Ambiguity at the heart of design work

Sensing and negotiating ambiguity in knowledge-creation work

CHARLOTTA LINSE
Life is about not knowing, having to change, taking the moment and making the best of it, without knowing what’s going to happen next. Delicious ambiguity.

Gilda Radner
Abstract

Ambiguities have long intrigued design and new product development (NPD) researchers: The fascination seems rooted in an endeavor to understand how design outcomes may be created despite the ambiguous nature of such work. There are several classic contributions on how to categorize, avoid and approach ambiguities. Some of the newer theories have also pointed to benefits arising from temporarily sustaining ambiguity.

Little research has considered how ambiguities emerge, how ambiguities are sensed by practitioners, and the actions the practitioners take, either to harness or to reduce the generative and transformative power of ambiguity, however.

This is unfortunate, since ambiguities are at the heart of such knowing-work. If one does not know how to sense the emergence of ambiguities and act to reduce or harness their generative and transformative power, i.e. negotiate ambiguity, the work might become unproductive, confused, uncreative, and might require more energy and attention.

The purpose of this research is to portray how ambiguities emerge and are negotiated in knowing-work. This is achieved by drawing on two cases of design and NPD work, from practice epistemology.

The results indicated that the emerging ambiguities changed in the ongoing work, some being reduced, others becoming obsolete or persisting. The results also included five generalized actions to negotiate ambiguity: (1) constructing points of references, (2) mediating between perspectives, (3) anchoring in expertise, (4) disarming future resistance, and (5) creating shared visions.

This research has concluded that the very essence of design work concerns the emergence and fading away of ambiguity. The actions taken to negotiate ambiguity mediates the emergence of the design outcome. This research makes two contributions: first, it illustrates how ambiguities open up design work by creating a space for action; second, it illustrates how actions to negotiate ambiguity maneuver in this space for action.

Keywords
Ambiguity, negotiating activities, design work, NPD, knowledge-creation work, practice epistemology
Sammanfattning

Den typ av arbete som tar sig an utvecklandet av nya produkter och tjänster omges ofta av oklarhet kring vad som skall skapas, hur den framtida marknaden ser ut samt vilka utmaningar som kommer att framträda under arbetets gång. Sådana oklarheter har studerats i design- och produktutvecklingsforskning, ofta under antagandet att oklarheterna bör undvikas och minimeras. Dock finns det även nyare forskning som pekar mot att oklarheter kan vara fördelaktiga i arbetet.

Forskningen är dock begränsad vad gäller hur oklarheterna framträder i arbetet, hur praktiker förnimmer dessa oklarheter, samt hur en kan ta sig an dessa oklara situationer för att söka reducera eller dra nytta av potentialen i oklara situationer.

Detta är olyckligt, då oklarhet ligger i skapandearbetets kärna. En sådan begränsad kunskapsbildning leder till förenklade antaganden kring oklarhetens roll i design- och produktutvecklingsarbete. Därtill får det rent praktiska konsekvenser då designkonsulternas praktik och yrkeskunnande delvis är höljd i dunkel, genom att deras förmåga att förnimma och förhandla oklarhet tidigare förbiseits.

Syftet med denna forskning är således att studera hur oklarheter framträder samt förhandlas i skapandearbetet, genom att stödja sig på empiriska studier av arbetet i två designkonsultföretag, utifrån ett praktikperspektiv. Resultaten visar både att oklarheter uppkommer och försvinner kontinuerligt i arbetet, samt beskriver fem förhandlingsaktiviteter: (1) skapa referenspunkter; (2) medla mellan perspektiv; (3) förankra i expertis; (4) avväpna framtida motstånd; och (5) skapa gemensamma visioner.

Slutsatserna visar på att oklarheter skapar tolkningsutrymme i arbetet: i tvetydighetens många tolkningar öppnas ett utrymme för skapande och möjlighet till omtolkning. Därtill framkommer att förhandlingsaktiviteterna manövrerar i detta tolkningsutrymme, genom att nyttja eller minska oklarhetens många tolkningar.
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1 Introduction

Design and new product development work (NPD) is riddled with ambiguity. The work sets out to create a future design outcome, for which its intended use and characteristics, its future market and the process of its creation is partly unknown. Such unknown dimensions embed ambiguity as a natural aspect in design and NPD work, which has long intrigued researchers: The fascination seems to be rooted in a drive to understand how design outcomes may be created when it is unclear how to make unanimous interpretations about what is to be created and how.

In essence, this translates into a question of how design outcomes may be created despite its ambiguous qualifiers, such as it being defined in multivocal objectives, unclear demands etc. The purpose of the present research is to focus on just that by portraying how ambiguities emerge and are negotiated in knowing-work, a theoretical label that includes both design and NPD work.

The knowing-work ethos is anchored in practice epistemology (Souto 2013) and describes the kind of interpretative and analytical work in which ambiguities are considered to naturally emerge in human sayings and doings (Nicolini 2011; Gherardi 2012b). In combination, this enables the present research to make claims on the emergence and fading away of ambiguities in human sayings and doings during the creation of future design outcomes.

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1 The concept of “design outcome” is used to signify the products or services created in the design and new product development work.
2 Some of the classic contributions are those by Simon (1973), Schön (1983), Krippendorff (1989), and Weick (1995), later contributions include Lester & Piore (2004), Duimering et al. (2006), Brun & Saetre (2008), Brun et al. (2008), Brun et al. (2009), and Rajabalinejad & Spitas (2012).
3 Alvesson (2004, p. 49) discussed knowledge-intensive work as riddled with ambiguity, and that ambiguity implies that the possibility of rationality becomes seriously reduced, i.e. that “clarifying means-ends-relationship or exercising qualified judgment” is challenged.
4 “Knowing-work” has also been called “knowledge-creation work”, in the literature. These two labels will be used synonymously throughout this thesis.
By drawing on practice epistemology, this research will show that ambiguity in design and NPD work can open up the work by creating a space for action that may enable newness and creativity to flourish in-between a multitude of interpretations. Furthermore, the present research will introduce the notion of negotiating activities to show how such a space for action can be maneuvered in order to both harness and reduce the generative and transformative power of ambiguities, as such making use of its potential and reducing it when it is considered a threat.

Before discussing the shortcomings and problems with the literature on ambiguities in design and NPD work, two illustrative passages will be cited and discussed. These refer to two kinds of knowing-work, namely the new product development of mobile phones and the architectural design of a new building. These examples are presented to avoid going astray in the theoretical discussions, due to not having established the kind of practical situations that are in focus.

### 1.1 Two examples of ambiguity

Two illustrative passages are drawn from Lester and Piore’s book *Innovation – The Missing Dimension* (2004). These passages exemplify ambiguity in different types of knowledge-creation work. The first describes some of the ambiguities of creating a future design outcome that was totally new: as such interpreting the future demands and usage situations was ambiguous. The second passage describes some of the ambiguities that emerged when creating a design outcome for stakeholder demands that were vaguely verbalized and changing.

#### 1.1.1 The ambiguity of creating a “totally new” product

Lester and Piore (2004) described that “at least in the early stages of product development, it simply is not possible to arrive at a clear, unambiguous set of objectives for the project” (Lester & Piore 2004, p. 40). As an example of this they described an ambiguous situation that draws on new product development in mobile phone technology:

> In the early years of mobile phones, for example, none of the leading manufacturers knew for certain how the new technology would be used by consumers. The product was totally new. The closest analogs were the two-way radios used by police and emergency services, taxi
fleets, truckers, and the like. Many engineers believed that the mobile phone would remain a car-mounted device, used primarily by people in mobile professions. ... Almost no one imagined the extent to which ordinary customers would quickly demand mobile phone equipment.

... Only after seeing how consumers treated the initial products were engineers able to envisage a hand-held instrument that could be used while walking down the street or in the airport.

Lester and Piore (2004, p.40–41)

In this passage, Lester and Piore (2004) described a situation that they referred to as exemplifying “radical uncertainty” (p. 42) – which can be likened to what is here called ambiguity. The passage exemplifies the kind of situations in which the possible future scenarios are too uncertain even to be envisioned or hypothesized about (Lester & Piore 2004).

Thereto, Lester and Piore (2004) implicitly discussed how ambiguous situations can be approached when they mentioned drawing analogies to similar technologies and “seeing” the product in use. This was described in a context in which product developers are said to initiate work without a unanimous understanding for what they are trying to create.

1.1.2 The ambiguity of interpreting customer needs

Another passage is drawn from what Lester and Piore (2004) described as an interpretative approach to customer needs, which in essence means that customer needs come into being when they are articulated in interaction with a designer. The specific example concerns architectural work and describes how the architect interpret and co-create customer needs:

The client begins by talking about the building he thinks he would like. His ideas at this early stage are typically quite vague. The architect then sketches two or three rough drawings. The client looks at the sketches and points out where they seem inadequate, using them to try to explain to the architect what he now has in mind, but also rethinking what he wants in light of the architect’s interpretations. In the course of the conversation, the architect may ask why one or another feature of the client’s proposal is desirable and suggest an alternative way of achieving that aim.
During this process, the client may realize that two of the three drawings have features that should be incorporated into the final design. The architect then produces another sketch that reflects this conversation with her client but is also influenced, perhaps, by another building she has recently observed or by a colleague’s critique. The client looks at the new drawing and tries to restate (and rethink) what he really wants. And so it goes through the schematic design phase, until client and architect arrive at a common general understanding of the building.

Lester and Piore (2004, p.76–77)

The above example implies that customer demands are unclear and that an understanding of customer needs is intertwined with creating knowledge of the future design outcome, to arrive at an attuned, unanimous understanding. This suggests that the classical models of design and new product development work – which describe the identification and prioritization of stakeholder demands as preceding development activities (Lester & Piore 2004), i.e., in a sequential manner (e.g., Elias et al. 2002; Achterkamp & Vos 2008) – have little explanatory power and give little support to the practical accomplishment of knowledge-creation work.

The role of stakeholders and their desires is something that will enjoy much attention throughout this thesis, and is thus something that will be discussed further.

1.2 Ambiguities in work

This dissertation is positioned within research into ambiguity, which relate to the present topic to varying extents. Overall, one may classify research into ambiguity in three categories that relate to ambiguities in knowing-work.

The first stream of research does not specifically focus on ambiguity. Rather, ambiguity has been studied as it occasions sensemaking (Weick 1995), in relation to choice and decision-making (March & Olsen 1976), or as something that reduces the possibility of rationality in knowledge-intensive firms and work (Alvesson 2004). These are often considered the classical contributions to an overarching academic understanding of ambiguity in work, and will be referred to as such throughout this thesis.
The second stream of research into ambiguities is found in studies of ambiguous phenomena in other lines of work and other industries than knowing-work in design and NPD firms. For example, ambiguities have been studied as they emerge in the organizing of construction projects (Sahlin-Andersson 1989), as uncertainty and equivocality in process development projects in process industries (Rönnberg Sjödin et al. 2016), or as unexpected events in projects in the defense industry (Geraldi et al. 2010). Such contributions are on the periphery of this research.

The third stream focuses more specifically on ambiguities, or the practical doing of ambiguous work, in various kinds of knowing-work, and as such includes the literature most relevant to the present research. The classic contributions to this stream include theorizing about the organizing of design tasks as ill-structured problems (Simon 1973), about how professionals reflect in action in relation to “problematic situations characterized by uncertainty, disorder and indeterminacy” (Schön 1983, p. 16), and about that “design is making sense (of things)” (Krippendorff 1989, p. 9). All these classic academic works strengthen the notion that knowledge-creation work is ambiguous to its very core.

Later contributions to the third stream include, for example, strategies for managing NPD projects with ambiguous requirements and task ambiguity (Duimering et al. 2006); or for coping with uncertainties in design leadership by “maximizing desirable and minimizing undesirable uncertainties” (Rajabalinejad & Spitas 2012, p. 55). Such research is based on functionalistic assumptions that ambiguities may be identified, anticipated, maximized, minimized, and transformed, i.e., that they are object like.

In these various contributions, “ambiguity” has been defined in somewhat different ways, and at times synonyms have been utilized instead of or as well as the word as such. In the following subsections, the implied meaning of the concept of ambiguity as used here will be clarified, and then the classical roles of ambiguity in design and NPD research will be described.

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5 Functionalism implies studying a phenomenon in terms of how it affects stability and the social order (Burrell & Morgan 1979).
1.2.1 The connotation of ambiguity

A natural consequence of the various foci of the literature is that there are many slight variations in what is meant by “ambiguity”. Many utilize similar concepts such as uncertainty, equivocality, or complexity, at times with similar and at other times with different connotations.

This thesis builds primarily on Weick’s (1995) idea of ambiguity and uncertainty as emerging either from confusion due to multiple interpretations, or from ignorance due to lack of interpretation.6 By adopting a practice epistemology, ambiguity may be disconnected from individual shortcomings and instead points toward a contrariness intertwined with the situation that emerges in human sayings and doings (Nicolini 2011; Gherardi 2012b). Furthermore, Brun et al. (2008) add a qualifier to the ‘something’ being interpreted (which they call ‘cues’), that is, making interpretations of statements, artifacts, or situations. All in all, leaning on these contributions, ambiguity implies an inability to make unanimous interpretations of statements, artifacts or situations.7

The usefulness of the ambiguity concept

One may argue that ambiguities are natural in just about any work practice, since humans are likely to interpret the same situation in different ways. Such a claim is not refuted here, though the focus is somewhat more specific: this research studied not only situations in which design work participants made different interpretations, but also, situations in which it was impossible to settle on unanimous interpretations collectively or make univocal interpretations individually, without jumping to conclusions and as such potentially overlooking valuable alternatives. This might be compared with the impossibility of imagining future usage situations when creating the very first mobile phones, as described in the first passage from Lester and Piore (2004).

Design and NPD work has time and again been acknowledged as constituting a work practice riddled with ambiguity, anchored in creating meaning as regards unknown, future design outcomes (see, e.g.,

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6 Weick (1995) explicitly distinguish between ambiguity as confusion and uncertainty as ignorance. In this thesis Weick’s definition of both concepts are included under one and the same label, however, namely ambiguity.

7 In relation to this, it is important to point out that in situations in which it is unclear how to create any meaning, that also implies making an interpretation, although perhaps not one of much use.
Duimering et al. 2006; or the references to uncertainty in Khurana & Rosenthal 1998; Kim & Wilemon 2002; Stockstrom & Herstatt 2008).

The present research more specifically draws on the kind of work that is intended to create something new, e.g., a design outcome. This implies that interpretations must be made regarding the unknown, future design outcome of the ongoing work practice. In other words, researching ambiguities in knowing-work goes beyond studying the multiplicity of interpretations, to considering situations in which it may also be unclear what to interpret.

1.2.2 Ambiguity in design and new product development work

Many models for doing design and NPD work have been constructed, researched, strengthened, and discarded over the years. Describing such work in terms of models and other systematic approaches is an accessible and often utilized way of communicating designerly ways of knowing and doing. A common, closely connected, discourse to discuss such work as a sequential process entails talking about problem-setting and problem-solving as subsequent foci in the work (see, e.g., Schön 1983; Engwall & Westling 2004).

In essence, striving to foresee, plan and systematically structure the work is connected to an intention to enfeeble what Ullman (2003) has described as the design process paradox, that is, “the more you learn the less freedom you have to use what you know” (p.18). This idea of a paradox is connected to ambiguities in that the work is considered ambiguous and shrouded in ignorance early on, only to become unambiguous and enlightened later, when one has little freedom to change the paths already taken.

Leaning on other research than the extant literature on NPD for a moment, helps to pinpoint the shortcomings of the classical trust in work methods and models. Despite all the good intentions to account for ambiguous phenomena in these various structured approaches, ambiguities may still emerge in the void between such rules and the rule-following in the knowledge-creation work practice (Gherardi 2012b). Similarly, Alvesson

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* See, for example, Clark & Wheelwright (1993), Eisenhardt & Tabrizi (1995), Ulrich & Eppinger (1995), Cooper (2008), Lockwood (2010), Stickdorn & Schneider (2010), Micheli et al. (2012), and Johannesson et al. (2013).

‡ See, for example, Hoberg (1998), Ullman (2003), Engwall et al. (2005), Dubberly et al. (2008), and Stickdorn & Schneider (2010).
(2004) described the inevitability of ambiguities emerging in knowledge-intensive work, which seriously reduce the possibility of rationality in establishing means-ends relationships and exercising qualified judgements.

By failing to acknowledge the inevitability of ambiguities emerging in NPD work, the classical literature has attributed ambiguities the role of deviations, i.e., something that interrupts the ongoing work practice and that does not fit the normative model of how to undertake the work.

Some NPD research is anchored in the assumption that the work practice is riddled with ambiguities though. For example, Brun et al. (2009) have classified what they call “sources” and “subjects” of ambiguity. The sources of ambiguity refer to in what way ambiguity transpires, that is, in the novelty, multiplicity, or validity and reliability of interpretations. The subjects of ambiguity, on the other hand, refer to the part of the work to which ambiguities relate, namely, product, market, process, or organizational resource ambiguity (Brun et al. 2009).

Brun et al. (2008) have also explicitly questioned the negative assumptions surrounding ambiguity in NPD, concluding that ambiguities may be beneficial in NPD work. Brun et al. considered various kinds and categories of ambiguities in NPD work (2009), as well as how ambiguities may be beneficial (2008). Although making valuable contributions, this literature treats neither the emergence and sensing of the various ambiguities in NPD work, nor the practical harnessing of their “beneficial aspect” in ongoing work.

1.2.3 Different approaches to handling ambiguity

As mentioned, ambiguities have often been treated as deviations in design and NPD work, more so in the NPD than the design work literature. This negative assumption comes through in expressions and concepts concerning how to overcome the hurdles caused by ambiguous phenomena, concepts such as mitigating uncertainty (Brattström et al. 2012), managing uncertainty (De Meyer et al. 2002; Ward & Chapman 2003), and reducing ambiguity (Khurana & Rosenthal 1998; Brun & Saetre 2008).

Others have discussed the benefits of sustaining ambiguity (Brun et al. 2008), however. Brun and colleagues did not assume that ambiguity must
be reduced at all times. Actually, Brun and Saetre (2008) have proposed a model for testing multiple interpretation as well as the assumptions underlying such interpretations, with the intention of either reducing or sustaining ambiguity.

**A more neutral approach**

Those who take a more neutral stance toward ambiguity do so by discussing, for example, “tolerating ambiguity” (Yanow & Tsoukas 2009, p.1349), “coping with the ambiguity” (Gherardi 2012b, p.139), or even “sustaining ambiguity” (Brun et al. 2008, p.305), as already mentioned.

Yanow and Tsoukas’ (2009) research focuses on reflection-in-action, and tolerating ambiguity is mentioned only in passing as something included in skillfully performing design work, so little can be learned about how to tolerate ambiguity from this research.

What can be learned from Brun et al.’s (2008) article is that NPD work may benefit in at least four ways from sustaining ambiguity, namely, by “retaining fallback options, saving costs, saving time, and retaining ideas” (p.303). Although presenting an interesting finding, Brun et al. (2008) did not actually describe the activities for sustaining ambiguity; rather, ambiguities either were or were not there, and had either beneficial or negative influences.

Moreover, for Brun et al. (2008) the status quo is that ambiguities should eventually be reduced, while a few examples are cited of the benefits of sustaining ambiguity, temporarily. For example, they claimed that “by not fully reducing ambiguity, however, and instead by leaving certain interpretations open, the project will retain these as fallback options” (Brun et al. 2008, p.309-310). In this quotation, the line of reasoning is anchored in the assumption that reducing ambiguity is the norm. Moreover, although interpretations are left open, few clues are given as to how that is done in the practical accomplishment of the work.

**Ambiguity in practice-based studies**

Gherardi (2012b) went into great depth in describing the professional practice of coping with ambiguity, doing so by describing what she calls “a three-stage process of negotiation” (p.139). Her description of negotiating activities is intertwined with an empirical story about the blue-collar work
of assembling battery plates. The three stages of negotiating portrayed are: “coping with the ambiguity of interpretations”; “coping with the ambiguity of implicatures”; and “coping with the ambiguity of implementing the action” (Gherardi 2012b, p.139).

This dissertation, which is inspired by Gherardi’s (2012b) notion of a process of negotiation, refers to ambiguity being handled by means of “negotiating activities”. The concept of “negotiating ambiguity” is neutral toward the emergence of ambiguity implying that practitioners may seek to influence the multiplicity of interpretations, but cannot control them as object-like entities. “Negotiating ambiguity” captures the generative dance of combining both sensing ambiguities, and alternately reducing or harnessing them. The term “negotiating” has also made itself known in other practice-based research, for example, with reference to “negotiated meanings” (Gherardi & Nicolini 2002, p.433).

1.3 An academic understanding for ambiguities in knowing-work

As presented above many research efforts have contributed to an understanding of how ambiguities can be classified, reduced, and managed in design and NPD work (i.e., De Meyer et al. 2002; Brun & Saetre 2008; Brun et al. 2009). Some have even demonstrated that it might be temporarily beneficial to sustain ambiguities in NPD work (Brun et al. 2008).

Few have considered how ambiguities emerge in design and NPD work or how emerging ambiguities are sensed by the practitioners, however. Furthermore, little effort has been directed toward how practitioners act to reduce or harness the generative and transformative power of ambiguities – that is, how ambiguities are negotiated in the ongoing work practice.

Those who have considered the becoming and fading away of ambiguities from practice epistemology, have done so in research addressing work practices that differ distinctly from knowing-work10.

This is unfortunate, since ambiguities are at the heart of design and NPD work, as ambiguous situations emerge as a natural aspect of knowing-work.

10 For an example, see Gherardi (2012b) who relies on studies of blue-collar workers in an assembly line, as previously mentioned, and studies of safety practices in construction.
The limited understanding of the emergence and sensing of ambiguities in the practical accomplishment of knowing-work may have contributed to mistaken and simplistic assumptions about ambiguous phenomena being detrimental to design and NPD work. If the generative and transformative power of ambiguities were acknowledged, that might open up for harnessing ambiguities in some situations, and reducing it in others. This knowing-in-practice of sensing and doing, either to harness or reduce the generative and transformative power of ambiguity, is here called negotiating.

1.3.1 The purpose of the research

The purpose of this research is to portray how ambiguities emerge and are negotiated in knowing-work.

This research purpose is approached by adopting practice epistemology, in which it is natural to consider design and NPD work examples of knowing-work. Practice epistemology implies that this research shifts the unit of analysis “from individuals and their actions to practices and their relationships” (Nicolini 2011, p.602). This enables one to study the continuous unfolding of the work practice (Gherardi 2012b) in which ambiguities emerge, are sensed, and negotiated. This sensing and negotiating of ambiguities is assumed to be part of the practitioners’ knowing-in-practice, which is a concept referring to the practical accomplishment of everyday work (Gherardi 2012b).

The empirical findings draw on observations and interview material from two case studies: One was a study of service design work undertaken by consultants who had an industrial or engineering design education. The other was a study of NPD work undertaken by consultants with an industrial or engineering design education, or with a mechanical engineering background.

For simplicity, the former is referred to as service design work and the related organization as the Service Design Consultancy. The latter is referred to as technical design work and the related organization as the Technical Design Consultancy. To reduce confusion, the empirically studied work is henceforth referred to in the aggregate using the label “design work” unless only one of the cases is referred to. Furthermore, when design work is discussed in relation to extant literature it is also called knowing-work.
1.3.2 The importance of the research

This research contributes to a deeper understanding of ambiguities as a natural aspect of knowing-work. Ambiguities are considered as they emerge in human actions during design work. Furthermore, the negotiating activities reveal how people sense, face, and handle such ambiguities in the ongoing design work. Understanding these human actions opens up new opportunities for sensing and negotiating ambiguities, from which one may learn how to handle ambiguous situations in a generative and transformative way.

The conclusions suggest that ambiguities create a space for action in the knowing-work that allows and empowers creating new and other meanings. As design work participants sense emerging ambiguities, these may be negotiated in such a way as to maneuver in the space for action. In following up on several interpretations in parallel, the multiplicity of interpretations may be matched in new and various ways, to create a design outcome that attunes to some interpretation(s) of the work objective.

Overlooking the practical accomplishment of sensing and negotiating activities in knowing-work might have had consequences for how these work practices have been theorized in prior research and taught in education. Thereto, it may have had practical implications: if one does not know how to sense the emergence of ambiguities and when it is appropriate to act to reduce or harness their generative power, the work may become unproductive, stale, and non-creative.

Humans always make interpretations, and if one acknowledges that there might also be other possible interpretations that are just as valid in a given situation, one is likely to act more professionally. Disregarding ambiguities as they emerge, and not engaging in negotiating activities, means choosing ignorance over enlightenment.

That the knowing-in-practice of sensing and negotiating ambiguities is shrouded in mystery in both academia and among practitioners may also have consequences in the long run, for example, impeding communication about the objective of design work and the accomplishments of a design outcome. This might be important when initiating design work or when selling and buying design and NPD work as consultancy services.
1.4 Outline of the thesis

First a literature review is presented in three consecutive chapters. In Chapter 2 (“Ambiguity in knowing-work”), the concept of “ambiguity” is distinguished in relation to knowledge-creation work, both by relying on the classical contributions to an academic understanding of ambiguities as well as by focusing more specifically on ambiguities in design and NPD work. In Chapter 3 (“An analytical separation of ambiguities”), a theoretical framework for studying the concept of ambiguity in the empirical material is created and described. In Chapter 4 (“Negotiating ambiguity: approaching unclear situations”), various theorized approaches to unclear situations are reviewed and the concept of “negotiating activities” is introduced and justified.

After the three chapters of literature review, the new material that this thesis contributes is presented in four consecutive chapters. First, the methodological considerations and choices are described in Chapter 5 (“Constructing meaning in and through research”). Thereafter, the empirical settings of the empirical studies of the design work are described in Chapter 6 (“The two consultancy organizations”). Chapters 7 and 8, “Findings from the service design work” and “Findings from the technical design work”, describe the empirical findings from the two cases. Both of these chapters follow the same structural logic of first introducing the emerging ambiguities and then describing the negotiating activities.

