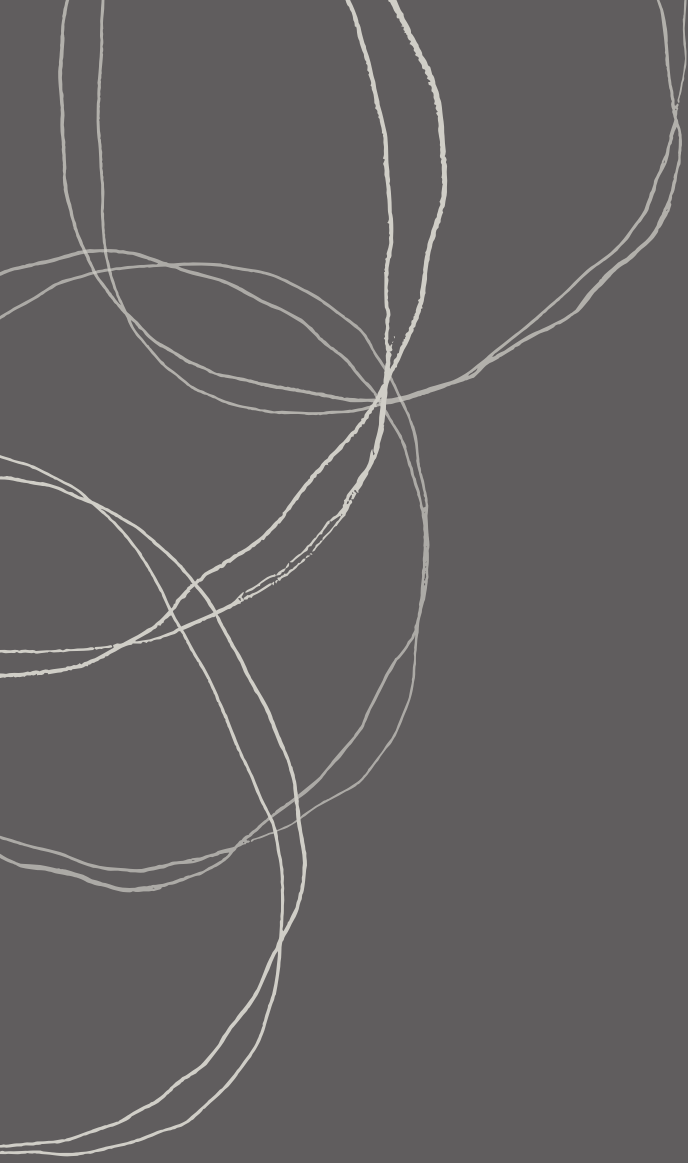
Our research question was: *What are the barriers and enablers for design research collaborations to be of use in the work of design professionals?*

This study illustrates that impact on design practice is not easily accomplished and distinguished several challenges which require consideration. The two main barriers that this study found are that design professionals are under-prioritized as audience and not regarded as learners. The study also identified related enablers.

The first barrier is that design professionals are under-prioritized as audience. Especially in collaborative research projects, different worlds meet and bring their agendas, which means that these projects have to deal with multiple audiences. This barrier is not fully under the influence of researchers, because impact on design practice seems a blind spot for funding parties. Although the role of the creative industry towards the societal challenges is acknowledged, it seems that the knowledge base for the design discipline has to be built in the slipstream of the efforts for other audiences. The same parties can also be enablers to prioritize design professionals as audience. Funding agencies can address impact on design practice in their protocols, and researchers can incorporate them in their project goals.

The other main barrier is that design professionals are not regarded as learners. The last three groups of challenges all reflect that researchers have difficulties to identify the needs of design professionals and to support their learning sufficiently. This means that it is important that they better understand this learning process. As enablers, this study points in the direction of involved design professionals in the project, to bring in the practice perspective. However, the study also shows that having a design professional on board is no guarantee for learning by other design professionals. This means that this involvement needs further study.

We believe that the results from this study can be informative for researchers, funding agencies and other involved parties who want to inform design practice through research. However, we note its limitations. We studied a single, national research program in a specific (eHealth) domain and with a strong emphasis on developing fundamental knowledge (next to impacting practice). This limits the generalizability. Also, the study only touches lightly on the subject of tacit knowledge and shows only a few of the various roles in which design professionals can be involved.



CHAPTER 6

Learning within research projects

This chapter is based on: Zielhuis, M., Sleeswijk Visser, F., Andriessen, D., and Stappers, P. J. "Learning within research projects" (under second round as review as journal article)





6.1 INTRODUCTION

In the literature review in chapter 3, collaborative design research projects are put forward as great opportunities for the involved design professionals to learn by taking active part. As researchers do not know how this learning process works, they cannot support this optimally. This study aims to fill that gap by studying the learning process of design professionals who actively take part in research projects. The insights from the previous chapters are used to recognize such learning. This includes the understanding of the three topics categories that are useful for design professionals, of their learning beyond the application topic of the project, and of the diversity of their learning, such as a designer's network in the care sector that has been increased. We review and discuss these learning processes in four projects. The chapter ends with suggestions on how this learning can be promoted in future collaborative research projects.

6.2 METHOD

Participants in the study were four design professionals who had taken part in a collaborative research project which they considered as useful for their work. These four professionals were interviewed about their participation in this project. The interviews centred on the project activities which they described as important for their learning, in line with Goodyear et al. (2021). We studied these in a process research approach (Langley et al. 2013).

The main research question in this study is: How do design professionals develop actionable knowledge for their own design practice when they take part in a collaborative research project? To answer this main question, we started from three key questions:

- RQa) Which actionable knowledge did the design professionals gain and found useful? And which missed chances did they indicate in hindsight?
- RQb) How did their roles and activities support explicit reflection?
- RQc) How was their learning supported by other people or artefacts?

Based on the results, we derived the main characteristics of this learning process and formulated practical tips to support this.

Cases

We selected design professionals from four different collaborative research projects on several criteria. Most important was that the professionals reported on these projects as very useful experiences for their design practice. That meant the projects had been completed and that we interviewed them retrospectively. A second criterium was that the design professional had an active and substantial part in the project for a period longer than six months. Third, all participants had over six years of design experience in industry. Fourth, all projects had a substantial design component (e.g. using the double diamond process). One of the projects (in which 'John' took part) was explicitly put forward by the researchers as RtD project. Finally, all projects were conducted in close collaboration with multiple partners. Since the research of the first author focuses on knowledge development in design research in a Dutch context, all participants were based in the Netherlands. Table 6.1 gives an overview of the four design professionals (using pseudonyms) and the respective projects.

Pseudonym	Bob	John	Mary	Tess
Project topic	Involving residents in solar parks design	Designing meaningful conversations about personal futures	Activity monitoring of children for physiotherapy	Facilitating design-oriented future thinking
Case context	A village as optional site for a solar park	Various elderly care organisations	Physiotherapy practices for children	A sustainable energy cooperation
Project partners	University (landscape architecture) knowledge institute (behavioural science and PV technology), printing company, <u>service design agency</u>	University (design research), university (design academy), care institutions, municipalities, <u>four design agencies</u>	University of Applied Sciences (co-design; lifestyle), hospitals, physiotherapists, university (behavioural science). The <u>design professional</u> was hired by the UAS.	University of Applied Sciences (co-design), energy cooperation, two <u>design agencies</u> . Note: the <u>design agencies</u> take part without funding.
Research design	A central case study in which a mock-up of a solar park is built.	Several case studies which contribute to the development of a central conceptual framework.	A design project in which an activity monitor and corresponding tools are built in a series of design sprints.	A series of design sprints to develop future tools and a central case study to apply the tools.
Methods	Structured interviews, contextmapping, co-creation sessions	Scenario thinking, participatory and empathic user research methods, contextmapping tools	Structured interviews, contextmapping, co-design sessions,	Design sprints, reflective sessions
Collaboration duration	2 years	2 years	1 year	6 months
Design professionals: Training; design practice experience	Industrial design; Six years' experience	Industrial design, 10 years' experience	Communication and multi-media design; Six years' experience	Information science, industrial design, art academy, psychology; 14 years' experience
Design agency	Service design agency (10 employees)	Social design agency (10 employees)	Self employed	Self employed
Motivations for agency to join	All: Make relevant contribution; positive prior collaboration	Further build portfolio of agency	To learn from research partners	To learn from other design professional; to extend network
Entry point for design professional	Shortly after start, after a colleague was involved in proposal writing.	Shortly after start, when additional expertise was needed.	Shortly after start to replace someone else.	Involved before project initiation.
The design professionals' practice role	Product and service designer	Research director & service designer	Owner, designer, facilitator, illustrator	Strategic designer, organizational designer

Table 6.1. Overview of the four cases.

Data collection and analysis

Data was primarily collected by interviewing each participant and drawing a process map together. Due to covid measures, the interviews were held online using an online collaborative environment, in which drawings, post-its and texts could be created and organized. Additionally, several project documents, such as publications and end-reports, were collected, studied and used as prompts and means for data triangulation. The interviews were audio-recorded and transcribed. The interview questions were directed by the three questions.

To construct a rich process map of each project, the relevant activities were organized in the corresponding roles which the participants distinguished. Some of these roles were explicitly assigned and labelled in the project, others were identified and labelled by the participant during the interview. The interviewer constructed the timeline and its contents, while regularly asking the participants if these represented their words. In some cases, the participants took an active role in drawing up sticky notes and moving them around.

As talking about learning experiences can be difficult, we used several prompts, such as pictures from the project, to activate the memory. Also, existing data such as timelines or dates functioned as triangulating measures. We offered several examples of actionable knowledge, from explicit to implicit (Markauskaite and Goodyear 2017) on a variety of topics. This way, the participants would not hesitate to name things which they would otherwise consider too mundane, such as a new method that they continued using after the project, an increased network, or practical tips they shared within their design agency.

Each interview resulted in a large poster with the organized process map, annotated with quotes and short narratives on the various events (example in figure 6.1). These process maps were used to analyse on question b (explicit reflection in relation to roles) in a cross-case analysis session on the wall.

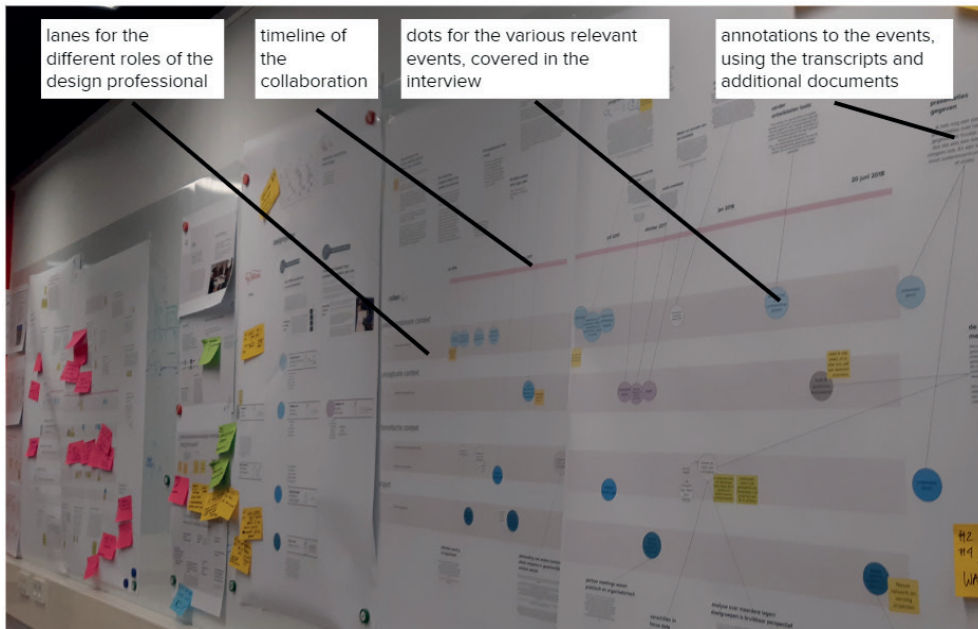


Figure 6.1. The process map of the research collaboration process of one participant, organized along a timeline and in different roles (lanes) and events (dots) which were annotated (text blocks).

The analysis was partly emerging from the data and partly driven by the literature. We used the topic categories of designing, application domain and project organization (Zielhuis et al., 2022) to organize the resulting actionable knowledge (RQa), and the roles for structuring RtD collaborations by Sleeswijk Visser (2014) as a starting point to organize the roles. To look for explicit reflection (RQb), we organized the key learning events in deliberative, reactive, and implicit learning (Eraut 2000).

To validate the analysis results, a focus group was held in which the participants reflected on their own and each other's process maps and the presented insights.

6.3 OBSERVATIONS

The cases of design professionals in research projects gave insight in what and how they learned and how their learning was related to their project activities. In this section, we discuss the observations on the research questions a-c; in the next, we draw conclusions on the main research question and provide implications for future research projects.

Much learning goes unnoticed

In answer to research question a, we found that all four design professionals reported a wide variety of actionable learning outcomes. The results are organized in table 6.2 in the topic categories of designing, application domain, and project organization. Each participant reported examples on at least two of the three categories. Some of the learning outcomes were explicit and could be put into words, such as a new method. Others were less explicit, such as an improved confidence: *'I became more confident in addressing things. In future projects I will ask where partners would like support.'* The interviews helped them to identify and articulate some of the less explicit outcomes.

Two participants developed useful knowledge about the application domain. A big learning outcome for John was that he better understood the pressure under which healthcare professionals have to operate, and what a designer can offer in that context. Bob learned about the central project topic: the involvement of residents in solar parks development. What is more, all learned much beyond the application domain, namely about designing (techniques and methods) and project organisation. For Mary and Tess, the value of the projects lay in the exchanges about methods, not in the respective application domains of physiotherapy or sustainable energy. Mary did not even report the application domain at all in this list. Her normal work is visualizing client processes, which does not go deep into domain topics.

All participants reported learning about designing. Most examples are about co-design and contextmapping, the area in which these participants mainly work. Bob and John both deepened their understanding of and expertise in working with sensitizers (a technique in contextmapping [Sleeswijk Visser et al., 2005]). Already familiar with the concept sensitizing, they even better appreciated its value by the prominent use in the project: *'We worked more with sensitizers since then, to warm up the topic and keep it alive'* (John).

Notably, many examples concern a deepening and strengthening of the design professionals' existing knowledge and expertise. For instance, Bob deepened his expertise in facilitating co-creation sessions, and was better able to recognize and articulate his own strengths in facilitating.

Respondent Topics	Bob	John	Mary	Tess
Designing	Deepened expertise in facilitating co-creation sessions <i>'I realized the power of giving people specific instructions in a co-creation session to get them going.'</i>	Knowing how to talk about futures; Deepened understanding of working with sensitizers <i>'We worked more with sensitizers since then, to warm up the topic and keep it alive.'</i>	Deepened understanding of methods and techniques (e.g. contextmapping); improved grasp of facilitating <i>'Methods became alive.'</i>	Deepened understanding of futuring methods and techniques; Tips for practical techniques and tools <i>'I applied the tips we shared directly in the next client session, about getting people from one state to the next.'</i>
Application domain	Insights in how people view solar parks, and ways to involve them in a design process; Extended network; Showcase in solar park design	Extended network and follow up projects; understanding of domain issues and what design can offer <i>'Healthcare is under so much pressure that people run into problems but don't have the time to zoom out.'</i>	-	-
Project organization	Improved skills and confidence to work with a complex consortium <i>'I became more confident in addressing things. In future projects I will ask where partners would like support.'</i>	Insights about layering your project outcomes; Extended network	Benefits of working in large consortium; Extended network; Insights on how to work (and how not to work) in complex consortia	Insights on the potential of research-practice collaborations; Extended network and follow up projects

Table 6.2. Overview of the learning outcomes as reported by the design professionals in the four cases, in the three topic categories from study 4. Empty cells mean no reported learning outcomes.

All four reported on learning about project organization, particularly in such complex, layered consortia. Working in such projects deepened and extended their understanding and skills in this. For instance, Bob realized how project partners tend to go their own, mono-disciplinary, way, and that design professionals are particularly good at keeping a focus on the user perspective within the consortium.

The examples illustrate how the professionals learned much beyond the main project topic. Interestingly, learning about the project topic was not always recognized or described as such. For instance, Bob described the learning process about co-creation with residents in solar parks development rather as *'developing knowledge together'*.

Reflection on their own practice is rarely planned...

Tables 6.5-6.8 in the appendix provide a more detailed overview for each participant of the roles, corresponding activities, and the learning process. This shows that each took on at least four roles and that many roles emerged during the project. The design professionals extended their activities to theory building as well as managing and facilitating. For instance, Bob did not only take part in user research and the design of the solar park, but also joined the theory development and facilitated stakeholders meetings. Experienced in dealing with group dynamics, Mary even took the initiative to make everybody's roles more explicit which led to role adjustments.

In response to (RQb), we found that explicit reflection was often part of the project when it concerned learning about the project topic. Such reflection took place by connecting experiences from various roles. It helped when this reflection explicitly connected to their own practice and prior experience. For instance, as tool developer, Tess was tasked to reflect on her own practice about helping people think about the future: *'We shared the problems which we ran into in practice and the way we dealt with these'*. For Tess, this resulted in highly articulated actionable knowledge. However, not all explicit reflection led to useful learning outcomes for the professionals, as the link to their practice could not always be made. Some explicit knowledge in the project is simply too far from their practice. For instance, Bob mentions explicit reflection and discussion about a behavioural model, used by the researchers. Although Bob found this model interesting, he considered it too time consuming for his practice.

The design professionals also initiated explicit reflection on topics not foreseen by the project plan. For instance, Mary joined the project with a very firm intent to learn about facilitating, which was not the topic of study. She was tasked to co-facilitate several sessions, and further developed her existing skills and techniques along the way. This means that her reflections on these methods and tools were a matter of her own initiative. This example illustrates that the design professionals all learned in different roles: in those roles – assigned or emerging – which were relevant for their own daily practice. For Mary, this was a role of facilitator. However, learning about other topics beyond the project subject was in most cases a matter of reactive learning, unplanned by the project nor the design professional. The way John learned about working with sensitizers is an example of such reactive learning.

... but is supported in exchanges with peers...

In answer to research question c, we found that reflection was often supported by exchanges with others. Bob reflected that *'by explaining and motivating your approach, you are almost forced to make this explicit.'* This activity helped him to articulate the implications for his own practice. He better became aware of his own strengths and what he would do differently in future situations.

The exchange with researchers or professionals from other domains is appreciated, but the exchange with other design professionals brings the most. Tess described that *'exchanging with other agencies that work in industry is really different from exchanging with researchers.'* Bob ascribes this to a difference of culture, between *'brooding on a paper for over a year and a having to finish your project in a month.'* However, a participant noted that just working with each other is no guarantee for exchange: *'Working alongside other designers and researchers, you can still exchange little.'*

In several cases, these exchanges with peers focused on a joint task. John worked intensively on a design case with one other agency and learned much about *'the tools and the type of conversations in healthcare.'* Mary described the joint preparation of co-creation sessions. She took the opportunity to learn from a certain colleague how and why to apply a certain facilitation technique: *'This really deepened and strengthened the methods I already used.'*

For Tess, the exchange with peers was even a planned activity within the project, which was highly useful. *'It is so valuable to exchange with colleagues about difficulties you encountered and how you handled them. Normally, you talk with each other or watch or read each other's cases, but you don't go that deep.'*

The participants made it clear that chances were missed for even more exchange. John would have liked more profound exchange with the other involved design professionals, to *'look back with them at how they approached things and which role they took.'* Bob missed real exchange in many other collaborations: *'I rarely experience that a partner in a consortium asks us: why do you things like this?'* John proposed that partners are not inclined to question each other's expertise: *'partners rather keep within their own silo's instead of questioning each other's approach.'*

... and by artefacts

In all four cases, reflection was often supported by artefacts, such as templates, tools, prototypes, etc. Some of these artefacts were object of study or intended project outcomes. For instance, Tess was involved as tool developer to translate the project insights into new tools to support futuring. By doing this, she deepened these insights. *'By thinking about it and designing it, you come to new insights. This is closely tied together.'* Additionally, Tess and the other design professionals brought tools and materials from their own practice to reflect on. *'It made it very practical to see the worksheet that they use, or my talking stick.'*

Seeing each other's artefacts and work methods was very helpful. *'We immediately applied the tips that we received in the next client session.'* Mary made an adaption from another tool. She mentioned a dice-tool, of which the sides could be changed, for instance to make a name-generator. *'I took this home for a session. My partner, working in a similar field, immediately said: we also need to use these in our work! We discussed that this dice-tool is versatile and handy beyond co-creation sessions.'* She summarized this as: *'to see a way of working being actually applied, helps you to make the step yourself.'* To conclude, design professionals taking roles as tool developer and interacting with many (intermediate) artefacts seem to provide many learning opportunities.

6.4 GENERAL DISCUSSION: LEARNING IN RESEARCH ACTIVITIES

This study started from the notion that collaborative research projects in which design professionals are involved hold great potential for helping these professionals with their work. We set out to answer the question: How do design professionals gain actionable knowledge while taking part in a collaborative research project? We found that this learning can be characterized with three dimensions: they learn in a way which A) is not always recognized by themselves, B) needs to be supported by explicit reflection, and C) takes place in roles which inform one another and develop throughout the project. These three dimensions play out differently for learning on and beyond the project topic.

As is typical for such non-formal learning (Eraut 2000), the design professionals are not always aware of all their learning. Especially on the project topic, learning comes with a paradox: the professionals learn a lot when closely collaborating with others but recognize this more difficultly as learning. Their focus on contributing to the project makes it difficult to see themselves as learners. Furthermore, it is difficult for them to

recognize and oversee what they learn throughout their involvement. This especially goes for learning on topics on which they already have an extensive repertoire, such as designing. As Eraut (2000) argued, learning involves synthesis with prior knowledge. This means that for these professionals, who enter the project with ample prior knowledge and experience, explicit reflection is needed to strengthen and better articulate this.

Learning needs to be supported by explicit reflection. On the project topic, reflection is often organized, but seldom directed to the learning of design professionals. Beyond this topic, reflection is the result of the design professionals' own initiative. Goodyear et al. (2021) point at the agency by the learner – in this case, the professional – to engage in learning. In these projects, the learners had to rely heavily on their own agency to create and seize learning opportunities. In fact, the interviews for this study helped them to become aware about their learning. Furthermore, learning is often supported by exchanges with project actors and interaction with artefacts. When the designers reflect on and improve tools or other artefacts during the project, these artefacts function as boundary objects (Star, 1989). Similarly, the exchanges with fellow project partners – especially peer design professionals – support their reflection and help them relate the project findings to their own practice. When designers exchange about their work with others, they are prompted or even forced to articulate what they perhaps do intuitively. As especially experienced professionals often develop intuitive approaches (e.g., Dorst & Dijkhuis, 1995), an explicit articulation of their approaches can be very valuable as outcome of a collaboration. With sparring partners who are also peer professionals and can reason from a similar practice, this exchange can be even more relevant and on point.

Finally, the design professionals learn better if they are involved on multiple levels and corresponding roles. In line with Stappers and Sleeswijk (2014), we found that these various roles inform each other. What is more, the results suggest that this interplay between roles also applies to the roles they take in design practice. For instance, involvement in the project as tool developer does not only support the role as designer in the project, but also in professional practice. Furthermore, learning beyond the project topic can happen in a variety of roles, even in a role as facilitator or manager.