In a third part of the thesis, comprising three chapters, the material from the two prior sections is analyzed and compared to draw conclusions. First, the empirical material is discussed at an aggregated level by comparing the two cases in Chapter 9 (“The emergence of ambiguity and activities to negotiate them: an empirical analysis”). In Chapter 10 (“Discussing the intertwineement of ambiguity and negotiating activities in knowing-work”), the generalized statements of the empirical analysis are discussed in relation to the literature review and the theoretical framework. In Chapter 11 (“Ambiguity at the heart of design work”), the research is synthesized and conclusions are drawn, the contributions are presented, and avenues for future research are finally suggested.
2 Ambiguity in knowing-work

The term ambiguity has been used and defined in various ways in extant literature. Although many have differentiated between ambiguity, equivocality, and uncertainty, they have done so in various and contradictory ways. In this chapter, both classical and contemporary scholars of ambiguity are reviewed.

2.1 Classical theories of ambiguous phenomena

Some of the major scholars who have set the stage for research into ambiguity, equivocality and uncertainty are March and Olsen (1976), Alvesson (1993) and Weick (1995). They have laid the foundation for an academic understanding of what is here called ambiguity. They have done so by treating ambiguity as an aspect of other phenomena; March and Olsen (1976) considered ambiguity as an aspect of decision-making; Alvesson (1993) embedded ambiguity in theories of knowledge-intensive firms and work; Weick (1995) discussed ambiguity as occasioning sensemaking.

2.1.1 Ambiguity and decision-making in organizations

March and Olsen’s seminal book Ambiguity and Choice in Organizations (1976) treated ambiguous phenomena in relation to several aspects of organizing work. Their starting point was that “all organizations confront elements of ambiguity in decision making. For some organizations ambiguity is a dominant condition.” (March & Olsen 1976, p.12). In one chapter, March and Olsen concluded that the world is “more complex, less stable, and less understood” than is described in mainstream theories of choice in organizations. The conclusion they drew from this is that individuals “are placed in a world over which they often have only modest control”, though organizational participants are seen as “problem-solvers and decision-makers”, i.e., that they make choices under ambiguous conditions (March & Olsen 1976, p.21).
March and Olsen used the concept of ambiguity to “signify four major kinds of opaqueness in organizations”, namely: ambiguity of intention, ambiguity of understanding, ambiguity of history, and ambiguity of organization. Ambiguity of intention concerns that “organizations are characterized by inconsistent or ill-defined objectives”. Ambiguity of understanding refers to the obscurity of the world: “technologies are unclear; environments are difficult to interpret” and means–ends connections are unclear, i.e., “it is hard to see the connections between organizational actions and their consequences”. Ambiguity of history concerns the past, as it “is not easily specified or interpreted. History can be reconstructed or twisted”. Ambiguity of organization notes that “individuals vary in the attention they provide to different decisions; they vary from one time to another. As a result the pattern of participation is uncertain and changing” (March & Olsen 1976, p.12).

Despite presenting one of the seminal theories of ambiguity in organizations and in relation to work, March and Olsen’s research has limited value for this thesis. March and Olsen did not emphasize what is here called knowing-work; rather, they drew on decisions in an educational context such as selecting a new dean, and participation and reorganization in a university (March & Olsen 1979). This difference in empirical focus is assumed to affect the nature of the emerging ambiguities that are the subject of theorizing.

2.1.2 Ambiguity and sensemaking in organizing processes

One detailed review of definitions of and differentiations between ambiguity, equivocality, and uncertainty was presented by Weick (1995). He distinguished between what occasions sensemaking due to ambiguity versus due to uncertainty: Ambiguity causes “people to engage in sensemaking because they are confused by too many interpretations”, while uncertainty occasions sensemaking because people “are ignorant of any interpretation” (Weick 1995, p.91). In this, Weick differentiated between ambiguity, as confusion from too many interpretations, and uncertainty as ignorance from unclear or no interpretations.

Other literature that Weick (1995) summarized distinguishes between ambiguity and equivocality in different ways, the former being described in terms similar to those applying to uncertainty above: “some have argued that ambiguity is more about unclear meaning and ‘equivocality’ is more
about the confusion created by two or more meanings” (p.92). Here equivocality is likened to ambiguity, as defined above. As such, uses of the concepts ambiguity, uncertainty, and equivocality are not only varying but also contradictory.

Another distinction between various concepts referring to unknown or unpredictable phenomena was presented by Alvesson (1993; 2001; 2004). In Alvesson’s (2004) research into knowledge-intensive work, ambiguities are understood to transpire in situations in which either “a group of informed people are likely to hold multiple meanings or … several plausible interpretations can be made without more data or rigorous analysis” (p.48). In Alvesson’s line of reasoning, ambiguity differs from uncertainty in that it cannot be clarified simply by gathering more facts.

Weick’s (1995) review of definitions and uses of ambiguity, equivocality, and uncertainty has been recognized as introducing another dimension for capturing the intricate network of multiple meanings and interpretations in work. Such a dimension is said to emerge in framing “ambiguity” as a “combination of equivocality and lack of clarity” (Brun et al. 2009, p.65). In other words, Brun et al. (2009) contended that Weick conceptualized ambiguity as emerging from either “lack of clarity” or because “two or more meanings can be assigned to the same cue” (Brun et al. 2009, p.65), “cue” being “a piece of oral or written information, a physical artifact, or a situation” (Brun et al. 2008, p.306).

Weick (1995) did not conclude his review of ambiguity, equivocality, and uncertainty by settling on exclusive definitions of the terms, but rather focused on what the differences in meaning imply for sensemaking: “Ambiguity understood as confusion created by multiple meanings calls for social construction and invention. Ambiguity understood as ignorance created by insufficient information calls for more careful scanning and discovery” (p.95). For Weick it is therefore not what occasions sensemaking that is crucial, but rather the kind of sensemaking such occasions call for.

2.1.3 Ambiguity, complexity, equivocality, and uncertainty

Another approach to conceptualizing ambiguity is that of Zack (2001), who distinguished between ambiguity, complexity, equivocality, and uncertainty as different knowledge problems. Zack’s vies of knowledge is in line with classical conceptions of knowledge discernible in the
Discussion of “knowledge problems” as challenges in processing knowledge (2001).

Classical conceptions of knowledge based on a functional resource view have been questioned by Alvesson (2004), Gherardi (2012b), and Sandberg and Tsoukas (2016), among others. In the functional resource view, knowledge represents “a ‘truth’ or at least something instrumentally useful on a particular subject” (Alvesson 2004, p.41). Such a view of knowledge has affected how knowledge has been researched, which Alvesson (2004) described as the “unfortunate tendency to trace the significance of knowledge through its effects, ascribing the effects to something that one knows little about” (p.53-54). Practice epistemology instead implies that knowledge is both created and communicated in knowing, that is, in the doings and sayings of a work practice (Sandberg and Tsoukas 2016).

Alvesson (1993) was also describing ambiguity based on its effects when he said that ambiguity “means that the possibility of rationality – clarifying–ends relationships or exercising qualified judgement – becomes seriously reduced” (p.1002). In later research, Alvesson (2001) continued this line of reasoning, arguing that the reduced possibility of rationality calls for knowledge creation as a basis for making informed judgments. By doing so, Alvesson connected ambiguous situations to knowledge creation, which is essential to this thesis.

Given the practice epistemology followed here, “challenges in creating and communicating knowledge” is a more suitable wording of what Zack intended by the label “knowledge problem”. Despite the different epistemological stance, Zack’s distinction between the four concepts relating to ambiguous phenomena have merit for understanding ambiguity in this research, given that it is related to knowledge in Zack’s conceptualization. These four concepts were intended to capture elusive and opaque phenomena in relation to knowledge, which is also the intention here. As such, Zack’s theory may inform this research into distinctions between various elusive and opaque phenomena.

Zack (2001) relied on Herbert A. Simon when contending that “complexity is simply ‘a large number of parts that interact in a nonsimple way’. … Complex situations are not necessarily vague or unpredictable” (p.3): uncertainty, on the other hand, is an inability to “choose from an exhaustive and well-defined set of possible states, even if that set is not
complex” (p.4). In other words, in these conceptualizations, neither complexity nor uncertainty is understood as unpredictable. Unpredictability, however, is a cornerstone of the phenomenon to be captured here.

What primarily distinguishes Zack’s (2001) approach to problems of creating and communicating knowledge is its differentiation between equivocality and ambiguity. Equivocality, in Zack’s view, refers to multiple and differing meanings or interpretations of the same thing. Such multiple and differing meanings “may be mutually exclusive or in conflict” (p.6). What makes ambiguity unique, and thus different from equivocality, is not the prevalence of multiple interpretations or meanings. Instead “ambiguity represents an inability to interpret or make sense of something” (Zack 2001, p.5). Weick (1995) was citing a similar conceptualization of the term when he claimed that “some have argued that ambiguity is more about unclear meaning and “equivocality” is more about the confusion created by two or more meanings” (p.92). This shared conceptualization of ambiguity, as something unclear that imposes an inability to make interpretations, is built upon here.

### 2.2 Later contributions to theories of ambiguous phenomena

Building on the ideas of Weick (1995) and Zack (2001), Brun et al.’s research claimed to classify ambiguities according to two dimensions: “sources of ambiguity” and “subjects of ambiguity”. To create such a classification, Brun et al. (2009) relied on empirical studies of NPD projects for medical devices, arguing that NPD activities “often take place under unstable, unpredictable, and changing situations” which justifies theorizing about the origins, manifestations, and effects of ambiguity (Brun et al. 2008).

The sources of ambiguity were identified as “multiplicity of the subject”, “novelty of the subject”, and “validity and reliability of information”, with “subject” referring to the interpretation of a cue. While “multiplicity” originates from “multiple and conflicting interpretations of a cue at any given time”, “novelty” instead emerges from “new interpretations over time”. Validity and reliability, on the other hand, cause ambiguity due to
“unrepresentative cues and because of inconsistent cues” (Brun et al. 2009, p.74).

The subjects of ambiguity were distinguished as “product ambiguity”, “market ambiguity”, “process ambiguity,” and “organizational resource ambiguity.” These subjects represent where the ambiguity can be claimed to transpire. As the term indicates, “product ambiguity” refers to ambiguities pertaining to the product being created. “Market ambiguity” is related to the external stakeholders. “Process ambiguity” pertains to ambiguities related to “the work process to be followed in the NPD project”. Finally, “organizational resource ambiguity” is related to the available resources (Brun et al. 2009, p.74).

2.3 The concept of ambiguity

In summary, reviewing the literature on various approaches to unknown and unpredictable phenomena reveals a few recurring patterns. It becomes obvious that research intended to define ambiguity in work can be differentiated according to approaches based on the origins of ambiguity (e.g., confusion, ignorance, and sources), how ambiguity transpires (e.g., subjects), and the effects of ambiguity (e.g., reduced possibility of rationality, sensemaking through careful scanning).

This research combines elements of the work of Weick (1995), Zack (2001) and Brun et al. (2008, 2009), making use of their compatible understandings of the concept of ambiguity. The essence of Weick’s conceptual development can be summarized as *ambiguity emerges either as confusion due to multiple interpretations or as ignorance due to no interpretations.* The variance between no and multiple interpretations can be summarized as the absence of unanimous interpretations, that is, no single, unanimous interpretation can be agreed upon.

Similarly, Zack contended that “ambiguity represents an inability to interpret or make sense of something” (2001, p.5). As such, Zack added the idea of “an inability” focusing on an embedded impossibility, but did not explore whether this inability stems from no or multiple interpretations. From practice epistemology, an inability of making interpretations is an impossible statement: In situations when human beings perceive an impossibility or inability of making any interpretations, that is in itself part of interpreting the situation.
In this research, Zack’s (2001) notion of an inability does have merit when focusing on a collective of practitioners, that is, in combination with the term unanimous, i.e., that there is an inability of making unanimous interpretations. Such an inability is not intended to pinpoint individual shortcomings or conflicts, but rather pin down the ability to acknowledge multiple interpretations.

The third piece of the puzzle, was added by Brun et al. (2008, 2009) in their notion of “a cue”. The “cue” corresponds to what Zack merely referred to as “something” in the quotation above. This “something” is a vague reference and as such it is reasonable to ask: “(multiple or no) interpretations of what?” What Brun et al. (2008) contribute to the discussion, is an understanding of what is being interpreted, or not, by including the idea of a “cue,” as “a piece of oral or written information” (a statement), “a physical artifact” (an artifact), or “a situation” (p.306).

Such a definition of what ambiguity “is” may be complemented by Alvesson’s (1993) idea that “the possibility of rationality ... becomes seriously reduced” in ambiguous situations, connecting the understanding of ambiguity to its entwinement into work practices.

In combination, these seminal contributions may be understood as that ambiguity implies an inability to make unanimous interpretations of a situation, statement, or artifact that seriously reduces the possibility of rationality.

2.4 Theoretical perspectives in the study of ambiguous phenomena

Research into ambiguities in knowledge-creation work may adopt any of several approaches. The particular approach adopted here has implications for the nature of the ambiguities theorized upon, and for the effects the ambiguities are considered to have.

2.4.1 Three levels where ambiguities manifest

Three approaches are briefly distinguished and described, before the third approach, the one adopted here, is examined in detail. The first two approaches do not explicitly relate the research to knowledge-creation work as such. However, the examples cited in these research streams can
be framed as knowledge-intensive in accordance with Alvesson’s definition (2004).

The literature considered below does not always use the term “ambiguity” to refer to the unpredictable and opaque phenomenon being theorized. However, decisions to consider literature that also discusses related concepts, such as uncertainty, are based on the various and often overlapping uses of the concepts as described earlier. The decision as to whether to include a particular line of reasoning is based on whether the opaque phenomenon in question fits the definition of ambiguity used here.

**Ambiguity and individual uncertainty**

First, research may address on the ambiguities and uncertainties that individuals perceive and approach in organizations. Despite a common desire to consider individuals, there are many ways to do so. For example, some have paid attention to ambiguities in relation to leadership (e.g., Cohen & March 1974) and settled on four recurring types of ambiguities leaders face: ambiguity of purpose, ambiguity of power, ambiguity of experience, and ambiguity of success.

In short, these types are conceptualized based on ordinary theories that become problematic from a leadership perspective. Ambiguity of purpose arises when “ordinary theories of decision making and intelligence become problematic”. Power becomes ambiguous when “ordinary theories of social order and control become problematic”. Ambiguity of experience comes about when “ordinary theories of learning and adaptation becomes problematic”. Finally, ambiguity of success arises when “ordinary theories of motivation and personal pleasure become problematic” (March and Olsen 1976, p.48-49. In sum, these four types of ambiguities are based on the idea that there is “something” in the work of leaders that is not easily captured in various leadership theories.

Others have theorized about uncertainty as perceived by individuals during daily operations from an employee perspective. For example, Milliken’s (1987) definition of uncertainty borrowed from Gifford et al. (1979), is “an individual's perceived inability to predict something accurately. An individual experiences uncertainty because he/she perceives himself/herself to be lacking sufficient information to predict accurately or because he/she feels unable to discriminate between relevant data and irrelevant data” (Milliken 1987, p.136). Building on this definition, Milliken
(1987), distinguished three kinds of uncertainty: (1) state uncertainty, an inability to make predictions about changes in the environment; (2) effect uncertainty, an inability to predict the nature of an impact on the future; and (3) response uncertainty, an inability to predict the consequences of a response.

This first kind of ambiguity, which is often referred to as uncertainty when it concerns individual perceptions, is not coherent with practice epistemology. This is mainly because the individual perspective tightly couples the uncertainties to individuals, to both their cognition (i.e., thinking something is uncertain) and their impressions (i.e., feelings of uncertainty or anxiety).

**Ambiguities in organizations**

The second approach comprises research that addresses organizational ambiguities based on their origins, with an emphasis on decisions. March and Olsen (1976), for example, pioneered the seminal theories of ambiguity and decision-making in organizations, as described earlier. This research into ambiguities is embedded in the tradition of neo-institutionalism (Gherardi 2012b).

This second approach has been adopted by many researchers, advancing our understanding of ambiguous phenomena. One such researcher is Sahlin-Andersson (1989), who connected strategic considerations to ways of coping with and exploiting ambiguous situations. The core of Sahlin-Andersson’s research is viewing ambiguity as embedded in organizing processes in-between architecture and construction work. She theorized about this based on an example of project cooperation across organizational boundaries. Although Sahlin-Andersson’s research is closely related to the present research, it is still based on a somewhat different ontology: ambiguities are treated as static and object like, that may be reduced and ultimately eliminated.

Despite a different perspective and assumptions, Sahlin-Andersson’s (1989) work is cited in the theoretical discussions presented here. Many of the ideas about opaqueness versus clarity and subsequent connections to organizing that Sahlin-Andersson presented constitute a sound foundation for understanding the becoming and fading away of ambiguities in work, and are therefore of value for this thesis.
Ambiguities in work practices

The third approach to theorizing about ambiguous phenomena in knowledge-creation work is based on practice epistemology. Following practice epistemology entails considering ambiguities as inherently embedded and emerging in the knowing-work practice (Souto 2013). Discussing this third approach in general terms is vague and creates little value. Rather, ambiguities emerging in practice should be connected to the specific work practice being researched.

Therefore, ambiguities emerging in practice will henceforth be described with a specific emphasis on ambiguities in knowledge-creation work, that is, in knowing-work. Knowing-work has been developed by Souto (2010) as a subcategory of Alvesson’s concept of knowledge-intensive work (2004). “Knowing-work” is “marked by emergent, unplanned and situational sensemaking” (Souto 2013, p.52) and, just like knowledge-intensive work, is characterized by “ambiguity intensity” (Alvesson 2004; Souto 2010).

2.5 The ambiguous knowing-work

“Knowing-work” is a theoretical concept stemming from practice-based studies (i.e., Souto 2010, Souto 2013) that builds on prior theorizations of knowledge work. Souto relied on Boland and Tenkasi explaining that knowledge work may be understood as a type of work that “creates new understandings of nature, organizations or markets and applies them in valued technologies, products or processes” (Boland and Tenkasi 1995, p.350 cited in Souto 2010, p.100).

Knowing-work is portrayed as a subcategory, that is, as a specific kind of, knowledge work, which comprises the kind of work practices that are “entirely focused on creating knowledge”, such as that performed by researchers, authors etc. (Souto 2010, p.100). There is also prior literature that has compared the notion of design thinking to knowledge work. For example, Rylander (2009) compared the two, and concluded that they anchor in different epistemologies but could potentially cross-fertilize. It seems however, that Rylander did not consider the studies on knowledge work anchored in practice epistemology, which to be fair was a rather small body of literature at the time.
In practice epistemology, ‘creating knowledge’ does not refer to the cognitive processes involved in creating some kind of theoretical or objective knowledge (Sandberg & Tsoukas 2016). Rather, it refers to work activities needed in order to construct a specific and communicable understanding in interactions between humans and artifacts (Gherardi 2012b). Such knowledge-creation work activities are undertaken in relation to a certain design outcome, be it a new product, a PhD thesis, or a business plan.

2.5.1 The ambiguous nature of knowing-work

Knowing-work may be undertaken on behalf of either external or internal clients and is characterized by “the intense use and application of intellectual resources, personal judgement, and professional assessment” (Souto 2010, p.100). The work practice may have “an underpinning plan or a predefined method for the execution of the work activities” (Souto 2010, p.102).

Any plans or methods for knowing-work, may be discarded at any given time for the benefit of the unfolding circumstances, however. Work plans or methods do not determine the actions of knowledge creation (Souto 2013): plans and methods are preliminary but must be put into use and revised in the practical accomplishment of the work. In line with this argument, knowledge creation by definition must be ambiguous (Alvesson 2004): the translation from generalized work practices, such as plans and methods, into specific knowledge-creating activities does not present a straightforward means–ends relationship. The situated nature of knowing-work implies that generalized and decontextualized rules for how to undertake a work practice must be situated in a historical, social and cultural context (Nicolini et al. 2003).

Souto discussed the ambiguous nature of knowledge work by comparing the various approaches and discussions presented in extant literature. In doing so, she relied on, among others, Alvesson’s (2004) notion of knowledge work as unordered and ambiguous, Markus et al.’s (2002) comparisons between emergent and unstructured processes in knowledge work, and Carlsen et al.’s (2004) conception of knowledge work as non-routinized. In particular, the rhetoric of Markus et al. (2002) illustrates how knowledge work, and knowing-work as a subcategory of that, may be understood to be ambiguous.
Emergent processes in knowing-work

Markus et al. (2002) have made an important distinction between “emergent processes” and ‘unstructured processes’. This distinction clarifies the peculiar nature of emerging work practices as well as pinpointing why ambiguity-intensive work does not mean “badly organized”, “insufficiently structured”, or the like. The difference between “emergent” and “unstructured” is subtle but important: “emergent” implies that the work is created in situated doings, while “unstructured” instead refers to chaos and lack of control, suggesting that “structuring is possible and desirable” (Markus et al. 2002, p.182).

What may be understood from Markus et al.’s (2002) distinction is that the ambiguous nature of knowing-work should be understood neither as chaotic and unstructured, nor as by definition causing anxiety or uncertainty among individuals. Instead, the ambiguous nature of knowing-work relates to the continuous flux of the work practice: knowing-work emerges in a geographical, temporal and relational context and is mediated in the interactions between humans and artifacts (Nicolini et al. 2003).

In summary, this thesis uses practice epistemology as a foundation for studying the emergence of ambiguities in knowing-work and the actions to negotiate them. Knowing-work is established as an ethos of the traits unifying design work and NPD work, i.e., that focus on knowledge creating activities. The value of the knowing-work label is that it enables one to emphasize similarities and generalize findings across both design and development work.

2.5.2 Ambiguity in design or NPD work

In the following two subsections, research concerning ambiguities is separated into foci on NPD and on design work. Such a separation is made because somewhat different traditions and ideas underlie these two streams (see, e.g., Micheli et al. 2012), that have largely kept to themselves. However, the boundaries between them are blurred: each relates to the other, and in ongoing work, design work and NPD are more or less intertwined (Micheli et al. 2012). For example, Ulrich and Eppinger’s (1995) book treated both product design and product development, but has been most prominently cited in NPD research.
Ambiguity in new product development work

In the classic design and NPD literature, an underlying assumption seems to have been that ambiguities are negative and thus that ambiguities should be avoided. This assumption seems connected to a long tradition of emphasizing that NPD work flourish in structured, systematic approaches and detailed plans (see, e.g., Graner & Mißler-Behr 2012).

The emphasis on structure, systematic approaches and detailed plans is characteristic of a school of thought articulated, for example, in Clark and Wheelwright’s seminal *Managing New Product and Process Development* (1993) and Ulrich and Eppinger’s *Product Design and Development* (1995). Both these distinguished books contribute detailed descriptions of, for example, models for addressing task dependencies (i.e., sequential, parallel, or coupled), methods for managing the projects, and tools for concept generation, selection and testing.

Classical theorizing about models, methods, and process descriptions for design and NPD work as such portrays it as straightforward and foreseeable. Later contributions have continued on the same trajectory by focusing on which models and methods to make use of (see, e.g., Graner & Mißler-Behr 2012; 2013), rather than questioning the need for structured approaches to begin with or the practical accomplishment of working in accordance with such structured approaches.

These traditional models for organizing new product development work in essence propose either doing work activities linearly and sequentially, or iterating the sequential work activities (Clark & Wheelwright 1993; Ulrich & Eppinger 1995; Ullman 2003; Johannesson et al. 2013).

Textbooks to present NPD work in an understandable and accessible way, have proposed a few alternative models to choose from such as concurrent engineering or agile development (Johannesson et al. 2013). These simplified textbook models do have similar counterparts in the academic research on NPD. For example, Eisenhardt and Tabrizi (1995, p.84) presented a “compression model” and an “experiential model” to contrast two ways for “achieving fast adaptation through product innovation.” The differentiation between these two models were a qualifier relating to

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11 This school of thought seems to prevail also in later literature about NPD work, see for example the accessible textbooks by Ullman 2003 or Johannesson et al. 2013, which summarize the more prevailing structured approaches into a few generalized methods.
ambiguity, the former model assuming a “well-known, rational process” and the latter “an uncertain process” relying on “improvisation, real-time experience, and flexibility” (Eisenhardt & Tabrizi 1995, p.84). Much research has focused on how to optimize the use of various methods in the ongoing work (e.g., see the reviews of literature in Graner & Mißler-Behr 2012, 2013).

The development and substitution of various systematic approaches seems in itself connected to handling ambiguities by assuming that ambiguities may be planned away. In concurrent engineering, for example, several competences, between which a close collaboration is advocated, work in parallel in the development (Johannesson et al. 2013). The ambiguity emerging in having to make late and costly changes is ideally minimized in this model, since all competences are integrated early in the process.

In agile development, the work is organized into shorter “sprints” by being separated into identifiable, demarcated tasks planned for a foreseeable future. This is theorized to make the work more flexible (Johannesson et al. 2013). The increased flexibility, in turn, is anticipated to make it possible to include and account for ambiguities as they emerge. However, one may justifiably question the assumptions underlying the idea of subdividing work into discrete tasks, when it is riddled by ambiguity in objectives, activities and results alike.

Ambiguity in design work

The classical approach in research into design work has been to consider it a reflective (Schön 1983) and sensemaking (Krippendorff 1989) work practice. In these approaches, ambiguities seem to be considered a naturally occurring aspect of the work, i.e., that the work practice is about reflecting on and making sense of ambiguous phenomena. However, the connection to ambiguity is not explicit.

Schön praised the problem-setting embedded in professional design work and claimed that the practitioner “must make sense of an uncertain situation that initially makes no sense” (Schön 1983, p.40). Furthermore, Schön implied that this making of sense was part of the design work practice and claimed that “our knowing is in our action” (Schön 1983, p.49).
Krippendorff (1989, p. 9) added to this line of thinking in the ingenious definition that “design is making sense (of things)”. The single definition alludes to three intertwined interpretations. A first interpretation is that “design is making sense (of things)” which emphasizes that design is initiated under ambiguous conditions and must strive to translate the ambiguous design objective into a meaningful or sensible outcome. A second interpretation is that “design is making sense (of things),” which emphasizes doing and knowledge creation concerning future outcomes. Finally, a third interpretation is that “design is making sense of things.” This third interpretation indicates that design is concerned with creating knowledge in such a way that an unknown future design outcome may be constructed.

In the newer design work literature, many models, toolboxes, and other systematic approaches have been created to make the work more orderly and structured (e.g., Lockwood 2010; Stickdorn & Schneider 2010). In line with these efforts to create explanatory models of design work, acknowledgement of ambiguity and of sensemaking seems to have faded away. For example, more than a third of Lockwood’s anthology Design Thinking: Integrating Innovation, Customer Experience, and Brand Value, is devoted to methods for design thinking (Lockwood 2010), while ambiguity goes unmentioned.

Similarly, Stickdorn and Schneider’s (2010) anthology on service design thinking describes the value and utilization of at least 25 tools for service design thinking. These tools are to be understood as constituting a toolbox from which one may pick and choose. Carlgren et al. (2016), on the other hand, described challenges, several of which relate to ambiguity, of integrating design thinking into innovation work: for example, “misfits with existing processes and structures” is described as ruling out unanimous interpretations about how to systematize the work (p.356).

There is, however, newer literature that does acknowledge the ambiguous nature of design work. For example, Dorst and Cross (2001) have found that the professional practice of design work is much more evolving, improvised, and original than can be captured in models and methods. In line with such claims, a more mysterious aspect has often been postulated to close the gap between rigid systematic approaches and the practical “doing” of design work.
This mysterious aspect has been researched under many different labels, expressed in terms such as “analogizing from abstract experiential knowledge” (Ball et al. 2004), “creativity from surprise” (Dorst & Cross 2001), and “coping with uncertainty through design leadership” (Rajabalinejad & Spitas 2011). These expressions are intended to capture the unexplainable dimension of design work models, often by assigning it to some kind of innate ability.

Other lines of research have found a middle way between a firm belief in models and methods and the assumptions of innate, personal abilities. For example, Verganti (2009, p.viii) focused on the process of inventing radically new meanings of products and services, going as far as to claim that “design-driven innovation is the R&D process for meanings”.


3 An analytical separation of ambiguity

This chapter examines, in detail, the emergence of ambiguity in the kind of work of interest here, which will result in a theoretical framework. Brun et al.’s (2009) categorization of subjects of ambiguity will be relied on, with one slight difference. The fourth category, which Brun et al. (2009) described as an inability to make unanimous interpretations of the available resources in terms of “the participants, their responsibilities and roles, management, and financial resources” (p.74), has not been afforded its own subsection.

The reason for this decision is that although such organizational resource ambiguities may emerge in relation to knowing-work, they are not really aspects of the work activities involved in creating a design outcome. As expressed by Brun et al. (2009), organizational resource ambiguity pertains to “the resources available to the project organization” (p.74). In other words, this fourth category of ambiguity emerges in relation to the staffing and funding of the project, rather than the work activities in the knowing-work (which more specifically relate to creating a design outcome). The staffing and funding of the project were furthermore work activities that were undertaken by other individuals, with other professional backgrounds, than the design consultants.

Brun et al. (2009) established three other categories of ambiguity that relate more clearly to the design work activities when creating a design outcome, calling them product, market, and process ambiguity.

One may argue that Brun et al.’s (2008, 2009) worldview is more absolute than the practice epistemology adopted here. On the other hand, the intent of this thesis is to build on and contribute to the literature on design and NPD work by assuming a practice epistemology, adding a new perspective and demonstrating the benefits of a less absolute worldview. The work practice that Brun et al. (2008, 2009) relied on can furthermore be assumed to be somewhat similar to the work practice sought here. They used four case studies of medical-device companies to gather empirical
material on ambiguities in NPD work, with the work project as the unit of analysis. As such, Brun et al. considered aspects particular to work aimed at creating a new design outcome. This differs from, for example, March and Olsen (1976) who did not specifically concentrate on knowledge-creation work, but rather theorized about ambiguities and choice in relation to continuous line work in organizations.

The categorization of ambiguities according to the product, process, and market dimensions is understood here as an analytical distinction made to facilitate the analysis and communication of ambiguous phenomena. In ongoing emerging work practices, these various ambiguities should be understood as intertwined.

### 3.1 Product ambiguity

Product ambiguity pertains to an inability of making unanimous interpretations of any aspect of a product being created, such as “the product concept, the intended setting for its use, its functional requirements, its performance, its prices, and the technologies involved” (Brun et al. 2009, p.74). This quotation is part of Brun et al.’s (2009) theorizing about ambiguities in NPD work, which is based on empirical examples from the medical-device industry. In sum, what Brun et al. said is that product ambiguity concerns the kinds of ambiguities that emerge in relation to the design outcome being created.

Product ambiguity may emerge at any time during knowing-work, given that it is related to interpreting multiple aspects that are constantly emerging and changing, such as the product concept and the technologies involved. From practice epistemology, one may infer that the design outcome is subject to interpretations situated in time and space and dependent on the historical, social, and cultural context being interpreted (Blackler 1995; Nicolini et al. 2003).

Krippendorff’s (1989, p.9) seminal work characterized the purpose of design work as “making sense (of things).” This ingenious definition implicates three simultaneous meanings depending on where the emphasis is placed. These three interpretations can be related to three ambiguous aspects of design work. One interpretation specifically concerns product ambiguity, when the emphasis is that “design work is making sense of things.” Such an interpretation indicates that design work
is concerned with creating knowledge in such a way that an unknown “thing” may be constructed (Krippendorff 1989). This interpretation in turn implies that when design work is initiated, the design outcome (i.e., the “thing”) does not make sense: the product is ambiguous.

The aspects that Brun et al. (2009) mentioned (in the quotation presented at the start of 3.1), such as the product concept and functional requirements, are often considered in design work and design research. Extant literature has shown that such aspects are deliberated on in relation to defining the product, i.e., specifying characteristics of the product-to-be such as function and performance (Ullman 2003).

Khurana and Rosenthal (1998) summarized a number of common problems in the early phases of NPD work, among others the product definition was one pinpointed area. They claimed that a common problem emerging in defining the product is ambiguity about the technologies or features of the product-to-be. Such a problem must be weighed against another common product definition ambiguity, namely the “overspecification of tolerances” (Khurana & Rosenthal 1998, p.62). Another problematic area in Khurana & Rosenthal’s (1998) literature review was the project definition. They noted that the project definition is connected to resource allocation, project priorities, and market contingencies, with “unclear objectives” being defined as a common problem (p.62).

In this thesis, the ideas of ambiguous and unclear project definitions, as presented by Khurana and Rosenthal (1998), are combined under the label of “ambiguous objectives” because product and project definitions are considered to go hand in hand. This is in line with Duimering et al.’s (2006, p.239) claim that NPD projects are initiated with a set of “more or less ambiguous statements defining required product characteristics and features” connecting the project statements (i.e., project definition) with product characteristics and features (i.e., product definition).

The conclusions of this thesis are generalized beyond product development or design work to the overarching concept of knowing-work. One empirical example is drawn from the development work to create a new physical product, while the other empirical case is based on the design work to create a service. These two cases are compared under the rubric of knowing-work, which includes both of these kinds of knowledge-creation work. Given that the “product” label may well be used to refer to both
physical goods and services, the term “product ambiguity” does not present a particular problem by excluding the design outcome of one of the studied work practices. Instead, it includes the design outcome in both empirical cases, be it a physical good or a service.

3.1.1 Ambiguous objectives

Product ambiguity may be detailed in greater depth by discussing ambiguous objectives. First, the connection between product ambiguity and ambiguous objectives will be detailed. Product ambiguity can be considered to transpire in the design work objective. The aspects that Brun et al. (2008) related to product ambiguity (e.g., the product concept and the intended setting of its use) are ideally part of establishing the objective of design work.

Johannesson et al. (2013) described how the initial “product specification” (here called the “design objective”) is intended to “include and describe all criteria that are relevant for the product being developed” (p.117). Furthermore, they argued that the product specification should, among other things, comprise criteria that are “solution independent and univocal” (Johannesson et al. 2013, p.151). This line of reasoning readily expressed in Johannesson et al.’s textbook is mirrored in research articles on the so-called fuzzy front-end (see, e.g., Moenart et al. 1995; Khurana & Rosenthal 1998; Stockstrom & Herstatt 2008). The common claims about establishing criteria for the design outcome early on, in design and development research, was already questioned in the introduction for being too reductionist.

At the same time, Johannesson et al. (2013) questioned the possibility of including and describing all relevant criteria, also claiming that “the product specification is indeed a living information set that should be developed and updated during the product development process, as the understanding for the product to be evolves” (p.150). As such, Johannesson et al. (2013) considered the notion that there may be an inability to make unanimous interpretations about the product to be, and that such interpretations may be intertwined with the product development activities.
Ambiguous goal formulations in project management

The discussion of unknown aspects of design and development work has a counterpart in project management research. Extant project management literature has often problematized ambiguous objectives or goal formulations. It has been argued that NPD projects are initiated based on a set of “more or less ambiguous statements defining required product characteristics and features” (Duimering et al. 2006, p.239). Such ambiguities have been conceptualized as stemming from that many aspects of the work are initially unknown or opaque (Duimering et al. 2006), and this line of argumentation concludes that ambiguities, uncertainties, and complexities influence “the difficulty of managing NPD projects” (p.240).

Other research, however, is less normative in its negative stance toward ambiguity, instead emphasizing ambiguity as naturally embedded in the intricate nature of project work (see, e.g., Sahlin-Andersson 1989; Engwall 2002). Design and NPD work may be considered specific kinds of project work.

In other words, ambiguity may also be associated with something more neutral or even positive: ambiguities may be used strategically for congregating interest, to create engagement, to unify groups of people, etc (Sahlin-Andersson 1989). Such a positive view of opaque and unclear phenomena has been considered on in project management research. Extant literature on goal formulation in project management has argued that the primary function of goal-setting is to “create project beginnings rather than predicting project ends” (Engwall 2002, p.262). The primary purpose of goal-setting in projects is considered to be to enable action, in such a line of reasoning (Engwall 2002), so ambiguous goal formulation may in fact be intentional (Sahlin-Andersson 1989; Engwall 2002).

Furthermore, project management research has indicated that it is problematic to specify work objectives in excessive detail too early (Engwall 2002). Early on, the work is subject to uncertainty and ambiguity, while the later work is smoother in planning and undertaking as the work participants have a somewhat more shared understanding of the outcome to be achieved (Engwall & Westling 2004). Karrbom Gustavsson and Hallin (2015) built on the idea that projects cannot have clear goals from the onset, and proposed two project modes to better understand the role of goals in projects, i.e., “goal seeking and goal oriented.” These two modes “should not be understood as representing a dichotomy but as two different
states a project can be in” (Karrbom Gustavsson & Hallin 2015, p.373). The goal-oriented mode describes (the parts of) a project in which the goals have been clearly defined, with specified activities, resources, and time frames. In the goal-seeking mode, on the other hand, the project is seeking to specify its goals (Karrbom Gustavsson & Hallin 2015).

Claims about the inability to unanimously define project objectives or goals are connected to ambiguity in that project goals cannot be about making unanimous interpretations of the project end in the early phases of the work—the future is unknown and thus ambiguous.

Instead, ambiguous goals enable work to be initiated by participants with various interpretations and interests in relation to the work objectives (Sahlin-Andersson 1989; Engwall 2002). Ambiguous objectives also allow multiple actors to emphasize and concentrate on different parts of the objective depending on the emerging work practice (Sahlin-Andersson 1989).

A group of stakeholders with heterogeneous expectations and agendas in relation to a project may assemble and collaborate around an ambiguous goal formulation, providing that they may all fit their own agendas into this formulation (Sahlin-Andersson 1989; Engwall 2002). This has been recognized as an important aspect of design and development projects, given that they have been framed as collective undertakings (Engwall et al. 2005).

Lester and Piore (2004) invoked the same line of reasoning in implicitly warning that the drive to clarify may in fact eliminate “the very conditions of uncertainty that are needed for creativity to flourish” (p.69). In other words, clearly defined work objectives may restrict the creative space and as such the potential of knowledge-creation work.

3.2 Market ambiguity

Market ambiguity relates to an inability of making unanimous interpretations of external stakeholders in terms of “who they are (e.g., users, government agencies, and competitors), what their roles, needs, and interests are, and what market segments to target” (Brun et al. 2009, p.74). Furthermore, practice epistemology allows one to appreciate that this is not a static picture: as the design work unfolds, the stakeholders as well as
their needs and interests may change, similarly the designers’ understanding of these desires also change.

Much theorizing about the role and handling of stakeholders is found in research into project management (see, e.g., Obeng 1995; Elias et al. 2002; Littau et al. 2010), NPD (see, e.g., Clark & Wheelwright 1993; Johannesson et al. 2013), and design work (see, e.g., Kelley 2001; Stickdorn & Schneider 2010; Cooper et al. 2011), research streams that seem to emphasize various aspects of handling stakeholders.

In the project management literature, much theorizing is based on the idea of evaluating stakeholders according to their interest in the project, the extent to which they are affected by the project, and the extent to which they are assumed to influence the project (Elias et al. 2002; Olander 2007; Achterkamp & Vos 2008; Tonnquist 2008; Maylor 2010; Littau et al. 2010). The idea of stakeholders was established by Freeman in 1984 and has since mainly attracted attention in project management research focusing on construction or the IT sector (Littau et al. 2010). Freeman’s definition of a stakeholder has been questioned for reasons of being ambiguous in that it may include just about anyone (Olander 2007; Achterkamp & Vos 2008).

In the NPD literature, the idea of stakeholders is fairly similar to that in project management, except that the unit by which stakeholders are defined is the new product rather than the development project. This seems to mean that in the product development literature, stakeholders are conceptualized as organizational groups, such as the manufacturing or marketing department, that have an interest in the characteristics of the new product (Johannesson et al. 2013).

Literature on industrial design work and design management instead tends to emphasize ways of learning about end-consumer needs, often under the label of user-centered design (see, e.g., Ulrich & Eppinger 1995; Kelley 2001; Stickdorn & Schneider 2010; Cooper et al. 2011). There are endless discussions of how such learning is preferably achieved. For example, Kelley (2001) described how IDEO, the leading design firm in the USA, “go[es] to the source. Not the ‘experts’ inside a company, but the...

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12 “Freeman (1984) describes the concept of stakeholders as any group or individual who can affect, or is affected by, the achievement of a corporation’s purpose” (Olander 2007, p.278).
actual people who use the product or something similar to what we’re hoping to create” (p.23).

There are objections to the strong emphasis on end-consumers, however. For instance, Verganti (2006; 2009) concluded that emanating from whatever end-consumer say that they need or want, will only lead to improvements of existing products and services. Instead, Verganti proposed what he called design-driven innovation, that is, an approach to radically invent new product meanings, from an internal company perspective (Verganti 2006; 2009). In this thesis, such a distinction is beyond the scope in a way. The matter of considering stakeholders, depends solely on if ambiguities relating to the stakeholders (be it clients, suppliers or end-consumers) emerged in the ongoing design work.

In this thesis, market ambiguity is considered to be based on the relationship with the design work practice. In essence, this means taking account of the various demands that the varying stakeholders impose on the practice.

### 3.2.1 Ambiguous demands

Ambiguous demands relate to an inability of making unanimous interpretations of stakeholders’ requests and expectations of design work. Demands as to what design work should deliver have long attracted considerable attention in design research. Likewise, the ambiguous nature of such demands has been considered under various labels.

In the classical design and new product development literature, customer demands have attracted considerable attention. The common rhetoric is to articulate principles similar to “listen to the voice of the customer” (Lester & Piore 2004, p.76), implying that customers have clear opinions that they voice and that should be “heard” in the development work. Such an idea is based on the understanding that customer needs are preexisting and that design and development work is about “identifying” the needs and then creating offerings to match such needs in a linear, sequential fashion (Lester & Piore 2004).

Any ambiguities connected to such a view of customer demands could therefore be assumed to arise from miscommunication between customer and designer. In contrast, the interpretative view of customer demands
disputes the classical notion of preexisting needs, shifting the center of attention to the emergence of ambiguities.

Often, in NPD or project management research, the matter of the stakeholders’ demands, that goes beyond the customers, is approached with a process model including: identifying stakeholders, evaluating their needs and interest in relation to the project process and result, and managing these demands either by meeting needs and desires or by managing expectations (Elias et al. 2002).

Stickdorn and Schneider (2010) related the demands in service design work to the varying stakeholder groups. Service design work is said to be initiated with explorative activities to “understand the culture and goals of the company” for which a service is being designed. Thereafter, service design work generally focuses on “identifying the real problem” by “gaining a clear understanding of the situation from the perspective of current and potential customers” (Stickdorn & Schneider 2010, p.128). This may at first glance seem straightforward, but the “goals of the company” and “customer perspective” are somewhat more ambiguous.

The ambiguous nature of demands is somewhat acknowledged later in Stickdorn and Schneider’s (2010) book when they asked: “How do you know what customers want, need and desire?” (p.140). Unfortunately, the question was not taken seriously, as the remedy for “knowing what customers want” was reduced to the following: “deep-seated or hidden needs and cultural trends can all be identified from dialogue with customers” (Stickdorn & Schneider 2010, p.140).

It is this oversimplified view that Brun et al. (2009) problematized when they described market ambiguity as the inability to make unanimous interpretations about who the stakeholders are and what their “roles, needs, and interests are” (p.74). In other words, stakeholders’ demands are ambiguous, given that they both vary between stakeholders and change over time.

**Some established design work methods for approaching ambiguous demands**

The extant design research literature offers some clues as to how to approach stakeholders’ ambiguous demands, telling of endless toolkits and methods for learning about end-consumers and how to analyze their
demands. Stickdorn and Schneider (2010) proposed a few: “shadowing,” “contextual interviews,” and “the five whys” as ways of learning about end-consumers’ behaviors and underlying desires.

In “shadowing,” the designer observes end-consumers, front-line staff, etc. “Contextual interviews,” was described as an ethnographic technique undertaken in the context in which a service is provided, “allows interviewers to both observe and probe the behavior they are interested in” (Stickdorn & Schneider 2010, p.162). “The five whys” refer to a technique for exploring a specific problem by asking “why” repeatedly so that one can “uncover the motivations that are at its root cause” (Stickdorn & Schneider 2010, p.166).

Stickdorn and Schneider also proposed many techniques for analyzing what the designers have learned during, for example, shadowing or other interactions with stakeholders. A few of the mentioned techniques are “customer journey maps,” “personas,” and “what if.” A “customer journey map” is constructed based on interaction points between end-consumers and a service provider and “provides a vivid but structured visualization of a service user’s experience” (Stickdorn & Schneider 2010, p.158). “Personas” are idealized end-consumer groupings based on shared interests, such as similar demands or needs, which visualize “different perspectives on a service, allowing design teams to define and engage the different interest-groups that may exist within their target market” (Stickdorn & Schneider 2010, p.178). “What if” is a technique for considering outlandish future scenarios by provoking participants to “imagine the kinds of problems [such situations] would present” (Stickdorn & Schneider 2010, p.182).

These ways of learning about various interest groups and analyzing their potential demands are only a few of many such methods presented in the extensive literature on design techniques for considering stakeholder demands. The point is not to present a comprehensive overview, but rather to illustrate how the design literature has approached the ambiguity of demands emerging from having various stakeholders with differing and changing desires regarding the future design outcome.
3.3 Process ambiguity: ambiguity of implementing actions

Process ambiguity relates to an inability of making unanimous interpretations of work activities, such as “tasks to perform, dependencies among them, sequences in which to perform them, their inputs, and their outputs” (Brun et al. 2009, p.74). Brun et al. made this statement in relation to NPD in the medical-device industry. However, the quotation can be assumed to have a bearing on this thesis as well, given that it also concerns situated actions to create knowledge and thus to construct something new, be it a product, service, or something else.

There is a long tradition in NPD research to theorize on and emphasize the usefulness of various systematic approaches to structure sequences and dependencies between work process activities (e.g., Clark & Wheelwright 1993; Brown & Eisenhardt 1995; Ulrich & Eppinger 1995). Others have distinguished between organizing NPD work when the work process is assumed to be predictable and plannable in detail versus when the work activities are uncertain and the market and technologies are shifting (Eisenhardt & Tabrizi 1995).

The idea of talking about work processes, their inputs, outputs, and the like, reflects a more functionalistic and absolute view of work and knowledge than does the view of work practices and knowing applied here. Part of the difference is that practice epistemology discards both the idea of dualisms, such as mind/body (Gherardi 2012b; Sandberg & Tsoukas 2016) and the input, process, output schema as discussed here. In practice epistemology one considers emergence (Nicolini 2011) and entwinement (Sandberg & Tsoukas 2016), indicating that interpretations of “input” and the understanding of an eventual “output” are entwined and become simultaneously, in situated actions.

Another aspect of the difference between Brun et al.’s (2009) functionalistic theorizing and the view of work activities adopted here is that one does not talk about processes in practice epistemology; rather, there are process descriptions and models, which are understood as rules of a work practice. A generalized rule does not equal knowing the rules, nor does it prescribe the situated actions that go into enacting them (Gherardi 2012b). In other words, “process” is understood as a prescribed,
generalized rule to be followed, but that may—at any time—be disregarded in preference for the emerging situation (Souto 2010).

Despite some differences, the “process ambiguity” category presented by Brun et al. (2008; 2009) is included here, but with a slight change in focus: process ambiguity is utilized to shed light on the doing, or the situated actions, in the work. The intent is to capture an inability to make unanimous interpretations of actions to be implemented, and of means–ends relationships between doings and their outcomes.

The difference between Brun et al.’s more functionalistic worldview and the practice epistemology adopted here has implications for how the analytical subcategories of process ambiguity are established. Strictly following the work of Brun et al. would imply creating subcategories such as “tasks to perform” and “dependencies among tasks” (compare with the quotation at the beginning of section 3.3). Such separation is incompatible with the idea of discarding distinct categorizations, such as dualisms (e.g., separating work into discrete tasks, dependencies, etc). Instead, the framework for understanding process ambiguity in this thesis is based on practice-based studies that problematize various aspects of “doing work.”

In sum, process ambiguity is separated into two distinct categories: (1) rule ambiguity and (2) ambiguous means–ends relationships. These two categories are described in the following subsections.

### 3.3.1 Rule ambiguity

Rule ambiguity refers to an inability of making unanimous interpretations of how to enact generalized rules in ongoing, situated work practice. This ambiguity emerges in what Gherardi (2012b) described as the void between, on one hand, generalized and decontextualized rules and, on the other, sustaining and translating rules in the situated work practice.

Like any work practice, design work is situated in a network of norms, traditions, methods, and models for how to ideally undertake the work. However—as previously established—there seems to be something in the work that is not easily captured in such “rules.” Designers themselves describe their work in terms of “‘getting close’ to the situation, they talk about the importance of ‘richness’ of the problem area, and they do stress the merit of getting ‘first-hand experience’ of the problem situation” (Dorst 2011, p.528). The elusive choice of words points to the difficulties of
unambiguously describing the activities in design work according to some kind of predefined, sequential method.

Rules may be understood as the “normative infrastructure of practices” (Gherardi 2012b, p.132), and include anything from tacit, unwritten rules to “explicit, legitimated and materialized” rules (Gherardi 2012b, p.140). The very nature of rules means that there is always a margin of ambiguity between the generalized rules and their situated enactments in work practices (Gherardi 2012b). The need to contextualize and situate rules calls for a kind of knowing that the rule itself cannot specify: any attempts to make a clarifying rule suffer from the same predicament, i.e., that yet another clarifying rule is needed. Any given rule therefore requires understanding an infinite series of clarifying rules (Sandberg & Tsoukas 2016).

Rules and rule-following—or rules and “knowing the rules” as Gherardi put it (2012b, p.132)—stem from Wittgenstein’s philosophy in that rule-following is about taking part in a work practice, rather than being about finding “correct” interpretations of generally stated rules (Sandberg & Tsoukas 2016).

Gherardi (2012b) elaborated on “negotiating the ambiguity of rules” (p.139) by citing an example of a production game. The “rule” in her example was “sustained by a network of tacit rules which are unwritten, shared and contested at the same time” (p.140).

In the example, blue-collar workers were assembling batteries, subject to a daily production quota. The “rule” was that the daily quota should be lowered in case of poor-quality battery plates, given that the speed of assembly depended on the quality of the battery plates. In essence, Gherardi established that three kinds of ambiguities emerge in relation to this rule: (1) ambiguity of interpretation, (2) ambiguity of implicatures, and (3) ambiguity of implementing the action (Gherardi 2012b).

In the production game example, ambiguity of interpretation emerged in establishing the quality of the battery plates, since this is not an either/or state but rather a scale ranging from “good” to “bad.” Ambiguity of implicatures emerged in interpreting the utterance that “the quality is poor” as implying that the quota should be reduced, since this may also be expressed as an ironic joke, a conversation starter, etc. Ambiguity of implementing the action emerged in initiating actions to lower the
production speed when the quality of the battery plates is established as poor, by arguing with and convincing the responsible managers, since the blue-collar workers themselves were not in charge of setting the daily quota (Gherardi 2012b).

Gherardi’s description of the production game exemplifies how rule ambiguities may emerge, be sustained, and negotiated by collective action in an ongoing work practice. This example may be likened to design work in that the models and methods of how to undertake design work may be understood as rules for the work practice. However, ambiguity may emerge in relation to enacting the rules in practice, which is why the models and methods have little explanatory power for the design work practice itself.

Rule ambiguity also transpire in the emerging nature of knowing-work, which implies that “in the moment of meaning creation, rationally planned activities may be abandoned and the knowledge worker may act differently according to the circumstances and the resources they have for their interpretative actions” (Souto 2010, p.102). What may be understood from this quotation is that, although decontextualized and generalized plans or work descriptions may have been made to guide the work, they are under constant revision and may be abandoned at any point, given the emerging circumstances.