Table 6.3 summarizes these three dimensions of the learning processes. Column A depicts the awareness of learning by the design professional, column B the explicit reflection, and column C the learning related to project tasks and roles.

	A: Awareness of learning by the design professional	B: Explicit reflection	C: Tasks and Roles in which learning takes place
Learning on project topic	Learning is recognized with some difficulty, and rather seen as ‘developing knowledge together’. <i>‘The whole project is about developing knowledge together’ (Bob)</i>	Explicit reflection takes place, but requires extra effort to connect to professional practice. Reflection is supported by exchanges with others, and by interactions with tools and artefacts as object of study or intended end products. <i>‘It’s a rare opportunity to exchange with colleagues’ (Tess)</i>	Being involved in the heart of the project supports learning, as multiple levels and roles inform one another. <i>‘Thinking about and designing are closely tied together’ (Tess)</i>
Learning beyond project topic	Learning is recognized with some difficulty: learning outcomes are varied and sometimes implicit, and much is strengthening what they already know. <i>‘Learning about designing has overlap with what you already know’ (John)</i>	Reflection results from the professionals’ initiative, and is supported by exchanges with others, and interactions with applied tools and artefacts. <i>‘I saw this researcher develop a tool, and went to discuss this with her’ (Mary)</i>	Various roles can be relevant for a professionals’ specific practice. Some of these roles only develop during the project. <i>‘What I do in such projects is keeping the focus on the user perspective’ (Bob)</i>

Table 6.3. Three characteristics of learning by design professionals when they take part in research projects, on the main research project topic and on topics beyond this.

Implications for collaborative research projects

Based on the insights, we propose that learning on the project topic by the involved professionals should be a matter of interest for all involved. Learning by the design professionals will also make the collaboration itself more effective. Therefore, table 4 suggests actions for the lead researchers (R), design professionals (D), and funding agencies (F) on the three dimensions which table 3 distinguished.

Drawn together, these actions can build a reflective structure within research collaborations to offer the necessary support of the learning by design professionals. The three elements of this structure are 1) handles to recognize learning potential for design professionals and to direct reflections 2) opportunities for explicit reflection, and 3) a role arrangement which enables the design professionals to be involved throughout the project.

	Awareness: Recognize and value learning	Articulation: Support reflection	Task and roles: Assign relevant roles
On project topic	<ul style="list-style-type: none"> R: Find out where project goals match the professionals' personal interest. F: Recognize the opportunity towards practical impact through these partaking design professionals. Include this in criteria and evaluations. 	<ul style="list-style-type: none"> R: Create opportunities for design professionals to use artefacts to connect the project to their practice. R: Include reflective activities on the design professionals' practice. D: Get involved in activities that enable the translation of theory to design practice, such as the creation of tools. F: Facilitate the above conditions for learning. 	<ul style="list-style-type: none"> R: Involve design professionals throughout the project on multiple meta-levels and in more than one role. D: Explicate the different roles that you are expected (and willing) to take in the project. F: Facilitate this involvement of design professionals in funding.
Beyond project topic	<ul style="list-style-type: none"> D: Reflect on personal learning intentions before the start, and be keen on emerging opportunities. 	<ul style="list-style-type: none"> R: Facilitate exchanges with peer design professionals, such as exchange meetings and joint activities. 	<ul style="list-style-type: none"> R: Embrace the additional roles that design professionals want to take to contribute and learn.

Table 6.4. Guidelines to make research collaborations more actionable for the involved design professionals.

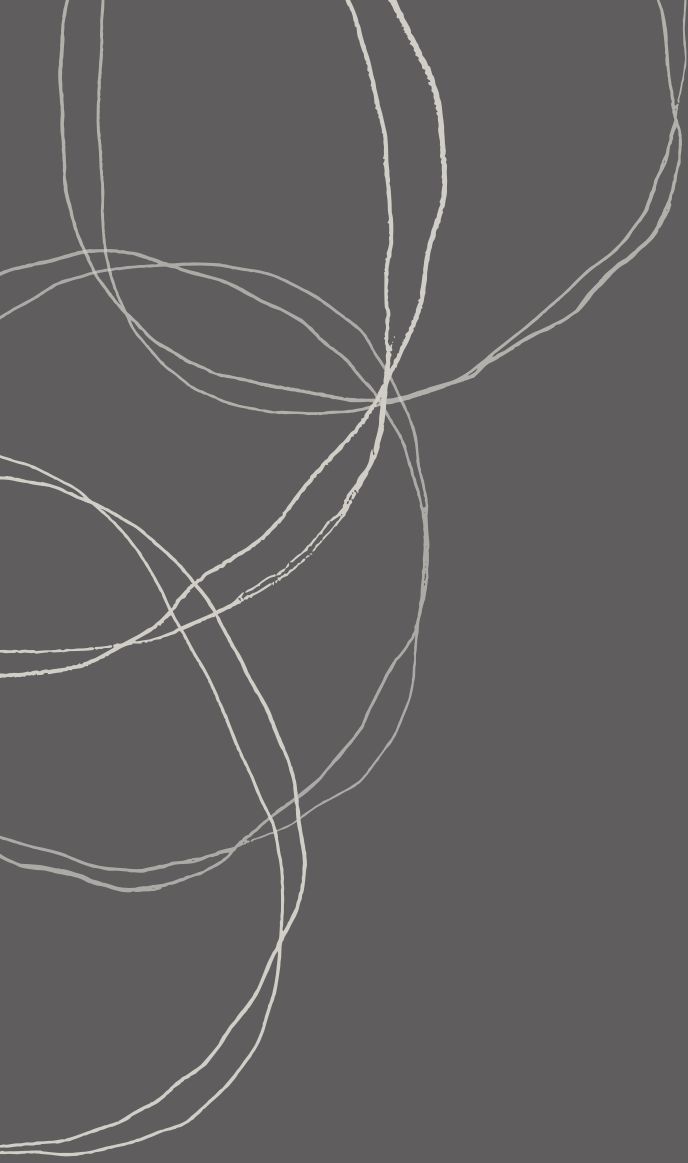
6.5 CONCLUSION

The main contribution of this study is the application of existing notions about learning, to provide empirical examples of the learning process by design professionals in collaborative research projects. A further contribution lies in showing the many different roles of the design professionals in such projects. We propose that researchers may not sufficiently realize this varied contribution nor the effort for the professionals to manage this.

As limitation of this study, we note that the applied retrospective method may have left some implicit learning unidentified. Furthermore, learning is conceptualized in this study as individual learning. Although the study took social aspects of learning into account, it did not study the opportunities or barriers connected to group learning. The study was also limited to participants in the so-called fuzzy front-end of design (see Sanders and Stappers [2012]) in co-design, service design, and organizational design. Finally, we reported on projects within the same national (research) culture and funding context. Future studies could be directed at implicit learning, for instance by following a professional closely, and could include different design areas such as app development, AI, or VR design, and different international contexts. Future studies could also extend this work to group

learning, for instance by taking a learning histories approach (Kleinsmann, Sarri, & Melles, 2020; Roth & Kleiner, 1998), in which teams jointly study their learning process.

This study investigated how design professionals develop actionable knowledge for their practice in collaborative research projects. We conclude that they do not recognize some of their learning and need explicit reflection. To support this learning, this chapter provides guidelines for researchers, design professionals, and funding agencies to recognize and value the varied learning which takes place, to support explicit reflection on practice, and to assign relevant roles.



CHAPTER 7

How designers learn from research projects in which they did not participate

The dataset as developed in this chapter can be found in the 4TU.ResearchData repository: <https://doi.org/10.4121/2fc8ec68-ca4d-4273-8910-29a6ea24a729.v1>





7.1 INTRODUCTION

How do designers learn from research projects when they are not directly involved? The previous study focused on the direct involvement of design professionals in design research projects. In this study, we address the indirect learning for those who are not directly involved: in zone 2, through contact with project actors, and in zone 3, through knowledge products. Similar as in the previous study, learning is conceptualized in this study at the scale of individuals. This chapter describes a survey study amongst an international group of design professionals and researchers to address the following research question: *How do design professionals learn from research projects in which they did not participate themselves?*

7.2 A BOUNDARY CROSSING PROBLEM

The previous studies raised the issue that design professionals are not regarded as learners. The reviewed literature in chapter 3 (e.g., Beck and Ekbia, 2018; Gray, Siegel, and Stolterman, 2014; Kreimeyer, 2016) as well as the multi-case study in chapter 5 showed that researchers do not always value or even identify practice needs. The multi-case study added that some researchers see no difference between themselves and design practice.

Furthermore, the literature review suggested – and the case studies in studies 4 and 5 confirmed – that the learning process on the boundary is not sufficiently supported. Although learning cannot be forced, it can be supported in what Goodyear et al. (2021) call a *learning situation*. Bouw, Zitter, & De Bruijn (2021) discern several different *designable elements* of such situations (i.e. elements that can be purposefully designed; Ellström et al., 2008; Zitter and Hoeve, 2012). Bouw et al. study learning situations in the educational discipline, which means they study the boundary between school and work. These elements include both the socio-cultural setting and the physical/digital setting in which learners perform their tasks (Carvalho & Goodyear 2018; Zitter & Hoeve 2012). For instance, a setting of a group assignment for students concerns a *social* element of a learning situation, a tool which they can use is an *instrumental* element, and a field trip concerns a *spatial* element.

In light of the previous studies, we discern three groups of designable elements of learning situations on the boundary zones between research projects and design practice. Currently, much attention by researchers goes to appropriate *knowledge products* in interaction zone 3. There is only limited attention for *in-person exchanges*, in what we indicate as zone 2: the activities in which design professionals interact with project actors from research collaborations. The literature (e.g., Chakrabarti & Lindemann, 2016) as well as the insights from the previous studies indicate that design professionals learn by more

extensive in-person contact such as in workshops or consulting (studies 4 and 5). These in-person exchanges are also elements of the learning situation which can be designed or organized. A special category of in-person exchanges are the *exchanges with fellow design professionals*. The literature indicates that there already is some attention for people who can act as intermediary between research and practice (e.g., Norman, 2010b), and the empirical findings confirmed that these people are important for learning (study 6).

We will investigate the above three elements of learning situations from a boundary crossing perspective (Engeström, 1987; Wenger, 1998). Boundaries are often not that clearly demarcated and are also described as *zones*, for instance by Kellogg, Orlikowski, & Yates (2006). Akkerman and Bakker (2011) argue that boundaries have an ambiguous nature, being 'both-and' as well as 'neither-nor' phenomena at the same time: they are middle ground as well as nobody's land. Akkerman and Bakker distinguish four learning mechanisms which take place at the boundary. These mechanisms allow a study of learning on the boundary with more nuanced eye for the activities at the boundary. These four mechanisms, introduced in section 3.4, are: identification, coordination, reflection, and transformation (see table 7.1).

By relying on *boundary objects* (Star, 1989) and *brokers* (Sin, 2008) to translate to practice, the current efforts to reach design practice seem driven by the rather practical mechanism of *coordination*. Akkerman and Bakker describe this mechanism as the efforts to organize efficient work at either side with minimized contact between the two sides. The other rather practical mechanism is *transformation*, which centres on collaboration and co-development of practices. The previous studies already showed that merely inviting design professionals in the project is not enough for effective co-creation. The literature supporting this mechanism emphasizes that *transformation* does not necessarily follow from collaboration. Explicit effort is required to jointly work on a shared problem space while at the same time maintaining and using the uniqueness of either side.

Next to these two mechanisms which focus on activities, Akkerman and Bakker distinguish two mechanisms which are dialogical and reflective in nature. The first is *identification* of one's own identity as well as that of the other side. The issue that the differences between design research and design practice are not sufficiently addressed – even when they co-create – seems to be a lack of *identification*. The second dialogical mechanism is *reflection* on the different ways of working on either side of the boundary. Reflection can have two faces: one of *perspective making*, of further developing and articulating one's own understanding of a particular issue, and one of *perspective taking*, of seeing one's practice through the eyes of another.

Learning mechanisms on the boundary

Focus on activities and practice	<i>Coordination</i> of distributed work <i>Transformation</i> of previous ways of working
Focus on dialogue and creating perspectives and identity	<i>Identification</i> of the own identity and that of the other <i>Reflection</i> on the different ways of working on either side of the boundary

Table 7.1: The four learning mechanisms of boundary crossing (Akkerman & Bakker, 2011): two mechanisms with a focus on activities and two with a focus on dialogue. They are extensively described in table 3.2.

Together, these four mechanisms offer a more nuanced lens to study the learning which takes place on the boundary between research and practice. Not only can they be used to investigate the role of boundary brokers and objects more closely but they can also be used to study in-person exchanges.

Informed by the insights from the previous chapters, we conducted a survey study about the learning opportunities of three categories of designable elements of learning situations: 1) in-person exchanges, 2) boundary brokers, and 3) knowledge products. Both design professionals as well as researchers were asked about their experiences with these three elements. We analysed these learning opportunities with the four learning mechanisms as theoretical lens.

7.3 METHOD

The questionnaire was directed at researchers as well as participating and non-participating design professionals, as they can all be involved in the activities on the boundary. The survey was distributed online, to efficiently reach a diverse group of respondents as to their nationality, experience, and design specialism.

A large part of the questions was directed at all respondents and several extra questions at only the researchers. The questionnaire was piloted by two researchers and a design professional to check whether they understood the questions and could provide meaningful answers within the envisaged 15 minutes.

Organization of questionnaire

The questionnaire consisted of six groups of questions (listed in Appendix C). The first group aimed to get an **insight in the respondents**, asking for the country in which they work, the design field in which they position their work, and the amount of experience in the field. Respondents had to indicate whether they work in industry (labelled in this chapter as 'design professionals'), in academia ('researchers'), or in both ('researcher-practitioners').

Three groups of questions were directed at the main topics of interest in this survey: the learning opportunities provided by in-person exchanges, boundary brokers, and boundary objects. For each topic, the questionnaire offered questions with a 5-point Likert scale or multi-response closed questions. Each was combined with open questions to explain the responses.

In-person interactions. We asked the respondents to rate several in-person activities in how these inform design professionals. A range of suggestions was offered which spanned the current spectrum of output of design research projects. This range was informed by the review (e.g., Telenko et al., 2016; Ponn (2016) as well the previous chapters (e.g., the empirical examples from studies 4 and 5). The respondents were asked to further motivate their responses.

Boundary brokers. One of the in-person interactions, which is worth investigating further, is the interaction with other design professionals. We asked the researchers whether they had involved a design professional from industry to help bring findings to a broader design professional audience, and we asked the professionals whether they had been this bridging practitioner. We asked both groups to rate and reflect on the influence of such bridging.

Knowledge products. To explore the role of knowledge products as boundary object between research and practice, we asked the respondents to rate the importance of several output formats in helping design professionals. The proposed formats were informed by the literature in chapter 3 (e.g., various forms of intermediate level knowledge such as guidelines and patterns, Gaver & Bowers, 2012; Löwgren, 2013; Sleeswijk Visser, 2018), as well as the empirical insights in study 4. In related open questions, the respondents were asked to further motivate their responses.

The survey addressed two other relevant aspects of learning by design professionals which were introduced in chapter 3 and which were further investigated in respectively studies 4 and 5: the actionable knowledge as the learning result, and the barriers and enablers in the project context. Both topics were included to better investigate the learning opportunities.

Actionable knowledge. Several questions were aimed at finding out whether the respondents actually had experience of research projects leading to actionable knowledge for design professionals. We used the three content categories which arose from study 4 (i.e., knowledge about designing, about application domain, about project organization) to identify more concretely how design practice was helped. The questionnaire combined questions with a 5-point Likert scale with open questions. To find out whether the

researchers could report on experiences in which they were successful in helping design professionals, we also asked them how they knew that this was the case. For instance, did they ask the professionals what they had learned?

Project context. Study 5 gave insight in the broader context in which researchers work to contribute to design practice, and which provides barriers and enablers. We asked the researchers to rate several possible enablers to successfully contribute to design practice, such as funding for output for design practice. Researchers and researcher-practitioners were also asked for their own motivation to bring knowledge to design practice. Finally, we asked all the respondents two open questions, to gather their advice for researchers who aim to contribute to design practice, and any additional insights, remarks, or experience on the topic of the questionnaire.

Data collection and analysis

The online questionnaire was shared via LinkedIn, email, and online platforms of various communities and networks, and we used snowball sampling via our own contacts to reach a diverse group of researchers and design professionals. These platforms and communities predominantly span the fields of service design, product design, and user experience design, and include some from a broader design field.

The open questions were analysed qualitatively. First, the answers were sorted to the type of respondent (researcher, design professional, researcher-practitioner) and to the three designable elements of the learning situation (knowledge products, brokers, and in-person exchanges). Next, we analysed the results using the lens of the four learning mechanisms by Akkerman and Bakker (2011). Open analysis was conducted to identify emerging themes.

The qualitative analysis was supported by descriptive statistics on the multiple choice and Likert type questions. To test on differences in the responses to the ordinal Likert type questions between the group of researchers and design professionals, we used the non-parametric two-tailed Mann-Whitney U test (Wilcoxon, 1945).

7.4 RESULTS

The questionnaire was completed by 48 respondents. Their answers reflect that the questionnaire drew responses from people who were already interested in and motivated for the topic of the connection between design research and design practice and that the respondents could draw from relevant experience. The sample was sufficiently widely distributed as to nationality and design specialism. All 48 entries were taken into analysis.

Characteristics of the sample

The group of 48 respondents consists of 21 researchers (working in academia), 16 design professionals (working in industry), and 11 researcher-practitioners (working in both). Most respondents are experienced (figure 7.1). Roughly half of them work in the Netherlands, and the other half in a range of countries on several continents (figure 7.2) in a diverse range of design fields (figure 7.3).

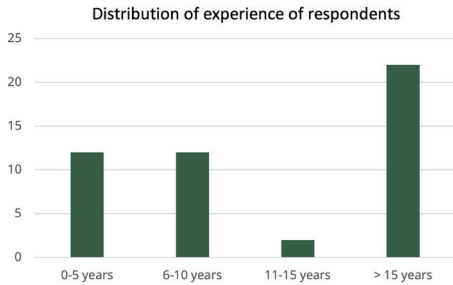


Figure 7.1: Years of experience of the respondents.

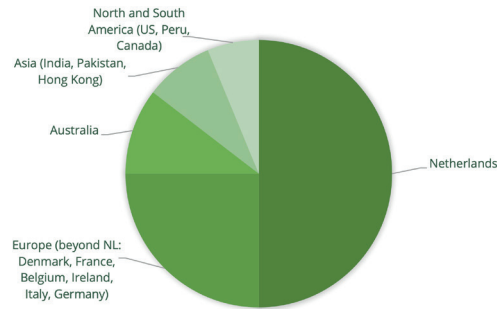


Figure 7.2: Respondents categorized by the countries in which they work.

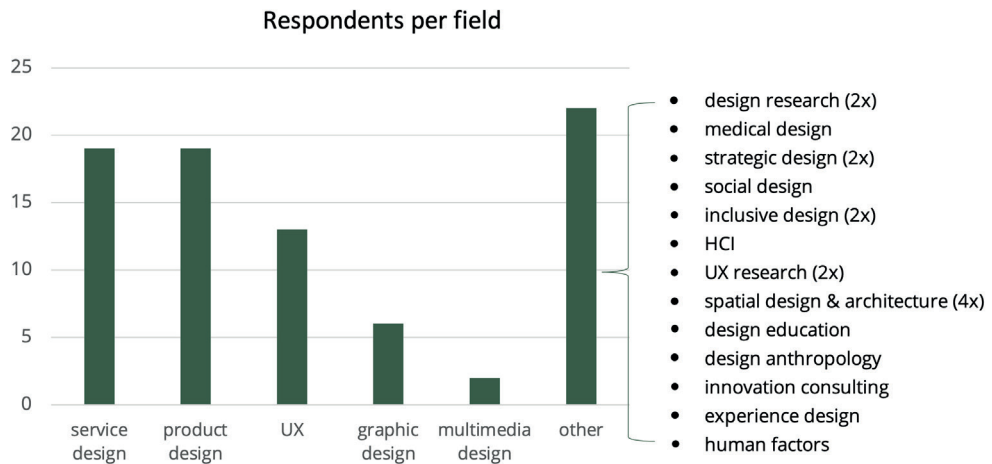


Figure 7.3: Distribution of design fields in which the respondents (N=48) work, organized along the suggested fields. In the open field by 'other', they filled in various additional fields.

Three elements of learning situations

The results show the diverse range of how learning is supported by in-person exchanges, boundary brokers, and knowledge products. The responses on this are overall related to actual informed experience. When asked how they knew whether they were actually successful in helping design professionals, 71% of the researchers report on indications such as ‘we asked the professionals’ or ‘we used metrics’.

The results confirm the importance of **in-person exchanges** for the learning by design professionals. Figure 7.4 shows the percentage of all respondents who mark the suggested in-person interactions as ‘important’ or ‘very important’ for design practice. Appendix D1 shows the detailed results. Workshops are scored the highest, followed by consulting to practice, training activities, and practice venues. Presenting at scientific conferences is valued the least by all respondents as a way to reach design practice. For most categories, there is no significant difference between the respondent groups. Only workshops are an exception in this: their value is rated significantly higher by researchers or researcher-practitioners than by design professionals (Mann–Whitney $P = 0.021$ two-tailed). The next section discusses this difference using the boundary crossing mechanisms.

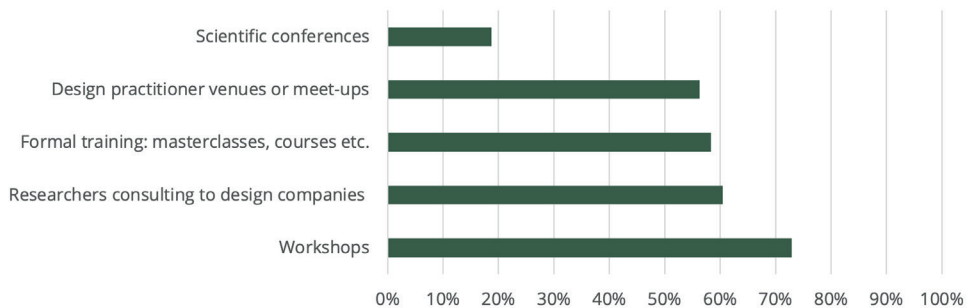


Figure 7.4. Percentage of all respondents ($N=48$) who mark the suggested in-person interactions as ‘important’ or ‘very important’ for design practice.

The findings also confirm that design professionals can function as **brokers** between research and design practice and show that they can do this in different ways. Most researchers (81%) have used design professionals as brokers to reach a broader audience. Their responses reflect a range of the presented categories: to develop tools or guidelines for design professionals, to (co)-write papers, blogs or other output for practitioners, to host workshops, to present findings to other design professionals at conferences or meet-ups, or to share findings in their own company or network. Many

(67%) of the design professionals and researcher-practitioners indicate to have been involved themselves in such a bridging role. The respondents who can report on such experiences – either by involving others or by being this bridge – overall rate this influence as quite substantial: 85% of the respondents rate this as somewhat or very important. Appendix D5 shows the detailed responses to this question. Section 7.4 will show that this bridging role can serve various purposes.

The results also show how **knowledge products** are supportive for learning by practitioners. Figure 7.5 shows a top three: tools and toolkits; designs or prototypes; and case descriptions. Academic papers are rated lowest. There is no significant difference between the three groups of design professionals, researchers and researcher-practitioners in their rating. Appendix D2 shows the detailed responses on this question.