### 3.3.2 Ambiguous means–ends relationships

One challenge in design work research seems to be anchored in the means–ends relationships of the work activities. This challenge is evident in the design research literature when designers are said to be “exploring the broader problem situation,” to be “gathering clues” that “lead to the emergence of themes” (Dorst 2011, p.528). This exploration, clue gathering, and theme emergence are understood to happen informally and not as established formal design activities.

Another line of reasoning in design research that may be related to process ambiguity and ambiguous means–ends relationships is the notion that completeness is a virtue in design work, which should instead be conceptualized as harnessing incompleteness (Garud et al. 2008). This reasoning argues that design work concerning a “problem” unfolds in a process of participation. Simultaneously, this emerging process changes the nature of (the understanding of) the ‘problem’. What this research concludes is that “design” should be considered both the medium and the
outcome of action (Garud et al. 2008). In relation to portraying design work as ambiguous and intensively focused on creating knowledge, an important parallel can be made: Considering design work a knowledge-creation work practice in which ambiguities emerge and the created knowledge changes the interpretation of the objective of practice echoes the idea of considering design both the medium and outcome.

The literature on industrial design has concluded that the expert knowing of designers is an aesthetic ability (e.g., Svengren 1995): designers are able to see the interplay between an outcome’s shape and other characteristics. This idea that designers can “see” an interplay refers to a kind of knowing that is not easily captured without assuming a practice epistemology. With a practice epistemology, however, the becoming of materiality has been captured under the label of formativeness, i.e., how a design outcome “acquires form within working practices” (Gherardi et al. 2013).

Yet again, practice epistemology allows us to create a framework and study what earlier design research avoided altogether or mystified in vague descriptions that relate to innate abilities or work-life experience. With practice epistemology, the actions of “exploring,” “gathering,” and “seeing” may be considered part of ambiguous means–ends relationships.

Already in 1993, Alvesson established the idea of ambiguous means–ends relationships in knowledge-intensive work in his definition of ambiguity when he said that “ambiguity means that the possibility of rationality—clarifying means–ends relationships or exercising qualified judgement—becomes seriously reduced” (Alvesson 1993, p. 1002). The underlying assumption of such a statement is that correlation between work activities and their outcomes cannot be established with certainty (Alvesson 2004).
4 Negotiating activities: taking action in ambiguous situations

This chapter covers a literature review about various ways of approaching ambiguous situations. The theorized approaches to handling ambiguity has varied greatly in extant literature: anything from mitigating uncertainty, or tolerating ambiguity to introducing play as a metaphor for ambiguous rule-following. In this chapter, various approaches to handling ambiguity are described, and the chosen concept of “negotiating ambiguity” is derived and motivated.

4.1 Alternative approaches to negotiating activities

Previous research into approaches for handling unknown or unclear situations has been undertaken from various perspectives and with various foci. For example, some have concentrated on the early phases of product development (e.g., Khurana & Rosenthal 1998), others on project management (e.g., De Meyer et al. 2002), and yet others on improvisation or work practices (e.g., Styhre & Börjesson 2011).

This and other research has approached the matter of unclear phenomena under various labels, mostly in relation to uncertainty but at times in relation to ambiguity as well. These labels include mitigating uncertainty (Brattström et al. 2012), managing uncertainty (De Meyer et al. 2002), and reducing ambiguity (Khurana & Rosenthal 1998).

4.1.1 From mitigating uncertainty to reducing ambiguity

All these various labels and approaches have their merits and pitfalls. Both Brattström et al.’s (2012) and De Meyer et al.’s (2002) research is based on the assumption that it is desirable to mitigate or manage uncertainty. Mitigating uncertainty is understood as a “fundamental aspect” of product development work (Brattström et al. 2012, p.743) that is achieved by means of systematic processes and structures.
Managing uncertainty is held to be the “Holy Grail” of project management in the case of “novel or breakthrough initiatives” (De Meyer et al. 2002, p.60). De Meyer et al. (2002) acknowledged that uncertainties are natural to projects (their empirical object) but are nonetheless difficult to manage. They proposed a model of the project manager’s role, tasks, and relationships depending on the type of uncertainty (i.e., variation, foreseen uncertainty, unforeseen uncertainty, and chaos). While their research assumes that one may identify the type of uncertainty and, furthermore, that one may then act accordingly, the present research studies the unfolding of the work over time, with unclear means-ends relationships, and with ambiguities emerging and fading away.

Brattström et al. (2012), instead introduced trust as a mediating variable between “on one hand, mitigating uncertainty through the existence of systematic processes and structures and, on the other, stimulating creativity through allowable variation in work processes and structures” (p.743). They demonstrated both how to create trust and that “trust can function as a mediating variable enabling firms to combine systematic processes and structures with creativity” (p.750). As such, it is assumed that uncertainty is mitigated by systematic processes and structures, claimed to be opposed to creativity, though this assumption is not followed up in the rest of the article.

The two approaches of mitigating or managing uncertainty are portrayed as standing in contrast to stimulating creativity (Brattström et al. 2012) or learning (De Meyer et al. 2002). In essence, both of these studies conclude that the contrasting logics of managing uncertainty versus fostering creativity and learning should be approached by “striking a balance” (De Meyer et al. 2002, p.67; Brattström et al. 2012, p.743).

Khurana and Rosenthal (1998) instead discussed the aim of achieving order and predictability in the early phases of development work as a matter of “reducing ambiguity” by either formalizing processes or fostering a specific culture. Among several issues, they described the importance of striving “to be as explicit as possible about the product concept to avoid ambiguity” (Khurana & Rosenthal 1998, p.69). Such a statement clearly reflects a view of ambiguity that is very different from the connotation here. The assumption here is that ambiguity is unpredictable to the very core, which in essence makes it impossible to avoid beforehand by, for example,
“being explicit about a concept.” Instead, ambiguous phenomena must somehow be approached as they emerge.

What the above and many other studies have in common is that they propose balancing the restrictive dimensions of reducing, mitigating, and managing uncertainty with several freedom dimensions, such as creativity, improvisation, and learning. The underlying assumption of such proposals is that these dimensions counteract one another.

In summary, many approaches to handling uncertainty are described in rational, straightforward, and rule-like terms such as systematic information-gathering processes (Brattström et al. 2012) and having “competent people” respond to unexpected events (Geraldi et al. 2010). Such approaches fall short when ambiguity emerges in connection with the rule-following involved in such rational and straightforward processes, however. Imagine, for example, that one cannot be systematic in “information gathering” because the need for information is opaque or because no matter what “information” one gathers, there is still a need for qualitative judgments based on experience and knowing. Or let us assume that the “competent people” may respond in multiple ways to something unexpected. Regarding such situations, much of the literature on approaches to uncertainty holds little explanatory power.

Some studies portray ambiguity as a naturally occurring aspect of work, which is innately unpredictable and stands in stark contrast to plans and method descriptions. The focus of this thesis is accordingly on approaching ambiguous phenomena. The literature adjacent to various ways of considering and approaching ambiguous phenomena is reviewed in the following sections.

4.1.2 Reducing, tolerating or coping with ambiguity

Ambiguity has often had negative connotations, viewed as something that interrupts the steady state of everyday practices (Sahlin-Andersson 1989). A more neutral connotation transpires in expressions about how to address ambiguous phenomena, such as “tolerating ambiguity” (Yanow & Tsoukas 2009, p.1349), “reducing ambiguity” (Brun & Saetre 2008), and “coping with the ambiguity” (Gherardi 2012b, p.139). All three expressions imply that ambiguity is something challenging or difficult, but that could be endured.
Yanow and Tsoukas (2009) were relying on Weick and Heidegger when they described the work of designers as coping “more or less adequately in a preinterpreted world,” such “coping” being said to be partly about making do with whatever is at hand, improvising, and “tolerating ambiguity” (p.1349). Yanow and Tsoukas (2009) did not expound on the concept of “tolerating ambiguity,” however. Instead, they concentrated on the overarching term “coping” when discussing reflection-in-action in order to connect improvisation with “practice and its surprises” (Yanow & Tsoukas 2009, p.1339). One can surmise from this that “reflection-in-action” is connected to “tolerating ambiguity” in terms of coping with surprises in a preinterpreted world.

Brun and Saetre (2008) argued that ambiguities should be “reduced,” although considering them “an essential component of ‘fuzziness’” in the early stages of product development (p.573). Here, ambiguity is understood as “the existence of two or more interpretations of a single cue” (Brun & Saetre 2008, p.576), considered a necessary evil in product development work. Ambiguity reduction is described in terms of the project participants’ responses to ambiguous situations. Brun & Saetre (2008) proposed what they called a hypothetical–deductive method for testing “the multiple interpretations that give rise to ambiguity and the assumptions underlying these interpretations” (p.573).

Such a method does not capture fine-grained situated actions but rather presents yet another generalized model of how to “reduce ambiguity.” Relying once more on Gherardi’s (2012b) argument about rules and enacting them, a generalized model (i.e., a rule) requires translation into situated actions, i.e., “what people actually do,” which would either require an infinite sequence of clarifying rules or is part of knowing-in-practice (p.132). In other words, “what people actually do” to reduce ambiguity may not be captured in a process model. Although Brun and Saetre claimed to be studying the “ambiguity-reduction process” (2008, p.580), practice epistemology may still contribute by considering the situated actions involved in approaching ambiguities in knowing-work. Gherardi (2012b), for example, embedded negotiating the ambiguity of rules as a natural aspect of knowing-in-practice.

Gherardi’s (2012b) research followed practice epistemology when discussing “coping” with various semantic ambiguities as part of “negotiating the ambiguity of rules” (p.135). Gherardi relied on the
example of production games and the multiplicity of possible interpretations about connections between the variance in quality of the production material, the evaluation of the production material, and the daily production quota. The “rule” of the production game is that if the quality of the material is poor the production quota should be lowered. However, the connection is not straightforward, so Gherardi treated the process of negotiating this rule as a “three-stage process” comprising: (1) “coping with the ambiguity of interpretations,” i.e., evaluating the quality of the material as poor individually and collectively; (2) “coping with the ambiguity of implicatures,” i.e., interpreting whether the evaluation of the quality as poor should be understood as a joke, a conversation starter, or implying a lowered production quota; and (3) “coping with the ambiguity of implementing the action,” i.e., determining who should initiate the action to lower the quota (Gherardi 2012b, p.139).

This three-stage process implies a sequence of negotiating activities in order to cope with and to reduce or eliminate ambiguity. In other words, the assumption is that ambiguity is unwanted and should be reduced. Such an assumption is to be expected given the example on which Gherardi relied (2012b), i.e., that production speed should preferably be high, that poorer quality affects the speed negatively, that quality must be evaluated and that evaluating the quality is ambiguous.

4.1.3 Beneficial aspects of ambiguity

A body of research argues that ambiguities are not only innate to certain work practices but are also a prerequisite for the work (e.g., Brun et al. 2008; Styhre & Börjesson 2011). Assuming that ambiguities are innate in a particular line of work by definition neutralizes some of the negative assumptions about them as deviations to be eliminated. Moreover, some research explicitly claims that ambiguities may also be beneficial in NPD work (see, e.g., Brun et al. 2008).

The most outspoken proponents of sustaining or even sometimes increasing ambiguity are Brun et al., particularly in their paper from 2008. They studied four cases of NPD in the medical-device industry, concluding that companies may benefit from sustaining ambiguity. In reaching such a conclusion, they identified four positive aspects of sustaining ambiguity: (1) retaining fallback options, (2) constraining costs, (3) saving time, and (4) retaining ideas (Brun et al. 2008).
Another beneficial aspect according to Engwall (2002) is that an ambiguous objective may enable a group of people with implicitly or outspokenly divergent intentions and agendas to agree and work together. Engwall (2002) argued that ambiguities are innate in goal-setting in project management, claiming that the primary function of such goals is to “create project beginnings” (p.262). Such claims reflect a more neutral assumption about the role and impact of ambiguities, but do not consider the work practices needed to address ambiguities.

Other project management research has theorized that, for example, “managing uncertainty” is a way of balancing planning and learning in order to adapt to unforeseen, yet unavoidable, events (De Meyer et al. 2002, p.67) that emerge during the ongoing work practice.

4.1.4 Taking action in ambiguous situations

Sahlin-Andersson (1989) was arguing that it is a common misconception to equate organizing with acts of making something clear: organizing may just as well be about maintaining opaqueness. This indicates that unclarity, i.e., ambiguity, does not necessarily stand in stark contrast to, or have a negative impact on, organizing. By extension, this implies that ambiguities must not necessarily be reduced or mitigated but may also be sustained. Some research has focused on ways of taking action in ambiguous situations. Two such contributions are described below, namely: play and sensemaking.

Play as the adherence to ambiguous rules

Styhre and Börjesson (2011, p.23) introduced the notion of play as a way to capture the adherence to “a structured set of rules” intertwined with “openness to emergent properties.” Their empirical material was drawn from what they described as the uncertain, complex, and temporal work in the culture industry, specifically that of producing theatrical performances. This was presented as a new take on project management, building on a very different kind of work than traditionally exemplified with, in project management research. Furthermore, Styhre and Börjesson (2011) asserted that their research into project management in the culture industry might “serve as a source of influence for knowledge-intensive industry engaging with complex projects such as R&D, innovations work, and new product
development” (p.24). Their research therefore has a bearing on theorizing in the present research as well.

The concept of play is based on the assumption that structured rules and openness to emergent properties do not necessarily contradict or counteract each another, but that both are innate to cultural productions (Styhre & Börjesson 2011). Just as both of these logics are prerequisites for play, they are also shown to be innate in cultural productions. In other words, organizing work in cultural production is not intended to reduce or eliminate all uncertainty but to combine rules and structure with emergent properties. Such a notion is also adopted as the prevailing view in this thesis, incorporated in the label “negotiating ambiguity.”

**Sensemaking as coping with ambiguity**

It has been implied that the purpose of design work is to facilitate sensemaking (Eneberg 2011). The seminal work of Krippendorff (1989) about the purpose of design clearly shows a connection between theorizing about design and about sensemaking: he proposed that “design is making sense (of things)” (p.9).

Sensemaking literature takes off from the way of coping (that is humans acting to transform a startling situation into something understandable), i.e., making sense of a situation (Weick 1995; Krippendorff 2006). Sensemaking is the more or less conscious making of sense that emerges in-between individuals. The most distinguishing characteristic is that sensemaking is retrospective: it is about creating meaning to lived experience (Weick 1995).

Situations that must be made sense of are triggered by “cues” that come into being through “noticing” (Weick 1995): sense makers extract cues from the environment that surround them. Cues provide points of reference that help decide what information is considered important as well as link ideas to larger systems of meaning. Ambiguity and uncertainty have been theorized as two common causes for needing to make sense of situations (Weick 1995).
4.2 Negotiating ambiguity: building on a conversation metaphor

Lester and Piore’s (2004) book analogized design and development work in the form of a “conversation.” This metaphor was introduced as a way to capture the more interpretative, non-analytical dimensions of design and NPD work, during which participants “often have no idea where their discussion is going when it starts; and even if they do, the actual direction may turn out to be quite different” (Lester & Piore 2004, p.53). This quotation is interesting in several respects. For one, the quotation captures an ambiguity when initiating knowing-work, as in an inability to make unanimous interpretations of the intended design outcomes. This illuminates the haphazard nature of such work, in claiming that it could change direction at any time.

The role of ambiguities and how to approach them is not implicit in Lester and Piore’s (2004) conversation metaphor. Rather, they explicitly discussed ambiguity in conversations as “the resource out of which new ideas emerge” (p.51), claiming that interpretation “plays in the space of ambiguity” (p.53). In sum, these quotations suggest that new ideas emerge when making interpretations under ambiguous conditions.

The conversation metaphor explicates such ambiguous conditions in that the term “conversation” implies several autonomous participants. The presence of multiple participants implies that a conversation is not fully manageable and cannot be planned in advance, instead being subject to the whims and (hidden) agendas of the participants.

Lester and Piore (2004) did not stop at using the conversation metaphor in describing the intertwinment of ambiguity in interpretative product development work, but also elaborated on how ambiguity may be approached from a managerial perspective. To do so, they analogized managerial work to the role of a hostess at a cocktail party (Lester & Piore 2004).

The role of the hostess in facilitating conversation at a cocktail party is described as fourfold. First, the hostess must “choose the guests” by “identifying people with the right background and selecting particular representatives” that she assumes will engage in and contribute to the conversation. Second, the hostess must “initiate the conversation” by encouraging participants to come to the party and engage in conversations...
with one another. A related challenge is the risk that participants may not open up, for example, due to “fear of disclosing competitive assets,” inhibiting the conversation. The hostess should therefore offer specific topics for discussion. Third, the hostess should “keep the conversation going” to reduce the risk of misunderstandings and to facilitate the creation of a common language. Fourth, the hostess must “refresh the conversation” by introducing new topics of discussion or bringing in new people with different backgrounds, preventing the conversation from “getting stale” (Lester & Piore 2004, p.58–64).

The analogy of the hostess conveys the ambiguity and situatedness of the manager’s actions. The manager makes interpretations in several ambiguous situations, for example, about what “people” will be able to contribute, how to reduce the risk of misinterpretations, and how to act according to such assumptions. The focus of this research is not on the manager’s specific role, but on the emerging “conversation” as the participants interact with one another.

More specifically, the conversation metaphor anchors the concept of “negotiating ambiguity”. The approach to ambiguities is seen as a conversation to negotiate interpretations in ambiguous situations.

### 4.2.1 Negotiating: a concept anchored in practice-based studies

The concept of “negotiating” appears in practice-based studies (Gherardi & Nicolini 2002), but is also grounded in project management research, for example, in which it has mainly been used to label certain interactions with stakeholders (e.g., Elias et al. 2002). The “negotiating” concept is also rooted in the tradition of sociology, in which “negotiated order” is a well-established and theorized concept and phenomenon. The idea of negotiated order relates to the creation and sustaining of meaning in organizations (Gherardi 2012b).

The term “negotiating ambiguity” is connected to the conversation metaphor, although it is based primarily on Gherardi’s (2012b, ch.6) theorizing about rules and knowing the rules. Gherardi’s specific example concerned the daily production quota for batteries, described as a “conflictual and cooperative game” that is ambiguous in many respects (2012b, p.135).
The production quota itself is an unambiguous number determined by a management team. Fulfilling the production quota is less straightforward as it depends on the material quality of the battery plates, with lower quality prolonging the production time per battery. The quality of the battery plates is evaluated in terms of whether the plates are “soft,” with softness indicating lower quality. Ambiguity emerges in evaluating the quality, as it is not an either/or decision but rather evaluation on a continuum to answer the question “How soft are the soft plates?” (Gherardi 2012b, p.136).

Gherardi (2012b) drew on situations in which an inability to make unanimous interpretations emerges, concerning the authority to establish that the plates are “soft” (i.e., rating the battery plate quality as low), the connection between the plate quality and the production quota (i.e., how much the quota will be reduced), as well as the initiation of actions to reduce the production quota if the material quality is established as low. What Gherardi (2012b) proposed is a decision model of “how this community resolves semantic ambiguity in order to initiate action (and vice versa)” claimed to be more generally applicable, a model referred to as a “three-stage process of negotiation” (p.139).

The work practice on which Gherardi (2012b) relied differs markedly from the empirical material about knowing-work emphasized here. On the other hand, Gherardi (2012b) assumed a practice epistemology in studying approaches to “resolve semantic ambiguity in order to initiate action (and vice versa)” (p.139), which merges well with the conversation metaphor. Moreover, her conceptualization of a sequence of coping actions for negotiating ambiguity has merit when theorizing about approaches to ambiguous situations.

Gherardi’s (2012b) introduction of the term “negotiate” is ingenious as the term captures the essence of practice epistemology, in which ambiguities emerge and multiple interpretations are made, compared, and weighted against one another.

4.2.2 The concept of “negotiating ambiguity”

According to Oxford living dictionary (2016) “negotiate” is defined as a verb, as follows: (1) “obtain or bring about in discussion” or “try to reach an agreement or compromise by discussion,” (2) “find a way over or
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through (an obstacle or difficult route),” or (3) “transfer to the legal ownership of another person” (Oxford living dictionary 2016).

The first definition of the meaning of “negotiate” connects well to the conversation metaphor. Negotiating ambiguity accordingly implies trying to reach an agreement or compromise in ambiguous situations by means of discussion. However, in this thesis, Lester and Piore’s (2004) metaphoric view is adopted, so “discussion” or “conversation” is understood as analogous to the interpretative dimensions of knowledge-creation work.

Based on the second definition of “negotiate,” one may consider acts of “negotiating ambiguity” with ambiguity understood as an “obstacle or difficult route.” Doing so implies that “negotiating ambiguity” is to be understood as finding a way over or through ambiguity.

The third understanding of “negotiate” may be disregarded in the present context, as it refers to a linguistic expression in a distinctly different context. However, the first two understandings have explanatory power for describing what is meant by “negotiating ambiguity” in this research. Specifically, combining the two first definitions of “negotiate” in connection with the term “ambiguity” renders our linguistic definition of “negotiating ambiguity.”

In this thesis, “negotiating ambiguity” is therefore understood as finding a way over or through an inability to make unanimous interpretations, by reaching agreements or compromises in conversation. This thesis relies on Lester and Piore’s (2004) metaphoric view, in which “conversation” is understood as analogous to the non-analytical, interpretative dimensions of knowing-work. “Negotiating ambiguity” as such captures a more or less aware approach that is not completely controllable or even foreseeable.

Yet another characteristic of the concept of negotiating ambiguity, comes through in a comparison with Gherardi’s (2012a) term “docta ignorantia”: the notion of “docta ignorantia” is introduced as the type of acquired knowledge that can “furnish instantaneous responses to all the uncertain and ambiguous situations of practice” (Gherardi 2012a, p.21). In this quotation, Gherardi pinpoints “what makes it possible to grasp the meaning of a situation instantaneously, and to propose the appropriate response at the same time” (Gherardi 2012a, p.20). In this second quote, an important difference between Gherardi’s notion of “docta ignorantia”
and negotiating activities, as discussed in this thesis, emerges: negotiating activities is rather the type of acquired knowledge that can furnish prolonged and appropriated responses to the uncertain and ambiguous situations of practice

4.2.3 “Negotiating ambiguity” in practice-based research

The definition of “negotiating ambiguity”—as finding a way over or through an inability to make unanimous interpretations, by reaching agreements or compromises in conversation—recalls Gherardi’s (2012b) theorizing, which in addition to addressing rules and knowing the rules, also touched on ambiguous phenomena in relation to how “ordinary work is practically accomplished” (which is incidentally the title of chapter one). In such discussions, Gherardi relied on an example of telemedicine drawn from Bruni et al. (2007, cited in Gherardi 2012b). The specific example concerns teleconsultancy between two doctors, a general practitioner and a cardiologist. The two doctors were discussing a specific patient whose symptoms evoked an inability to make unanimous interpretations about the patient’s health status, as the patient felt ill but had a normal electrocardiogram.

Gherardi (2012b) concluded that the doctors “seem almost to be suggesting interpretations to each other, as in a dance where two actors must lean on each other to find a point of balance which permits their movement” (p.23). Gherardi (2012b) compared the two doctors’ turn-taking in interpretation to a “dance”; such turn-taking is instead called “negotiating ambiguity” in this thesis.

The metaphor of “negotiating ambiguity” offers many possibilities for extending the analogy and fits with other research on knowing and practice as well. Such other research oscillates well with the definition of “negotiate”, especially if the tensions related to the word are emphasized. Recall that the Oxford living dictionary’s (2016) definition mentioned reaching a ‘compromise’ or finding a way around “an obstacle” or “difficult route”. Such wording implies that actions to “negotiate” arise from conflicts, disagreements, and other obstacles. Extant literature on practice, knowing, and ambiguity has analogized work with precisely such tensions.

For example, Patriotta’s (2003) book about how knowledge is created, utilized, legitimated, and institutionalized in an automobile manufacturing setting called for “debates” to settle “controversies” in ambiguous
situations. Patriotta (2003) developed a line of argumentation that treated knowledge as being “subject to conflicts of interpretation and controversies” and that managing knowledge is “handling and settling controversies and debates, particularly in situations of ambiguity” (p. 205). Moreover, Patriotta (2003, p. 205) concluded that organizational knowledge is “a negotiated outcome that needs to be stipulated over and over again”.

Similar reasoning is evident in Nicolini’s (2011) conception that “the normalcy of practice is a truce” (p. 613), a conflict temporarily at rest. To make such a claim, Nicolini (2011) relied on a study of telemedicine. The specific example concerns telemonitoring chronic heart failure patients to prevent instability and possibly hospitalization. Nicolini argued that the “truce” in traditional medical practice was interrupted by the transition to monitoring patients at a distance by phone, in which the medical practitioners’ knowing was partly challenged.
In this thesis, it is assumed that the world is made sense of and understood through social construction. This view of knowledge may be traced back to Berger and Luckman’s seminal *The Social Construction of Reality* and to the work of Carl Mannheim (Crotty 1998). Social construction implies that the world cannot be discovered, but is rather constructed as we look upon it. The social constructionism view does not dispute that the world also exists when we do not look upon it, instead emphasizing that *meanings* about the world emerge when humans construct it (Crotty 1998).

This thesis adopts practice epistemology, a practice-based approach to studying knowledge and learning (Sandberg & Tsoukas 2016). This is coherent with social construction, since work practices are considered to emerge and become in the very doing of work (Nicolini 2006).

Research into knowing-work has traditionally been grounded in practice epistemology, in which creating knowledge is seen as situated activities based on interaction with humans and artifacts (Gherardi 2012b). Furthermore, ambiguities are considered inherent aspects of knowing-work: ambiguities emerge in knowledge creation and call for knowledge-creation activities. Ambiguities are negotiated in knowing-work by undertaking various actions to cope with the emerging cues (Gherardi 2012b). The *practice* of knowing-work (exemplified here by design work) is therefore the unit of analysis in my research.

The research methodology used to construct meaning is interpretative; the design work practice that I studied was performed in real time during my studies with me as a co-creator and subjective interpreter (Louis 1981). I produced the final story during the processing of data as I constructed, interpreted, and wrote up the material. As a researcher, I consider myself to have been part of creating my research phenomenon in two main ways.
First, the studied phenomenon was constructed by comparing and contrasting various established fields of research in light of the empirical observations. In this process, I added new understandings to my pre-understanding, as described here.

Second, several parallel stories may be told about the world. As a researcher, I create a story about a phenomenon; simultaneously, the story I tell is constructing the phenomenon under study. These stories, or narratives, may have more or less explanatory power for the studied phenomenon, but are not true or false.

### 5.1 An epistemology of practice

Utilizing practice epistemology as a way of developing an academic understanding of the emergence of and activities to negotiate ambiguity in knowing-work sets the stage for the present approach. In line with practice epistemology, this research shifts the unit of analysis in the study of ambiguities in design and development work from individuals and their actions to practices and their relationships (Nicolini 2011).

Practice-based studies draw on various well-known philosophical thinkers such as Wittgenstein and Heidegger, who “show that social practices provide the inevitable background understanding on which explicit interpretations (representations) form” (Sandberg & Tsoukas 2016, p.185). Wittgenstein furthermore contributed to the becoming of practice-based studies by claiming that rule-following “is not about finding the correct interpretation but taking part in a practice” (Sandberg & Tsoukas 2016, p.186).

Practice-based studies can imply various things, given that “practice” as a concept is polysemic (Gherardi 2012a). Practices, plural, is synonymous with activities or doings, while practice, singular, refers to work professions (i.e., praxis). In this research, practice epistemology is used as a lens to look at a work practice (i.e., design work) in which practice is also the empirical object (i.e., design work activities). To make this clearer, the following chart is intended to position the stance taken here in relation to other approaches to study practice.
As illustrated in Figure 1, there is no one unified practice theory or practice-based approach (Nicolini et al. 2003; Sandberg & Tsoukas 2016). The various practice theories do share a common philosophical basis in Wittgenstein and Heidegger, from which three approaches to studying practices have emerged: commonsensical theories of practice, general theories of practice and domain-specific theories of practice (Sandberg & Tsoukas 2016).

Commonsensical theories of practice set out to study what people do, which is juxtaposed, for example, to what people say that they do, or to normative work-process descriptions of what people should do. The value of such practice theories is limited, though it can contribute descriptions of phenomena about which we know little (Sandberg & Tsoukas 2016).

General theories of practice instead take a philosophical stance regarding theorizing about practices, including the contributions of Bordieu, Giddens, and Schatzki. Such research has systematically conceptualized what defines practices as such and the underlying logic of such arguments (Sandberg & Tsoukas 2016).

Figure 1. Three approaches to studying practices.13
Domain-specific theories of practice include various streams of research. Practice epistemology, which addresses organizational knowing and knowledge, is one such stream. Other prevalent streams of domain-specific theories of practice include “strategy as practice” and “performative approaches to routines” (Sandberg & Tsoukas 2016). Under the domain-specific theories of practice, “practice” can be used both to refer to analytical or empirical objects (i.e., describing practices or activities under, e.g., another epistemology such as positivism) and as an epistemology. The latter provides the richest approach. Here, practice is used in both ways: a work practice is the empirical object of study, i.e., design work, which is studied using practice epistemology.

5.1.1 The power of the practice epistemology

The power of practice epistemology is that it enables a different way of seeing, in that the focus is on the emerging relationships between and continuous entwinement of actors and materials over time and space (Sandberg & Tsoukas 2016). Individuals still appear in research descriptions anchored in practice epistemology, not as rational decision makers but as carriers of practice (Nicolini 2011).

Seeing actors as embedded in practice implies integrating them into the research based on how they enact rules, handle experiences, etc., to enact the practices in which they partake (Sandberg & Tsoukas 2016). In other words, the focus in this research is not on people, or on what they do, but on people’s doing in situations (Souto 2010, 2013).

Practice epistemology implies talking about knowledge in knowing: that is, knowledge is created, used, and communicated in knowing. Furthermore, the outcome of knowing is created and communicated knowledge (Souto 2010, 2013).14

The choice to adopt practice epistemology in this research has several implications that should be clarified, these are described in the following subsections.

14 To describe the empirical material, a word is needed referring to the results of design work delivered to the external clients, however. The results of design work, which are embedded in and communicated through prototypes, products, services, PowerPoint presentations, and the like, are referred to as design outcomes.
Portraying what is mobilized in work

First, one does not describe practice, doing so being associated with studying practice in line with commonsensical theories of practice. Instead, in practice epistemology one describes what is mobilized in practice (Gherardi 2012b, ch.1). An attempt to describe the entirety of a work practice would not only be challenging, or impossible, for the writer but would also likely be taxing for the reader (Nicolini 2011).

This means that the empirical material in this thesis is not conveyed with an intent to describe the design work practice in full detail. Instead, the descriptions of the empirical material are presented with an intent to portray what is discursively and materially mobilized in design work to sense and negotiate ambiguities. As such, empirical illustrations are included mainly to strengthen the claims made (Nicolini 2011).

Intertwinement of knowing and knowledge

Second, knowing and knowledge have a central position in practice epistemology, as working is equated with knowing-in-practice (Sandberg & Tsoukas 2016). Knowing-in-practice is the practical accomplishment of everyday work, which means that different kinds of work activate different kinds of knowing-in-practice (Gherardi 2012b, ch.1).

An important aspect of design work practice is aesthetic understanding, which allows the designers to interact with visually represented artifacts throughout the work. Gherardi (2006) described aesthetic understanding as an intermeshing of feeling, understanding, and knowing. For design research, this paves the way for the second reason to adopt practice epistemology. Practice-based approaches pay attention to the material aspects of the social world (Gherardi 2006): Knowing is considered to be mediated by sociomateriality, meaning that knowing emerges in a context of interaction between humans and artifacts (Nicolini 2011).

The margin of ambiguity

Third, practice epistemology enables us to concentrate on the margin of ambiguity between generalized rules and rules-in-action (Gherardi 2006). Generalized rules must be interpreted and put into situated action to acquire meaning, which implies that rules are simultaneously given and emergent (Gherardi 2006). In other words, practice epistemology allows
us to look outside established rules, and enabling a focus on how individuals in their practicing enact these rules by following rules situationally. This may be related to established design work theories, which have traditionally focused on process descriptions and models of how to ideally undertake the work (e.g., Dubberly et al. 2008), giving ambiguities the role of deviations. A practice epistemology allows us to look beyond such normative models.

5.1.2 Studying knowing-work with practice epistemology

Findings in qualitative, case-study research provide rich and significant insights into particular phenomena (Brown 2008). In the present research, the studied phenomenon is how ambiguity is sensed and negotiated in design work.

Practice epistemology distances this research from a rational–cognitive view of knowledge (e.g., Gherardi 2006; Corradi et al. 2010), which has traditionally emphasized knowledge from a cognitive perspective, i.e., as rational and cognitive processes in the minds of individuals. The implication of such distancing is that the classical dualities of mind and body, thinking and doing, are thrown aside. Using practice epistemology to understand design work implies that such dualities do not exist in the creation of knowledge.

Examples of knowing-work include the following work practices: design, innovation, business development, business planning, strategy making, and research. These kinds of empirical work have previously been studied under various labels, such as NPD or innovation management (see, e.g., Andriopoulos & Lewis 2010). However, given the focus of this research, “knowing-work” is more suitable, the term having been established in research aligned with practice epistemology (Souto 2012; Souto 2013).

The value of applying practice epistemology is to capture the specifics of emerging activities that are uniquely and situationally connected to their temporal, geographical, and relational contexts (Nicolini et al. 2003; Souto 2010; Gherardi 2012b).

From practice epistemology, design work is conceptualized as ongoing and situated actions anchored in sociomaterial and discursive practices (Gherardi 2008). Knowledge comes into play in the form of experiences and in anchoring the work in the professional practice (Gherardi 2012a).
Utilizing the fundamental ideas of practice epistemology puts the empirical material in context and emphasizes the interplay between artifacts and competent reasoning and doing among practitioners (Corradi et al. 2010). The practice lens allows us to “see” the work of the designer as both the situated translation of generalized rules for how to design according to professional design practice, and as the situatedness of designing for a particular project or client for a specific purpose.

5.2 A methodology for studying design work as knowing-work

This research was designed for and funded through a research project called “Creativity on Demand” whose original purpose was to explore and explain how industrial design consultancies are managed and organized. More specifically, the intention was to explore how the creative aspects of design work are balanced against business demands for efficiency and effectiveness in these organizations selling the service of being creative on demand. To that end, the project also studied whether any differences could be identified between service design and technical design as regards the balance between creative aspects and business demands.

As is not uncommon in case study research, the eventual thrust of the research was constructed during the research process, as I entered into dialogue with previous theories and positioned the case study findings in that context (Ridder et al. 2012).

The change in perspective emerged continuously as a deeper understanding of the work practice under study was constructed. During the data collection, it seemed as if there was “something” in the design and development work that was theorized as problematic, yet did not show obvious signs of being problematic in the undertaking of design work. This “something” was later conceptualized as a discrepancy between ambiguities framed as having a negative impact (which should be reduced) in previous theories, and an unembarrassed embrace of ambiguous situations in the work by the practitioners.

This discrepancy emerged in the void between the design and development literature and the empirically studied design work. The discrepancy was initially challenging to articulate. However, after encountering practice
epistemology, the issue became more perceptible and it became possible to establish a vocabulary for talking about this void.

5.2.1 Making generalizations about a work practice

The aim of this research has been to generalize about a work practice (i.e., design work as a type of knowing-work) and about the emergence and negotiating of ambiguity in such work. Setting out to explore and understand such phenomena limits the choice of possible research methods (Hatch & Yanow 2003).

No claim is being made that statistically sound generalizations are being made, or that those are even desirable in this research. The present study focuses on the practice of knowing-work rather than the organizations in which this work occurs or the individuals undertaking this kind of work. Situations, and not individuals, are the more appropriate level of analysis if knowledge is considered to be embodied in practice (Patriotta 2003).

This research makes contributions that may be applicable in similar work practices, which has implications for the case selection logic. Generalizing about a practice implies that the sampling should be representative of the practice (Guba & Lincoln 1982); therefore, in this case the knowing-work is focal, rather than the population (e.g., knowledge workers or designers) or the organizations (e.g., knowledge-intensive firms). Perhaps the most typical approach when researching knowledge in organizations has been to draw examples from the context of consultancy firms (Patriotta 2003), which was also done here.

Generalizing from two case studies

Two case studies make up the empirical foundation of the research. In accordance with practice epistemology, the two case studies are considered one large dataset including multiple examples of ambiguous situations and negotiating activities. Multiple case studies, combining several data collection methods, are used to create a holistic perspective (Guba & Lincoln 1982). Doing so here creates a rich and qualitative empirical dataset of the work practices under study.

With the ambition of maximizing what may be learned from the individual cases, research material has been gathered via multiple case studies (Stake 2005). Case studies also free the researcher to be responsive to and shift
focus in line with what appears during the period of empirical data collection (Alvesson & Sköldberg 2009). Patriotta (2003) supports the choice of qualitative research for practice epistemology by claiming that “if knowledge is embodied in practice it has to be retrieved by following organizational actors in their everyday dealings” (p.38).

The studied cases of knowing-work draw on design work practice organized as consultancy projects. Studying these design consultancy projects in great detail in different organizations makes it possible to draw conclusions as to what Brown and Duguid (2001) have called “networks of practice.” Design work undertaken as consultancy projects spanning different formal organizations may be seen as belonging to one network of practice.15

The case studies have been inspired by applied ethnography. Applied ethnography differs from conventional, pure ethnography in that the observation intensity is lower, the dependency on prior theory is greater, and it requires more objectivity and verifiability (Ball & Ormerod 2000).

5.2.2 A methodology for studying ambiguity

Previous practice-based research (e.g., Souto 2010, 2013) has established that ambiguities are prevalent aspects of knowing-work. Less is known about how these ambiguities emerge and are negotiated, however. Given the limited understanding of the research phenomenon in previous research, the main objective of the multiple case studies is to gather complementary material (Ridder et al. 2012), i.e., to find multiple examples of emerging ambiguities and a multitude of complementary ways of negotiating ambiguities.

A critical voice may ask whether it is even possible to study ambiguous phenomena, given that the research would be trying to capture something elusive, unknown, and unpredictable. In the following, the adopted view is clarified in order to describe how one may study ambiguous phenomena using practice epistemology.

15 They make the distinction that organizations are aimed at embracing communities of fundamentally different practices, “conducting” them to “play” in harmony. Networks, on the other hand, unify people within a common work practice (Brown & Duguid 2001).
Observing the emergence of ambiguous situations

Gherardi (2015, p.6) expressed the main benefit of practice epistemology as follows: “practice makes it possible to see and to represent a mode of ordering the social in which doing and knowing are not separated and the knowing subject and the known object emerge in their ongoing interaction.” From this, one may infer that it is possible to “see and to represent” ambiguities as emerging in knowing-work, as well as to study the knowing and doing intertwined in activities to negotiate ambiguity.

The specification of situations as ambiguous is a retrospective endeavor, based on breaches in logic that call for activities to negotiate a new logic. It is important to recall that ambiguity should not be understood as equivalent to obstacles or problems. An obstacle or problem need not have emerged in the design work for a situation to become ambiguous. In other words, the design practice need not have been hindered by something at a certain time for a situation to be deemed ambiguous.

Shifting the focus from knowledge to knowing allows analysis of empirical phenomena that are mediated (i.e., transpire in language, technology, collaboration, and control), situated (i.e., geographically, temporally, and relationally), provisional (i.e., constantly constructed), and pragmatic (i.e., purposive and object oriented) (Blackler 1995; Gherardi 2012b). Observations and interviews are suitable for capturing such dimensions; my presence enabled me to consider such phenomena in constant flux and as they happened in the here and now.

The emergence of ambiguity was recognized by analyzing the empirical material for inabilities to make unanimous interpretations about situations, statements, or artifacts, by following traces backwards in the collected material. This allowed me to suggest what could be seen as ambiguous in the work.

The methodology for collecting data was performed with a broader scope than focusing on just ambiguities. I aimed to gather material about design work practice as it emerged in the two studied cases. The reasons for taking this broader approach are partly described in the following subsection.

5.2.3 Comparing the design of the study to prior research

Contracted design work has previously been explored in semi-structured interviews (Abecassis-Moedas et al. 2012). Much research into design and
development work has emphasized process models and methods for how such work is, or should, be undertaken. Such theorizing has been presented in both conceptual papers (see, e.g., Kim & Wilemon 2002; Cooper 2008) and in research based on interview data (e.g., Duimering et al. 2006). Still others have theorized about processes for creating product meanings by having groups of students follow certain process models (Dell’Era et al. 2011).

Common methodologies for researching ambiguities in design and NPD as well as common methods in practice epistemological studies is summarized below.

**Design of studies of ambiguity in new product development**

As demonstrated in the literature review chapters, Brun et al. (2008; 2009) addresses both a similar phenomenon (i.e., ambiguity) and a similar kind of work (i.e., NPD) as in the present research. They considered the sources and subjects of ambiguity (Brun et al. 2009), benefits of ambiguity (Brun et al. 2008), and reduction of ambiguity (Brun & Saetre 2008).

The research by Brun et al. (2008) was based on “a holistic multiple case-study design” in the medical-device industry (p.580). In all four cases, the focus was on the early phases of NPD, since one is “likeliest to encounter ambiguity” there (Brun et al. 2008, p.581). The cases were selected in order to obtain a diverse sample: the organizations varied in “size, age, product technology and their approach to NPD” (Brun et al. 2008, p.581). Data were collected from interviews, non-participant meeting observation, documents, as well as product demonstration and clinical instruction video files (Brun et al. 2008). Most of the material, however, was the over 40 interviews and over 900 pages of documentary data.

Although studying a similar phenomenon, Brun et al.’s perspective was very different, given that they did not apply practice epistemology. As such, the somewhat differing methodology applied here should not primarily be compared to that of Brun et al., but rather to practice-based studies that apply practice epistemology.

**Design of practice epistemological studies**

Research into knowing-in-practice draws on studies of diverse lines of work, ranging from safety practices in construction work (Gherardi &
Nicolini 2002) to cardiology consultation practice in teleconsultation work (Gherardi 2012a). The research methods for collecting data seem to vary as well: In one study of caring for patients at a distance in medical practice, Gherardi (2012a) used recorded “phone calls made to the center in the course of a year,” totaling over 1000 calls (p.22). These were first analyzed quantitatively (e.g., identifying whether the telephone call was “problematic”). Later, a typical month was selected, and the calls were transcribed and qualitatively analyzed in their entirety. Gherardi (2012a) said that the discursive practices “constitute a microcosm which gives access to broader organizational and institutional conditions” (p.22).

In another study of caring for patients at a distance in medical practice, Nicolini (2011) used material from a three-year investigation using multiple data collection methods. These methods were observations of “meetings, promotional workshops, and training sessions,” “50 ethnographical and semi-structured interviews,” collecting and analyzing “documents, tools, and pictures,” as well as traveling to other sites to make comparisons with other telemedicine practices (Nicolini 2011, p. 606). In the present research, this latter example is a more suitable analogue, as it considered several aspects of the studied knowing-work, combining multiple methods to collect data.

As will be described in greater detail later in this chapter, the data collection methods used here were mainly semi-structured interviews and participatory observations, complemented with project documentation (e.g., time plans and sketches), information e-mails, etc. Comparison with Nicolini’s (2011) data collection methods support the methodology applied here. The empirical material was included in communicating the research according to the same agenda as presented by Nicolini (2011): “the vignettes and illustrations ... are used here mainly to provide empirical illustration for my claims and to help my claims ‘come to life’ and make sense. There is therefore no attempt to paint complete pictures of the phenomena at hand ... a task that would be beyond the scope of this work” (p.607).

The processing of research material was made on several fronts in parallel (Alvesson & Sköldberg 2009): Periods of exploration of the empirical material were alternated with episodes of literature study. The explorations of the empirical material refer to both the gathering of material as well as the processing of already collected material.
The purpose and value of the research comes from having iterated and compared empirical material and literature streams in connection with the studied work. This is a research design that has been labeled “abduction” (Alvesson & Sköldberg 2009), which implies that the formulation of a researchable problem is neither strictly derived from the literature nor constructed based on a practical need.

5.3 Design of the study

The approach to collecting empirical data was rather similar in the two case studies. In both cases, I aimed to submerge myself in the case organizations to deepen my understanding of their practice. The goal was to learn from both what was said and what was not said and done during meetings and other interactions that I observed.

In line with an interpretative approach to research, the focus in the utilized examples was on how the participants made sense of situations, events, and interactions (Hatch & Yanow 2003) in the specific context of the design consultancy. Descriptions that exemplify the practices may greatly improve our understanding of how the work is performed. This is also why the case study was chosen for collecting empirical material: the cases can be used as illustrative examples of the studied practices.

In this research, the cases function as examples of how ambiguity emerges and can be negotiated in knowing-work. The role of examples is important for illustrating that which cannot be articulated but must be shown and practiced (Nordenstam 2005; Flyvbjerg 2006). A practitioner doing knowing-work in fields other than design consultancy may therefore identify with and learn from the described examples. The case descriptions are based on how unanimous interpretations for the final design outcome are continuously constructed by creating knowledge and simultaneously addressing ambiguous situations that emerge during the design work.

5.3.1 Selecting the empirical scene

In this research two cases make up the empirical scene. These two examples do not represent two opposites or extremes on a spectrum, but rather were selected because they complement each another, one exemplifying service design and the other product design and development. The cases were chosen because they seemed to offer
opportunities for detailed and complementary learning rather than being representative of and thus generalizable for a larger grouping (Stake 2005). The cases were selected based on a desire to study design work in successful consultancies, based partly on the assumption that these must somehow have found a way to succeed in their ambiguous work. If this criterion of company success had not been adopted, the empirical material might have been more representative of how design work is generally done. Adopting the criterion, however, is thought to have increased the opportunities for learning about how to negotiate ambiguity.

The primary reasons for selecting the studied consultancies is that their work is intense in terms of knowledge content and that they may be framed as knowledge-intensive firms (in accordance with how Alvesson 2004 defined the concept) that undertake knowledge-creation work.

A first criterion: design and development work in knowledge-intensive firms

Both the studied cases may be claimed to create knowledge in their work. Both the design consultancies sell what has previously been conceptualized as professional knowledge work (Miles 2005), but take on quite different kinds of contracts. One concentrates on designing services and the other on designing and developing products for serial production. The former consultancy is referred to as the Service Design Consultancy and their work as service design work. The latter is referred to as the Technical Design Consultancy and their work as technical design work. The concept of “technical design work” refers to the joint work practice undertaken by several professions, that is, engineering design, industrial design, mechanical engineering, and project management.

These consultancies employ individuals with varying backgrounds and educations. The consultants are both engineering and industrial designers as well as mechanical engineers and project managers. In other words, knowing-work is undertaken in both of the firms, but with differing design outcomes. Combining findings from the two cases may render complementary results about how ambiguity may be negotiated during knowing-work practice.16

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16 Throughout this dissertation, I alternate between referring to “service design work,” “technical design work,” and the overarching labels “design work” and “design work practice.” I use the more specific terms
Gaining access to these two organizations was unproblematic: The Service Design Consultancy had prior experience of working with PhD candidates and other researchers. The Technical Design Consultancy had less experience of working with researchers, but displayed interest in the research project in which the empirical material for this thesis was collected. The Technical Design Consultancy had also been lecturing on “Creativity on Demand,” which was the title of the research project.

A second criterion: Selecting successful cases

The studied case companies were also selected based on the intention to study knowing-work in “successful” organizations. I wanted to study successful organizations based on the assumption that if the organizations had been successful in previous projects, that would indicate that they could deliver design outcomes that their clients were satisfied with. This, in turn, implies that the design consultants are successful in their knowing-work practice and may be good examples to learn from. The chosen empirical cases fulfill the following criteria:

First, both of the organizations had been in business for at least seven years at the time of the empirical studies (as of 2017 they are at least twelve years old). The criterion of age was based on the assumption that it would be difficult to establish whether a younger organization would be economically successful (or even sustainable) in the long run. As it was, both organizations had also managed to endure the economic downturn in 2009/2010.

Second, both of the companies were growing, which may be considered an indication that they were successful in their markets. They were growing in terms of number and scope of client contracts, number of employees, as well as annual turnover at the time of selection.

Third, both of the organizations had returning clients. This criterion is seen as indicating that clients had been pleased with their previous contracts and were returning to the consultancy with new contracts. Being able to make clients satisfied with the outcome of the design consultancy is assumed to indicate that the knowledge-creation work somehow manages

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*to emphasize that a particular line of reasoning is based on findings from the studied work in one of the two cases.*
to incorporate the clients’ wishes and demands into the final design outcome.

Finally, the two organizations could also be framed as successful based on what they have achieved in terms of design outcome. The service design firm is one of the leading service design consultancies in Sweden, being very active in disseminating service design as a concept and method for achieving user-oriented services. Managers and employees of the consultancy lecture and arrange workshops at universities and conferences on the many advantages of service design. Likewise, the Technical Design Consultancy has been nominated for several design awards in Sweden, and won a few. Its managers arrange yearly seminars for both existing and prospective clients and partners. During these seminars, they lecture on product development, creativity, and design, establishing themselves as experts in these fields.

5.3.2 The two studied organizations

The Service Design Consultancy designs conceptual service solutions. The Technical Design Consultancy is hired to conduct projects in both the earlier phases of design and the later stages of technical development and product industrialization. The two organizations had approximately the same numbers of employees during the empirical data collection (Table 1). These numbers are somewhat imprecise for at least two reasons: first, they differ depending on whether subcontractors are counted; second, the numbers differ between the start and end of the empirical data collection period. More information about the case companies can be found in Table 1, such as:

The empirical studies included people with experience or education in service design, industrial design, engineering design, mechanical engineering, and project management. In this thesis, “designers” refers to people with any of the above experience and/or education (unless otherwise specified). Likewise, “design work,” “design work practice,” “design activities,” and the like refer to all of these practitioners’ doings and sayings.

In addition to the designers, the companies’ project managers and managerial teams also participated in the empirical studies; these are referred to by their individual titles. The educational backgrounds of most
of the participating individuals, both designers and managers, are in industrial design, engineering design, and mechanical engineering.

Table 1. Profiles of the two design consultancies.

<table>
<thead>
<tr>
<th></th>
<th>Service Design Consultancy</th>
<th>Technical Design Consultancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of establishment</td>
<td>1998</td>
<td>2004</td>
</tr>
<tr>
<td>Number of employees (2012)</td>
<td>~25</td>
<td>~30</td>
</tr>
<tr>
<td>Employee education</td>
<td>Mainly industrial design</td>
<td>Mainly mechanical engineering, but also industrial design</td>
</tr>
<tr>
<td>Why deemed successful?</td>
<td>• increasing annual turnover • continuously recruiting • returning clients • generally considered leading in its field in Sweden by design researchers</td>
<td>• increasing annual turnover • continuously recruiting • returning clients • nominated for and won design awards</td>
</tr>
<tr>
<td>Clients</td>
<td>Service providers in areas such as banking, insurance, and healthcare</td>
<td>Industrial companies with mass-produced products</td>
</tr>
<tr>
<td>Types of contracts</td>
<td>Service design: • improved customer experience in grocery stores • prepackaging the most common banking services for retail customers</td>
<td>Technical design: • industrial design of portable gas grill • industrial design and technical development of ergonomic torque wrench</td>
</tr>
<tr>
<td>Contracts executed as</td>
<td>In-house projects</td>
<td>In-house or staffing projects</td>
</tr>
</tbody>
</table>

I had an assigned contact person in each organization. In both cases, the contact persons were the initial points of contact, taking an interest in the research project and helping set up the collaboration by identifying a suitable project to study. At the Service Design Consultancy, the contact person was also the project manager of the studied service design project.
At the Technical Design Consultancy, the contact person was the product development strategist who was also the Vice-CEO.

**Two kinds of projects**

The service design work was executed mainly as in-house projects in which the consultancy work was undertaken in the firm’s facilities and the consultants were in charge of the project planning, management, and execution. The technical design work, on the other hand was executed in two ways. Some projects were undertaken as in-house projects. Like the service design projects, in these projects the consultancy was completely responsible for the work processes. Other projects were executed as staffing projects in which the consultants worked mostly in projects managed by the clients in the clients’ facilities.