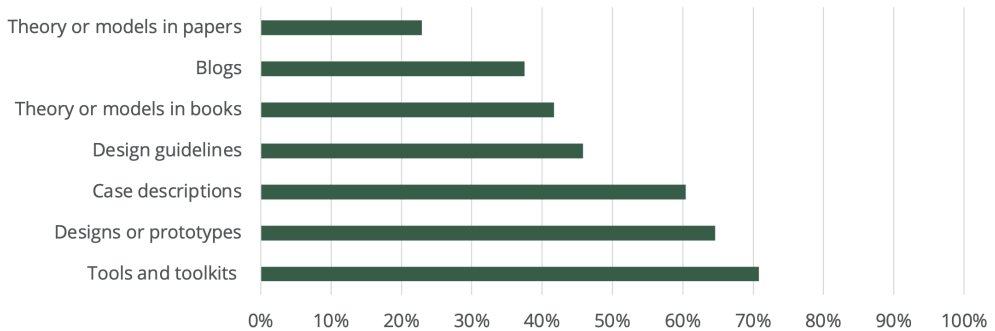


Figure 7.5. Percentage of all respondents (N=48) who mark the suggested output formats as 'important' or 'very important' for design practice.

The survey results also provide insight into the content of professionals' learning. Figure 7.6 shows that, according to a large part (around half) of the respondents, research projects do not only support design practice on the topic of the design process. The category 'improved the design process' is ranked the highest, but the other two topics (project organization and application domain knowledge) score high as well. There are no significant differences between the three respondents groups. Appendix D3 shows the detailed responses on this question.

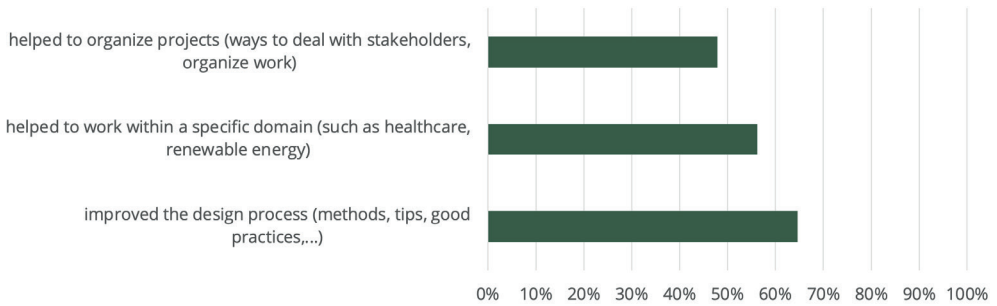


Figure 7.6: Percentage of respondents (N=48) who report that design professionals are 'sometimes', 'often' or 'always' helped on these topics by research outcomes.

Several enablers in the project context are found important to support the learning situation of design professionals. The three enablers suggested (partner organizations, funding, and motivated individuals) were all found 'important' or 'very important' by more than 60% of respondents. Appendix D4 shows the detailed responses on this question. There is no significant difference between the rating between the three respondent groups. The category 'individuals who are motivated to serve design practice' scores somewhat higher than the other categories. As the three categories all contain very different types of aspects, we merely conclude that the three groups find all these enablers important and that relevant enablers are found both inside (individuals, partners) as outside the project (funding).

7

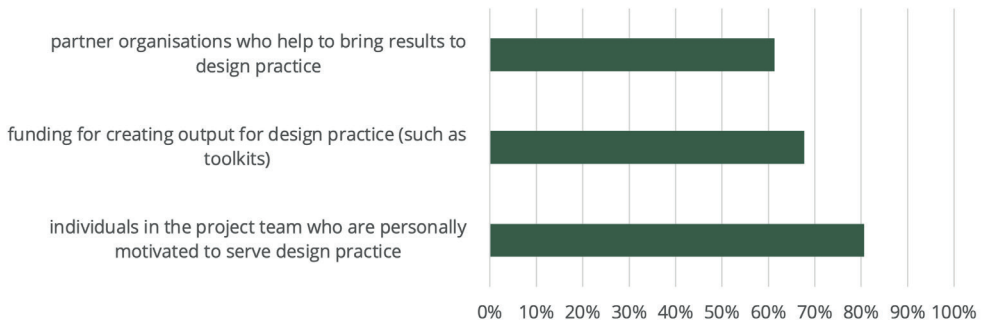


Figure 7.7: Percentage of respondents (N=48) who mark the suggested project conditions as 'important' or 'very important' for design practice.

7.5 RESULTS AND DISCUSSION: LEARNING ACROSS THE BOUNDARY

The learning opportunities related to knowledge products, brokers, and in-person exchanges can be further explained in light of the four boundary crossing learning mechanisms (Akkerman and Bakker, 2011). The illustrative quotes in this section are marked as (R) for researchers, (D) for design professionals, and as (D/R) for researcher-practitioners.

Identification: exploring the boundary

The responses show that there is a lack in – and need for – *identification* on both sides and distinguishes opportunities to further support this. Identification (see figure 7.8) happens when, confronted with a boundary, people are triggered to gain renewed insight in their own and the others' identity (Akkerman & Bakker, 2011).

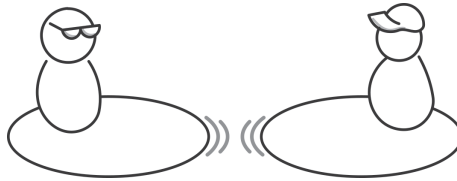


Figure 7.8: Identification: researchers and design professionals gain renewed insight in their own and the others' identity.

The findings suggest that, unfortunately, design professionals and researchers hardly explore the boundary or even enter the boundary zone. According to the respondents, both sides often go their own way with little awareness of the others' learning needs. One of the design professionals describes that for the field of service design "*practitioners are busy 'getting on with it', whereas academic research seems so ungrounded in reality that it barely attracts the attention of the average service designer working in an agency or in-house*" (D). A large group of professionals is not aware of what research projects have to offer: "*I don't think practitioners are even aware of research and what goes on in academia besides 'nuts and bolt' training and education*" (D). Researchers, on the other hand, lack insight in the practice context, for instance in the limited time that practitioners have to execute methods for their activities: "*The issue with researchers is that they have plenty of time and sometimes live in a bubble. Solutions that could work, as proven by research, will fail in practice because the time needed to implement is not the time that you will be paid for*"

at an agency. It would not surprise me that, due to time, many design companies just stick to the light versions of methods and models. With limited effect" (R). A related problem is that design professionals are often not the sole or let alone explicit identified audience. For instance, one of the researchers explains that in one of their projects, *"the workshops were not aimed at design professionals only. Hence, we don't have much feedback and do not know the impact"* (R).

Although the respondents talk about others who are unaware of what goes on at the other side of the boundary, many of them seem quite informed themselves. This is likely the reason that they responded to this questionnaire. The design professionals among the respondents are already quite informed of what goes on in research projects, and vice versa for the researcher-respondents. The responses reflect ongoing *identification* efforts from professionals as well as researchers when they talk about the ways of working on either side. For instance, they are able to identify the more *"intuitive approaches"* (D) in design practice. The respondents note that they need to better understand each other and the reasons why they work in a specific way. For this, it is necessary that *"both fields become more appreciative of each other and better trust the other's process"* (D).

Both sides show insight into what the work in design practice entails, and also in the way research is able to support this. The quantitative results in the previous section (figure 6) show that the various groups of respondents all recognize that design research projects can support three topics of design practitioners' work, and not only on the topic of the design process. Several design professionals remark that research outcomes do not only concern the design process itself, but also the organization of work around the design process, for instance in collaborations to *"get designers and stakeholders from A to B in a design problem"* (D).

From this informed position on the boundary, the respondents are able to provide suggestions for further *identification*. They call upon researchers to get to know practice better. A lot of the answers – to different questions – come down to this: *"learn more about design practice"* (D), or *"understand what is really useful to practitioners"* (D/R). Researchers are called upon to be open minded and respectful to the ways of working in practice, as *"designers with business priorities are not necessarily unethical or lacking fundamental knowledge. Academia is not higher or lower than professional practice, and both have their place"* (D/R). A design professional observes that *"sometimes, academic researchers don't seem to take the design process seriously, because the academic way of working is perceived as superior. But there is a big value in both ways of working, each with their different outcomes"* (D).

We found that involved design professionals can support this identification process as boundary broker, because design professionals listen to and trust other professionals: *“From designer to designer is the most effective way because it is a trusted source for knowledge. They are sceptic about researchers and new theories” (R)*. Others describe these bridging professionals as ‘ambassadors’ who can add to the authenticity of the research.

Several respondents suggest that both academics and practitioners need to share their own approach more frequently: *“We could share more experiences about doing research and about our practice. Just because we apply methods in a different way, or apply different methods, doesn’t mean that we cannot share and listen to each other’s stories” (D)*.

In short: both sides need to get acquainted and step into the boundary zone. The already informed researchers, design professionals, or researcher-practitioners are people who can support this *identification* process in others, for instance by bringing other design professionals and researchers into contact with each other.

Coordination: handing over results

As expected, the respondents report on a range of efforts in which the lead researchers *coordinate* the connection between research and practice, by translating research results to suitable formats for practice, or by using design professionals to translate findings in the right language or in the right place (as depicted in figure 7.9). This is mostly a one-sided matter in which researchers hand-over their knowledge to professionals. The researcher-respondents seem to already have various handles to smoothen this hand-over and provide easy-to-use results.

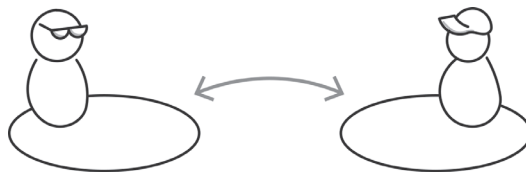


Figure 7.9: Coordination: researchers who coordinate a smooth hand-over of knowledge between design research and design practice.

Although researchers rely much on knowledge products, such as toolkits, to cross the boundary to practice, they report several problems in this. For instance, the slow turnaround time of research and the limited accessibility of results (e.g., lack of open source) are mentioned. Another problem is the high pressure to produce academic

publications: *"Academia places a major focus on getting research published" (R)*. Many research dissemination protocols and standards are not accommodating to a design practice audience: *"Sometimes these protocols are so formal and complicated that it kills the taste of an issue" (R)*. Despite these constraints, several respondents suggest that researchers expand their options. One of the researchers comments: *"Researchers should leave their comfort zone of traditional and formal ways. Meet people and see how they consume information. Maybe a meme is more effective than a presentation, or a piece of poetry more effective than a paper" (R)*. A related concern for researchers is the use of appropriate channels. *"Use the platforms they are using, such as newsletters or design magazines" (D)*. Several researchers have good experiences with different mediums or platforms: *"I have lately realized that sharing findings in videos is more effective than in research papers. And I have shared one of my conference papers on a public blog, which I think gains more access than a scholarly journal" (R)*.

Both researchers and professionals state that knowledge products for design practice should be easy to apply and consist of *"easy-to-use materials" (R)*. Design professionals need materials which they can *"directly apply to your day-to-day job" (D)*. Many efforts by researchers aim to support that design professionals interact with knowledge products and try them out: *"Experiencing and interacting makes it easier to translate to own situation" (R)*.

Easy-to-apply examples are mentioned, from a whole range of particular artefacts to more general theory. Designs and prototypes are often mentioned as knowledge products that are easier for design professionals to interact with: *"A lot of design professionals don't read a lot of papers. Show actual use cases" (D)*. Designs and prototypes are an effective and quick means to share knowledge between researchers and industry, and *"they tend to speak the language of industry" (R)*. The quantitative results (figure 5) and qualitative results show that tools and toolkits are especially appreciated: *"Tools and toolkits are always helpful to assist in product development, they give you a broader view and help you to come up with more ideas. (D)*. Toolkits are also appreciated because of their short and easy-to-read text, which is in the language of the practitioners, and *"easy to digest, gets to the point" (D)*. Researchers have the same experience: *"The synthetic aspect and the brevity of the text to read seem the most useful" (R)*. Another researcher comments that toolkits *"explain findings in an easy way, using the language of application rather than abstraction. They allow designers to quickly grasp many concepts" (R)*. Even more abstract models and frameworks are mentioned as easy-to-apply: *"I don't think I will find the time to read academic papers, but models or frameworks are good to integrate in our work. So it needs to be shared in an easy to digest format" (D)*.

Design professionals can take an important brokering role to support the hand-over. As the quantitative results (section 7.4) show, this group of respondents is already quite familiar with the bridging role which design professionals can take. Almost a quarter of the respondents work in both academia and design practice. Most respondents explain the suitability of design professionals as brokers largely from arguments that relate a *coordinating* perspective. For instance, they explain that design professionals bring the message “*not in academic language or writing*” (R). One of the design professionals needs other professionals to choose between the available toolkits: “*It would help to have valid testimonials to designed toolkits. Plenty are available online, but I need an easier means to choose between them*” (D).

In short: researchers rely much on knowledge products to do the crossing. They pay attention to the practical and easy interaction with the knowledge products, for which they already have some handles. Apparently, knowledge from concrete to abstract can be easy-to-use. Design professionals can support the hand-over between research and practice, but their brokering role is put forward predominantly as a practical bridge to translate. The results on the other mechanisms below suggest that knowledge products (as boundary objects) as well as boundary brokers can be even more than this practical bridge.

Reflecting: two reflective processes

The results show how, triggered by the boundary crossing, *reflection* by design professionals takes shape on the different ways of working on either side. Figure 7.10 depicts a design professional who reflects with their practice on the research project to find a fit. Although researchers can also expand their perspective by engaging with design professionals, this was not investigated in this study.

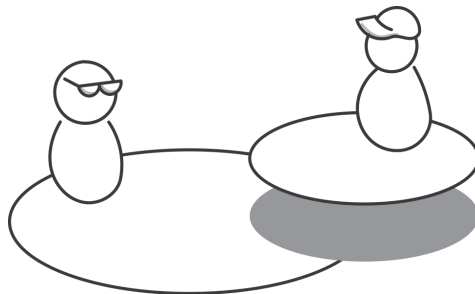


Figure 7.10: Reflection: design professionals reflect on the ways of working in their own practice as well on the research project, to inform their future practices.

We found that design professionals engage in two different reflecting activities to evaluate the contribution of research outcomes to their practice. We recognize these as the two reflective processes which Akkerman and Bakker (2011) distinguish. The first is a *quick scan* to explore the potential of research outcomes for their practice. This is a matter of *making perspective* and further developing their view on their own practice. For instance, in workshops, they quickly assess possible results ('what can this method/theory/idea bring') and the application context ('could this be relevant for my practice?'). In this quick scan, they make an explicit connection to their own practice context. The design professionals also do a *deep dive*, which is matter of *taking perspective* and developing a new perspective. This deep dive is directed at really understanding the content ('what do we know about this'), the mechanics ('how do you go about this'), and background ('why does it work like this'). This happens for instance in training or by studying books. The results suggest that researchers are not always aware that both types of activities can be supported with different types of knowledge products (zone 3) as well as in-person activities (zone 2).

In the *quick scan*, design professionals explore the potential of research outcomes for their practice. This quick scan is supported by various types of knowledge products: case studies, scenarios, examples, and prototypes. For case descriptions, the respondents explain that "*they're real-life examples*" (D) and can "*demonstrate the use of a tool or a model*" (D). One of the researchers comments that design professionals "*love to learn about what others did, to get their imagination running, to imagine theory and methods applied to their own field*" (R). Brokering design professionals can also support this quick scan by helping to "*formulate examples*" (R). In-person exchange is also supportive, for instance in "*direct interaction between researchers and designers, so that any questions can be answered on the spot and ideas can be shown in concrete and rich outputs such as prototypes or movies*" (R). Several design professionals indicate to prefer small-scale meetings such as workshops, as they are "*a smaller way of having a conversation than a big conference. The scale and the option for a dialogue is most important*" (D).

Design professionals also need to *dive in deeper*, to really understand the background of methods, tools, or other insights from projects. This needs to happen at the right time in a practice project, when one needs the knowledge and is able to dive in from a specific application context. This seems to explain why consulting is so highly valued (figure 5). One of the design professionals comments that "*the best way is to involve a researcher on a certain topic in the design process. Give them a moment to present during your project, or interrogate them on the subject*" (D). This deep-dive cannot be supported by knowledge products alone, as "*real-life contact with researchers and training is important to learn new things and develop your skills*" (D). This is why training is appreciated. Explanatory depth is

provided in some way by papers, but even more by books: *"I like to have a book or tool. You can have these lying around in your design studio and use them whenever you please. Books are often better explanatory than papers"* (D). Both researchers and design professionals also put case descriptions forward as helpful formats for this, as these are *"rich in context"* (D). One of them advises to *"give as many concrete examples as possible, share case studies, and test results"* (D). Not only success experiences are worthwhile to share, but also failures are found to be highly instructive: *"Could we do a night of storytelling on projects that worked and failed? I learned a lot on such nights!"* (R).

An interesting category in this regard is formed by workshops. The quantitative results on the rating of workshops (figure 4) show that although all respondents value workshops, researchers rate them higher than design professionals do. The qualitative results suggest that researchers may expect too much from workshops and fail to realize that these often cannot offer both a quick scan as well as a deep-dive. For instance, a researcher responds that workshops provide *"focused time to learn the framework and then practice the activities or the framework. Then how to incorporate it in their everyday practice"* (R). The results from the design professionals suggest that in many cases, workshops support only the quick scan.

In short, there are two reflective processes which can be supported by knowledge products, but also require in-person exchange. The responses indicate that brokers can also support these reflecting processes.

Transformation: bringing about change

Finally, the respondents report on *transformation* efforts in which both sides join forces to bring about change. The results show how this requires more than just working together: the work needs to be driven by both practice as well as academic needs.

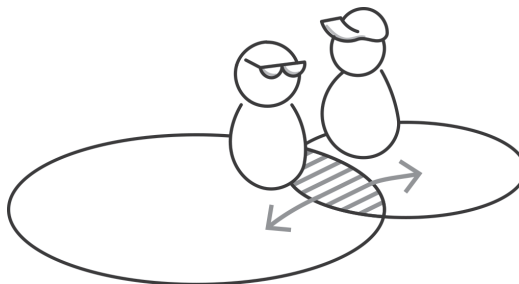


Figure 7.11: Transformation: in which partners collaborate to bring about change in design practice as well as research projects.

The answers show that this particular group of researcher-respondents is highly motivated to contribute to design practice. The researchers want to see research findings translated into real world impact and even see this as obvious, because *“that’s what academic design research is here for”* (R). The quantitative results on *project context* (figure 7.7) also indicate that the respondents see motivation by individuals as an important condition.

However, wanting to contribute to practice is not the same as understanding it – which is central in *identification*. It is also not the same as actually being driven by the need from practice. The researcher-practitioners, who work in both fields, emphasize that they are driven by an understanding of what is actually needed in design practice: *“I generally bring my work in industry into academic research”* (R/D).

Some researchers also indicate that they are familiar with practice needs from previous experience in industry. One of them explains: *“I have spent ten years in industry and understand the need for what I research”* (R). For another, their experience in practice has helped to come to better methods and tools: *“As a design professional, I was unhappy about some of the results and impacts of my designs. I felt a need for better methods and tools”* (R). Other researchers, without this experience, do not report on whether they understand practice needs.

Many respondents stress that joint work is necessary: *“It is less about bringing results from research to practice, but more about involving practitioners in research for the benefit of both their practice and my research”* (R). This requires funding: *“research partnerships can allow industry to allocate staff time to projects”* (R). The other way around, design professionals invite researchers to join practice: *“Come work with us”* (D).

Merely inviting design professionals in the project is not enough, they need to be involved in a steering role: *“start with senior designers, and involve them in planning and goal-setting”* (R). The involvement should have consequences for the direction for the research and *“provide direction for your research and the outputs you can produce”* (R/D). Some respondents even suggest the formation of new, in-between practices between research and practice: *“It would be great if there is a better process for researchers to become practitioners when they want. There are lots of great ideas in research but they, unfortunately, stay on paper. A forum where researchers are linked to design practitioners might be useful”* (D).

One of the design professionals indicates that design professionals, by being involved in research projects, can fulfil a brokering role: *“I think engaging as a professional, and producing meaningful results that can be communicated, is more likely to influence other*

professionals than an academic trying to influence professionals” (D). Another explains how “involvement of professionals in research projects brings a real-world element to the project. It helps ensure that the research is grounded. Outcomes are more likely to be of value to, and adopted by, design professionals” (R/D).

In short: the active collaboration between researchers and design professionals is necessary, and this involvement should have consequences for the direction of the research. When they are involved in such a way, they also take a *boundary broker* role.

7.6 GENERAL DISCUSSION AND CONCLUSION

This chapter studied how design professionals learn from research projects in which they did not participate. Taking a boundary crossing perspective, drawing on Akkerman & Bakker (2011), the study shows that these professionals draw on more than knowledge products (zone 3) to learn. They also draw much on in-person exchange (zone 2). Table 7.2 pulls the findings together about the learning opportunities related to three designable elements of learning situations: in-person exchanges, actions by boundary brokers, and boundary objects. Related learning opportunities are found for all four learning mechanisms. In answer to the main research question, *how do design professionals learn from research projects in which they did not participate themselves?*, we draw three main conclusions.

1. The boundary needs to be acknowledged and explored

The study illustrates that the boundary between research projects and design practice offers a learning potential, but that this potential is not unlocked without *identification* efforts. The study further confirms that both sides – research as well as practice – need to become aware of the other’s world and willing to understand each other. The insight from study 5, that researchers do not always consider design professionals as a separate audience with different needs, is an example of a lack of identification from the researcher’s side. Without such identification, the boundary crossing and thus the learning will be limited. This study adds that design professionals, on their part, also need more awareness of what research projects have to offer, if only in availability of opportunities and resources to really dive into topics.

2. Two reflective processes require multifaceted support

This study distinguishes two different groups of *reflective* interactions by design professionals. We found that they 1) perform a quick scan to recognize the value of this

research for their practice, and 2) dive in more deeply to really understand. The first process can be seen as *perspective making*, in which the professionals further develop their own understanding of a particular problem, and the second as *perspective taking* in which they develop a new perspective in light of the research. These two processes require different support to which in-person exchanges, boundary brokers, and boundary objects can all contribute.

We found that some knowledge products are better suited to support the quick scan and others to support the deep dive. This seems connected to the differences in knowledge functions. Various studies (e.g., Rogers, 2004; Stolterman, 2021; Van Turnhout et al., 2019) argue that design professionals need more than prescriptive knowledge, such as evaluative and even generative and inspiring knowledge. The interviews in study 4 confirmed that design professionals can use this whole range, but also noted that knowledge which is intended as prescriptive can function in a generative and inspiring way. The current study adds that especially the latter category of generative and inspiring knowledge is needed to support the quick scan and to *make perspective*.

More importantly, this study shows that both the quick scan and the deep dive can be supported by the interaction with other people and require more than the support with knowledge products. The study implies that these in-person interactions also fulfil different functions: some are generative and inspiring (e.g., in workshops) and others are informative by being prescriptive, evaluative, or explanatory (e.g., in training). We propose that future studies could be directed at the differences.

Three designable elements of learning situations

In-person exchanges

Events in which design professionals interact in-person with academic researchers to connect to research findings (zone 2, this thesis)



Actions by boundary brokers

Actions by individuals who bridge the evidence and practice divide (Sin, 2008), by being active in research as well as design practice.