The staffing projects, which were undertaken elsewhere than in the Product Development Consultancy’s own facilities, were not covered in this research. The main reason for not considering these projects was that they were not as clearly intended to create new knowledge and eventually a design outcome, but more often focused on implementing changes, refining existing products, or providing expertise based on already acquired knowledge. These projects were unsuitable for study for three other reasons as well. First, it was difficult to include these projects for practical reasons, given that I as a researcher was situated in the firm’s office facilities. Second, such projects were outliers relative to those of the Service Design Consultancy, which had no projects of similar form. Third, these were often small projects that involved only one consultant, so many prevalent aspects of the collective dimension of knowing-work would be challenging to study.

**5.4 Collecting empirical material**

As a researcher, I am integral to producing the empirical material, bringing with me my interests, agendas, and pre-understandings (Garsten 2003). By submerging myself in the ongoing design work, I deepened my understanding of what was and was not said and done during the meetings and other interactions that I observed. As a qualitative case study researcher, I relied heavily on the testimony of participants and on subjective observations (Stake 2005).
The research method for collecting empirical material in the two cases was based mainly on participatory observations and semi-structured interviews. It is an established procedure to close in on a phenomenon by combining several data collection methods (Stake 2005). Table 2 presents an overview of the methods used to collect empirical material.

As can be seen in Table 2, the collection of empirical material of the two studies was equally long at 3.5 months. Therefore, varying extents of the consultants’ projects were covered given that the projects in the Technical Design Consultancy usually lasted much longer than did those of the Service Design Consultancy. Not having included all phases of the studied project at the Technical Design Consultancy may be considered a drawback. However, I make no claims to have covered all ambiguities that might emerge in the work; rather, this research is intended as a first step in identifying how ambiguities may be negotiated in knowing-work.

Observations were well-suited for enabling me to personally perceive the nature of the cases, as active participation fostered insights into the practice. Adding interviews to the data collection allowed me to convey multiple realities perceived by different people (Stake 2005).

The starting point was to participate in all interactions related to one project in each consultancy firm. Between the scheduled and spontaneous interactions, I was working in the open-plan office space, listening to conversations between project members. At times, I also participated in meetings/workshops in other projects, so that I could compare those meetings with those in the project of primary interest.

In a sense, the interviews served as supplementary material for the research, increasing the volume of empirical material and filling gaps, making the results more robust. Given that all project phases usually included in design work were not undertaken during the observation period, I had to ask about other activities that were often performed in the projects. Supplementing with interview material let me compare my observations with previous, parallel examples that were not captured in the observations, giving greater breadth and completeness to the research.
<table>
<thead>
<tr>
<th></th>
<th>Service Design Consultancy</th>
<th>Technical Design Consultancy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How?</strong></td>
<td>Comparative case study inspired by applied ethnography</td>
<td>3.5 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.5 months</td>
</tr>
<tr>
<td><strong>When?</strong></td>
<td>September 2011–January 2012</td>
<td>February–May 2012</td>
</tr>
<tr>
<td><strong>Number of employees (during empirical study)</strong></td>
<td>10–15 (increased during the study)</td>
<td>~30 (varied around 30 during the study)</td>
</tr>
<tr>
<td><strong>Interviews</strong></td>
<td>Nine semi-structured interviews lasting an average of 1.5h each</td>
<td>Eleven semi-structured interviews lasting an average of 1.5h each</td>
</tr>
<tr>
<td><strong>Informants’ job titles</strong></td>
<td>CEO, service design director, key account managers, concept designer, and four service designers</td>
<td>CEO, Vice-CEO, two consultant managers, two project managers, two industrial designers, and three engineering designers</td>
</tr>
<tr>
<td><strong>Daily work observations</strong></td>
<td>Three days per week: all individuals employed in the organization were continuously observed, as were external parties, clients, and end-consumers</td>
<td>Three days per week: 13 individuals employed in the organization were continuously observed, as were clients and subcontractors</td>
</tr>
<tr>
<td><strong>Meeting observations</strong></td>
<td>Approximately 10 internal meetings (~2 h each), 3 external meetings with clients (~2 h each), 4 seminars (~2 h each), 8 end-consumer interviews (~30 min each), and 8 workshops (half or whole day)</td>
<td>Approximately 15 internal meetings (~2 h each), 1 external meeting with a client (~2 h), and 1 seminar (~4 h)</td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td>Project-related documentation, project-related correspondence, work-process descriptions, and documents describing the company</td>
<td></td>
</tr>
<tr>
<td><strong>Other empirical data sources</strong></td>
<td>Participating in informal meetings, lunches, coffee breaks, discussions in the open-plan office space, etc.</td>
<td></td>
</tr>
</tbody>
</table>
Doing much of the observation work before the interviews meant that I was already familiar with the language, expressions, and cultures of the case companies and could formulate the questions in a language closer to that of the informants. This facilitated the so-called dynamic dimension of interviewing (Kvale & Brinkman 2009).

An example of an activity that I did not observe in person but learned about during interviews was the handling of end-consumer interactions in the Technical Design Consultancy. This activity was not part of the project phases that I observed but was undertaken earlier during the initial phases of the project. Had I relied on observations only, I would have been unaware that the Technical Design Consultancy includes end-consumer interactions in their work, just as the Service Design Consultancy does. By adding interviewing to the data collection methods, I gained insights into how, when, and where end-consumer interactions are undertaken in the Technical Design Consultancy.

### 5.4.1 Performing observations

By examining episodes of work, one covers both the “practice and the knowing that goes into its accomplishment” (Nicolini 2011, p.605). Studying the ongoing working practices enabled me to consider both observable and reportable competences (Gherardi 2012b). These competences emerged from the practitioners’ knowing how to see, how to speak, and how to act during their working practice (Gherardi 2012a). Participant observation is a suitable strategy for practice-based studies given that the researcher is continuously present and may participate in the ongoing practice (Alvesson & Sköldberg 2009).

The extent of the observations corresponded to an average of three days per week for a total of nine months (see Table 3). In the Service Design Consultancy, the observations were undertaken during a timeframe equal to the duration of the studied client project, so the entirety of the client project could be covered by the observations. In the Technical Design Consultancy, the observation period covered only part of the studied client project, since the duration of the whole project exceeded the observation period for that organization. Varying proportions of the projects were observed due to the different project lengths in the two organizations: the observation duration was the same in both organizations, but the second organization has markedly longer projects.
Table 3. Data collection through observations.

<table>
<thead>
<tr>
<th></th>
<th>Service Design Consultancy</th>
<th>Technical Design Consultancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation intensity (approximate)</td>
<td>3 days/week</td>
<td>3 days/week</td>
</tr>
<tr>
<td>Internal meetings:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debriefings</td>
<td>-</td>
<td>15 (~2 h each)</td>
</tr>
<tr>
<td>Work meetings</td>
<td>10 (~2 h each)</td>
<td></td>
</tr>
<tr>
<td>Workshops</td>
<td>8 (3-7 h each)</td>
<td></td>
</tr>
<tr>
<td>External meetings:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debriefings</td>
<td>-</td>
<td>1 (~2 h)</td>
</tr>
<tr>
<td>Work meetings</td>
<td>3 (~2 h each)</td>
<td>-</td>
</tr>
<tr>
<td>End-consumer interactions</td>
<td>8 (~30 min each)</td>
<td>-</td>
</tr>
</tbody>
</table>

Gaining access to the two organizations facilitated the empirical data collection through observations in two ways. First, I was granted full access to the premises during office hours, allowing me to participate directly in all project meetings and workshops related to the studied projects during the study period. I was both invited to attend certain meetings and could initiate participation in other meetings, seminars, and workshops. Second, I had a desk in the open-plan office space and which enabled me to observe the design consultants’ everyday behaviors. Being present in the facilities allowed me to include both everyday work practices and ad hoc encounters outside the planned activities (e.g., during lunch or coffee breaks) in the data collection.

Observation strategy

The observations were undertaken deliberately based on three considerations directing the data collection process and dependent on prior theory. First, the starting point was to pinpoint the studied work practice by mapping how the design consultants undertook their design contracts. Such an understanding is essential to be able to situate any findings in the context of activities, participating individuals, and overall requirements and constraints. Second, the objective was to identify how
the design consultants’ contracted work was managed and organized. This is important in order to understand the role of including more or less defined objectives into the guidance of the work. The third consideration was to learn about how ambiguity transpired in the observed design work. By observing how knowledge workers embraced and undertook client contracts that challenged their knowledge domain, one could gather insights into how they approached and handled what was unknown to them.

The research is in no way claimed to be based on unmediated observations (i.e., starting from a “blank slate”). Rather, the observations were guided by a deliberate approach based on predefined objectives and literature readings that shaped or filtered what I apprehended (Hatch & Yanow 2003).

The data collection strategy of the observations was to document various occurrences that, in combination, would yield a palette of insights into how design consultancy is managed and organized. In general, the observations concentrated on who was doing what, how, when, where, and with whom. This general strategy was also translated into more specific situations. When making observations, I aimed at noticing and taking notes on:

- **who** (if anyone) led the work, was doing what, and was (not) participating
- **how** the work was made to progress, and how discussions were or were not moderated by participants and artifacts of the practice
- **when** this occurred, planned or spontaneously, in the project
- **where** this occurred
- **why** a person rationalized doing something at a certain point in time and place

It was relatively straightforward to identify the activities to include in the observations during the studied projects’ planned activities (e.g., meetings and workshops), and I attended all types of planned activities, both concerning internal consultancy matters as well as with clients.

Deciding what spontaneous activities to observe required more consideration. Given that many discussions emerged in parallel in the open-plan office space, I needed a strategy for choosing what spontaneous activities to prioritize. When making observations in the open-plan office
space, I was attuned to discerning any spontaneous discussions or activities related to how project outcomes were created in the firm, managerial issues relating to the design projects, and anything to do with the project I was following. These observations were also guided by the categories described above.

**Observation tactics**

My level of participation varied since I adopted a role similar to that of the employees. So as not to draw attention to myself as an outsider, and instead blend into the organizations, I perceived that the best way was to participate in certain parts of the work and interact with the employees, while staying in the background at other times. When the employees were actively participating in meetings and workshops, I followed their lead. When the employees were more passive in their work, so was I.

During meetings with clients and interactions with end-consumers, I adopted a more passive role, staying in the background and only speaking when spoken to, because that was the behavior I observed in the employees.

I actively participated in workshops, joining in discussions and making suggestions during brainstorming workshops. In doing so, I may have affected the final outcomes. The outcome of the design process was not the object of study, however, making this potential impact less important: the focus here is on how knowledge was created rather than on what knowledge was created.

During status meetings, which are for checking progress, I was more passive, in line with the consultants’ behavior. My participatory responses were not planned, but rather reactions to how I perceived the organizations’ meeting and workshop cultures.

All observed participants were aware that I was present and conducting research: I had no hidden agendas. The observations were documented by means of field notes, audio recordings, and photographs. Note-taking was the primary documentation tool and was continuously utilized. Meetings were audio recorded so that I could take fewer notes during them and give fuller attention to participating in ongoing work. Photographs were taken primarily to help me remember specific situations rather than for use as visual material in this thesis.
5.4.2 Performing interviews

The objective of using triangulation in the data collection was to learn from multiple perspectives on the sensing and negotiating of ambiguity in knowing-work. The intention in performing interviews was primarily to learn about the informants’ perceptions and descriptions of freedom and constraints in their work.

Among other purposes, the interviews were conducted to learn from examples of previous design work projects that the informants had worked with. Their reflections on previous experiences deepened the temporal range of the gathered material, adding a retrospective perspective to the observation’s focus on the here and now. As the informants reflected on their practices, they described experiences of past, and parallel projects, complementing the empirical material with numerous detailed examples. In this way, the interviews offered multiple perspectives, allowing me to compare the views of various individuals (Stake 2005).

In the present research, the interviewing contributed to creating a more detailed view of the ambiguities faced by project managers and design consultants, including how these ambiguities were negotiated by individuals in different projects.

Together with the informants, I co-constructed the material collected during the interviews through dialogue and interaction, helping them share their experience. All interviews were semi-structured so that I could join the informants in freer dialogue, enabling the joint construction of meaning.

During interviews, I influenced the insights and understandings created as I decided what questions to ask and as I responded to the interviewees’ answers. Simultaneously, what I tried to make sense of was highly dependent on what the informants told me. By predetermining three areas to address in the interviews, I endeavored to make the interviews more disciplined. These three areas were based on what I assumed would be important in the final research:

- Each interview began with a short introduction about the purpose of the case study to orient the respondent to the theme to be discussed.
• The first discussion area was the informant’s personal background in terms of education, work experience, etc. This was discussed in order to situate the informant’s answers and opinions in context.

• Second, the interview addressed the consultancy’s organization, markets, competitive advantages, etc., to gain insights into what the employee considered the company’s core business and into how well and in what way that business objective is accomplished. Within this area, phenomena such as creativity and uncertainty were discussed as well as the structures of work processes and routines.

• The third area concerned the challenges and opportunities the interviewee could identify in their work as well as whether there were any changes that they would like to see.

Specific questions were not scripted in advance, to allow spontaneous interpretation and interaction. Not all relevant discussion topics can be foreseen, but in a semi-structured interview, the interviewer may follow the informants into unforeseen areas (Kvale & Brinkman 2009). By following their answers and switching tracks only a few times, I was able to cover many topics of presumed interest.

All interviews were audio recorded, with the respondents’ permission. Interviews that were considered to include many potentially useful quotations and examples were transcribed in full; these transcripts are detailed, indicating pauses and acknowledging, for example, laughter or heavy sighing. Other interviews were summarized in shorter documents, not verbatim transcriptions, including most of the informants’ answers and stories. At times, I included quotations in these summaries when I considered them illustrative of certain points. Details on all the interviews are presented in Table 4, on next page.
Table 4. Data collection through interviews.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time (min)</th>
<th>Title and organization</th>
<th>Transcribed (T)/Summarized (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-11-30</td>
<td>61</td>
<td>Project manager and service designer, SDC</td>
<td>T</td>
</tr>
<tr>
<td>2011-12-07</td>
<td>52</td>
<td>Service designer, SDC</td>
<td>S</td>
</tr>
<tr>
<td>2011-12-07</td>
<td>86</td>
<td>CEO and founder, SDC</td>
<td>T</td>
</tr>
<tr>
<td>2011-12-08</td>
<td>N/A</td>
<td>Senior service designer, SDC</td>
<td>N/A</td>
</tr>
<tr>
<td>2011-12-09</td>
<td>61</td>
<td>Senior service designer, SDC</td>
<td>T</td>
</tr>
<tr>
<td>2011-12-09</td>
<td>40</td>
<td>Conceptual designer, SDC</td>
<td>S</td>
</tr>
<tr>
<td>2011-12-14</td>
<td>57</td>
<td>Key account manager, SDC</td>
<td></td>
</tr>
<tr>
<td>2011-12-21</td>
<td>86</td>
<td>Project manager and service designer, SDC</td>
<td>T</td>
</tr>
<tr>
<td>2012-03-23</td>
<td>42</td>
<td>Product development strategist and vice-CEO18, TDC</td>
<td>S</td>
</tr>
<tr>
<td>2012-05-03</td>
<td>52</td>
<td>Industrial designer, TDC</td>
<td>T</td>
</tr>
<tr>
<td>2012-05-24</td>
<td>40</td>
<td>Product developer, TDC</td>
<td></td>
</tr>
<tr>
<td>2012-06-13</td>
<td>39</td>
<td>Product developer, TDC</td>
<td>S</td>
</tr>
<tr>
<td>2012-06-28</td>
<td>53</td>
<td>Project manager, TDC</td>
<td>T</td>
</tr>
<tr>
<td>2012-06-28</td>
<td>46</td>
<td>Product developer and industrial designer, TDC</td>
<td>S</td>
</tr>
<tr>
<td>2012-06-28</td>
<td>47</td>
<td>Project manager, TDC</td>
<td></td>
</tr>
<tr>
<td>2012-06-28</td>
<td>44</td>
<td>Consulting manager, TDC</td>
<td></td>
</tr>
<tr>
<td>2012-06-28</td>
<td>68</td>
<td>Consulting manager, TDC</td>
<td></td>
</tr>
<tr>
<td>2012-06-29</td>
<td>45</td>
<td>Product developer, TDC</td>
<td>S</td>
</tr>
<tr>
<td>2012-08-20</td>
<td>158</td>
<td>Product development strategist and vice-CEO18, TDC</td>
<td></td>
</tr>
<tr>
<td>2012-08-28</td>
<td>67</td>
<td>CEO, TDC</td>
<td></td>
</tr>
</tbody>
</table>

17 The audio file for this interview was lost shortly after the interview.
18 The "Product development strategist and vice-CEO" was interviewed twice and thus appears on two occasions in the table.
5.5 Analyzing explorative practice-based studies

The material was analyzed in two levels. The first, was made up of activities to process the vast amount of empirical material. The second, deepened the initial explorations by detailing and describing the emergence of ambiguity and activities to negotiate them. This part of the analysis construct the relationships between the emergence of ambiguities, the sensing of ambiguity and how ambiguities are negotiated in situated activities.

5.5.1 First level of analysis: processing the empirical material

The empirical material was processed continuously from the collection of data began. The observed activities, discussions, and other phenomena comprised in the empirical material were analyzed from various perspectives to create a coherent picture of meanings and implications. These meanings are not something that can merely be “grasped” from studying the material, but must rather be constructed based on interpretation (Hatch & Yanow 2003).

Much of the empirical material was processed during the writing. The process of writing the empirical descriptions was iterative between the two cases, as a description of something in the first case triggered ideas concerning the second case, and vice versa. Accordingly, the empirical descriptions were written in parallel with many other parts of the dissertation, such as the literature review, the methodological discussion, and the analytical chapter.

Questions guiding the first level of analysis

Rennstam and Ashcraft (2014) have provided detailed guidance for practice-based fieldwork in organization studies to “enable qualified accounts of the nature of knowing” (p.15). In their article, they pose a number of questions to guide explorations into knowing in organization studies. The present research used these questions as tools for analyzing the empirical material during the first level of analysis. The questions were as follows (Rennstam & Ashcraft 2014, p.14–15):

a) What are the practitioners doing? (e.g. hammering, soldering, comforting, explaining, ordering, driving, etc.?)
b) How do the practitioners come to know the objects of their knowledge ... that is, how can the nature of the relationship with the objects and the processes of knowing be described? ... How is the process of knowing characterized by communicative, embrained, encultured, embodied, embedded and/or encoded knowledge? Is the knowing based on experimentation, trial and error, or more reflexive methods?

c) What are the outcomes—for example, in terms of actions, emotions, tensions, power relationships, or the six types of knowledge listed above—of the knowing[-work]?

d) What actors beyond the immediate practitioners have influence over the practice of knowing, and how and when is this “made present” in the actual work of the practitioners?

Answers to these questions are included in workshop summaries and illustrations, which are described in more detail below.

**Workshop summaries**

Based on field notes, audio-recordings, and photographs or filmed sequences, the workshops were summarized into short descriptions. Such descriptions were intended both to give an overview of the studied design work and to prompt my memory. The summaries describe how the work was undertaken by including what was going on and who did what during each workshop. The documents also contain photographs taken during the workshops as well as brief facts about where the work was undertaken, who was participating, how long the workshop lasted, and how I interpreted the overall purpose of the workshop.

**Transcriptions and interview summaries**

Processing the empirical material entailed transcribing some interviews and summarizing others, as described in section 5.4.2. The two contact persons were interviewed several times, first to learn about the specific projects to be observed and the organization’s norms and values in general. Secondly to make interviews that were more comparable to the other interviews, by focusing on freedom and constraints in the design work. By performing these supplementary interviews early in the observation period, I was able to understand what were typical and what were particular characteristics (e.g., durations and work objectives) of the
projects observed. These early dialogues with my contact persons also facilitated my understanding of the work in such a way that I could more easily establish what was “at the core of the practice and at the margins” (Gherardi 2012a, p.16).

Other interviews were summarized instead of transcribed verbatim in their entirety because I did not primarily intend to analyze what people said, in general, about their work practice. Rather, I was interested in how they talked about freedom and constraints in their work, that is, how they reflected on ambiguities and maneuvering room in design work.

There was accordingly no need to transcribe every word of many of the interviews; rather, my intention was to summarize the content and constructed meanings I wished to extract from them. These summaries do contain certain quotations that I have chosen to include, for example, detailed descriptions or illustrative examples of ambiguous situations or negotiating activities. Summarizing the interviews was a continuous endeavor, and as the research objective emerged, I revisited the audio files and interview summaries to add quotations that illuminated the becoming research objective.

**Illustrations and mind maps**

One way of comparing and contrasting the gathered material was to draw illustrations of certain situations and of the people participating in them. This technique helped me take a step back, “seeing” the situations and actions of which they were representative.

Similarly, literature readings in various theoretical fields were related and compared to one another by drawing mind maps. These mind maps then provided a basis for creating a conceptual framework in which to anchor the research.

The illustrations and mind maps were rather working material, than intended to be part of representing the analysis in this thesis. Therefore, the illustrations and mind maps are not included in the empirical findings of analysis chapters.

**5.5.2 Second level of analysis: analyzing data in light of the literature**

Analyzing data was an ongoing endeavor. Qualitative case study data should preferably be analyzed iteratively in accordance with reflexive
practice (Alvesson & Sköldberg 2009). With every new iteration, knowledge is created and more detailed meaning may be constructed (Srivastava & Hopwood 2009). The approach in this research is probably best described as continuous, taking the iterative approach to its extreme.

The research focus emerged in combining reading from various literature streams perceived as more or less close in topic to the becoming conceptualization of the empirical findings. The reciprocal relationship between literature and empirical findings means that both informs the other (Weick 2003). The literature streams and empirical findings were compared to establish similarities and differences between design work practice and the extant literature of design work, NPD work and projects, ambiguity and knowledge-creation work. From these comparisons, I could establish how theory describes the empirical work and construct a void between what extant literature says and what goes on in the empirical doing.

Due to the richness of the empirical material in practice-based studies (Nicolini 2011), only the richest ambiguous situations were considered here. Ambiguities emerge continuously in design work, but this research concentrates on the most prominent ones that were negotiated. Many ambiguous situations emerged in the two studied design work practices. The focus on the phenomenon of negotiating ambiguity in knowing-work grew out of a realization that established design work theories do not fully describe the depth or many details of ambiguous situations. The unit of analysis is the knowing-work practice during which ambiguity is negotiated. In other words, the second level of analysis was oriented toward analyzing the sensing and negotiating activities connected to specific ambiguities in knowing-work.

Given the abundance of empirical data, there is a vast number of minor, yet not inconsequential, ambiguous situations that one could describe and discuss in this research. However, doing so might blur the overall picture and not necessarily clarify the points made here. The emphasis should rather be on the richest ambiguous situations and negotiating activities.

**Questions guiding the second level of analysis**

The second level of analysis was very much guided by the chosen practice epistemology. The analysis as such focused not only on the practitioners’
actions, but also on situating these activities in a temporal, geographical, and relational context following the conventions of practice epistemology.

To analyze the emergence of ambiguities and the actions taken to negotiate them, a few questions were posed to guide the work. These questions were utilized as “sparring partners” during the second, deeper level of analysis.

The first few questions concern the nature of the ambiguities that emerged in the knowing-work. These questions are anchored in practice epistemology and its assumptions regarding knowing-in-practice, while focusing on ambiguities. Some examples of such questions are:

- What was the kind, type, or nature of the ambiguities?
- How, where, and when did the ambiguities emerge?
- How did the practitioners negotiate the different kinds of ambiguity?

In addition to these, a few more questions were posed to situate the activities to negotiate ambiguities. These questions were constructed to represent different aspects of practice epistemology. Some examples of such questions are:

- What did the practitioners mobilize to negotiate ambiguity?
  Discursively? Materially? For example:
  - What kinds of discourse did they mobilize or enact?
  - What were their sayings and doings?
- What skills did they enact in negotiating ambiguity?
  - What kinds of material were used in this negotiating? How did they use such material?
  - Was there any aesthetic behavior? For example: Thinking that something was beautiful? That an idea was beautiful?
- What was the anchoring in the professional practice of designing when negotiating ambiguity?
  - What was the anchoring in norms, rules, traditions?

The answers to these questions guided the descriptions of both the empirical findings and the analysis.
Identifying the studied concepts in the ongoing design work

The extensive use of complex concepts calls for a description of how these concepts were identified in the studied design work. How does one know whether to call a situation ambiguous or to define an action as negotiating?

*Ambiguity* is understood as an inability to make unanimous interpretations of a situation, statement, or artifact that seriously reduces the possibility of rationality. Constructing parts of the empirical material as pertaining to ambiguities was a retrospective endeavor undertaken during the processing of data. Looking backwards, one may connect later parts of the work with phenomena that were previously subject to a multiplicity of interpretations.

*Negotiating ambiguity* refers to the kinds of activities that approached ambiguous situations and influenced their prevalence. Negotiating ambiguity does not mean controlling, handling, or managing ambiguities; rather, the concept implicates reaching agreements or compromise in finding a way over or through inabilities of making unanimous interpretations, to harness or reduced the power of ambiguity.

An activity emerging in the empirical material was identified as a negotiating activity when it was undertaken in relation to an ambiguous situation, for example, when discussing and comparing interpretations when in situations where possibilities for making multiple interpretations regarding a cue emerged. For example, doings that compared several ways of interpreting an ambiguous objective, such as assuming various stakeholder perspectives, were understood as an activity to negotiate the ambiguous objective. Such activities transpire in the empirical material as the design practitioners argued about what would make the transition “pleasant” (part of the formulation of the objective of the service design work) from specific end-consumers’ perspectives. For example, one designer said of an end-consumer, “One person told me that they wanted a pamphlet sent to their home,” to which another designer responded: “But Deborah didn’t want that,” referring to an interviewee by name.