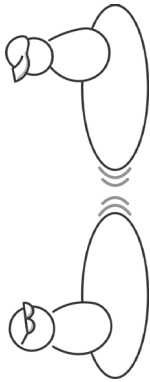
Boundary objects

Knowledge products which inhabit both research and design practice and satisfy the informational requirements of both (Star, 1989)

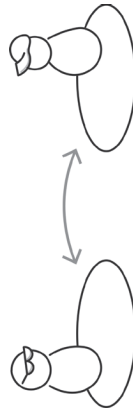


Learning mechanisms

Identification of what goes on at either side of the boundary



Coordination of the exchange of research results with practice



Meetings between design professionals and researchers (meet-ups, platforms)

Introducing design professionals and researchers to each other

Knowledge products such as blogs which bring awareness for research in the context of design practice

Platforms and events which refer to and share output (online platforms, meet-ups, conferences)

Supporting the hand-over of research outcomes to design practice by using the right words

Interactive, easy-to-apply knowledge products such as prototypes, tools, and models

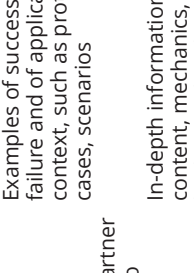
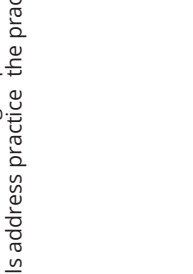
<p>Reflection on research and practice in light of each other, to expand future design practices</p> 	<p>Short and direct interactions within workshops or informal meetings</p> <p>Functioning as sparring partner for design professionals to support their reflection</p>	<p>Examples of success and failure and of application context, such as prototypes, cases, scenarios</p> <p>In-depth information about content, mechanics, and background such as case descriptions or books</p>
<p>Transformation of both research and practice, by joint work at the boundary</p> 	<p>Extensive interactions in consulting, training, or workshops</p> <p>Collaborative projects in which researchers and design professionals address practice needs</p>	<p>Knowledge products which are the result of joint work and can be used in both research and practice</p>

Table 7.2: The identified learning opportunities for design professionals through indirect learning by boundary crossing (building on the mechanisms by Akkerman and Bakker, 2011), for three designable elements of learning situations: in-person interactions, boundary brokers, and boundary objects.

3. There are multiple brokering roles

In line with the findings by Akkerman and Bakker (2011), the study shows that the role of *boundary brokers* can be more than *coordinating efforts*, in which design professionals who took part in the research are used to find the right words to translate findings to practice. Our study shows that people who work both in research as in design practice can also support the other three boundary crossing processes (see table 7.2): by bringing researchers and design professionals in contact (identification), by exchanging with other design professionals to support their reflective process and relate to practice issues (reflection), and by co-steering the project and integrating practice needs into the research collaboration (transformation).

People who inhabit the worlds of academia as well as practice, such as the researcher-practitioners among the respondents, seem ideally suited to act as boundary brokers. Where the previous chapters already showed that inviting design professionals in the project is not enough to allow them to learn optimally, the current study adds that inviting them in the project is also not enough to let them fulfil these brokering roles. Sleeswijk Visser (2018) has pointed out a range of roles between theorizer on the one hand and designer on the other hand which combine design and research activities. Taking on such in-between roles seems a good position to act as boundary broker. The position of these boundary brokers should be further investigated in future studies. These studies could move beyond the *interpersonal* boundary crossing which was central in the current study. Following Akkerman and Bruining (2016), the four mechanisms could also be observed at an *intrapersonal* level for these brokers. For such brokers, boundaries can easily become blurred between their activities in research versus those in practice, which may require for instance more support for the *identification of* and *reflection on* these both sides.

Practical implications and limitations

We propose that project leaders, responsible for the results of their projects, can use the range of learning opportunities in table 7.2. to consider how the learning process by design professionals needs further support in their project. But, as Akkerman and Bakker note, the four learning mechanisms need not necessarily be addressed in each situation for successful boundary crossing. Therefore, we do not propose that each project should 'check all the boxes' of this table.

As limitation to this study, we note that it only includes a limited sample and builds on the responses to a relatively short questionnaire. Further studies could extend this work

more in-depth, for instance by conducting interviews. Another limitation is the focus on interpersonal learning which excludes both intrapersonal as well as organizational learning (Akkerman and Bruining, 2016). Future studies could also include these aspects.

Despite these limitations, we are confident that the distinguished learning opportunities are useful to make research projects more effective in their boundary efforts to contribute to the needs in design practice.



CHAPTER 8

It's not a gap. Mapping the boundary zones between a research project and design practice(s)

This chapter is based on: Zielhuis, M., Sleeswijk Visser, F., Andriessen, D., and Stappers, P. J. "It's not a gap. Mapping the boundary zones between a research project and design practice(s)" (under review as journal article, b)





8.1 INTRODUCTION

The previous chapters showed that a lens of 'learning by design professionals' is very helpful to discover the range of contributions from research projects to design practice. With this lens, we distinguished a range of learning opportunities, but also showed that these opportunities can easily go unnoticed and unsupported. In this chapter, we evaluate the key findings in a use context to find out whether they offer support. We address the situations in which lead researchers lack guidance – at the start and during a project – to oversee the learning opportunities and to identify actions to improve the learning structure. By translating the key insights from the previous chapters into tangible materials and by applying these materials, this study explores the way these insights are able to support lead researchers, guided by the following research question:

How can lead researchers identify concrete actions they can take within their projects to support learning by design professionals?

8.2 TOOL TO MAP RESEARCH-PRACTICE INTERACTIONS

In light of the insights from the previous chapters, we propose that when lead researchers aim to improve their contribution to design practice, they need to take timely and appropriate actions. We developed a tool to identify these actions by mapping out a project in terms of the interactions between research projects and design practice.

The tool is developed to be generative (Sanders, 2000) as a 'make toolkit' (Sanders and Stappers, 2012) to help researchers to quickly identify actions in their projects. Current tools to map research impact (e.g., contribution mapping by Kok and Schuit, 2012) are rather labour intensive and have an evaluative instead of a generative purpose. The underlying assumption of the tool in our study is that by eliciting the important ingredients and the relations between them, barriers and enablers can be identified as starting point for actions.

The envisioned use context for the tool is the beginning stages of a research collaboration as well as the further project stages when the project unfolds. For all three zones of involvement, supportive arrangements can be made in the early project phases, for instance by planning for explicit knowledge products for design practice (zone 3), organizing in-person activities such as workshops (zone 2), or involving design professionals in active roles (zone 1). However, research impact literature shows that many contributions to practice happen unplanned and along the way (Van Beest et al.,

2022, Kok and Schuit, 2012). Design research projects are particularly future oriented (e.g., Jonas, 2006) and emergent which makes them difficult to plan ahead. This means that not all interactions in these three zones can be planned or foreseen in advance and that researchers need to recognize and act on opportunities to create impact when they present themselves and to deal with barriers when they arise.

The previous chapters provide four main ingredients which can be used to map the relevant interactions. We map these in figure 8.1, which builds on the earlier presented figure 3.3. The first and perhaps most obvious (group of) ingredients of the model are *knowledge products*, which are central in what we indicated as zone 3 involvement. We concluded that viewing the contribution to design practice in terms of just knowledge products is rather limited, and that not all knowledge is shared in knowledge products. *Project actors* are the second ingredient because we aim to focus on personal learning. Also, chapters 6 as well as 7 showed that in-person interactions between people are very important for the learning by design professionals, and showed that boundary brokers can play a relevant role. This means that not only learners but also other enabling individuals in the learning process need to be mapped. What distinguishes zone 1 from zone 2 is that the actively involved professionals take one or more *project roles*, which form the third ingredient because of the learning opportunities these different roles can provide (interview study 6). The fourth ingredient is formed by the different *communities* which meet in design research projects. The literature review argued that the space between research and practice needs to be viewed as a boundary zone instead of a gap. Building on Dalsgaard et al. (2014), the different *communities* which meet are depicted in figure 8.1 as ellipses which overlap and create boundary zones. When the model is applied to the reality of a specific project, design practice can be depicted by multiple ellipses in more or less proximity to the project. Because we found that these other communities (such as academia) are often considered as more important audiences in design research projects, we include these other practices in our model.

This simple set of four main ingredients forms the underlying model on which we based the tool. In reality, this development did not proceed in such a linear way. The development of the tool actually went hand in hand with the further development of the underlying model.

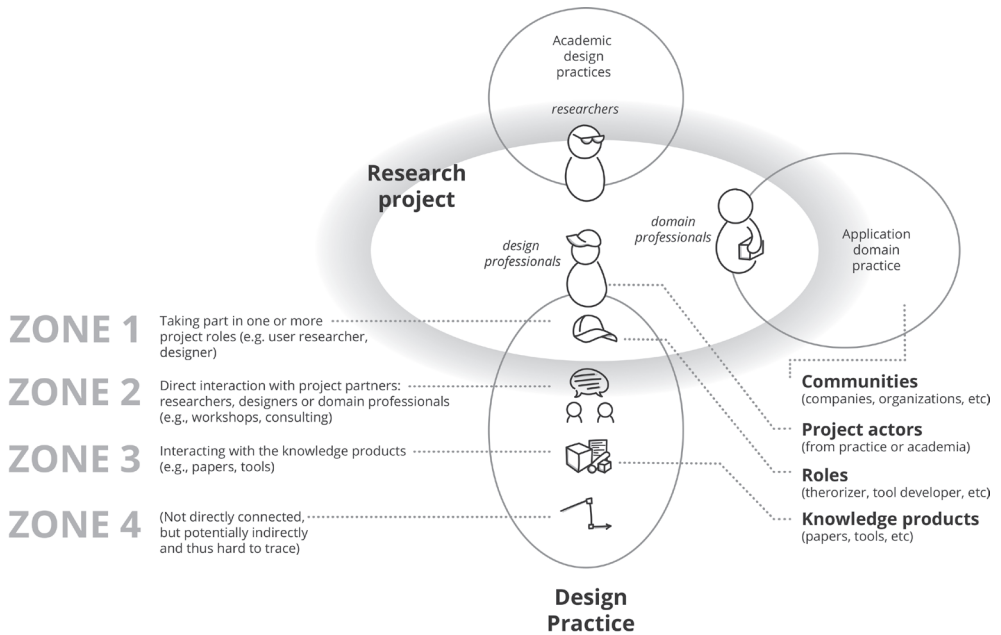


Figure 8.1: Four main ingredients on the zones of involvement between research projects and design practice(s) and their four main ingredients: knowledge products, project actors, roles, and communities (building on the three boundary zones and Dalsgaard et al., 2014).

The tool was developed in two iterations. The first iteration consisted of online materials. These were developed within one of our own projects in the early project phases of shaping project conditions. Figure 8.2 shows how a draft project plan was presented in terms of the proposed knowledge products, the involved project actors, their roles, and the 'meeting communities'. The latter was addressed by indicating a cross-cutting structure for the project for knowledge exchange between partners: a learning community. Table 8.1 gives an overview of the relation with the four ingredients. The underlying idea is that by providing an overview of the relevant ingredients, these materials would help to identify ways in which the future project could better contribute to design practice. The participants could move the elements and annotate them by placing post-it notes or drawing in the visual (examples in figure 8.2).

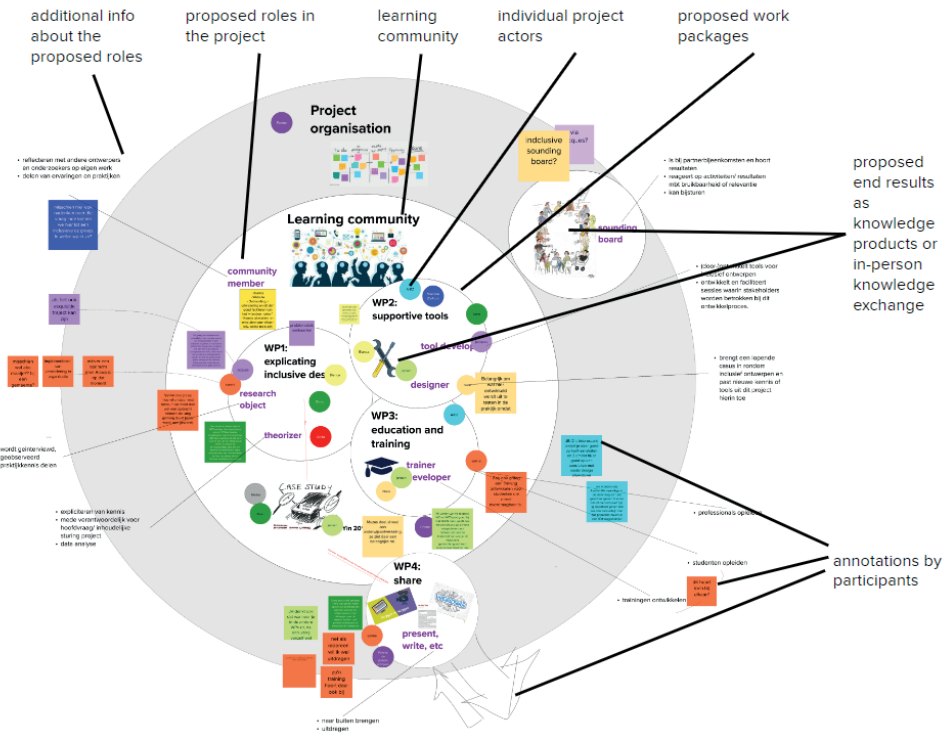


Figure 8.2: Visual mapping of a future design research project and its contribution(s) to design practice.

The second iteration was a tangible tool for in-person use. This tool was developed for use in the context of ongoing or finished projects, to retrospectively map the contributions to design practice. We therefore developed a flexible set with which participants could map very diverse projects (figure 8.3). Figure 8.4 shows the materials, which are linked in table 8.1 voor the four ingredients of the model. All materials (manikins, post its, cards) offered the opportunity to write or draw on them. This second iteration further built on the insight from the first that the different communities need to be distinguished better. Furthermore, the tool developed more diverse materials to represent the four ingredients, for instance by adding stickers to indicate which project actors are most motivated to contribute to design practice.



Figure 8.3: Use of the toolkit in the workshop.

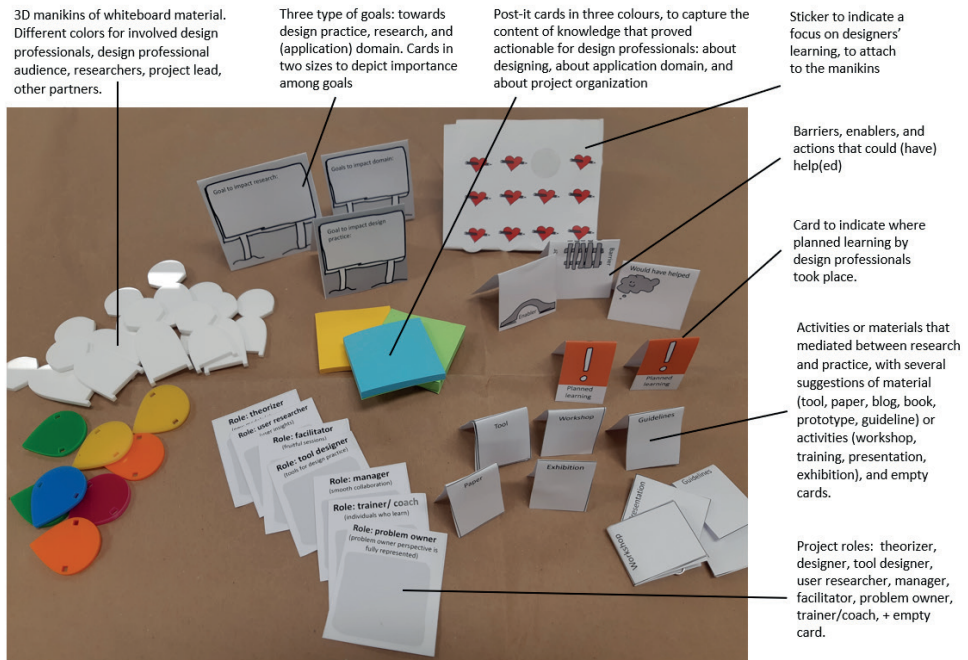


Figure 8.4: Toolkit to map an (ongoing or finished) design research project and its contribution(s) to design practice.

8.3 METHOD

Cases

We included research projects in which the lead researchers aimed to improve the contributions by their projects to design practice (in zone 2 and/or 3) and in which design professionals took an active part (zone 1). Table 8.1 describes the two different case contexts. Although the materials were aimed for use in multiple design domains, the cases in this study were cases of participatory or co-design.

The first case was a project about inclusive design in the grant-writing stage. The proposed consortium included various design agencies with ample experience in collaborating in research projects. The tools were used in a meeting between the researchers and design practice partners ('Partner Meeting' in table 8.1) to discuss the draft project plan and the involvement of the design professionals. The first author was one of the researchers in this project and facilitated the meeting. After the facilitator presented the draft plan using the visual overview in figure 2, the participants parted in three break-out groups to discuss their involvement, place themselves – as dots – in the visual, and note their comments. In a plenary round-up, each participant shared their view and motivations on the work package(s) and role(s) in which they want to be involved.

Characteristics of cases 1: Project preparation meeting (online)		2: Conference workshop (in-person)	
Goal	- Preparation of project proposal (future oriented)	- Reflect on opportunities for practical impact (retrospective)	
Participants	- 4 researchers + 7 design professionals (project team)	- 12 researchers	
Case project(s)	A research collaboration in preparation:		
	- Two-year project	- Funded multi-year projects, led by universities	
	- Funding for UAD to support SME	- Co-design/ participatory design	
	- Inclusive design	- Practice partners in application context and design practice partners	
	- Design practice partners	- Societal impact goals (e.g. inclusion, better healthcare)	
	- Primary audience: creative SME	- Goals to contribute to design practice	
Tool	- Visual overview of work packages, project actors, and role(s): figure 2	- Tangible toolkit to map a project and its contribution(s) to design practice: figure 4.	
Project actors	- Individual researchers and design professionals represented in the visual.	- 3D manikins in several colours to distinguish the involved researchers, design professionals, and other partners.	
	- Proposed results of a work package are visualized as in-person interaction (training)	- Cards to indicate where learning by design professionals was explicitly the goal.	
		- Post-it notes to capture the topics with which design professionals were helped.	
		- Stickers to mark individuals with a personal drive to contribute to design practice.	
		- A range of cards for in-person exchanges such as workshops or presentation.	
Roles	- Pre-described roles (based on the roles by Sleeswijk Visser, 2018), placed within each work package: theorizer, designer, tool designer, user researcher, trainer.	- Pre-printed (based on the roles by Sleeswijk Visser, 2018) as well as empty role cards: theorizer, designer, tool designer, user researcher, manager, facilitator, problem owner, trainer/ coach.	
Knowledge products	- Proposed results of two work packages are visualized as knowledge products: academic publications, tools for design practice.	- Cards to indicate tools, papers, prototypes etc.	
Meeting communities	- Learning community is depicted as a cross-cutting structure in the project	- The participants draw circles to indicate design communities or organizations within the application context of the project (see figure 3 or 6).	
		- Open goals cards for three different communities: the application domain, design academics, and design practice.	

Table 8.1: Characteristics of the two case contexts and the two tools.



The second case was a workshop at an international design research conference ('Conference Workshop'), facilitated by two of the authors, about the contribution of research projects to design practice. The workshop hosted 12 researchers with different nationalities as participants, two of them with experience in industry. The participants were invited to bring in their current projects, so we could work with projects in which the responsible researchers could still take action to readjust. Upon registration, the participants were asked to shortly reflect on their project in terms of the involvement of design professionals and the aims (and results) in impacting a design practice audience. This attracted participants with an interest in and experience with contributing to design practice and made sure they brought projects in which they already worked with design professionals. The half-day workshop started with a presentation of the difficulties and opportunities in such projects to contribute to design practice, and a demonstration of the table-top toolkit (figure 8.4) with an example project. In three four-person groups, the participants mapped one of their projects using the toolkit to identify barriers and enablers and relevant measures that could be taken for improvement.

To be able to study the use of the tool without the explicit facilitation of us as its maker, each case included breakout sessions which were not led by us and which allowed the participants to use the materials in their own way.

Data collection and analysis

Data collection on the first case (Project Meeting) consisted of recording the central session and the three break-out sessions, taking field notes, and asking researchers (N=2) and design practitioners (N=3) several questions. We asked them if and how the session provided them with any new perspective about their own or other partner's interests, and about any consequences for their own or other's practical involvement. We also asked whether the session led to any other outcomes and whether they would like to see any elements from this process in future grant writing processes. Data collection on the second case (Conference Workshop) consisted of recording the three plenary presentations of the groups and collecting the materials produced during the workshop. Furthermore, we conducted a member check on the findings with the three participants who brought in their case. The recordings were transcribed.

The model and its ingredients were used in both cases on the one hand to develop tools for researchers to make sense of their project, and on the other hand to analyse how this worked out, resulting in the overviews of figure 8.5 (case 1) and 6 (case 2).

8.4 RESULTS AND DISCUSSION

The observations on the application of the model and the identified actions within each case are organized along the four ingredients and illustrated by quotes by the participating researchers (indicated as R), and by design professionals (D) within each case. First, we address the overview which was created with the tools and how this helped the participants to identify barriers, enablers, and corresponding actions.

Identifying actions by creating overview

In case 1, several design professionals noted that the presented visualization was very helpful, because *“you unravelled things, which made it more accessible for us to consider them as a whole. The visual aspect helps me enormously (D)”*. The proposal of work packages and roles functioned as a starting point to which the participants could build and add: *“it was not fully crystallized, so they [the practitioners] could add their own touch. But it was concrete enough to be able to see what they could contribute (R)”*. Several actions were identified to make the project arrangements more worthwhile for the partaking design professionals (zone 1) as well as those beyond the project (zones 2 and 3). While planning ahead, the participants only indicated one barrier but several enablers. These are indicated in figure 8.5 and further discussed in the sections for each ingredient.

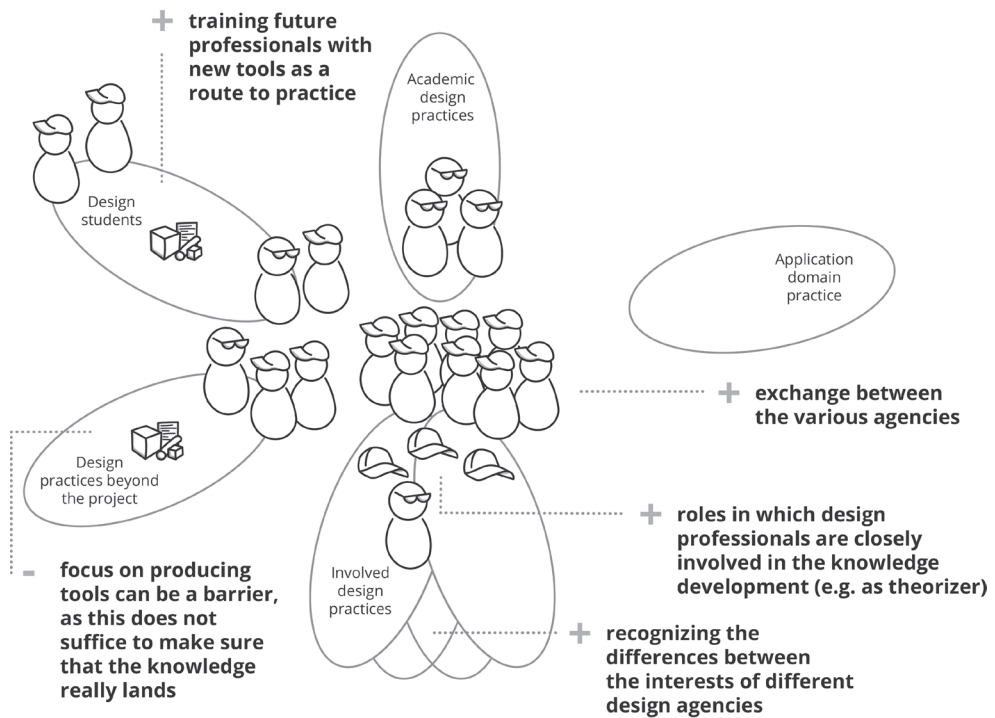


Figure 8.5: A barrier (indicated with a minus -) and various enablers (plus +) in case 1, mapped on the model.

In case 2, the workshop participants who brought in a case gained a better view on the contribution of their project to design practice and on the relevant barriers and enablers: *“This exercise was really helpful to show us the different stakeholders and their roles, and the different barriers that we have (R).”* The facilitated exchange was seen as helpful to identify actions to improve the contribution to design practice: *“the team today have been very helpful in enabling the kind of conversations necessary for the project”*. The two researchers who brought in ongoing projects formulated concrete actions, such as involving more design organizations into the project. Some of the identified barriers had not even been considered as such prior to the workshop. The three groups made different choices in the materials they used. Every group personalized the figures, by adding initials or faces, and added extra features. For instance, one group added flags to label some barriers as more important than others. Figure 8.6 maps the main identified barriers and enablers from the three projects on the model. These are further explained in relation to the four ingredients.

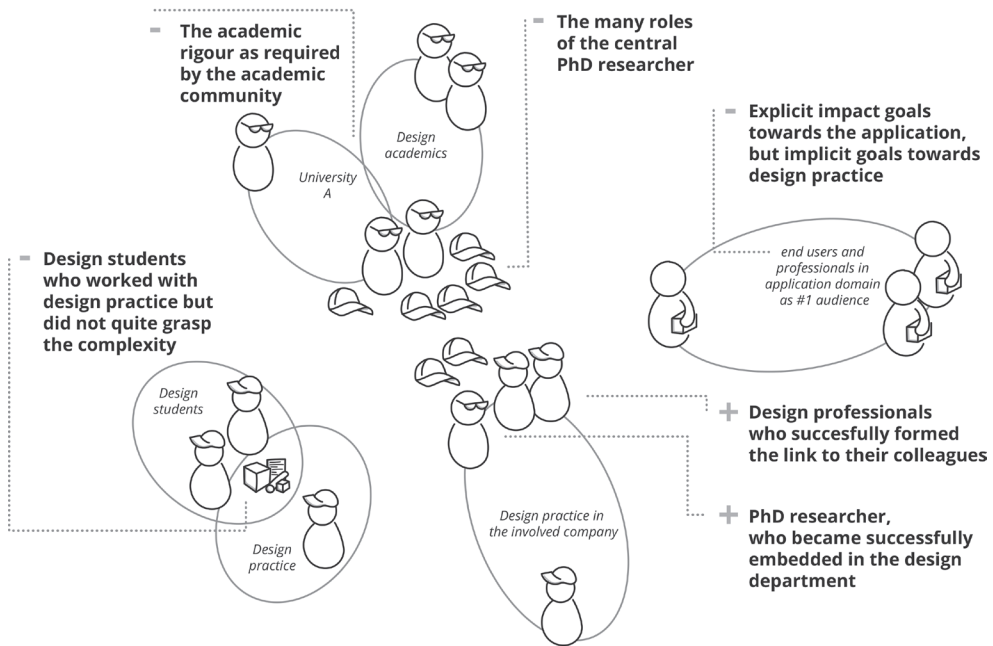


Figure 8.6: The identified main barriers (indicated with a minus -) and enablers (plus +) from the three projects in case 2, mapped on the model.

Knowledge products

In case 1, knowledge products for practice were discussed in light of the proposed work package which would develop practical tools for inclusive design. Although the participants did not question this as part of the project aims, and several even wanted to be involved in this development (see 'project actors' and 'roles'), the eventual use of tools within design practice was put in perspective: *"In research projects, people work very hard to finally squeeze out an end product which just lies there. How can we make sure that this knowledge really lands?"* (D). Several design professionals rather emphasized the importance of in-person ways to share knowledge such as the learning community (see 'meeting communities') and training (see 'project actors').

In case 2, the cards to indicate knowledge products were not much used in the mapping. The participants mentioned and placed several knowledge products, such as guidelines and papers, to explain the project, but they did not relate these to the barriers and enablers. They predominantly used the other toolkit elements which revolved around people and in-person exchanges such as workshops and training.

Project actors

In case 1, the needs and interests of the involved design professionals became more clear. These varied within a single agency: *“My colleague has different interests than I do. Personally, I would like to try out tools, but my colleague is more interested in developing theory (D)”*. The proposed work packages about training and the professionals learning community triggered many responses. The design professionals see training of future professionals as one of the routes to practice, as well the knowledge sharing among professionals.

In case 2, the toolkit elements stimulated the participants to position concrete persons, point at them, and connect them to the various tangible elements that represented design practice, such as the stickers to mark a personal motivation (figure 8.7). Although the participating researchers already worked closely with design professionals, explicitly placing them on the table helped one of them to realize that their project team did not actually check back on the design professionals in how the project was useful for them: *“This is a wonderful way of reflecting on what happened. For me it became clear that we haven’t checked back. We were quite sure that the design practitioners learned something, but we didn’t check (R)”*.



Figure 8.7: Personal motivation to support design practice ('heart & pencil' sticker).



Figure 8.8: Individual who overcame barriers and connected to design practice.

Several barriers and enablers in the boundary zones with design practice were related to the expertise of specific project actors. For instance, one project showed that using students as bridge to practice can pose difficulties, as they may not capture the complexity of the content. One of the researchers explained: *"We tried to spread the tool through students, but the students didn't have enough experience with the complexity that they were actually working with."* There were also successful examples of individuals as a bridge to practice. For instance, a participant identified a PhD researcher, who *"actually became quite embedded [in the design department], to help get buy-in from the rest of the team (R)"* (figure 8.8). In the same case, the participants also identified two design professionals who successfully connected to their colleagues: *"They initiated a workshop with the entire development department, introducing the theories, using a case study (R)"*.

Roles

In case 1, concretely discussing the roles and corresponding activities helped the design professionals to not only articulate their needs, but also the ways in which they could help to address these: *"By letting the designers talk about the way they wanted to contribute, it also became more clear what they wanted to get out of it (R)"*. It became clear that they wanted to be more closely involved in the early knowledge development process: *"It gets much more interesting for us when we can really work on the content of a tool or method, and not just be a guinea pig by applying it. The knowledge that we gain is often more relevant to us than actually applying this specific tool (D)"*. Several roles were identified in which the professionals could be productively involved in the knowledge production. For some, this was in a role of tool developer of practical tools for inclusive design: *"Developing knowledge is in our agency very much in a 'doing' mode. In tool development, you are forced to put knowledge into manageable things" (D)*.

In case 2, distinguishing the various roles by project actors helped to identify barriers or enablers. These were not only related to the project roles by the design professionals. One of the groups noted that the PhD student combined many roles (figure 8.9) in the project, being the primary researcher as well as the designer in this project: *"I have to manage my own project, design the concept, make the theory. I also do the experiments, come up with the insights, and collaborate with other scientists (D/R)"*. With a background of working in design practice, bringing knowledge to design practice was an obvious goal for her. However, dedicating time and effort to this was difficult, given these many roles. This was especially difficult as the stated impact goals towards design practice were quite implicit.



Figure 8.9: The many roles of the central PhD researcher.

Meeting communities

In case 1, the structure of a learning community was proposed for exchange between partners, both during and after the project. The design professionals expressed that they indeed wanted to learn from the other agencies, because *“there is already so much (D)”* in practice. *“It is very interesting to hear how other companies approach this. Hearing their reflections and arguments, you reflect more intensively on your own views (D).”* One of the conclusions was that the exchange between design professionals in this community needed to get an even more prominent position in the proposal. The researchers better realized that this project would be a joint effort in which research and practice interest meet and in which mutual exchange is vital. A researcher noted afterwards that the project started to feel more like *“we are going to do this together”*, rather than *“we do this for them”* (R). The envisioned learning community did not only aim to engage the current partners, but also the communities beyond. Several professionals described how they could take an active role to connect communities beyond the project, and how this would even connect education and practice: *“we host a community in which we also invite the education institutions, to bridge the gap between what is taught at universities and what happens in practice”* (D). However, this was only addressed shortly. We concluded that mapping the different communities more explicitly would help.

The set-up of case 2 supported the mapping of different communities more prominently. Following the example which the facilitator set, the participants drew the meeting communities as circles in different arrangements using a variety in overlap or distance. For example, figure 8.10 shows the mapping of one of the projects. The created overview helped the participants to position the other ingredients and to identify barriers and

enablers with the corresponding cards. Figure 8.6 shows that these cards are not only placed within the boundary zones with design practice. For instance, one of the identified barriers is the pressure in academia to hold to academic standards: *"It is a PhD project, so it needs academic rigor (R)"*.

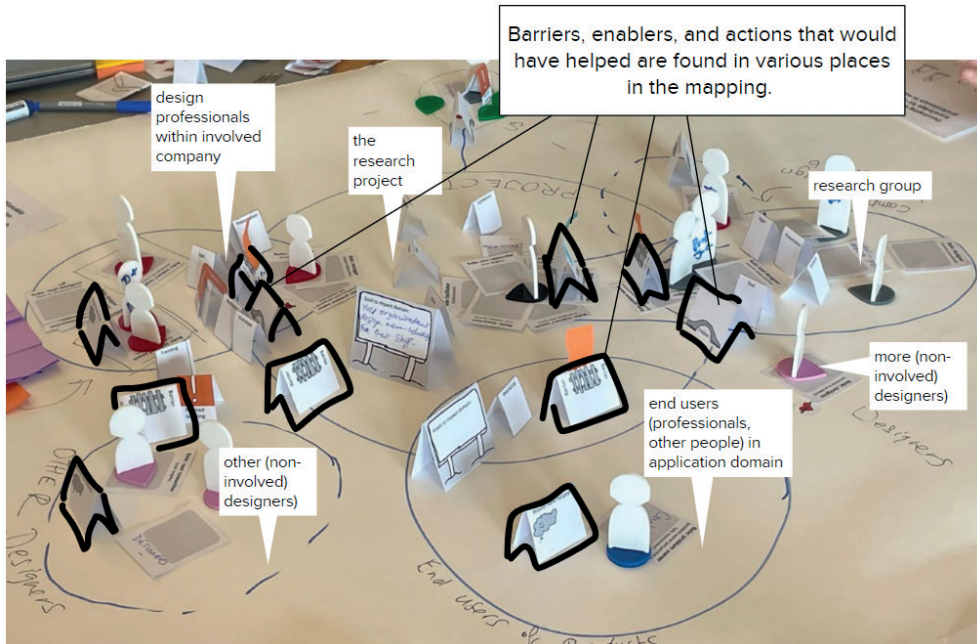


Figure 8.10: An overview of the mapping result in one of the cases, which shows the various communities and the barriers, enablers, and actions in various places in this mapping.

8.5 GENERAL DISCUSSION AND CONCLUSION

This study evaluated the key insights from the previous studies in a use context, by translating them into materials and exploring how lead researchers can identify actions to support that design professionals learn from their projects.

Building on Beck and Ekbia (2018) and Dalsgaard et al. (2014), the previous studies left the frame of a *gap* and instead distinguished the different *boundary zones* between a project and design practice(s). Based on the key ingredients provided by the previous studies, we proposed a model (figure 1) to position the relevant communities, people, roles, and knowledge products in relation to these zones. The two cases show a successful application of the model in four different research projects which represent two use cases by project leaders: a project preparation meeting (one project) and an evaluation

with peers as the project unfolds (three projects). The materials helped the participants to identify and express insights about actions for their projects. Whether these insights would lead to different actions is beyond the scope of this study.

In light of the observed use of the tool, we can draw conclusion about the applicability of the model – and thus the key findings in this dissertation – in these practice settings. We found that especially the toolkit items which represent people and their interactions, mapped in relation to the various communities, are important to identify actions for improvement. This is in line with the insight from the previous studies 6 and 7 that in-person exchanges and brokering individuals are important for the learning by design professionals. We conclude that the key insights from the previous studies, as introduced in the toolkit, are helpful in these use contexts. The current study emphasizes that especially the relations between the different ingredients are used to identify actions. We conclude that the metaphor of *zones* is more helpful to elicits the web of interactions in which knowledge is shared, than the metaphor of the *gap* comes with a rather narrow focus on knowledge products which should be got across.

The use of the tool in this study served a dual purpose. It helped to evaluate and explore the key findings in a practice setting, while at the same time helping the lead researchers who used the tool to quickly gain insight in contributions which happen unplanned and along the way. For these researchers, the tool served a generative purpose (Sanders and Stappers, 2012), aimed at identifying important actions. Current mapping tools in the field of Research Impact, such as the Contribution Mapping tool by Kok and Schuit (2012) are more labour-intensive in comparison to this tool. Unlike these tools, our tool helps researchers without providing a thorough and complete overview.

Practical implications and limitations

We propose that lead researchers use the proposed model in figure 1 to map their projects and identify actions to support learning by design professionals. The materials as developed in this study, particularly in the second iteration, provide practical examples of how the model can be applied. We do not argue that all design research projects necessarily need to impact design practice, but we do suggest that those projects that have this ambition use this or a similar generative tool.

A limitation of the study is that it does not report on use of the materials by others than the makers. Although we organized the use in these cases in such a manner that this was

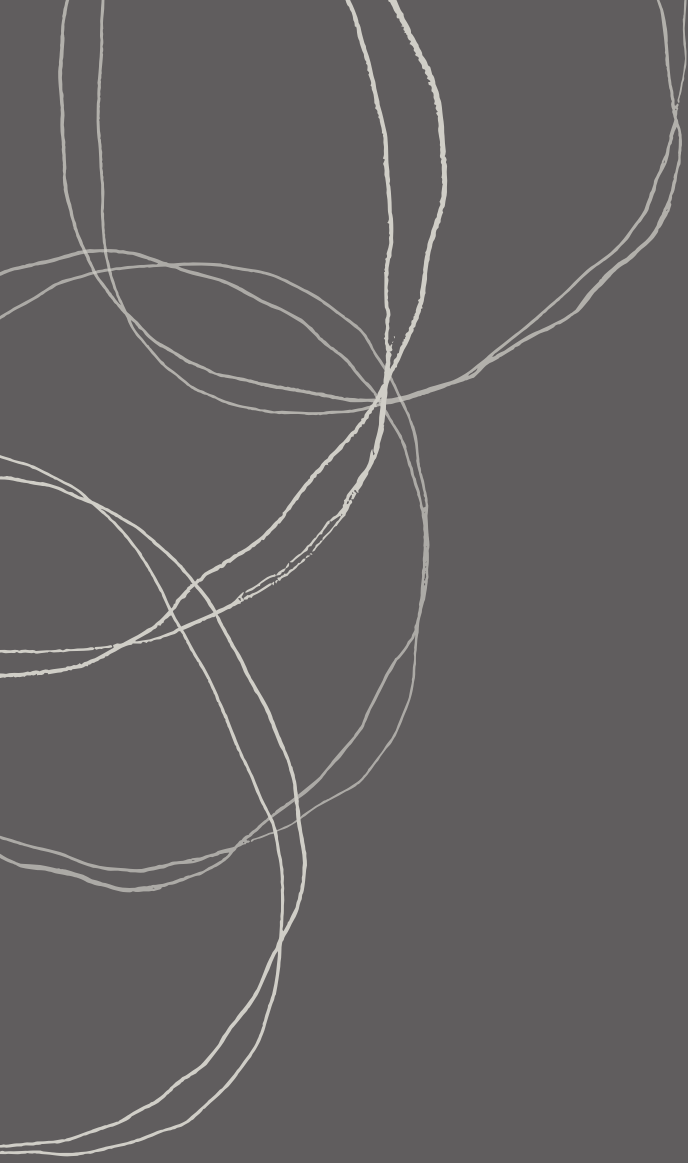
not directly led or influenced by ourselves in the break-outs, the use by participants is likely still influenced by the way we introduced the materials and organized the sessions.

Furthermore, a limitation of the model, and thus of the described tool and its envisioned use, is that it is not developed to map the boundary zones which are outside the scope of researchers. For instance, the way a method is picked up at a conference and further used or developed within companies is not addressed within this approach. Although interactions within this extra boundary zone will also be a combination of inter-personal exchanges and interactions with knowledge products, they take place outside the view of researchers. More input from different perspectives will be needed to map these interactions. What is more, the model builds on insights about individual learning and inter-personal interactions and does not include organizational learning. The earlier described mapping methods by for instance Kok and Schuit (2012) may be more appropriate for this purpose, or the overview provided by Chakrabarti and Lindemann (2016) of various interactions between research and industry.

Another limitation to this study is that the mapped projects all concern co-design. Although the identified barriers and enablers in these projects may reflect this field, we propose that the findings about the underlying model and application materials are not dependant on co-design. Even so, further studies could extend this work to other areas of design.

Finally, this study only explored the model and related tool in two specific use contexts: a project preparation meeting and a conference workshop with peer researchers. We cannot draw conclusions about other use contexts but we can imagine other contexts in which the underlying insights and the model are helpful, such as in the dynamics between a project and a funding organization (e.g. in proposals, monitoring, or evaluation).

Within the above limitations, we are confident that the proposed model can offer help to lead researchers to identify actions in their projects to support learning by design professionals.



CHAPTER 9

Discussion and conclusion



9.1 OVERVIEW OF MAIN FINDINGS

Findings from design research projects do not always effectively feed into design practice. To investigate this problem, this thesis studies externally funded collaborative design research projects which address societal issues and also aim to impact design practice. The general aim of this thesis is to provide insights and practical guidance for projects that have the ambition to strengthen design professionals in their work. The studied phenomenon is the learning by design professionals from collaborative design research projects, led by the main research question:

How can design research collaborations provide knowledge that design professionals will use in practice?

This chapter summarizes the main findings on the five sub-questions and draws these together in general conclusions on the main question.

RQ1: How are design research collaborations of use for the work of design professionals?

For the work of design professionals, not only design methods or techniques are useful. Based on the interview study 4, which investigates which knowledge from research collaborations was used by designers in their practice, we distinguish three categories of useful knowledge:

1. about designing: designerly approaches, methods, mindset and skills,
2. about the application domain: problem context and background, and
3. about project organization: ways to manage the design process and the meta-process around it.

Study 6, which retrospectively studies four design research projects in detail, shows that all four involved designers report at least two of the three categories. Study 7, which consisted of a survey, confirms these categories among a wider and more international group.

This shows that research projects have more to offer for design professionals than the findings on the primary topic of a study. For instance, a design professional can learn from the facilitation methods and techniques which are used in a research collaboration, while the core knowledge object of this project is the improvement of informal care pathways within a hospital.

Studies 4 and 6 also show that not all the learning outcomes by design professionals from research projects are explicated and articulated. When we look at the range of the learning outcomes, we see that 1) some remain unrecognized by the design professionals themselves and implicit until asked about, 2) some are recognized, but cannot be articulated and remain implicit or tacit, and 3) some are recognized as well as clearly articulated. Together, these span the broad range of *actionable knowledge* as described by Markauskaite & Goodyear (2017). What is more, not all of what these design professionals learn is necessarily *new* to them: some outcomes are an articulation or strengthening of what they already know or can. Especially when they are actively involved in a research collaboration, as in the four projects in study 6, design professionals can deepen their expertise (e.g., in facilitating) or extend their network (e.g. in the health sector).

RQ 2: What are the barriers and enablers for design research collaborations to be of use in the work of design professionals?

The main identified problems are that design professionals are under-prioritized as audience and not regarded as potential learners. As a result, their learning process remains unsupported. For both problems, we identify barriers as well as enablers.

The multi-case study 5 shows that design practice is not addressed as an important audience in collaborative research projects, where different worlds meet and bring their own agendas. Other audiences, such as domain professionals or the academic design field, are prioritized over design professionals. Project leaders under-prioritize design practice as audience, because serving design practice is often not supported by their institution or by the funding agencies. Study 8 shows that some barriers are beyond the influence of project leaders, such as knowledge institutions who reward academic outcome higher than societal impact. We also identify related enablers, such as a project leader who prioritizes design professionals or funding parties who include them in their requirements.

Study 5 also indicates three problems which together show how design professionals are not regarded as learners. The first of these problems is that researchers do not recognize that learning by design professionals can take place in different zones of involvement with research projects. This research distinguished three zones:

1. taking active part in the research,
2. contact with project actors (either researchers, design professionals, other domain application professionals),
3. engaging with knowledge products.

Although the involved design professionals can learn the most in the active zone 1, they are often not really seen as learners in the project. The literature review and the empirical data show that researchers predominantly focus on knowledge products as a way to transfer knowledge, and thus on zone 3. The multi-case study 5 adds that even this zone 3 is often only addressed at the project end. In this research, however, we find that attention to all three zones of involvement is required throughout the project.

Second, researchers can fail to recognize that the needs of design professionals are different than their own needs. Although design researchers also conduct designing activities in their projects, the context of professional practice with clients and limited timeframes is very different from theirs. The survey study 7 explains this as a boundary crossing problem in which there is a lack of *identification* of the different needs and interests on either side of the boundary (Akkerman and Bakker, 2011).

The third related problem is that researchers lack insight in the learning processes that takes place within the three zones and lack insight in what kind of support this learning requires. The interview study 6 and survey study 7 further investigate these learning processes and identify relevant enablers in answer to the respective research questions 3 and 4.

RQ 3: How do design professionals learn when they participate in a design research collaboration?

Learning by research participants goes easily unnoticed, even by the learners themselves. The multi-case study 5 shows that actively involved design professionals in zone 1 do not see themselves as beneficiaries of the research. They are primarily focused on contributing to the project. This means that it is not just researchers who have little eye for what the professionals learn in the process, but also these professionals themselves. By investigating four successful learning trajectories by participating design professionals, study 6 provides more insight into the learning which takes place, albeit somewhat under the radar.

The first characteristic of these learning trajectories is that, typical for non-formal learning (Eraut, 2000), the design professionals do not always recognize their own learning when it takes place. We suspect that design professionals – more than other professionals – are particularly focused on facilitating and serving a process. This might make it especially hard for them to address their own needs. The design professionals also do not necessarily recognize a better articulation or strengthening of their existing

knowledge and expertise as a lesson learned. The overview of the range of actionable knowledge for design professionals, as provided in answer to RQ1 can be a useful handle in this. For instance, it can be used as conversation starter between project partners.

The second and most important characteristic of the learning trajectories is how they rely on explicit reflective activities. These are necessary to help the design professionals articulate their learning outcomes and make the link to their practice. The current reflective structure in research projects is geared towards the topic of study, while the results on RQ1 show that design professionals also need reflection on other topics. Exchanges with fellow project partners – especially peer design professionals – can support this reflection and help the professionals relate the project findings to their own practice. Design professionals do not so much learn *from* others, but in interaction *with* others, as described by Vygotsky (1978) and Griffith and Guile (2003). The interaction with artefacts – be it conceptual, digital, or physical – also supports this explicit reflection. When the designers reflect on and improve tools or other artefacts during the project, these artefacts function as boundary objects in their learning process (Star, 1989). Especially the role of tool developer provides many learning opportunities, as this involves the translation of insights to practice tools and back again.