### 5.6 Communicating practice-based studies

Ambiguities emerged in the design work throughout the empirical data collection. In this thesis, the reader will encounter descriptions of several
examples of ambiguity from each case study. The empirical results are described in two chapters, one for each case study. The two chapters follow the same logic: the emergence of ambiguity is first described, then the negotiating activities are described.

The cases are described in different levels of detail: the service design work is presented as detailed descriptions of the emergence of ambiguities, and of the related negotiating activities, mainly by drawing on empirical snapshots of various situations. This is something Crevani (2011) eloquently described as presenting “episodes of collective work in the form of interactions” (p.63). The technical design work is presented in more overarching descriptions, but incorporating certain more specific episodes of collective work, conveyed mainly through dialogues.

These different levels of detail result from the chosen methodology for gathering empirical material in relation to the differences between the two design work practices. The service design work is undertaken as short contracts that last for only a few months, while the technical design work is undertaken as longer contracts that often last over a year.

The activities for negotiating ambiguities are not described with the intention of portraying the entirety of design work practice. Rather, as is customary in practice-based studies (e.g., Nicolini 2011; Gherardi 2012a), the empirical findings are presented as vignettes empirically illustrating the points made. In this research, such empirical illustrations convey either the emergence of ambiguities or the actions taken to negotiate them. Although ambiguities and the negotiating activities should not be seen as separable, they can be distinguished in writing for analytical purposes.

The stories told in the empirical chapters should not be understood as descriptions of empirical findings, to be analyzed in a second step. Instead, in line with communicating practice-based studies, the findings and analysis are partly intertwined in two chapters presenting empirical findings, and then compared in a cross-case analysis. The research objective (here concerning the emergence and negotiating of ambiguities) situates the empirical descriptions and anchors what merits attention.
6 The two consultancy organizations

The studied design work is undertaken as consultancy services on behalf of other large-scale organizations. The design work is undertaken in organizational settings that may be described to clarify the characteristics of the design work contexts and, in turn, to clarify the other lines of work to which the results may be generalized.

The nature of the contracted design work differs greatly between the Technical Design Consultancy and the Service Design Consultancy. The type of early conceptual design work undertaken in the Service Design Consultancy has a counterpart in the Technical Design Consultancy. However, such early conceptual design work is only a minor part of the entirety of the technical design work. After one or several conceptual designs have been established, the design work continues with both industrial design and engineering design activities. It is these later parts of the design work that were studied in the Technical Design Consultancy. The descriptions of ambiguous situations and situated activities to negotiate such ambiguities therefore differ somewhat between the two cases.

6.1 The Service Design Consultancy

The current owner and CEO founded the Service Design Consultancy in 1998 in cooperation with a former classmate from the University College of Arts, Crafts and Design in Stockholm. Their ambition was to create a market leading organization in what they labeled strategy-driven product design. Although business was initially slow, the Consultancy managed a series of design strategy projects concerning physical artifacts. Due to changing markets and strategies over time, however, clients began inquiring whether the firm could design strategies for services as well.
Consequently, the CEO identified the potential of designing services and, starting in 2006, decided to concentrate the business solely on designing services. During the empirical research for this thesis, the employees of the Service Design Consultancy usually described their work as “service innovation driven by end-consumer insights.” In other words, over its years in business, the Consultancy has shifted its focus from more product-oriented strategies to end-consumer-driven service design, both of which may be framed as knowledge-creation work.

Since the shift in focus, the business idea has been to create and improve services for clients so that these clients may meet the end-consumer needs in new and better way. The consultants compete for these contracts with other design consultancies and with IT consultants, since many service concepts result in IT solutions. The Service Design Consultancy lacks an IT department and therefore can claim to be independent of specific service outcomes (e.g., IT solutions). Given that the Consultancy lacks an IT department, or any other kind of product/service development unit that could realize the designed conceptual service as a marketable service, the design work does not include implementation of the conceptual design.

The Service Design Consultancy has been a trendsetter in the emergence of service design as an independent discipline in Sweden in many ways. It organizes regular breakfast seminars, workshops, after-work seminars, etc., intended to raise awareness and spread knowledge of service design. At these events, the Consultancy gives presentations about its various design projects or invites speakers, such as clients or researchers. The seminars attract many participants, ranging from current and potential clients, through designers, to researchers to policy makers. The Consultancy’s employees regularly lecture on service design in universities and participate in academic and industry-oriented conferences. In addition, the Consultancy collaborates with researchers from multiple disciplines and has coauthored books on service design.

6.1.1 Service design work as consultancy service

The service design work entails designing service concepts based on end-consumer desires and drivers. The design work is undertaken on behalf of external client organizations and regulated in contracts between the Service Design Consultancy and its clients. The clients are mainly large
service-providing organizations\textsuperscript{19} in both the private and public sectors that want to develop their service offerings. At times, the client organizations participate by staffing the project with their own employees; at other times, the clients are more like observers, engaging in only a few workshops and meetings.

Several client projects are undertaken in parallel and the employees are generally involved in more than one project at a time. Though the design projects vary in both duration and resource consumption, they are always sold on a fixed-price basis. Sales is an ongoing work task handled by both the CEO and a few key account managers. The key account managers are responsible for client contact throughout the contracts, but do not actively engage in the design work.

6.1.2 The formal organization

The Service Design Consultancy is managed at three levels: the board of directors, the management team, and what it sometimes calls production, i.e., the design teams that execute the client projects.

As the company was growing considerably during the study, several managers and employees expressed a need to formalize the organization by introducing more titles, formal responsibilities, and structures. Changes in this direction were made during the study period, when the management team implemented formal titles for the service designers, distinguished as service designer, senior service designer, and service design director depending on level of experience and seniority.

Since the collection of empirical material for this research was completed, the Consultancy has continued to grow. More formal titles and support functions have been introduced, such as (senior) concept designer and digital concept designer. In the empirical material, all descriptions are related to the employees’ titles during the study.

The service design consultants both staff and manage the projects that they are contracted to undertake. One or a few employees from the client organization may at times also be included in the design team.

\textsuperscript{19} The “service-providing organization” in the studied case is interchangeably called “the client organization.”
6.2 The Technical Design Consultancy

The Technical Design Consultancy was founded in 2004 by two of the six shareholders who were managing the organization at the time for collecting the empirical material. The company was initially established to offer an alternative way to undertake technical design projects. The idea was that such projects might achieve greater success by integrating both strategic and business thinking. During the projects, the Consultancy combines engineering and industrial design. Their competitors are therefore both traditional industrial designers and engineering consultants.

The two founders had learned from their own experience that the business orientation often got lost during technical design projects, with consultants often ending up solving the “wrong” problem. For technical design to succeed, they claim that consultants must first determine whether the problem—as defined by the client—is the “right” one. Clients approach consultancies with specific queries about problems or tasks that they want the consultancy to address. However, given that the contract is future oriented and problem based, the client may not have fully identified the underlying needs in areas outside their expertise. The Technical Design Consultancy, comprising experts in the field, therefore takes responsibility for defining the problem. Doing so increases the chances of actually delivering what the clients need rather than what they initially thought they wanted. With this in mind, the founders developed their own approach to technical design work, called business-focused product development.

Outcomes of projects undertaken by the Technical Design Consultancy have been recognized in several Swedish design contests, such as the Association of Swedish Engineering Industries’ Grand Award of Design and the Swedish Design Award. The Consultancy regularly arranges seminars about the concept of business-focused product development. To these seminars the Consultancy invites clients, prospective clients, and others interested in how to successfully manage combined industrial and engineering design. During these seminars, the consultants either give lectures on previous projects themselves or ask clients to give such presentations. Inspirational speakers in the field of product development are also invited.
6.2.1 Technical design work as consultancy service

The technical design projects entail designing and developing physical products based on the clients’ demands in accordance with what has been contractually agreed on. The clients are large-scale product organizations in the private sector.

The Technical Design Consultancy explicitly aims to develop successful products for its clients. By taking overall responsibility for both product strategy and product development, the Consultancy’s intention is to function as an external product development department for its clients, which are manufacturing companies of varying sizes. The typical client engages the Consultancy to develop products for mass production. This requires that the consultants design the product, in terms of both aesthetics and function, with consideration to production technique, price, and cost.

Some of the clients that contract the Technical Design Consultancy sell their products as consumer goods, while others serve the business-to-business segment. This means that the products that the Consultancy is hired to create sometimes target private individuals and sometimes professionals. Any future references to end-users in this thesis refer to the individuals who are to use the product, regardless of whether they are hired to do so.

The Technical Design Consultancy not only designs the products but also handles returns of non-functional or broken products. By handling the complaints emerging after product introduction to the market, the Consultancy increases its learning opportunities. From this they have the possibility to create knowledge about what technical content and production techniques that works more or less well in various contexts and may refine the product accordingly if the client wishes a second edition.

There is no typical duration for the projects, rather the duration varies greatly. The projects vary in scope and thus in number of consultants, invested resources, time needed, etc., due to the differences in the tasks that the clients bring with them when approaching the Consultancy. The technical design contracts are invoiced per consultant hour spent on the project.
6.2.2 The formal organization

At the time of the study, the organization’s management team comprised the two founders, i.e., the CEO and Vice-CEO, and three consultant managers. Each consultant manager was responsible for a division of employees as well as for sales.

Most staff of the Technical Design Consultancy are engineering or industrial designers. All of the consultants have the title *product developer*, but with different specializations, such as engineering design, industrial design, and project management. In peak periods or for specific specialist competences, the Consultancy sometimes hires subcontractors.

The founders of the Consultancy have an explicit human resources policy when hiring new employees: the product developers should be experienced, responsible people who identify with being suppliers. “Being suppliers” means that all employees should be professional and deliver their work results to both colleagues and clients on time and according to specifications.

The project teams consist of a mixture of engineering and industrial designers, depending on the specific project objective. The industrial design work is normally considered to constitute approximately 5–10% of the technical design work, which is mirrored in the proportion of industrial designers in the staff.

6.3 Models and methods for the design work

The following subsections present the generalized process models for undertaking the work in the two studied organizations. These work models are used during sales to convey to clients how the design work is done. These models are also used during the ongoing design work to make plans and to communicate within the design team about work activities that have been undertaken, and the work to come.

6.3.1 The service design work: a sequential process model

As is commonly found in classical design research, service design work may be described as a process of several general steps. Such a process follows a predefined sequence and includes repetition of a few of the process steps. The design work participants, i.e., the designers, seemed to have a shared
view of what knowledge should be created in each process step, referring to the design work as a straightforward effort to transform end-consumers’ needs and opinions into the features of a new service.

**A generalized process with sequential activities**

The generalized process comprised the following steps in the service design work: (1) the *pinpoint workshop* for interacting with and learning from client stakeholders, the results of which are summarized as keywords on Post-It notes; (2) the *questionnaire workshop*, in which the outcomes of the pinpoint workshop are translated into questions and trigger material as a basis for interacting with end-consumers; (3) *end-consumer interactions*, i.e., interviewing end-consumers about their desires concerning the proposed service; (4) the *insights workshop*, in which the outcomes of the end-consumer interactions are collectively interpreted and summarized in spreadsheets and as keywords on Post-It notes; (5) the *clustering workshop*, in which the outcomes of the insights workshop are organized by sorting the Post-It notes, categorizing end-consumers, formulating end-consumer journeys, and labeling categories; (6) *idea generation*, i.e., brainstorming possible outcome characteristics of each end-consumer category and phase of the end-consumer journey, summarized as keywords on Post-It notes; (7) *conceptualizing*, i.e., combining and concretizing the idea generation outcomes to form coherent design proposals by organizing the Post-It notes; and (8) *delivery*, i.e., communicating the final outcome to the client in the form of drawings, written text, and an oral presentation.

The generalized process includes a recursive pattern of “opening up” and learning from situated cues, interspersed with interpretative activities to synthesize the learning. Moreover, the script for how design work should be undertaken includes a sociomaterial aspect: the specific roles of visual, material, and discursive representations transpire in the generalized rules. The design work recursively includes discursive representations in the form of keyword summative.

The design work is continuously mediated by visual and material representations, for example, in the form of “trigger material” (i.e., illustrations and drawings to elicit reactions and responses from end-consumers) or “Post-It clusters” (i.e., the visualization of categories by grouping Post-It notes in clusters to signal affinity).
The service design consultants said that steps two to seven are undertaken repeatedly in each project. Iterating these steps ensures that the outcome is “end-consumer proof,” that is, that end-consumers will approve of the outcome. The project manager described the role of the end-consumer interaction in the overall service design work as follows: “What we do well is that we never make something up out of thin air—it can always be traced back to the end-consumers’ needs or passions.” In other words, the project manager’s talk about practice theorized that the design outcomes were based on conclusions drawn from interactions with end-consumers.

This process description of the service design work reflects a generalized script for how the work is undertaken, although when design work is practiced, the knowledge-creating activities are emergent and situated in the specifics of the emerging context.

**The perks of the process**

The process of undertaking a service design project were described to clients and other external parties as rather straightforward during meetings, presentations, conferences, and breakfast seminars arranged in the Consultancy’s premises on a regular basis. The consultants described their design work as comprising a number of general phases. These phases were described as following a predefined sequence and including iterations in which several phases are performed repeatedly. When consultancy employees described the design work in greater detail, they ended up describing the purpose of each phase, rather than actual activities. They then cited examples from previous projects to convey how the purposes of project phases have been fulfilled in the past.

In other words, the generalized description of the design work as comprising clear and discrete phases was a way of conveying how the designers work by talking about their work practice. However, when going into greater detail, the talk about the work practice theorized about what was being done by drawing on history and speaking from experience. Their habit of talking about the purpose of work phases reflected the designers’ view that design work is about learning and knowing. The purposes of various phases were often described in terms such as “after this phase, we should know more about … .”

Moreover, the participants in the service design work had different interpretations of the script, something that the project managers in
particular were unaware of. On the other hand, the service designers who worked with various project managers noticed differences in the knowledge-creating activities depending on which project manager was in charge of the specific design contract.

From this, one may conclude that the schema of general design work phases is a way for the designers to share (among themselves and with others) a language and a view of what the work is about. On a more detailed level, the expressed purposes and examples further indicate that the designers have similar views of what sociomaterial interactions (e.g., with stakeholders or visual representations) they should have engaged in and what they should have learned (e.g., about the client or end-consumers) after a phase is completed.

6.3.2 The technical design work: a model, values, and principles

The Technical Design Consultancy did not have a detailed standardized process model comprising steps to be strictly followed in all projects. Instead, the managers claimed that the aim is to ensure that the main ideas of business-focused product development permeate the work. In doing so, the consultants are expected to continuously consider business-related trade-offs, such as the cost of further development versus gains in product refinement, the cost of varying production techniques, etc.

A set of generalized activities

Although lacking a detailed process model, the technical design work was said to be guided by an overarching process model. The Technical Design Consultancy also established six principles that guide the work and six values that anchor the work. These principles and values were defined with the intention of capturing the essence of the company’s business idea, i.e., to undertake business-focused product development. The principles and values take precedence over the process in case of conflict, meaning that the design teams are free to undertake other activities or change the sequence of tasks as they see fit.

The technical design consultants described their work as comprising several phases: (1) product definition, i.e., defining characteristics that the product-to-be should have; (2) conceptual development, i.e., creating a number of potential conceptual designs; (3) prototyping, i.e., refining a few chosen concepts into functional models; (4) CAD and calculations, i.e.,
making detailed drawings and calculations of, for example, stress
durability; (5) testing procedures, i.e., conducting physical tests of, for
example, temperature resistance and conductivity; (6) industrialization,
i.e., refining physical appearance and simplifying the technical solution;
and (7) delivery, i.e., transferring product responsibility and submitting
drawings and documentation, etc., to the client. Validation was also
included in the Consultancy’s work description as a stand-alone element
pervading all work activities and to be undertaken continuously.

The specific order, priority, and emphasis of the various phases was said to
vary between projects. Consultants and managers alike conceived of the
process phases as guidelines rather than prescribing rules for what
activities to undertake in what order. During the ongoing design work, the
design teams are welcome to settle on somewhat different activities if they
are needed to fulfill the purpose of a contract. Primarily, however, during
the design work, the process phases are to be interpreted and imbued with
meaning, given that the phases do not really prescribe any knowledge-
creating activities.

Although repetition is common in iterative development models, the
Technical Design Consultancy aimed to avoid what they called
“unnecessary iterations” of the process because they were considered too
costly. Instead, the aim was to be thorough in the initial phases, to establish
a sound foundation for ensuing phases and therefore avoid costly changes
and reworking.

Principles that meditate the work

The Technical Design Consultancy had established a few principles to
inform the design work throughout each contract. The product
development strategist described these as follows:

• The business opportunity should be clear. If a business opportunity
cannot be expressed in simple terms this is considered to signify that the
conceptualization of the business opportunity itself is not any good.

• The product definition should be convincing. The product definition
specifies how the business opportunity is to be translated into a
functional product. If one cannot formulate a convincing product
definition, one must first reduce the number of uncertainties and
ambiguities by doing some kind of primary development.
• **Make sure to do the right things.** If one does not manage this principle, the outcome may be what the client verbally requested, but possibly not a design outcome that meets the client’s implicit needs. It is important to understand the underlying reason why something should be done to make sure one is “doing the right things” rather than just “doing things right.”

• **The product outcome should be good.** Once the Consultancy has created an outcome that is good (i.e., aligned with the business opportunity and product definition), further development efforts should be terminated. For that reason, the technical design work includes continuous learning, as improvements can always be made given newly created knowledge. One must learn to stop when a desirable outcome has been reached.

• **Make sure to validate continuously.** Technical design is validated through lab testing, financial calculations, reviewing drawings, receiving feedback on manufacturing specifications, etc. Continuous validation means that one receives continuous feedback on minor changes instead of discovering at the final stages of design work that major changes are needed.

• **All team members should be active in all phases.** It is considered important that the team members gain an overview of the entire process by participating in all phases. It is also seen as essential to include all relevant competencies early on, such as marketing and sales personnel employed in the client organizations as well as the material supply, production, and assembly organizations.

In addition to having established a set of principles to mediate the work, the Technical Design Consultancy also has a few values that anchor the work.

**Values that anchor the work**

Although the values are expressed as trade-offs, “both sides of the coin” are considered important—or even crucial—in the Technical Design Consultancy’s design work. The values should therefore not be understood as articulating “either/or” judgments, but rather as rating what should be given priority. The values guiding the work are as follows:
• **People versus processes and tools**: This means that people are valued over processes, so designers should be happy with how the work is being undertaken for the outcome to be good.

• **Definitions versus specifications**: Detailed specifications may reduce the degrees of freedom in an unwanted manner by over-determining the product and making it difficult to construct. Instead, the aim is to initiate technical design efforts based on a product definition including the intentions underlying and characteristics of the desired outcome. The definition should preferably answer the question “What should this product achieve?”

• **Conformity to vision versus excellence in performance**: At the Consultancy, it is deemed more important to fit products to client visions rather than to achieve the best performance.

• **Functional models versus prototypes**: When designing a new product, the engineering designers are expected to prioritize the functional aspects of the future product by making functional models with which to identify, early on, the weakest links and greatest challenges.

• **Adaptation to change versus following the plan**: Although the project managers are always required to have a project plan, it is considered even more important to continuously change and update the plan. The risk of changing a plan too little is that one might end up trying to fit reality to the plan instead of vice versa.

• **Describing with pictures versus describing in text**: The ultimate goal is for the team members to be able to communicate, both among themselves and with the clients. The product development strategist described how text easily tends to take priority over pictures, which might be disadvantageous at times.

### 6.4 Design and development work as knowing-work

In the empirical cases, the design consultancies are framed as undertaking knowing-work, given their focus on creating knowledge about new products or services. As such, their objective is understood as one of creating knowledge of the design outcome. Moreover, this knowing-work is undertaken in the form of consultancy services. In the following two
subsections, typical characteristics of the studied design consultancy work are described by citing examples of design work from prior projects.

6.4.1 The service design work practice: a typical case

A typical example of service design work was a project to design the process of applying for compensation claims, undertaken on behalf of the Swedish Social Insurance Agency in 2011. The objective was to review and revise the handling of compensation claims for temporary and long-term parental leave. The underlying objective was to increase the level of self-service while simultaneously increasing end-consumer satisfaction with the handling of compensation claims.

The end-consumers in this case were parents on either long-term or temporary parental leave. In Sweden, parents are economically compensated for temporary and long-term parental leave by the Swedish Social Insurance Agency. Long-term parental leave is typically connected to the birth of a child, and the months of parental leave that follow are shared between the parents. Temporary parental leave occurs in the case of a sick child when one parent stays at home to care for the child, who cannot attend preschool.

Before the service design project, applying for temporary parental leave in particular had been a cumbersome ordeal for parents and administratively intense for the Social Insurance Agency. In case of temporary leave, parents had to complete a form that they obtained from an Agency office. This form was then brought to the child’s primary daytime caregiver (i.e., preschool) for verification. Once the form was returned to the parents, they were to send it to the Agency, which would then review the compensation claim before eventually reimbursing the parents.

This complicated and time-consuming process had been digitalized, in that compensation claims could be made online. The Social Insurance Agency was not satisfied with the level of self-service, however, and hired the Service Design Consultancy to remedy that by focusing on the end-consumer perspective in the claim-handling process.

The design team interviewed parents about what functioned more or less well in the current service system as well as what would make them more inclined to use self-service. The project resulted in a proposal by the design
team to develop a digital platform giving parents an overview of the whole family via an easy-to-use interface with a personal login and other features.

Before the project, individual parents could see only their own leave usage and not the other parent’s usage, for example, of long-term parental leave days. During end-consumer interviews, many voiced surprise at this separation: both parents naturally considered themselves connected in these matters, given that the claims concerned children they had together. Such a design outcome might seem simple or logical in retrospect, but at the time provided the client with many insights into how to serve end-consumer needs and demands.

6.4.2 The technical design work practice: a typical case

A typical example of the technical design work was a project for the physical design and development of a sparkling water dispenser, undertaken on behalf of a large-scale product organization. The design work was undertaken as what the Technical Design Consultancy calls business-focused product development.

The Technical Design Consultancy takes on two main kinds of contracts, described as follows by one of the consultants: one type of project is what the Consultancy wants to do, that is, business-focused product development; the other type is what the Consultancy often does, that is, strengthening resources in clients’ product development projects.

In the latter case, the client is in charge of the entire project and the consultants participate as members of the project team, which is often located at the client’s facilities. Any ambiguities that emerge in such contracts and that concern the team and the project are handled mainly in the client organization. Such contracts are therefore not considered a basis for discussing the emergence of and negotiating with ambiguities in this research.

In the former case, however, the Technical Design Consultancy’s employees are in charge of the project and participate directly in the design practice. Any ambiguities that emerge in such contracts relate to the designers’ work, so their knowledge-creating activities are involved in negotiating the ambiguities. These kinds of contracts therefore constitute a suitable basis for the empirical results and analysis concerning the technical design practice.
As mentioned, one example of a business-focused product development project was the design and development of a sparkling water dispenser. According to the responsible consulting manager, the Technical Design Consultancy was contracted to undertake a series of development projects by the client. First, the Consultancy designed and developed an exclusive product range, which was followed by the design and development of a midrange product.

These projects were assigned, under contract, to the Consultancy by the consumer division of a large-scale company distributing and selling bottled carbon dioxide. The client organization had decided to extend its product lines by selling sparkling water dispensers. As it lacked necessary expertise and experience in developing kitchen appliances for the consumer market, it contracted the Technical Design Consultancy to function as an external product development department.

The design and development work in connection with the midrange product was structured as two separate projects. First, the Consultancy was contracted to create an initial design concept and to determine the conditions for the subsequent development work. Second, the consultancy was contracted to realize the design concept as a manufacturable product, together with all component specifications, user manuals, final testing, etc.

It might seem straightforward to design and develop a sparkling water dispenser. Ambiguities did emerge in the work, however. The most pressing problem, which also took the most time to resolve, was an ambiguity that emerged in connection with testing a physical prototype of the machine. During this testing, it became apparent that the carbonic acid froze in the nozzle when it was supposed to carbonate the water.

According to the product development strategist, it took the design team three months of hard work to troubleshoot this problem. The main issue, and the reason for the protracted troubleshooting, was that it was unclear to the design team whether the problem resided in production technique, choice of materials, or physical design characteristics. The troubleshooting activities to negotiate this ambiguity included comparison with competing products and consulting experts in production techniques. In the end, it turned out to be a production technique problem that was resolved by changing how the nozzle was manufactured.
7 Findings from the service design work

The empirical findings in this chapter were based in a study of service design work, mainly one design project of the Service Design Consultancy. The studied design work was organized as what the Consultancy calls an action research project. The project’s objective concerned designing the information to and communication with end-consumers regarding a transition between two IT systems.

The client organization in the studied design project provides banking services via these IT systems. Using either of the IT systems, even those with relatively limited computer skills can review their accounts and trade financial assets. The banking industry is characterized by high secrecy and security levels, which had several implications for the service design work.

First, banking end-consumers are mindful of the sensitive nature of banking services and tend to be fraud aware. Such fraud awareness translates into skepticism in the long run, which ultimately means that end-consumers often want to verify information from the service-providing organization by calling the customer care department. This behavior was costly for the studied service-providing organization and was a specific concern that the design work was to be aware of, target, and ideally reduce in the transition between the systems.

Second, the studied service organization was fraud aware and reluctant to share too much visual material before the transition between systems. Disseminating visual material about the user interface for the new IT system could have improved the end-consumers’ understanding of the new system. Simultaneously, disseminating such material could have increased the risk of scams by creating a basis for creating similar but fake web pages.

The service design project studied for this thesis was somewhat unusual, as compared with the typical design contracts in the organization, in two main ways. First, the composition of the project team was extraordinary: in addition to the project manager and an experienced service designer, the team also included one newly employed service designer, two trainees, as
well as two employees from the client organization. Usually, the teams are smaller and contain a larger proportion of experienced service designers.

Because the studied project was not undertaken by an ordinary service design team, a few extra team meetings were held to brief the less experienced participants about the design work to come. Such an extraordinary setting was useful for this research, as it illustrated the difference between business as usual and the specifics of the design work in the studied case.