The third characteristic of the learning trajectories is that learning takes place in roles which inform one another and develop throughout the project, rather than in an isolated role. The professionals can learn as designer, for instance while developing a testable prototype or trying out new methods. But they also learn as theory developer or tool developer, and even in more practical roles as manager or facilitator. Most importantly: they learn because these multiple roles inform each other, as indicated by Stappers and Sleeswijk Visser (2014).

RQ 4: How do design professionals learn from research projects in which they did not participate?

To learn from a project in which they did not participate, design professionals draw on more than knowledge products (zone 3). They also draw much on in-person exchanges (in zone 2), which do not gain as much attention yet by researchers as knowledge products do. The survey study 7 shows that zone 2 and zone 3 complement each other in the learning opportunities they offer. This study investigates three elements of learning situations: in-person exchanges, boundary brokers, and boundary objects. These elements are studied from a boundary crossing perspective (Engeström, 1987;

Wenger, 1998), particularly by using the four learning mechanisms by Akkerman and Bakker (2011): *identification*, *coordination*, *reflection*, and *transformation*. Three insights arise about the learning opportunities for design professionals.

The first insight is that to unlock the learning potential of the boundary, this boundary first needs to be acknowledged and explored. This requires efforts from both sides to become aware of the other's world and willing to understand each other. The lack of attention by researchers for the differences between academia and practice, as shown in the multi-case study 5, indicates that the boundary is often ignored.

The second insight is that design professionals go through two reflective processes with a different purpose. The first process is a *quick scan* for relevance of the research to their own practice and the second is a *deep dive* to provide more understanding. Both can be supported by knowledge products as well as in-person interactions. These in-person interactions need to be generative and inspiring for the quick scan (e.g., in workshops) and informative for the deep dive, by being prescriptive, explanatory, or evaluative (e.g., in training). We conclude that not only knowledge products fulfil different functions (e.g., Rogers, 2004; Van Turnhout et al., 2019), but that the same goes for in-person interactions. This study also adds some insights into the way prescriptive knowledge products (e.g., methods, tools) are used by design professionals. Previous research (Stolterman, 2008; 2021) has questioned the effectivity of prescriptive knowledge products and shown that flexible method usage leads to better results (Bender and Blessing, 2004; Fricke, 1999). The interview study 4 adds that knowledge which is intended as prescriptive can also function in a generative and inspiring way: design professionals may not use a tool as intended, but use it as inspiration or an example. This implies that researchers could pay more attention to the *generative* function of the tools and methods they offer.

The third insight is that design professionals can be boundary brokers in different ways when they take part in research projects. They can not only be used as a way to find the right words to translate to practice, which is mostly an effort of the *coordination* mechanism (Akkerman and Bakker, 2011). They can also be a broker by explaining to other professionals what research has to offer (for *identification*), exchange with them to support their reflective process and relate to practice issues (*reflection*), and collaborate in the integration of practice needs into the research (*transformation*). People who work both in design practice as well as in academia seem ideal brokers, but their broker positions could also come with difficulties when the differences between the two worlds are ignored or not recognized and the boundaries become blurred (see the first insight).

RQ5: How can project leaders identify concrete opportunities within their projects to support learning by design professionals?

Drawing together the results of the various studies, we identify four main ingredients of the learning process by design professionals. First of all, *knowledge products*, which are central in what we indicated as zone 3 involvement. But not all knowledge is shared in knowledge products. The previous overview of results shows that in-person interactions between people are very important for the learning by design professionals. Therefore, *project actors* are the second ingredient. *Project roles* form the third ingredient because of their learning opportunities for design professionals. The fourth ingredient is formed by the different *communities* which meet in design research projects.

Project leaders can use these four ingredients to map their projects, identify concrete opportunities to further support design professionals' learning, and take according actions. In the design study 8, the four ingredients were translated into a tool for project leaders. The study shows how in combination, these key ingredients enable lead researchers to quickly get an overview of the contribution to design practice and identify necessary actions for improvement. Relevant barriers and enablers can be identified in the relations between these ingredients.

The developed tool helps project leaders to provide a quick overview to identify important actions, using the principles of a make-toolkit (Sanders and Stappers, 2012). In this, it serves a generative purpose instead of the evaluative purpose of current research impact tools (e.g., Kok and Schuit, 2012). In light of our finding that design professionals tend to use offered tools as inspiration to make their own, we imagine that project leaders in the design field will similarly want to make their own tools. The tool as developed in this study provides a practical example for this.

9.2 GENERAL CONCLUSION

Drawing these insights together, we come to an answer to the main research question:

How can design research collaborations provide knowledge that design professionals will use in practice?

The research started from the notion that academic design research projects often fail to contribute to design practice. This is often described as the *research-practice gap*. In the interviews in this thesis with researchers and design professionals, a similar image

emerges at first. Researchers find it hard to reach design professionals and professionals note that research outcomes often do not fit their practice. However, this 'gap' frame tends to see knowledge production for practice as a rather linear process in which researchers send knowledge products to design practice over the 'gap' between these worlds.

This thesis takes a different approach by zooming in on the boundary places where these practices already meet. This provides insight in the otherwise unnoticed phenomenon of *learning* by design professionals in design research collaborations and it identifies opportunities for even more learning.

In answer to the main question, we conclude that collaborative design research projects can provide knowledge that design professionals will use in practice, when:

1. throughout the project, the project lead addresses design professionals as potential learners amidst the goals and agendas of the institutional and funding context of the project (e.g. by using the developed mapping tool).
2. the project lead considers the learning potential for design professionals in the three different boundary zones before deciding on actions in either of them. These zones are: 1) actively taking part, 2) interacting with people from the project, and 3) interacting with resulting knowledge products.
3. by the combined efforts in these zones, design professionals are supported in explicit reflections to integrate new findings into actionable knowledge for their practice.
4. design professionals are supported in three aspects of their work: 1) designing, but also 2) application domains, or 3) project organization.

The final model in figure 9.1 depicts these four conclusions:

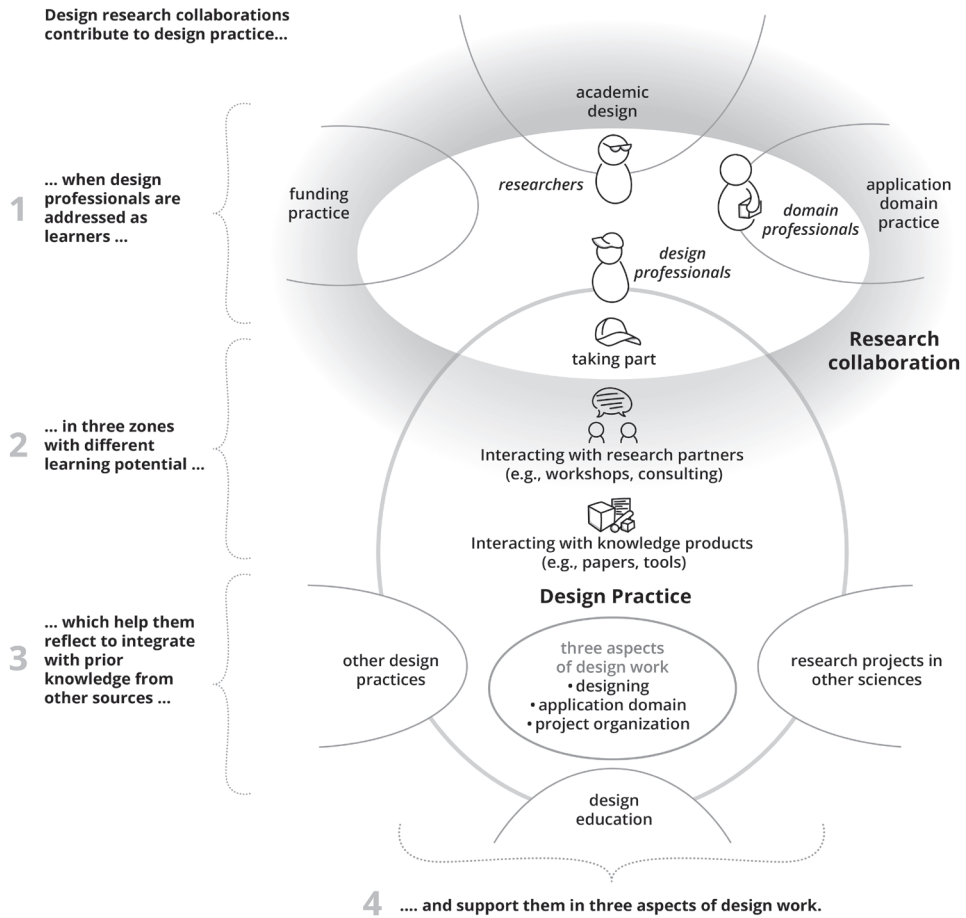


Figure 9.1: How design professionals learn from design research collaborations.

9.3 CONTRIBUTIONS

The main academic contribution of this thesis is the *learning* perspective. We propose that this is a valuable addition to the current perspectives to cross the boundary zones between research projects and design practice(s). By highlighting the development of personal and actionable knowledge of design professionals in the boundary zones between research projects and design practice(s), this thesis elicits various opportunities to cross this gap which were previously unnoticed, such as the various opportunities for explicit reflection within the project or the opportunities to involve design professionals brokers.

We also presume that the insights about learning in *boundary zones* between research project and practice(s) can have implications beyond the design discipline. This especially concerns the insights about the various in-person interactions (introduced as zone 2). Not only in the design domain is the boundary crossing between research projects and practice narrowed down to boundary objects (Basballe & Halskov, 2012; Bertelsen, 1989) or boundary brokers (Neal et al., 2015; Norman, 2010b), or is collaborative research seen as the answer without supporting actual co-creation (Wallin et al., 2014). In different domains, there seems little attention for the various in-person interactions which this research distinguishes as *zone 2* involvement. We propose that the nuanced perspective of the four learning mechanisms by Akkerman and Bakker (2011) can be applied in more disciplines to study the boundary zones between research projects and practice(s). Currently, these mechanisms are predominantly applied on the boundary between school and practice (e.g., Bakker et al, 2106).

The societal contribution of this thesis is its contribution to the practice of design research, by providing more clarity in the different ways in which design professionals can interact with research projects. There are more options for these professionals between reading a paper and being involved as an academic researcher. There is much to learn in in-person exchanges with people involved in the research projects. This thesis also showcases the variety of possible learning outcomes from interactions with research projects. Three topics are distinguished on which design professionals learn useful insights for their practice: designing, application domains, and project organization. Some learnings stay rather implicit: even the design professionals themselves are not always aware of how and what they learn. As this thesis unravels the important ingredients for learning, researchers as well as design professionals can now be more aware of these learning processes and be able to support them. This way, the collaborations and other

interactions between research projects and design professionals can run more smoothly and be more useful for design practice.

The insights in this thesis are relevant for those actors who are active on the boundary between research and practice, and who work in the practice of *collaborative research projects*. As not all barriers or enablers are under the influence of project leaders, the following pages present guidelines for three groups: project leaders of design research projects, design professionals, and funding parties.

Guidelines

The guidelines in this section are directly linked to the four main insights as presented in 9.2:

1. Address design professionals as learners, amidst the goals and agendas of the institutional and funding context of the project
2. Support learning in the three boundary zones: taking part in the research, interacting with project actors, and interacting with knowledge projects
3. Support reflections to integrate with prior knowledge
4. Support three aspects of design work: designing, working in an application domain, and project organization.

Figure 9.2 provides a visual overview of these four guidelines. The next pages list a version of these guidelines for project leaders of design research projects, design professionals, and funding parties. All guidelines are linked to the corresponding chapters which provide more background.

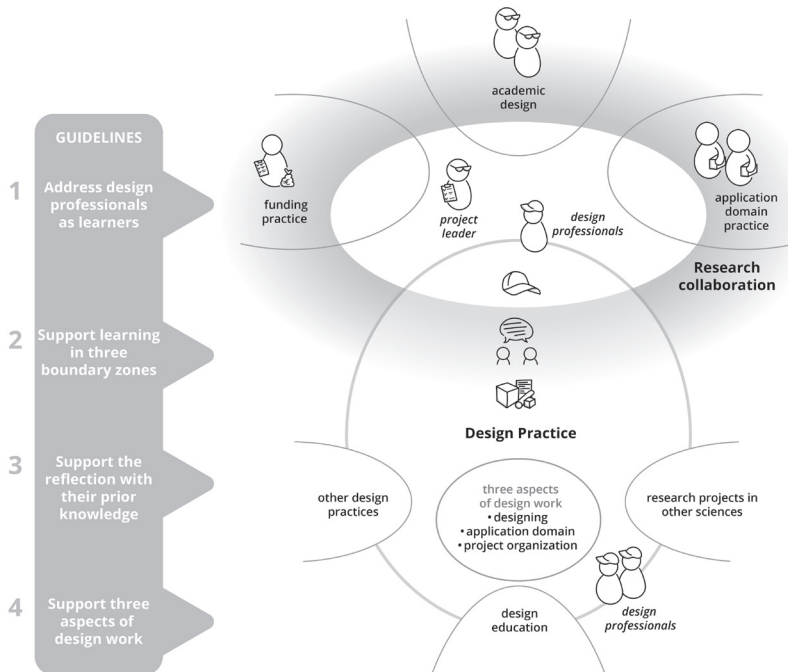


Figure 9.2: The main guidelines, based on the four main insights in this thesis.

GUIDELINES to contribute to design practice

For project leaders

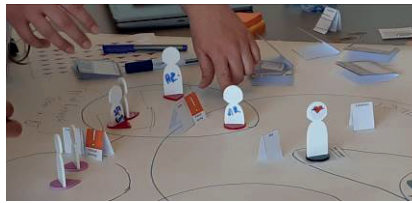


ADDRESS DESIGN PROFESSIONALS AS LEARNERS

1. Include the learning by the consortium's design professionals in the project goals. (chapter 5, 6 and 8)
2. Address design professionals as audience between the various other audiences (such as application domain or design academics). Identify for which design professionals beyond the consortium the research could be informative. (chapter 5, 7, and 8)

CREATE THREE BOUNDARY ZONES WITH DIFFERENT LEARNING POTENTIAL

3. Include the design professionals in your project in multiple roles such as theorizer or tool developer. Discuss the different roles and their learning opportunities with the involved professionals in the early stages of the project. Do not only involve them as object of study or in an isolated prototyping role. (chapter 6)
4. Support the learning process by non-involved design professionals from the start not only by producing suitable knowledge products, but also by offering opportunities for in-person exchange (e.g., workshops). (chapter 7)
5. Use the mapping tool to identify actions in these boundary zones. (chapter 8)



SUPPORT REFLECTIONS

6. Organize opportunities for explicit reflection, which helps the design professionals connect to their existing knowledge and expertise. (chapters 6 and 7)
7. For the actively involved design professionals, this can take place in reflection sessions and in opportunities for them to exchange with other professionals. (chapter 6).
8. For those not involved, this can take place in a combination of in-person exchanges and knowledge products that facilitate a quick scan on relevance (e.g., tools, or workshops), but also those that facilitate a deep dive to understand (e.g., books, case descriptions, training, consultancy). (chapter 7)

SUPPORT THREE ASPECTS OF DESIGN WORK

9. Articulate the needs of design professionals, which are different from those of academics active in the design discipline. Find out how the research project can become actionable for practitioners in three areas of their work: 1. designing, 2. working in a domain, 3. project organization. (chapter 4, 6, 7)
10. Let the involved design professionals articulate in which area(s) they want to learn through the collaboration (chapter 6).
11. If there are design professionals in your consortium, let them steer the way in which they can contribute most effectively to the project. Give them a stage to reach a broader design practice audience. (chapter 6, 7)

GUIDELINES to contribute to design practice

For design professionals



Design professionals can do several things to support that they themselves gain actionable insights from research, and that other design professionals can also do so (chapter 7):

ADDRESS YOURSELF AND COLLEAGUES AS LEARNERS

1. Acquaint yourself with what goes on in research. Not all knowledge products are behind paywalls and many researchers are happy to share. (chapter 7)
2. When you are involved in collaborative design research projects, formulate and discuss learning goals. (chapter 6).
3. When you are involved in a project, function as bridge to your peers which are not involved in the project (such as your direct colleagues, but also others in your field). Help them to connect to the research findings by sharing your experiences. (chapter 7)

ENGAGE IN THREE BOUNDARY ZONES WITH DIFFERENT LEARNING POTENTIAL

4. Engage actively in research projects. To learn the most, get involved throughout the project in multiple roles. Discuss and explicate possible roles in advance and several times in the project. Learn by getting involved in activities that enable the translation of theory to design practice, such as the creation of tools. (chapter 6)
5. When you are not involved in a project, interact with the knowledge products as well as with those who joined in the research. Reach out to researchers or design professionals who took part in a collaborative project to find out what it has to offer or join workshops with allow a short introduction. Many projects offer an output range of models, tools, and case descriptions which allow you to dive in deeper. (chapter 7)

ENGAGE IN REFLECTIONS

6. Exchange with peer professionals when you are actively involved in a project. Insist that multiple design professionals take part and that you can exchange with them by working together or meeting them in reflection sessions. (chapter 6)
7. Reflect explicitly on the relevance to your practice. Reflect on your personal learning intentions in a project before the start and be keen on opportunities along the way. (chapter 6)
8. Reflect explicitly on the relevance to your practice in activities which allow a quick scan of the project (e.g., workshops, conversations). (chapter 7)

SHARE THREE ASPECTS OF DESIGN WORK

9. Share your practice ways of working. Even when you are not actively involved in research, invite researchers to study your ways of working. Allow them an insight in the three areas of your work: 1. designing, 2. working in a domain, 3. project organization. (chapters 4, 7)
10. Bring the needs and existing knowledge from practice into research collaborations. (chapter 7)

GUIDELINES to contribute to design practice

For funding commissioners



Funding parties can do several things to support that research collaborations contribute to design professionals:

ADDRESS THEM AS LEARNERS

1. Include the knowledge contribution to the design discipline and practice in the criteria and evaluations of research programs. (chapter 5)

FACILITATE THREE BOUNDARY ZONES WITH DIFFERENT LEARNING POTENTIAL

2. Build an infrastructure of criteria and budget for research programs which allows various roles to be taken by different partners from research as well as practice. (chapter 6)
3. Build an infrastructure which facilitates that design professionals learn from dedicated output such as toolkits, but also from in-person exchanges such as workshops. (chapter 7)

SUPPORT REFLECTIONS

4. Provide room in this infrastructure for reflective activities to extract the learnings for design professionals, through in-person interactions and through flexibility to work with more than one design partner during the project to exchange with (chapter 6)

SUPPORT THREE ASPECTS OF DESIGN WORK

5. Plan relevant content for design professionals in research programs. Use the distinction in three types of content (about designing, a domain, and project organization,) to plan what type of output to generate. (chapter 4)
6. Address design professionals in your calls as a partner which can co-steer the direction of the research, and not just as an audience. (chapter 5, 7)

9.4 LIMITATIONS, REFLECTIONS, AND FUTURE RESEARCH

Although this research provides a rich insight in the phenomenon of learning by design professionals from collaborative design research projects, it is limited in its scope. Several limitations are discussed and tied to suggestions for further research.

First, the bulk of this study is conducted in the Dutch context. As a first step to a broader perspective, the survey study 7 involves international input. Future studies could investigate the same topic in other national contexts or compare these with our overall Dutch findings.

The second limitation is that the case studies in this thesis are predominantly Research through Design projects. These were included as these already aim to integrate the ways of design academics and design professional (Zimmerman, Forlizzi, & Evenson, 2007). Stappers and Giaccardi (2017, p. 55-57) distinguish various typical RtD processes: accumulating a collection of examples, iterating on successive prototypes, following the experimental scientific method, pursuing a program, and developing a conceptual framework which is filled with explorations. The cases in this thesis reflect most of these forms, apart from the first variant: accumulating a collection of examples. It may be that in design research projects with a different nature (e.g. more arts-based), there are other opportunities to learn for design professionals. Nonetheless, we imagine that the presented model and insights can also be a relevant starting point for design research projects beyond the studied Research through Design examples.

A third limitation is the inclusion of only experienced and senior design professionals. The work of senior designers is different than that of novices and they learn in a different manner (Dorst, 2008). Future research could extend this work to novice designers to find out how the three zones of involvement apply to them in their early career. Some of the insights in this thesis may also be relevant for future designers as they are educated, as these insights can help them to prepare for lifelong learning. For instance, design students can be made aware of the ways design professionals in practice will use design methods as inspiration for their own and how they learn from the interaction with fellow designers.

A fourth limitation is that the study spans a limited field of design. Differences between design fields or specialisms might also come with different ways of engaging with research. This thesis included many design professionals in the so-called fuzzy front end of design, such as service designers. The output of these service designers is different than the

output of app developers, which also makes their role different. Service designers are not only designers of new service plans but in many cases also facilitators of change. It could also be typical for the design profession that professionals are active on the many different levels in design research which Stappers and Sleeswijk Visser (2014) distinguished. Many designers do not only design, but also do research and facilitate processes. To do that, they also develop their own tools and build methodology within their field. It seems likely that these professionals will take different roles in a research project and that their learning will differ accordingly. Future research could be directed at studying design professional's roles in other design fields more prominently, building further on the work by Sleeswijk Visser (2018) and the insights in this thesis.

A fifth limitation is that learning is conceptualized as individual learning. Although this focus helped to elicit concrete learning examples, it leaves the social aspect of learning and knowledge untouched, as raised for instance by Eraut (2000). There could be other learning opportunities or barriers connected to learning as a group. Future studies could address the team dynamics and follow how teams develop knowledge together. The learning histories approach (Kleinsmann, Sarri, & Melles, 2020; Roth & Kleiner, 1998), in which teams jointly study their learning process, could facilitate such studies. This could even help these teams to engage in *triple loop learning*, described by Isaacs (1993) as learning about the context of learning. When teams are more aware of their learning process and learning situations, they are better able to improve this along the way. Additionally, Akkerman and Bruining (2016) note that the boundary crossing learning mechanisms can also be used to study boundary crossing at an organizational level.

A closely related limitation is that this research does not address the boundary zones which are outside the scope of researchers and which take place in a chain of interactions, for instance when a method finds its way within an organization. Instead, this research stays rather close to the circle of influence of the project leader. The learning perspective could be extended to the interactions beyond this scope. The mapping methods by for instance Kok and Schuit (2012) may be more appropriate for this purpose, or the overview provided by Chakrabarti and Lindemann (2016) of various interactions between research and industry.

Another limitation is that the learning perspective in this thesis is only investigated for design professionals but not for researchers. The boundary crossing theory implicates that both sides of the boundary can learn from each other. Gray, Stolterman, and Siegel (2014) already point out the importance of two-way interactions between research and

practice. Future studies could extend the learning perspective provided by this thesis to the learning by researchers in research-practice collaborations. In what way do researchers learn from practice and in what way do they transform their own academic ways of working?

Finally, the study is confined to the scope of research projects, but the findings also raise some reflections about the phenomenon of learning by design professionals beyond this narrow scope. The findings indicate that design professionals and researchers often work with each other long-term and in a successive range of projects. This means that the knowledge infrastructure around these research projects is also important and the way design professionals are involved in this infrastructure. In the Netherlands, which provides the main context for the research in this thesis, the SPRONG program (Regieorgaan SIA, 2020) provides a recent example in which knowledge institutions are funded to create collaborative structures between them on which they can further build projects. This SPRONG infrastructure supports the knowledge exchange between different projects and also allows practice partners, such as design professionals, to be involved beyond the mere scale of projects. Another positive development in the Netherlands is that in the coalition agreement by the Dutch government in 2021¹⁰, the role of the creative industry towards the societal challenges was acknowledged and an extra financial stimulus for the creative industries was agreed upon. This stimulus could make an important shift to improve the conditions of the funding programs to work with and for design professionals. Future studies could, longitudinally, investigate the way design professionals learn within such or similar infrastructure and how the identified elements of learning situations (such as in-person exchange and boundary brokers) translate to this infrastructure. Similarly, the knowledge infrastructure within design practice itself (e.g. within design agencies or learning communities) can be further studied in light of these findings.

The underlying value behind this research is that research should – directly or indirectly – contribute to practice. Unlike most universities, who generally reward academic outcome higher than societal impact, universities of applied sciences (UAS) explicitly include societal impact in their goals. A hopeful development in this regard is that universities also increasingly value societal impact and research-practice collaborations next to academic and quantitative impact measures. For both type of institutions, this research can provide practical directions to explicitly include design practice in their societal impact goals.

¹⁰ <https://www.government.nl/documents/publications/2022/01/10/2021-2025-coalition-agreement>

Limited by the above aspects, this thesis provides an overview of existing connections between academic design research and design practice. It offers insights about actionable knowledge which design professionals can derive from research projects, about their learning process to develop this knowledge, and about the efforts that are needed to support this learning. With these insights and the practical guidelines, design research collaborations are better able to equip design professionals with knowledge they need to fulfil their increasingly complex role in dealing with societal problems.

Final words

This thesis opened with a description of my experiences as a project manager in design research collaborations. These experiences formed the starting point of this PhD project. Looking back on the problems I encountered, the insights from this research would have made a difference. I now realize that I too was focused predominantly on producing knowledge products such as toolkits and guidelines. I even did not invite the partaking design companies to some sessions which – in hindsight – would have been very insightful for them. In future projects, the three zones of involvement will help me to structure the contributions to design practice. The insights on learning in each of these will help me to better support design professionals to learn.

SUMMARY

The design profession evolves and design professionals need new knowledge to keep up. 'Design professionals' are considered in this thesis as the professionals who conduct design work in industry, for instance in design agencies, consultancies, companies, or governmental organizations. These professionals develop new products, services or strategies, or apply their designing approach as organizational consultant. They turn to various knowledge sources to develop new understanding and skills. Academic research projects in the design domain are one of these sources. Some design professionals learn from the papers, toolkits or workshops which these projects offer, or by actively participating in such projects.

The central problem in this thesis is that findings from academic design research projects often do not help design professionals in their practice. Many theories or methods as developed within academia are not used in design practice. This thesis focuses particularly on *collaborative research projects*, because research and practice already meet within these projects. Aimed at societal challenges, academic researchers collaborate in these projects with practice partners from relevant application domains (for instance in healthcare) as well as with design professionals.

The aim of this thesis is to equip projects that have the ambition to strengthen design professionals in attaining this impact. Chapter 1 introduces the manner in which this thesis wants to do this: by offering knowledge about the opportunities and challenges in the current situation, by building insights about directions to improve, and by offering practical guidance.

The central research question is:

How can design research collaborations provide knowledge that design professionals will use in practice?

This central question is approached by answering several sub-questions. The first two questions develop a general understanding of design professionals and their ways of learning as well of the relevant challenges within design research projects in this light.

RQ 1) *How are design research collaborations of use for the work of design professionals?*

RQ 2) *What are the barriers and enablers for design research collaborations to be of use in the work of design professionals?*

The ensuing two questions investigate the learning processes by design professionals when they take part in a research collaboration, and when they do not.

RQ 3) *How do design professionals learn when they participate in a design research collaboration?*

RQ 4) *How do design professionals learn from research projects in which they did not participate?*

Question 5 builds further on the key insights on the previous questions to make them actionable.

RQ 5) *How can project leaders identify opportunities within their projects to support learning by design professionals?*

Driven by these questions, the research consists of different – retrospective as well as ongoing – empirical studies: various multi-case studies, a survey study, and a design study. Chapter 2 describes that the first two empirical studies have an explorative nature to determine the key elements of the central issue, which are further investigated in the following two studies. The research is overall qualitative and uses various qualitative methods such as interviews, focus groups, and document analysis. The final study is a design study in which the key insights are translated into a practical tool.

Chapter 3 reviews the literature on how design professionals develop their knowledge and make this actionable for their practice. Research projects are discussed amidst other knowledge sources which design professionals use and integrate into their *actionable knowledge*: knowledge which they can use in their work. The chapter argues that although the overall contribution by design academia to design practice can be improved, there is not an empty gap between design research projects and design practice. There is a zone in which already much is going on. Therefore, this thesis adopts the frame of *boundary zones* instead of the now dominant frame of the *research-practice gap*. Three zones are distinguished between a project and design practice(s): 1) actively taking part in a project, 2) interacting with project actors, and 3) interacting with knowledge products. This means that it is not just knowledge products such as tools and papers which do the

boundary crossing, there are also many in-person exchanges. The current perspectives on the boundary between research projects and design practice predominantly focus on knowledge products and do not take the learning process by design professionals into account. Therefore, this learning process is the central phenomenon of this study.

The first empirical study starts with the design professionals, their practice, and their ways of learning from research projects and other sources. Chapter 4 reports on interviews with eight design professionals to understand what *actionable knowledge* for design professionals means. The results show three topic categories of useful knowledge: 1) about designing (designerly approaches, methods, mindset and skills), 2) about the application domain (problem context and background) and 3) about project organization (ways to manage the design process and the meta-process around it). The study shows how the three zones between project and practice play a role in the learning process by these professionals. Design professionals use a variety of tools, papers, and books, to learn about these three topics. Prescriptive tools such as guidelines are found to be useful, but rather as demonstrator and a reference frame and not as prescribed by the developers. This chapter also shows that actively taking part in research projects allows these professionals to learn much more by building their own experiences in these projects.

Chapter 5 shifts the attention to the actions by researchers within these collaborative research projects. It studies the challenges within collaborative research projects to contribute to design practice. Ten public-funded design research projects are studied, in which impact on design practice was asked for by the grant giver and researchers expressed the aim to inform design practice. This chapter studies the explicated goals towards design practice and the ways in which research partners talked about and took action towards these goals. We find that contributing to design practice is not easily accomplished. The study shows that the contribution to design practice has to take place within the diversity of goals and agendas of other groups such as the application domain or academic design practice. Within this context, design professionals are under-prioritized as audience and not regarded as learners.

These first studies establish the key elements to further investigate in the next studies: the three boundary zones in which design professionals learn and the three topic categories of useful knowledge. The following studies dive more deeply in respectively the learning by design professionals when they are actively involved in a research project, and the learning by design professionals when they were not.

The active involvement of design professionals in collaborative research projects is studied more closely in chapter 6. Four collaborations are described which the partaking design professional considered as very useful for their work. The partaking design professionals are retrospectively interviewed about their learning activities and learning outcomes within these four collaborations. These activities and outcomes are studied with the theoretical lens of *non-formal learning*. The results show that design professionals can be active in many roles, from theory developer to organizing practicalities. These many roles provide many opportunities for learning, but at the same time make it difficult to recognize and articulate when and what they learn. These professionals need moments and activities of explicit reflection to learn effectively and to develop actionable knowledge for their practice.

Chapter 7 addresses the way research projects reach a broader design practice community. This chapter presents a survey study among an international audience of design researchers and design professionals (N = 48), to study their efforts on the boundaries between research projects and design practice. Studying this with a boundary crossing lens, the chapter argues that current efforts to contribute to design practice are predominantly efforts to hand-over suitable output such as toolkits. It concludes that 1) the boundary offers a learning potential but needs to be acknowledged and explored, 2) the two reflective processes of the quick scan and the deep dive require different support, 3) there are multiple brokering roles for design professionals.

In chapter 8, the key insights from the previous studies are brought into actual projects to find out whether they are actionable for lead researchers. This study investigates how lead researchers can identify actions to support that design professionals learn from their projects. A tool is developed to identify these actions by mapping out a project in terms of the interactions between research projects and design practice. Two cases show a successful application of the tool in four different research projects. The materials help the participants to identify and express their insights about actions to take in their projects.

Finally, chapter 9 draws the main insights together. In answer to the main research question, the thesis concludes that research collaborations can contribute to the learning process of design professionals for their practice, when:

1. throughout the project, the project lead addresses design professionals as potential learners amidst the goals and agendas of the institutional and funding context of the project.

2. the project lead considers the learning potential for design professionals in the three different boundary zones before deciding on actions in either of them. These zones are: 1) actively taking part, 2) interacting with people from the project, and 3) interacting with resulting knowledge products.
3. by the combined efforts in these zones, design professionals are supported in explicit reflections to integrate new findings into actionable knowledge for their practice.
4. design professionals are supported in three aspects of their work: 1) designing, but also 2) application domains, and 3) project organization.

The chapter provides practical guidelines for researchers, design professionals, and funding parties to apply these insights. For instance, we recommend researchers to organize more reflection and exchange moments between design professionals in their collaborative research projects.

The academic contribution of this thesis consists of the new perspective on the boundary zones between research and practice and of the insights about the learning process by which design professionals develop actionable knowledge for their practice. Although the empirical evidence draws predominantly from a national (Dutch) context with only limited international sampling, this knowledge in this thesis can have relevance for a broader international design context.

The practice contribution is directed at the practice of collaborative research projects. Stakeholders in this practice – researcher, design professionals, and funders – are provided with new insights as well as practical guidelines. We hope that this knowledge will contribute to transitions in the funding landscape and the infrastructure of research projects to enable design professionals in their increasingly complex role in dealing with societal problems.



SAMENVATTING

De ontwerppraktijk verandert en ontwerp professionals moeten hun kennis blijvend ontwikkelen. Met 'ontwerpprofessionals' worden in dit proefschrift de professionals aangeduid die ontwerpwerkzaamheden uitvoeren in de praktijk, zoals binnen ontwerp bureaus, consultancybureaus of overheden. Deze professionals ontwerpen nieuwe producten, diensten of strategieën, of zetten hun ontwerpende manier van werken in als organisatieadviseur. Zij wenden zich tot verschillende kennisbronnen om tot nieuw begrip en vaardigheden te komen. Dit proefschrift richt zich op academische onderzoeksprojecten binnen het ontwerpdomein als één van deze kennisbronnen. Sommige ontwerpprofessionals leren uit de artikelen, hulpmiddelen of workshops die deze projecten aanbieden, of door actief deel te nemen in deze projecten.

Dit proefschrift adresseert het probleem dat bevindingen uit academische ontwerpende onderzoeksprojecten vaak niet bijdragen aan de praktijk van ontwerpprofessionals. Veel theorieën of methoden die in de academische ontwerpwereld worden ontwikkeld worden niet gebruikt in de ontwerppraktijk. Dit proefschrift richt zich op collaboratieve onderzoeksprojecten, omdat onderzoek en praktijk elkaar hierin al ontmoeten. Gericht op maatschappelijke vraagstukken, werken academische onderzoekers in deze projecten samen met zowel relevante praktijkpartners vanuit toepassingsdomeinen (bijvoorbeeld in de zorg) als met partners uit de ontwerppraktijk.

Het doel van dit proefschrift is om de projecten die de ambitie hebben om de ontwerppraktijk te versterken, te ondersteunen in het realiseren van die ambitie. Hoofdstuk 1 introduceert de manieren waarop dit proefschrift deze ondersteuning wil bieden: door kennis op te leveren over mogelijkheden en knelpunten in de huidige praktijk, door inzicht op te bouwen over wat er beter kan, en door praktische handvatten hiertoe op te leveren.

De centrale onderzoeksvraag is:

Hoe kunnen collaboratieve onderzoeksprojecten kennis opleveren die ontwerpprofessionals gebruiken in hun praktijk?

Deze centrale vraag is beantwoord met behulp van verschillende deelvragen. De eerste twee deelvragen ontwikkelen een algemeen begrip van ontwerpprofessionals en hun manieren van leren en van de relevante uitdagingen binnen ontwerpende onderzoeksprojecten.

RQ 1) *Hoe zijn ontwerpende onderzoeksprojecten van waarde voor het werk van ontwerpprofessionals?*

RQ 2) *Wat zijn de belemmeringen en stimulansen in ontwerpende onderzoeksprojecten om van waarde te zijn voor het werk van ontwerpprofessionals?*

De opvolgende vragen onderzoeken het leerproces van ontwerpprofessionals wanneer zij deelnemen in een collaboratief onderzoeksproject en wanneer ze niet deelnemen.

RQ 3) *Hoe leren ontwerpprofessionals wanneer zij deelnemer zijn in een collaboratief onderzoeksproject?*

RQ 4) *Hoe leren ontwerpprofessionals van collaboratieve onderzoeksprojecten wanneer zij niet deelnemen?*

Deelvraag 5 bouwt verder op de kerninzichten vanuit de voorgaande vragen zodat deze toepasbaar kunnen worden.

RQ 5) *Hoe kunnen projectleiders concrete kansen in hun projecten identificeren om het leren door ontwerpprofessionals te bevorderen?*

Gedreven vanuit deze vragen, bestaat dit onderzoek uit verschillende – retrospectieve maar ook lopende – empirische studies: enkele multi-case studies, een vragenlijststudie en een ontwerpstudie. Hoofdstuk 2 beschrijft dat de eerste twee multi-case studies een exploratief karakter hebben om een overzicht te krijgen van de kernelementen van het vraagstuk. Deze kernelementen zijn nader bestudeerd in de daaropvolgende studies. Het onderzoek is grotendeels kwalitatief, en maakt gebruik van diverse kwalitatieve onderzoeksmethoden zoals interviews, focusgroepen en documentanalyse. De afsluitende studie betreft een ontwerpstudie waarin de kerninzichten zijn vertaald naar een praktisch hulpmiddel.

Hoofdstuk 3 bespreekt de literatuur over de manieren waarop ontwerpprofessionals hun kennis ontwikkelen en deze bruikbaar maken voor hun praktijk. Het hoofdstuk laat zien dat onderzoeksprojecten een van de kennisbronnen zijn waaruit ontwerpprofessionals putten en van waaruit ze kennis integreren tot *bruikbare kennis*: kennis die ze kunnen toepassen in hun praktijk. Hoewel de totale bijdrage vanuit ontwerp onderzoek naar ontwerp praktijk kan worden verbeterd, is het niet zo dat er een lege kloof is tussen

onderzoeksprojecten en ontwerppraktijk. Het is een zone waarin al veel gaande is. Daarom gebruikt dit proefschrift het frame van 'grenszones' in plaats van het dominante frame van de 'kennis-praktijk kloof'. We onderscheiden drie zones tussen een project en ontwerppraktijk(en): 1) actief deelnemen in een project, 2) interacteren met projectdeelnemers, en 3) interacteren met kennisproducten. Dit betekent dat het niet alleen de kennisproducten zijn die de grenszone oversteken (*boundary crossing*), er zijn ook veel uitwisselingen tussen personen. De huidige perspectieven op de grens tussen onderzoeksprojecten en ontwerppraktijken richten zich voornamelijk op kennisproducten. Ze houden daarbij geen rekening met het leerproces van ontwerpprofessionals. Dit leerproces is daarom het centrale fenomeen binnen dit proefschrift.

De eerste empirische studie start bij de ontwerpprofessionals, hun praktijken en hun manieren van leren via onderzoeksprojecten en via andere bronnen. Hoofdstuk 4 doet verslag van interviews met acht ontwerpprofessionals om begrip te vormen van wat *bruikbare kennis* voor hen inhoudt. De resultaten laten drie categorieën zien wat betreft onderwerpen van bruikbare kennis: 1) over het ontwerpproces (ontwerpde aanpakken, methoden, manier van denken en vaardigheden), 2) over het toepassingsdomein (de probleemcontext en achtergrond) en 3) over project organisatie (manieren om het ontwerpproces en het meta-proces daaromheen te organiseren). Deze studie laat zien hoe de drie zones tussen project en praktijk een rol spelen voor het leren van de professionals. Ontwerpprofessionals gebruiken een variëteit aan hulpmiddelen, artikelen en boeken om over deze onderwerpen te leren. Voorschrijvende hulpmiddelen zoals richtlijnen blijken nuttig te zijn, maar vooral als voorbeeld en referentiekader en niet op de manier zoals de ontwikkelaars hadden voorgeschreven. Dit hoofdstuk laat ook zien dat actieve betrokkenheid in onderzoeksprojecten deze ontwerpprofessionals in staat stelt om veel meer te leren, omdat ze hun eigen ervaringen in deze projecten opbouwen.

Hoofdstuk 5 verlegt de aandacht naar de onderzoekers binnen de collaboratieve onderzoeksprojecten. Het bestudeert de uitdagingen binnen collaboratieve onderzoeksprojecten om bij te dragen aan de ontwerppraktijk. Tien projecten met financiering vanuit de overheid zijn bestudeerd, waarin de doorwerking in de ontwerppraktijk vereist was vanuit de subsidieverstrekker en waarin de onderzoekers lieten blijken dat ze de ontwerppraktijk wilden informeren. Dit hoofdstuk bestudeert de geformuleerde doelstellingen richting ontwerppraktijk, de manieren waarop de onderzoekspartners hierover praten en de manieren waarop ze hier actie op nemen. Doorwerking naar de ontwerppraktijk blijkt nog niet eenvoudig te zijn. De studie laat zien hoe de bijdrage aan de ontwerppraktijk plaats moet vinden te midden van een

diversiteit aan doelen en belangen van andere groepen, zoals het toepassingsdomein van het vraagstuk en de academische ontwerpwereld. Binnen deze context worden ontwerpprofessionals achtergesteld als publiek en niet beschouwd als lerende groep.

Samen leveren deze studies de kernelementen die in de volgende studies nader worden onderzocht: de drie zones waarin ontwerpprofessionals leren en de drie onderwerpen van bruikbare kennis. Deze volgende studies duiken dieper in respectievelijk het leren van ontwerpprofessionals wanneer ze actief betrokken zijn in onderzoek en het leren van ontwerpprofessionals wanneer ze dat niet zijn.

De actieve betrokkenheid van ontwerpprofessionals in collaboratieve onderzoeksprojecten is nader bestudeerd in hoofdstuk 6. Vier samenwerkingen worden beschreven die door de deelnemende ontwerpprofessionals als heel nuttig voor hun praktijk worden beschouwd. Deze deelnemende professionals zijn retrospectief geïnterviewd over hun leeractiviteiten en de leeropbrengsten binnen deze vier samenwerkingen. Deze activiteiten en opbrengsten zijn bestudeerd vanuit de theoretische lens van *niet-formeel leren*. De resultaten laten zien dat ontwerpprofessionals actief kunnen zijn in veel rollen, van theorie-ontwikkelaar tot het organiseren van praktische zaken. Deze rollen bieden veel kansen voor leren, maar maken het tegelijkertijd ook lastig om te herkennen en articuleren wanneer en wat ze geleerd hebben. Deze professionals hebben momenten en activiteiten nodig van expliciete reflectie om effectief te kunnen leren en bruikbare kennis voor de praktijk te ontwikkelen.

Hoofdstuk 7 richt zich op de manier waarop onderzoeksprojecten een bredere gemeenschap van ontwerpprofessionals bereiken. Het presenteert een surveystudie onder een internationaal publiek van onderzoekers en praktijkprofessionals binnen het ontwerpdomein (N=48), om hun inspanningen te bestuderen op het grensvlak tussen onderzoeksprojecten en ontwerppraktijk. Vanuit de theoretische lens van *boundary crossing* argumenteert dit hoofdstuk dat de huidige inspanningen om bij te dragen aan ontwerppraktijk veelal gericht zijn op het overdragen van bruikbare eindproducten zoals praktische hulpmiddelen. Het hoofdstuk concludeert dat 1) ontwerpprofessionals andere ondersteuning nodig hebben voor reflecties op de bruikbaarheid (*quick scan*) dan voor reflecties op de inhoud (*deep dive*), dat 2) ontwerpprofessionals kunnen optreden als verbinders tussen onderzoek en praktijk op verschillende manieren, en dat 3) het grensgebied leerpotentieel biedt maar dat dit expliciete inspanning vraagt.

In hoofdstuk 8 worden de belangrijkste inzichten uit de voorgaande studies in daadwerkelijke projecten toegepast om er achter te komen of ze daadwerkelijk bruikbaar zijn voor hoofdonderzoekers. De studie onderzoekt hoe hoofdonderzoekersacties kunnen

identificeren waarmee ze het leren van ontwerpprofessionals kunnen ondersteunen. Om deze acties te kunnen identificeren is een hulpmiddel ontwikkeld waarmee een project in kaart kan worden gebruikt in termen van de interacties tussen het project en ontwerppraktijk. Twee casussen laten zien hoe dit hulpmiddel succesvol is toegepast in vier verschillende onderzoeksprojecten. De materialen helpen de participanten om hun inzichten over te nemen acties scherper te krijgen en uit te drukken.

Tot slot brengt hoofdstuk 9 de belangrijkste inzichten bij elkaar. Als antwoord op de centrale onderzoeksvraag concludeert dit proefschrift dat collaboratieve onderzoeksprojecten bij kunnen dragen aan het leerproces van ontwerpprofessionals ten behoeve van hun praktijk als:

1. de projectleider door het hele project heen ontwerpprofessionals adresseert als potentieel lerend publiek, te midden van de doelen en belangen van de organisaties en financieringsstructuur (bijvoorbeeld door gebruik te maken van het ontwikkelde hulpmiddel).
2. de projectleider het leerpotentieel overweegt voor ontwerpprofessionals in de drie verschillende grenszones, alvorens actie te ondernemen in een van deze zones. Deze zones zijn: 1) actieve deelname, 2) interactie met projectbetrokkenen 3) interactie met de resulterende kennisproducten.
3. in al die drie zones, ontwerpprofessionals worden ondersteund door expliciete reflecties en interpersoonlijke uitwisseling om nieuwe bevindingen te integreren tot bruikbare kennis voor hun praktijk.
4. ontwerpprofessionals worden ondersteund in drie aspecten van hun werk: 1) ontwerpen, maar ook 2) toepassingsdomeinen of 3) projectorganisatie.

Het hoofdstuk biedt praktische richtlijnen voor onderzoekers, ontwerpprofessionals en financieringsorganisaties om deze inzichten toe te passen. Zo worden bijvoorbeeld voor onderzoekers aanbevelingen gedaan om meer reflectie momenten en uitwisselingsmomenten tussen ontwerpers in te bouwen in collaboratieve onderzoeksprojecten.

De wetenschappelijke bijdrage van dit proefschrift bestaat uit het nieuw ontwikkelde perspectief op de grenszones tussen onderzoek en praktijk en uit de inzichten die ontwikkeld zijn rond het leerproces waarmee ontwerpprofessionals bruikbare kennis ontwikkelen voor hun praktijk. Ook al is de empirische onderbouwing voornamelijk ontwikkeld in een nationale (Nederlandse) context met slechts beperkte internationale sampling, de kennis in dit proefschrift kan relevant zijn voor een bredere internationale context.

De bijdrage aan de praktijk is gericht op de praktijk van collaboratieve onderzoeksprojecten. Aan de belanghebbenden in deze praktijk – onderzoekers, ontwerpprofessionals, en financiers – zijn nieuwe inzichten en praktische richtlijnen aangereikt. We hopen dat deze kennis bij zal dragen aan verschuivingen in het financieringslandschap en de infrastructuur van onderzoeksprojecten zodat ontwerpprofessionals w o r d e n ondersteund in hun steeds complexere rol in het aanpakken van maatschappelijke problemen.

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APPENDICES

APPENDIX A: DATA SOURCES (CHAPTER 4)

Documents			
Document type	Project proposals	Program call	Progress reports
Amount of docs (total 31)	10	1	20 (2x per project)
Interviews			
Respondent groups	Researchers	Design professionals	Funding experts and program manager
Individuals (total: 26)	17	4	5 (4 funding experts, 1 program manager)
Amount of interviews (total: 27)	20 (2x per individual, in 7 pairs and 3 individual interviews)	4 (1x per individual)	4 (1x, including one in pair)
Characterization	Background Interactive architecture <ul style="list-style-type: none"> Industrial Design Industrial design, human-computer interaction Industrial engineering Software engineering Psychology Health sciences Cognitive psychology Cognition & Media Psychology, Design Social Psychology Human-computer interaction Health sciences, psychology Communication & Media Psychology Human-computer interaction Psychology en public health Humanities, art, psychology and design Computer Science Engineering, Human Computer Interaction and User Centred Design Department <ul style="list-style-type: none"> Information Systems Behavioural, Management and Social Sciences Communication Science Strategic Communication Social and Behavioural Sciences Department of Public Health Healthcare & Social Work Industrial Design (3x) 	Background <ul style="list-style-type: none"> Arts & user interface technology Graphic design & user interface technology Information technology & PhD in design Design academy Company characterization <ul style="list-style-type: none"> Serious game development company: behavioural change, engaged learning, self-management, knowledge sharing Creative service design company: develops pre-commercial innovative communication and collaboration applications for health and ageing Transdisciplinary research & development of creative technological applications and innovative concepts with and for the care sector Development of interactive experience platforms: gamification, VR 	Function <ul style="list-style-type: none"> Funding advisors at a university (2x) Promoting and managing R&D collaborations in creative industries (2x) Program manager at funding agency

APPENDIX B: CASES (CHAPTER 6)

Role <i>(* developed during the project)</i>	Activity + quote <i>(* developed during the project)</i>	Learning	Supported by	
			Artefacts	People
Within research project				
Theorizer *	contribute to the theory development. <i>The researchers used a certain theoretical model about how people relate to the place they live. We contributed our ideas about how to apply this model.</i>			
Tool designer	Not applicable			
Designer	develop a prototype. <i>We designed a prototype for the test with residents. We made sunpark set-up as a kind of sample card. How do you like this, or how do react to that? We designed prints for that.</i>	X	Prototype of sunpark	
User researcher	interviews. <i>The interviews were organized by the research partners. We assisted them in setting up the interview format and conducted some of the interviews at people's homes.</i>	X		Residents
	facilitate co-creation sessions. <i>In the co-creation sessions, we really showed what we do best. We showed the residents what we learned in the interviews. We prepared several scenarios and let the participants work on those scenarios.</i>	X	Materials in session	Residents, and stakeholders
	evaluate the prototype with users*. <i>The researchers had the lead in this. We managed to get involved in this, because we wanted to contribute to this. This type of thing is what we do best! We helped them to make the questions much simpler.</i>			
Facilitator *	facilitate stakeholders meetings*. <i>There was tension between stakeholders in this problem context. My presence added value there, by being there at meetings and bringing my experience as facilitator. To keep addressing: 'I hear what you say, I think we find a common ground in this'. It is about asking questions and intervening and steering the conversation.</i>	X		Project partners
Manager	Not applicable			
Trainer	Not applicable			
Engineer	Not applicable			
Outside project				
(outside project roles)	interview for this study*. <i>I realize only now, that right from the start, we have to make more clear to the consortium partners that the exposure is very important for us.</i>	X		Interviewer

Table 6.5: The involvement of Bob in the research project in roles and corresponding activities, and the learning processes as part of this

Role (* developed during the project)	Activity + quote (* developed during the project)	Learning	Supported by	
			Artefacts	People
Within research project				
Theorizer *	take part in analysis sessions & reflecting on case. <i>The researchers were in the lead, but I was participant in several analysis sessions in which we reflected on the case and on a higher level, overarching the cases.</i>	X	Model of talking about futures	Researchers
Tool designer	Not applicable			
Designer	develop tools for the domain context, together with other agency (case A). <i>We developed two interventions for the care organization, one of these was a conversation tool.</i> further develop tools. <i>We made a small next step on the tools.</i> develop and build prototype (case B). <i>This case for us had a very practical take: we had to build an installation. The question was: how can we engage visitors in a festival setting in thinking about their futures?</i>	X	The tools	The other design agency
User researcher	conduct interviews at peoples' homes and sessions with stakeholders (case A). <i>We conducted interviews with caregivers and with elderly people at their homes.</i>	X	Interview materials	Elderly people
	test and evaluate the developed tools in practice. <i>The tools that we developed were applied by the care organisation.</i>	X	The tools	The care organisations
Facilitator	co-facilitate workshop about follow-up projects. <i>We had a session with relevant partners about a potential follow-up. We facilitated a workshop.</i>			
Manager *	organize practicalities with care partner. <i>Sometimes I was the project lead in this design case, together with the researcher. In many cases, I organized practical details with the care partner.</i>			
Trainer	Not applicable			
Engineer *	technical installation and logistics (case B). <i>We took care of very practical things, such as hiring a van and making the technical installation work.</i>			
Outside project				
(outside project roles)	host workshops and sessions as follow-up. <i>With several partners, we did follow-up activities such as a small project and some workshops.</i>			
	develop new tools. <i>A concrete result is that we worked more with sensitizers since then</i>	X	Sensitizers	Colleagues

Table 6.6: The involvement of John in the research project in roles and corresponding activities, and the learning processes as part of this

Role (* developed during project)	Activity + quote (* developed during the project)	Learning	Supported by	
			Artefacts	People
Within research project				
Theorizer *	<p>analyse in session. <i>I participated in a big analysis session. We put all our efforts so far on the table. The results steered my activities after that.</i></p> <p>analyse individually. <i>I also did my own analysis on data from another researcher. Some things did not appear in the presentations. I thought these very important, so I used several bits for my own task.</i></p> <p>analyse results in small group. <i>We did an analysis with a several researchers of the third co-creation session.</i></p>			
Tool designer	Not applicable			
Designer	design tools for physiotherapists. <i>I developed three tools for the physiotherapists: a protective cover for the activity monitor, something to educate them and an infographic that they could use in interacting with the children.</i>			
User researcher	<p>prepare interviews and send sensitizer. <i>The design researcher explained to me that you best send a sensitizer as preparation for a generative session.</i></p> <p>conduct interviews. <i>We conducted contextmapping to provide more depth to the qualitative interviews. In generative sessions, I explored with children what they need when they need to wear an activity monitor. We send a sensitizer as preparation.</i></p> <p>conduct interviews. <i>Before we did co-creation session number 2, I interviewed the physiotherapists.</i></p>	X	Tools (sensitizer)	Researcher
Facilitator	<p>facilitate co-creation sessions. <i>I co-facilitated and prepared the co-creation sessions with one of the researchers. We worked with physiotherapists and behavioural scientist for a half day. I also made visual notes of the session.</i></p> <p>design sprint. <i>I organized a design sprint for the project team: a dedicated week in which we made progress.</i></p>	X		Physio-therapists Researcher
Manager *	<p>exchange in project meetings & stand ups. <i>We had a weekly check-in with the project team.</i></p> <p>address group dynamics*. <i>There was much unclarity about the roles. Because I work a lot with group dynamics, I took initiative to discuss this.</i></p>	X		Researchers
Trainer	Not applicable			
Engineer *	Not applicable			
Outside project				
(outside project roles)	<p>talk to partner*. <i>My partner does similar work as me, sometimes we discuss methods or tools at home.</i></p> <p>informal exchange with colleagues*. <i>I met this other researcher at the university. Sometimes I see her put together another tool and discuss this with her.</i></p> <p>be interviewed for this study*. <i>Good to discuss this like this. Thinking about it, it raises some questions, like shouldn't we plan an evaluation for this project?</i></p>	X	Tool	Peer professional
		X	Tools	Researchers
		X		Researcher

Table 6.7: The involvement of Mary in the research project in roles and corresponding activities, and the learning processes as part of this

Role <i>(* developed during the project)</i>	Activity + quote <i>(* developed during the project)</i>	Learning	Supported by	
			Artefacts	People
Within research project				
Theorizer *	analysing the sessions. <i>With one of the researchers, I made a document and some graphics. To capture what we exchanged so far.</i>	X	The graphic overview	Researcher
Tool designer	take part in reflection session and develop tools. <i>We explored new forms, new tools.</i>	X	Tools (for futuring), jointly developed	Peer professionals
	reflection sessions. <i>The researchers asked me to devote a few sessions to capture our current knowledge. The other design agency was not involved at this point.</i>	X		Researchers
	take part in reflection session. <i>In half-day sessions, we shared the problems we run into in practice and how we deal with that, how we could learn from that. In the final session, we brought tools and materials from in our practice. That made it much more practical.</i>	X	Tools (for futuring), used in practice	Researchers & peer design professionals
Designer	Not applicable			
User	Not applicable			
researcher				
Facilitator	prepare and facilitate session. <i>We divided tasks in who would prepare the sessions. I designed and facilitated one of the sessions.</i>			
Manager *				
Trainer	coach students on futuring. <i>I was already involved on this topic, by working with students.</i>	X		Students, researchers
Engineer *				
Outside project				
(outside project roles)	applying insights in lead for client. <i>I was able to apply some of the tips we shared directly in the next session with one of my clients: about how to get people from one state to the next.</i>	X		Client
	applying insights in lead for client. <i>We had a lead, in which we operationalized this futuring approach in several steps. I saw a lot of synergy between these projects. But this project did not start.</i>	X	Project plan in steps	
	contact researcher beyond project context. <i>I gained access to new people. I contacted one of the researchers to talk some more about a particular topic.</i>	X		Researcher
	interview for this study. <i>Now we talk about it like this, I realize what the qualities are that make this type of collaboration work. The way we work as equals and find similarities.</i>	X		Interviewer

Table 6.8: The involvement of Tess in the research project in roles and corresponding activities, and the learning processes as part of this

APPENDIX C: QUESTIONNAIRE (CHAPTER 7)

Type of respondents (linked to answers to question 5)

1. Researchers
2. Design professionals
3. Researcher-practitioner

Likert scales:

- A. Never/ rarely /sometimes /often /always /I don't know
- B. Not important at all /not much important/ somewhat important/ important/ very important/ I don't know
- C. Extremely influential / very influential / somewhat influential / slightly influential /not at all influential / I don't know

Question	Type of question	For whom
Overview of sample		
In which country do you work?	Open	All
In which field(s) do you position your work? You can give more than one answer. Options: Service design/ UX/ graphic design / multimedia design / product design / other (open)	Multi-response	All
How long have you been working as a professional designer or design researcher? Options: 0-5 years / 6-10 years / 11-15 years / > 15 years	Multi-response	All
Do you fill in this survey as a researcher or as a design professional? Options: researcher: I work in academia / design professional: I work in industry / both: I work in academia AND in industry	Multi-response	All
Actionable knowledge for design practice		
Research projects can inform practice on a range of topics. How often have you experienced that your research project helped design professionals in the following three topic categories: Options: it improved their design process (methods, tips, good practices, ...) / it helped them organize their projects (ways to deal with stakeholders, organize their work ...) / it helped them work within a specific domain (such as healthcare, renewable energy)	Likert scale 1, 3 type A	
In this questionnaire, we focus on the research projects which are led by academia and often executed in a collaboration with partners from practice. Such research projects can inform practice on a range of topics. How often have you experienced that you (as design professional) were helped by a research project in the following three topic categories: Options: similar as Q7	Likert scale 2 type A	
What did you do to find out whether you were actually successful in helping design professionals? You can give more than one answer. Options: We used metrics (e.g. to count visits of the project website) / We asked the involved design practice partners for their view / We asked a range of (non-involved) design professionals for their view (e.g. about their use of a tool you developed) / None of the above / other (open)	Multi-response	1

Question	Type of question	For whom
Knowledge products		
Research findings are shared in a range of formats. How do you rate the importance of the following output formats in actually helping design professionals? Options: theory or models in papers / theory or models in books / design guidelines / tools or toolkits / designs or prototypes / case descriptions / blogs	Likert scale type B	1, 3
For the formats you consider (very) important, what is it that makes them useful for design professionals?	Open	1, 3
Research findings are shared in a range of formats. How do you rate the importance of the following output formats, in the way they are useful to you as design professional? Options: similar as Q9	Likert scale type B	2
For the formats you consider (very) important, what is it that makes them useful for design professionals?	Open	2
In-person interactions		
How do you rate the importance of the following in-person activities to share research results, in the way they inform design professionals? Options: Workshops / Presenting at scientific conferences / Presenting at design practitioner venues or meet-ups / Consulting to design companies / Formal training	Likert scale type B	1, 3
For the activities you consider (very) important, what is it that makes them successful in informing design professionals?	Open	1, 3
How important are the following in-person activities for you as a design professional to learn from research projects? Options: similar as Q13	Likert scale type B	2
For the activities you consider (very) important, what is it that makes them successful in informing you?	Open	2
Have you involved a design professional from industry to help bring findings to a broader design professional audience? You can give more than one answer. Options: Yes, to develop tools or guidelines for design professionals / Yes, to (co-)write papers, blogs or other output for a practitioner audience / Yes, to host workshops / Yes, to present findings to other design professionals at conferences or meet-ups / Yes, to share the findings in their own company or direct network / Yes, in another way (open)	Multi-response	1
Design professionals are sometimes involved in research projects which are led by academia. They can take various roles in these projects. Have you (as design professional) been involved in research projects to help bring findings to a broader design professional audience? You can give more than one answer. Options: similar as Q18	Multi-response	2, 3
How do you rate the influence of this active involvement of a design professional to successfully reach design professionals?	Likert scale type C	All (except previous Q='no')
Can you explain this influence?	Open	All (except previous Q='no')

Question	Type of question	For whom
Project context & other		
In your experience, how important are the following conditions for research projects to successfully contribute to design professionals? Options: Funding for creating output for design practice (such as toolkits) / Individuals in the project team who are personally motivated to serve design practice / Partner organizations who help to bring results to design practice (i.e., centre of expertise, valorisation organization)	Likert scale 1, 3 type B	
What motivates you to bring results from your research to design professionals in industry?	Open	1, 3
Which advice would you give to researchers who want to inform design professionals with their work?	Open	All
Is there anything else that you would like to add on this topic of bridging the research-practice gap? Do you have any relevant insights or experiences that you want to add?	Open	All

APPENDIX D: DETAILED SURVEY RESPONSES (CHAPTER 7)

D1: Rating of in-person interactions

Researchers (N=21)

Design professionals (N=16)

Researcher-practitioners (N=11)

		not important at all	not much important	somewhat important	very important	I don't know	
Scientific conferences	Researchers	1 (5%)	6 (29%)	8 (38%)	3 (10%)	2 (5%)	1 (5%)
	Design professionals	1 (6%)	5 (31%)	6 (38%)	2 (13%)	1 (6%)	1 (6%)
	Researcher- practitioners	3 (27%)	2 (18%)	0 (0%)	4 (36%)	1 (6%)	1 (6%)
Design practitioner venues or meetups	Researchers	0 (0%)	0 (0%)	6 (29%)	10 (48%)	2 (10%)	3 (14%)
	Design professionals	0 (0%)	4 (25%)	5 (31%)	5 (31%)	2 (13%)	0 (0%)
	Researcher- practitioners	0 (0%)	1 (9%)	2 (18%)	6 (55%)	2 (18%)	0 (0%)
Formal training: masterclasses, courses etc.	Researchers	0 (0%)	0 (0%)	5 (24%)	9 (43%)	5 (24%)	2 (10%)
	Design professionals	0 (0%)	1 (6%)	7 (44%)	4 (25%)	4 (25%)	0 (0%)
	Researcher- practitioners	0 (0%)	0 (0%)	4 (36%)	4 (36%)	2 (18%)	1 (9%)
Researchers consulting to design companies	Researchers	0 (0%)	1 (5%)	4 (19%)	13 (62%)	2 (10%)	1 (5%)
	Design professionals	1 (6%)	2 (13%)	4 (35%)	5 (31%)	4 (25%)	0 (0%)
	Researcher- practitioners	0 (0%)	0 (0%)	5 (45%)	4 (36%)	1 (9%)	1 (9%)
Workshops	Researchers	0 (0%)	0 (0%)	1 (5%)	8 (38%)	11 (52%)	1 (5%)
	Design professionals	1 (6%)	2 (13%)	5 (31%)	2 (13%)	5 (31%)	1 (6%)
	Researcher- practitioners	0 (0%)	1 (9%)	1 (9%)	5 (45%)	4 (36%)	0 (0%)

D2: Rating of formats of knowledge products

Researchers (N=21)

Design professionals (N=16)

Researcher-practitioners (N=11)

		not important at all	not much important	somewhat important	important	very important	I don't know
Theory or models in papers	Researchers	1 (5%)	9 (43%)	3 (14%)	2 (10%)	3 (14%)	1 (5%)
	Design professionals	1 (6%)	4 (25%)	8 (50%)	3 (19%)	0 (0%)	0 (0%)
	Researcher-practitioners	0 (0%)	2 (18%)	4 (36%)	2 (18%)	1 (9%)	2 (18%)
Blogs	Researchers	0 (0%)	2 (10%)	6 (29%)	4 (19%)	2 (10%)	7 (33%)
	Design professionals	2 (13%)	3 (19%)	5 (31%)	4 (25%)	2 (13%)	0 (0%)
	Researcher-practitioners	0 (0%)	1 (9%)	3 (27%)	6 (55%)	0 (0%)	1 (9%)
Theory or models in books	Researchers	0 (0%)	7 (33%)	5 (24%)	6 (29%)	1 (5%)	1 (5%)
	Design professionals	1 (6%)	3 (19%)	4 (25%)	6 (38%)	2 (13%)	0 (0%)
	Researcher-practitioners	0 (0%)	2 (18%)	2 (18%)	3 (27%)	2 (18%)	2 (18%)
Design guidelines	Researchers	0 (0%)	1 (5%)	10 (48%)	4 (19%)	4 (19%)	2 (0%)
	Design professionals	0 (0%)	2 (13%)	6 (38%)	4 (25%)	3 (19%)	0 (0%)
	Researcher-practitioners	0 (0%)	0 (0%)	3 (27%)	5 (45%)	2 (18%)	1 (9%)
Case descriptions	Researchers	0 (0%)	2 (10%)	6 (29%)	8 (38%)	2 (10%)	2 (10%)
	Design professionals	0 (0%)	4 (25%)	2 (13%)	5 (31%)	5 (31%)	0 (0%)
	Researcher-practitioners	0 (0%)	0 (0%)	2 (18%)	6 (55%)	3 (27%)	0 (0%)
Designs or prototypes	Researchers	0 (0%)	1 (5%)	3 (14%)	9 (43%)	6 (29%)	2 (10%)
	Design professionals	1 (6%)	4 (25%)	2 (13%)	5 (31%)	4 (25%)	0 (0%)
	Researcher-practitioners	0 (0%)	0 (0%)	3 (27%)	4 (36%)	3 (27%)	1 (9%)
Tools and toolkits	Researchers	0 (0%)	0 (0%)	5 (24%)	9 (43%)	6 (29%)	1 (5%)
	Design professionals	0 (0%)	2 (13%)	3 (19%)	5 (31%)	6 (38%)	0 (0%)
	Researcher-practitioners	0 (0%)	1 (9%)	2 (18%)	4 (36%)	4 (36%)	1 (9%)

D3: Rating of three topics of actionable knowledge for design professionals

		never	rarely	sometimes	often	always	I don't know
Helped to organize projects	Researchers (19)	1 (5%)	6 (32%)	4 (21%)	6 (32%)	2 (11%)	0 (0%)
	Design professionals (15)	3 (20%)	6 (40%)	3 (20%)	2 (13%)	1 (7%)	0 (0%)
	Researcher-practitioners (11)	1 (9%)	4 (36%)	3 (27%)	2 (18%)	0 (0%)	1 (9%)
Helped to work within specific domain	Researchers (19)	1 (5%)	4 (21%)	5 (26%)	5 (26%)	2 (11%)	2 (11%)
	Design professionals (15)	2 (13%)	3 (20%)	3 (20%)	6 (40%)	1 (7%)	0 (0%)
	Researcher-practitioners (11)	0 (0%)	3 (27%)	0 (0%)	3 (27%)	2 (18%)	3 (27%)
Improved the design process	Researchers (20)	1 (5%)	6 (30%)	2 (10%)	9 (45%)	1 (5%)	1 (5%)
	Design professionals (16)	2 (13%)	2 (13%)	6 (38%)	4 (25%)	2 (13%)	0 (0%)
	Researcher-practitioners (11)	1 (9%)	2 (18%)	1 (9%)	6 (55%)	0 (0%)	1 (9%)

D4: Rating of three project conditions

		not important at all	not much important	somewhat important	important	very important	I don't know
Partner organizations who help to bring results to design practice	Researchers (21)	0 (0%)	1 (5%)	5 (24%)	8 (38%)	6 (29%)	1 (5%)
	Researcher-practitioners (9)	0 (0%)	0 (0%)	3 (33%)	2 (22%)	3 (33%)	1 (11%)
Funding for creating output for design practice	Researchers (21)	0 (0%)	0 (0%)	4 (19%)	10 (48%)	6 (29%)	1 (5%)
	Researcher-practitioners (9)	2 (22)	1 (11%)	1 (11%)	3 (33%)	2 (22%)	0 (0%)
Individuals in the project team who are personally motivated to serve design practice	Researchers (21)	0 (0%)	1 (5%)	2 (10%)	5 (24%)	12 (57%)	1 (5%)
	Researcher-practitioners (9)	0 (0%)	0 (0%)	1 (11%)	2 (22%)	6 (67%)	0 (0%)

D5: Rating of influence of active involvement of a design professional

	extremely influential	very influential	somewhat influential	slightly influential	not at all influential	I don't know
Researchers (17)	2 (12%)	9 (53%)	5 (29%)	1 (6%)	0 (0%)	0 (0%)
Design professionals (9)	0 (0%)	3 (33%)	4 (44%)	1 (11%)	0 (0%)	1 (11%)
Researcher-practitioners (9)	0 (0%)	2 (22%)	5 (56%)	0 (0%)	1 (11%)	1 (11%)

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Marieke Zielhuis (1975) was born in Haskerland, the Netherlands. She is a researcher at the research group Research Competence within HU University of Applied Sciences in the Netherlands. She obtained her Master Industrial Design Engineering at Delft and started in 2002 at the HU. She has worked in various roles which reside between university and practice: in Centres of Expertise (i.e. collaborations between knowledge institutions and practice organizations), in education programs for practitioners, and in research collaborations with practice. For several years, Marieke worked as a project leader of design research projects. During these projects, her interest for the topic of this thesis arose. In 2019, she started her PhD work at Delft University of Technology. Marieke's research centres on the collaboration between research and practice partners and the contribution of research projects to practice.

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