During the briefing meetings, the project manager described what the design work would be about and presented the purpose of such activities. The project manager’s talk about the design practice was revealing in how it anchored activities in professional design practice and experience.

The briefing meetings are introduced here. However, they will also be treated more fully in the descriptions to come and be situated in the emerging context. At the first meeting, the project manager described the Consultancy’s whole design process from start to finish with the help of illustrative examples from previous client projects. Every step was explained as having a distinct purpose: the project manager said “here we try to understand …” with reference to every phase of the process. He also illustrated his presentation by citing both concepts that had succeeded and other concepts that had not appealed to end-consumers and hence were scrapped.

A second briefing meeting was added after the pinpoint workshop, the goal of which was to present the interview technique used in service design work in greater detail. The project manager also wanted the less experienced participants to understand the value of following the methodology and why they should do so in a certain way: In the organization, the method for gaining insights into end-consumers’ drivers is considered crucial to achieving a successful outcome.

The second major difference between the studied project and a “typical” service design project in the organization concerned the objective and scope of the project. The design work is usually undertaken with the objective of designing a new service or improving an existing one. In this case, the purpose was instead to design the transition from an older IT-based service to a newer IT-based service, from the end-consumer
perspective. The end-consumers were private individuals using the service system for banking tasks.

The service itself would not change in essentials, but all end-consumers would be transitioned from the old IT platform to a newer IT system, which could affect how the end-consumers interacted with the service-providing organization. The changes that would concern the end-consumers included a new user interface, as the IT platform would look and function somewhat differently.

The change in IT platform was assumed to have consequences for the end-consumers, as they would have to relearn how to use the service-providing organization’s system. The service design project was intended to design the transition so that it would be as seamless as possible for the end-consumers. To fulfill this objective, the service designers needed to learn about how the system change would be perceived by various end-consumers. For example, the service designers needed to learn: Whether end-consumers would perceive the change as a major one? If yes, in what way? What kind of help would the end-consumers want and expect from the service-providing organization? Through what channels would they expect such help or support (e.g., online or in the service-providing organization’s offices)?

### 7.1 Emergence of ambiguities

The following sections introduce the emergence of ambiguities in the studied service design work practice. Snapshots from the service design work are presented to illustrate the emergence of ambiguous situations in the design work and how such ambiguities made themselves known.

#### 7.1.1 Product ambiguity

As described in the theoretical framework, product ambiguity relates to an inability to make unanimous interpretations of the product being created, i.e., what this thesis mostly calls the design outcome.

In the studied service design work, product ambiguity emerged in at least three ways: (1) from an inability to make unanimous interpretations of the objective of the design work, i.e., the project purpose could be interpreted in many ways; (2) from an inability to make unanimous interpretations of
connections between the ambiguous objective and the ambiguous future design outcome; and (3) from an inability to make unanimous interpretations of conflicting functional requirements.

**Ambiguity in the objective of the design work**

It is not unusual to initiate knowledge-creation work with an ambiguous purpose or goal formulation. Ambiguity emerges in more or less every effort to create something: As was demonstrated in the literature review, ambiguity may be considered an embedded characteristic of knowing-work, especially in relation to defining work objectives or setting goals.

The ambiguous objective of the studied service design work transpired in an e-mail sent to several client stakeholders before a workshop to initiate the design work (see Figure 2). The design team as well as stakeholders from various parts of the client organization were to participate in the workshop.

![Figure 2. The design work objective as described in an invitation e-mail sent out before a workshop.](image)

The e-mail was primarily written as an invitation to the workshop but also included a preparatory assignment for all client organization participants. The purpose of the design work as formulated in the invitation may be seen as a discursive representation of the ambiguous objective at that time.
The workshop invitation discursively enacts the possibility of making multiple interpretations of the purpose of the design work, at that time as well as perhaps throughout the design project. The formulation of the purpose of the design work is vague and open to multiple interpretations in such a way that it challenges any attempts to measure whether the goal has been fulfilled. Ambiguities emerge in at least three ways in this formulation of the objective, as described below.

The purpose is ambiguous in terms of the desired characteristics of the design work outcome (“how to make the transition pleasant”). Trying to grasp the essence of “a pleasant transition” is not only challenging but also multivocal. “Transition” is a vague term given that it is unclear when this transition begins and ends. For example, one may consider the transition to begin when the client organization starts planning for it, when a plan has been settled, when the end-consumers’ online accounts have been transferred to the new system, or when the client notices that a transition has been made. To complicate matters further, the transition was to be undertaken in batches, with subsets of end-consumers being transitioned one at a time. The question arises as to whether “the transition” should preferably be considered and treated as one single transition comprising several rounds of end-consumer migrations, or as a series of many smaller transitions.

The purpose is also ambiguous when it comes to indicating who should ultimately know more upon finalizing the project (“create an understanding of”). The first question that arises here is where this understanding should be situated upon finalizing the project: Who should know more about making the transition pleasant? Although the design team might have constructed such an “understanding,” the formulation implies something more than its literal sense, i.e., it is not enough that the design team knows more. The design outcome of the knowledge-creating activities during the design work should also benefit the client organization in some way, although this is not explicitly stated.

The design objective is also unclear in terms of the criteria to be fulfilled (“as pleasant as possible for our customers”). Pleasantness is subjective, changing depending on the situation. The end-consumers (called customers in the e-mail) in this case are millions of individuals with personal desires and agendas. In other words, the qualifier to be fulfilled is ambiguous both because pleasantness is an elusive and immeasurable goal.
and because the end-consumers are not a homogenous group with a uniform understanding of what is pleasant.

Although ambiguous, the formulation of the design work purpose does give some indication of the client organization’s challenge that the Service Design Consultancy has been contracted to take on. One might assume that there is little “understanding of how to make the transition from the old system to the new system as pleasant as possible for [the end-consumers]” in the client organization.

**Ambiguity in establishing a fit: finding the “good enough deluxe” intersection between objective and design outcome**

Many of the work practices researched in practice-based studies are ongoing endeavors, such as construction safety or telemedicine/monitoring. In line with practice epistemology, the design work researched here is also seen as emergent and ongoing. It presents a somewhat different organizational setting, however, since the work is organized as design projects and sold as design consultancy services.

This means that a design project has a due date, indicating when the design work is to be finalized for a specific client. In combination with finalizing a design project, a design outcome should be delivered to the client organization that ideally attunes to a contracted pre-established goal. This differs from the continuous work practices of construction safety or caring for chronically ill patients in telemedicine. In this somewhat different nature of design work undertaken as a consultancy project, an ambiguity of establishing a fit emerges. More specifically, ambiguity emerges in an inability to establish a fit between the design work objective and the design outcome.

Several design concepts were created during the studied design work. Simultaneously, the ambiguous objective was sustained in the design work by making few efforts to rephrase the equivocal choice of words. The design work included knowledge-creating activities to interpret and analyze the ambiguous objective from various perspectives, however. More specifically, the design work included knowledge-creating activities to translate history-related experiences into future-oriented design hypotheses, communicated as design concepts.
What remained, however, was to establish a fit between the ambiguous objective and the design concepts resulting from the analytical and interpretative knowledge-creating work. It is here that the ambiguity of establishing a fit emerged in connecting the design purpose with the hypothetical design outcome.

Although not discussed in the studied design work project, a workshop relating to this topic was held internally in the organization at the time of the observation study. The workshop was called “Good enough deluxe” and its purpose was to initiate dialogue concerning the (sometimes too extensive) delivery of their projects. One project manager was both the initiator and convener of the workshop. She had made preparations for the workshop by qualitatively analyzing the Consultancy’s work according to a number of project characteristics, such as time plan, budget, and cost overruns.

During the workshop, the project manager described how the consultants tended to go “all in” even in smaller client projects with shorter durations and lower budgets. She rationalized this by saying that the consultants are ambitious individuals who want to perform their best at all times: there is always “something” more that can be done to improve something. The consultants themselves attributed this overworking, for example, to their great enjoyment of their work, their perfectionism, and their worries about delivering too little.

On the other hand, investing more time and delivering more than promised in small projects devalues the more extensive projects. In essence, the project manager argued that it would become difficult to sell more extensive projects at higher prices, if clients could hire them for smaller projects and receive a delivery almost as extensive as for the larger projects. Her outspoken intention was to initiate discussion of how the consultants could ensure delivery of what she called “good enough deluxe” in all projects, so that the clients get good value while the consultancy does not incur excessive cost overruns.

The discussion of how to deliver a design outcome that is “good enough deluxe” touched on uncertainty about not being able to “feel” that an objective had been met by the design outcome. Establishing a fit between the objective and the design outcome is apparently an ongoing source of ambiguity that persists up until final delivery to the client organization.
Ambiguity in conflicting functional requirements

In the design work, categories were established as a way of differentiating various, generalized end-consumer groups and their respective desires from the transition service. Based on these established desires, functional requirements, articulated as short, emphatic phrases, were imposed on the work. Ambiguity emerged from the conflicting functional requirements between these end-consumer categories.

The end-consumers were categorized based on similarities and differences between quotations from and stories about them. The categories were then labeled with keywords or key phrases thought to capture the essence of the groups’ attitudes toward the transition service. The keywords or phrases were sometimes quotations from end-consumers and at other times the designers’ words describing the essence of what they had learned from end-consumer interactions. A comparison of two such key phrases illustrates how the ambiguity from conflicting requirements transpired in-between the categorizations.

One key phrase established to represent an attitude emerging from the end-consumer interactions in the studied project was “Leave me alone!” That phrase discursively represented that some end-consumers were uninterested in receiving any information about the transition from the old service system to the new one, even though they would be affected by the change. These end-consumers were described by the designers as carefree as regards the IT service transition. Many of these end-consumers claimed that they were technologically skilled (and would manage to use the new system without much difficulty) to explain why they did not want much information about the transition. Other end-consumers with this attitude explained that they did not feel strongly about these kinds of IT services, and that they would be content as long as they were functioning well.

A key phrase to discursively mobilize experiences from the end-consumer interactions was “A picture of what it will look like.” That phrase summarized that many of the interviewed end-consumers expressed an expectation to receive a visual representation of the new system from the service-providing organization before it launched the new system (i.e., undertaking the transition). The end-consumers expressing such expectations had thus already translated their desires into a design proposal. However, they had not described in detail what such a visual representation should look like to be as useful as possible.
The two cited phrases, “Leave me alone!” and “A picture of what it will look like,” discursively mobilized parts of the designers’ experiences of the end-consumer interactions. However, these statements may also be seen as conflicting and not easily combined, i.e., how may one show the end-consumers what the new system will look like, while simultaneously leaving them alone?

These phrases of course summarize the stances of different, generalized end-consumer groups. The question posed above was relevant to consider in the design work given that one coherent design outcome, that catered to all end-consumers, was to be created. The question represents an ambiguity of designing to meet conflicting requirements.

In other words, ambiguity regarding conflicting functional requirements transpires in the void between various categorizations. Such ambiguity is embraced and sustained in the design work: during work activities to establish groupings, label categorizations, etc., there is an outspoken strategy of not evaluating or discarding any suggested categories or labels based on potential conflicts among them.

### 7.1.2 Market ambiguity

Many ambiguous situations compatible with the definition of market ambiguity emerged in the studied service design work, that is, situations in which external stakeholders and their needs or demands regarding the designed service could not be unanimously interpreted.

In particular, three kinds of ambiguous situations belonging to the market ambiguity category emerged in the service design work: (1) ambiguity emerged in having multiple stakeholders; (2) ambiguity emerged in the multiplicity of client demands; and (3) ambiguity emerged in conflicting implications of end-consumer interactions.

**Ambiguity emerged in having multiple stakeholders**

Ambiguity was emerging from the multiple stakeholders involved in, affected by, or affecting the design work. The invitation e-mail discussed earlier testifies to the possibility of grouping stakeholders into at least two categories: client stakeholders who received the e-mail and end-consumers mentioned in the e-mail (called customers in the e-mail). This indicates
that there were at least two stakeholder grouping with different, or even conflicting, interests.

This ambiguous situation transpired in a more complex situation made up of varied stakeholder desires. What are here called “desires” the designers called needs, demands, wishes, and expectations of primarily the end-consumers but also the client stakeholders.

In the studied case, the design work was undertaken on behalf of a large-scale service-providing organization. The design outcome of the work was though to affect a substantial portion of the service-providing organization’s customers. As touched on when describing the emergence of ambiguity in interpreting the purpose of the work, the end-consumers were millions of individuals with personal agendas and desires. Not all of these end-consumers were customers of the online service system and some only participated in a subset of the entire service offering. Even so, the number of end-consumers affected by the transition was substantial.

To differentiate between various end-consumer attitudes and desires regarding the transition service, the end-consumers were clustered into needs groups based on their talk during interaction activities. In the studied project, these were among others the “anxious” and the “unconcerned” end-consumer groups. Differentiating end-consumers based on their desires and attitudes does not follow classical customer segmentation models, nor does it allow for quantitative identification as do more common socioeconomic factors (e.g., age, address, and income).

The senior service designer said, “It will be most difficult for [the service provider] to find a way to identify ... It’s nearly impossible to find these groups in advance, and sort of understand what needs there are, and then sort of target information specifically to ‘you, who are like this.’ Because that will fail.” In other words, she clarified that ambiguity also emerged in activities to structure and differentiate the many end-consumer stakeholders.

With so many end-consumers, it is an obvious challenge to make brief qualitative interactions with enough of them to create knowledge that is representative of the end-consumer reactions and responses to the service being designed.

Despite the great many end-consumers, the service design work did not include any statistically sound methods for gathering data about them.
There was no ambition to interact with a statistically significant proportion of end-consumers (which might be deemed impossible with several million end-consumers). The project manager and the senior service designer together described the value of their qualitative work methods to the client contact person. The project manager said that it was “the end-consumer who determines whether [the design outcome] is good,” referring to that the end-consumers are integrated into the design work so as to judge prototypes of the design outcome being created. The senior service designer continued by saying that “we talk about saturation,” emphasizing that they were seeking to generalize across the various end-consumers by looking for similarities, rather than paying attention to individuals’ divergent opinions.

This view on end-consumer interactions was anchored in a long tradition of making qualitative interviews with a subset of end-consumers (often referred to as users, customers, or clients) in the professional practice of industrial design. Ambiguity as such also transpired in the void between the qualitative research methods for gathering material in the design work, and constructing a design outcome for such a huge end-consumer base.

Given the size of the client organization, the number of client stakeholders was also large. The IT-system transition was a major change for the organization, affecting many divisions, individuals, routines, and collaborations. The affected client stakeholders, with their various educational and experiential backgrounds, worked in many parts of the organization. Ambiguity attributable to having multiple stakeholders thus also transpired in relation to the client. More specifically, it made itself known in interpreting and catering to the varied and varying desires of the many individuals and collectives employed in the client organization.

Having multiple stakeholders is not uncommon when undertaking design projects. Yet it is worth mentioning as it does play a role in the inability to agree on what end-consumer desires to consider in design work. In the studied case, the large number of stakeholders is noteworthy, as the end-consumers totaled millions of individuals. As previously discussed, the objective of the design work was to “make the transition ... as pleasant as possible for [the end-consumers].” Relating that purpose to the many end-consumers was bound to entail ambiguity. One ambiguous aspect concerned the inability to agree that most variations in end-consumer
opinions had been voiced and noted during the end-consumer interactions in the design work.

**Ambiguity emerged in the multiplicity of client demands**

The possibility of making multiple interpretations of the design work objective also translated into multiple interpretations of the demands on the work. The e-mail invitation to the workshop discussed in the previous section also included a possibility that multiple demands might be imposed on the design work (see Figure 3).

The inability to make unanimous interpretations of the demands emerged from both designing for multiple end-consumers and having multiple client stakeholders. Asking client stakeholders for “input about any prioritized needs groups” implied that multiple conflicting end-consumer demands might emerge that must be prioritized. Moreover, the first question asked the client stakeholders to answer based on their “perspective and area of responsibility.” Such a formulation implied that the various departments of the client organization might impose different demands on the design work.

The e-mail continued by describing the purpose of the so-called pinpoint workshop and what the client stakeholders from various departments were to contribute to the workshop. In broad terms, the purpose of the workshop was to involve the client stakeholders in interpreting the purpose of the design work based on their various perspectives and experiences (see Figure 3).

The first two points invited the client stakeholders to facilitate the prioritization of end-consumer characteristics and the kinds of questions to address. The next two points and the following questions were more attuned to learning from the client stakeholders’ experiences, by asking them to hypothesize about the challenges of the new service relative to their experience of previous end-consumer interactions.

This last part of the e-mail suggested that the studied service design work was initiated with few or no interpretations as to what might make end-consumers satisfied with the transition. Rather, the end-consumers seemed shrouded in mystery: the questions concerned variations among end-consumers (“types of customers”), what would make the end-
consumers “pleased or discontented,” as well as what might make the transition problematic for the end-consumers.

The Service Design Consultancy describes the purpose of the pinpoint workshop as:

- to receive input on any prioritized needs groups/problematic areas requiring attention
- to receive input on question areas to focus on when talking to consumers
- to get the team quickly up to speed in order to move on and find new insights
- to foster an understanding of how the consumer experience is created/affected by [the new system]

1. Think about what parts of the new service that you think will have the greatest impact on customer satisfaction and the customer’s experience of the change, from your perspective and area of responsibility. What do you think will make them pleased or discontented? How can we manage to provide a good customer experience? What parts of the new service do you think will be crucial in order to succeed with the transition? What do you consider potential problems with the transition? Write down at least six short examples.

2. Think about whether there are any specific types of customers that are important to learn more about before the transition? For example, what customers do you think will be most difficult to please? What customers do you think will find the transition most problematic? Write down at least six brief examples.

3. What benefits will the new service have for the customers? Give a few short examples.

All participants will briefly present their contributions and write them down on Post-It notes. The notes will then be moved around and categorized, in a joint exercise, in the next step.

Figure 3. The described workshop purpose and a list of preparatory questions included in an e-mail sent as a workshop invitation.

The invitation e-mail was sent by the client contact person who had identified the client stakeholders, helped by colleagues in various
departments and in consultation with the project manager. The basis for identifying client stakeholders was a desire to represent several client organization departments that in various ways had a stake in the design work. The represented departments included the customer care and IT departments. The customer care department would be directly affected by the transition in that end-consumers would come to it for support. In contrast, the IT department was invited based on its understanding of the benefits and limitations of the new IT system.

Deciding what client stakeholders to invite entailed making guestimates of who would be able to affect or be affected by the transition service being designed. Such considerations were ambiguous to the consultants given that they were unfamiliar with the details of the client organization. However, such judgments were easier for the client contact person.

In other words, ambiguity emerged in the initiation and implementation of action. The work entailed so many unknowns that ambiguity emerged in not knowing how to prioritize between options, or in not initially knowing what humans and artifacts to interact with.

**Ambiguity emerged in conflicting implications of end-consumer interactions**

As touched on earlier in relation to product ambiguity, the design work was subjected to many conflicting implications of the end-consumer interactions. This was discussed above in terms of how conflicting end-consumer desires imposed different functional requirements on the design outcome. Here, the conflicting implications of end-consumer desires are instead discussed in terms of an inability to make unanimous interpretations of the end-consumers and of their needs and interests.

The script for undertaking the service design work included activities intended to further learning from stakeholders, especially from end-consumers. The knowledge-creating activities in the design work were largely dependent on experiences of such stakeholder interactions. As discussed earlier, the end-consumer desires were highly diverse, giving rise to an understandable inability to make unanimous interpretations of how as much as possible of the end-consumer desires could be tended to with the design outcome.
A feedback session was organized in the design work to further discussion of impressions and gut-feelings from the end-consumer interactions. In the discussion during the session, equivocal end-consumer opinions and quotations emerged. For example, the questions posed to end-consumers during the interactions included one asking them to reflect on the service-providing organization’s change of IT system. The end-consumers’ responses about the new system varied greatly, including:

- “Expecting troubles, because all systems have growing pains.”
- “As soon as I’ve logged in, I trust the safety precautions; if it seems fishy before that, I won’t log in but will call [the customer care department].”
- “It’s exciting when something is happening.”
- “I expect that it will be easier [to use].”
- “Expecting better-thought-out interfaces.”
- “Trust that it’s safe—don’t have the energy to worry.”

This short list of end-consumers’ answers illustrates that their attitudes toward and expectations of the service-providing organization varied greatly. Some were skeptical and expected troubles, while others found the transition exciting and trusted the service-providing organization.

The end-consumer responses to questions posed during the interactions were translated into short phrases or synthesizing words documented in a spreadsheet. In these spreadsheets, the summarized interactions were written down as answers to the questions after the end-consumer interactions were finalized. The following image of a spreadsheet illustrates two questions and the answers to them as summarized by one of the design consultants in the service design work (see Figure 4).

In the spreadsheet, the designer and the documented questions interacted with one another: The spreadsheet enacted the questions and the designer answered each question in several ways by mobilizing history, i.e., eliciting memories of several different end-consumer answers to each question. The cited spreadsheet included possible conflicts: for example, some end-consumers took the stance that “It’ll be fine” (line 14), indicating that they did not want to bother thinking about the transition, nor did they want much information from the service-providing organization.
Other end-consumers, in contrast, said that they wanted information about why the new IT system was being implemented (line 16). These, and similar, conflicting implications emerged in the end-consumer interactions, and transpire in the discursive representations that are made up of summaries in spreadsheets.

The conflicting implications of what the end-consumers said that they wanted were sustained in the design work. Instead of trying to reconcile conflicting desires, the design work embraced and sustained these opposing needs as they were transformed into conflicting keywords or key phrases, which were subsequently translated into design concepts that also presented conflicting characteristics.

The project manager described the difficulty emerging in conflicting implications during a workshop on structuring the multiple keywords and phrases into types. The project manager said to the design work participants, especially the client organization employees on the design team, that, “The challenge is really to impose some structure on all these ‘insights,’ or all these fragments, that we have collected. We started yesterday by reading a question and [an answer] aloud. ... [Then] one remember things that one has kept in mind, all these things that people said. So one reads something aloud and then one says, ‘Yes, but I heard this.’ Then maybe someone says, ‘Yeah, but I also got the feeling that some people log on four times a week to keep track’ and blah blah blah ... .”
In this quotation, the project manager articulated the ongoing discussion in the design work, during which multiple end-consumer desires emerged and were compared with one another. Moreover, he mentioned the difficulty of “imposing some structure” on the wide range of end-consumer desires that were not only unclear, but also embedded in the various individual design work participants’ interpretations. One service designer said that “all the information that is gathered is embedded in the individuals, even though it’s documented, it is embedded in individuals.” pointing to the ambiguity of end-consumer desires in the design work.

The service designer described that the end-consumer desires may be seen as gut feelings, created during the interactions and embedded in the designers’ experiences, that could not be put into unanimously and discursively represented, in that such representations entail interpretations of having participated in the interactions. In other words, this yet again points to the void between the generalized rules for undertaking design work (enacted in the process description), in which end-consumer desires were summarized in spreadsheets, and knowing the rules of how to anchor the ongoing, situated design work in end-consumer desires.

7.1.3 Process ambiguity

Ambiguous situations that resembled the theoretical definition of process ambiguity also emerged in the work—that is, an inability to make unanimous interpretations of the work activities, such as situating generalized rules or establishing means–ends relationships.

In the studied service design work, process ambiguity emerged in two main ways: (1) in finalizing (interim) activities; and (2) in the open-endedness of the work, as described in the following subsections.

Ambiguity in finalizing (interim) activities

In the design work, there was a repeatedly emerging rule ambiguity that transpired an inability to make unanimous interpretations of when to consider a work activity completed. The script for how to undertake the service design work did provide generalized guidance as to the purpose of each phase of the design work. However, as the rules were situated in practice, they provided equivocal alternatives for deeming an activity complete.
One example of an inability to make unanimous interpretations of goal fulfillment in a design work activity concerns end-consumer interaction, which was covered in the script for service design practice. The goal of such interactions is to create knowledge of end-consumer reactions and responses to the service being designed. The ambition is to know more about the needs, demands, wishes, and expectations (summarized here as “desires”) that may be inferred from the service-to-be from an end-consumer perspective, when the interactions are concluded.

In the studied consultancy, the approximate number of end-consumer interactions is determined when a project is being planned during the early phases of formulating a contract with the client organization. The actual number of end-consumer interactions performed in a project is mediated by the goal-fulfillment of the interaction phase. Ambiguity may emerge in the goal-fulfillment itself, however. The senior service designer said that the aim was “saturation,” which she clarified was achieved when similar answers started to reemerge among the various end-consumers.

In classical design work, the desires communicated by end-consumers are clustered according to recursive themes. From this, one may infer that most end-consumers’ desires may be taken into account by interviewing a subset of end-consumers. Fulfilling such a goal remains ambiguous, however: How do the designers know that they have interacted with enough end-consumers to be able to say something about the most prevalent desires?

A work meeting was organized after a second round of end-consumer interactions. The work meeting was for discussing and reflecting on the insights from end-consumer interactions and on the end-consumer categories derived from those insights. During the work meeting, the project manager asked the senior service designer (who performed the most end-consumer interactions) whether she had attained saturation in the responses. The senior service designer replied: “I definitely feel that the end-consumer categories are correct—that’s what it’s all about.” On the other hand, she continued, she had not encountered any “anxious” end-consumers in this phase.

What came through in this dialogue was that the qualifier for finalizing the end-consumer interactions, i.e. reaching saturation amongst the answers, was attained as gut feelings among the designers. The senior service designer claimed that she found support for the categories that they had
created based on generalized end-consumer attitudes toward the IT-system transition. The “anxious” end-consumers referred to were one such category.

There is no guarantee that the design work participants had interacted with enough end-consumers to have encountered all variations in attitudes and desires regarding the service being designed. This may be inferred from that end-consumers are all individuals with different reactions and responses. At any point in time, repeating the activity and performing one more interaction might bring to light a previously unencountered reaction or response to the interview questions or visual material. On the other hand, as the senior service designer put it, they are “not interested in one person’s diverging opinion.” Nevertheless, ambiguity emerged in deciding that enough end-consumers had been interacted with and that the most common recurrent attitudes and desires had been included.

**Ambiguity in the open-endedness of the work**

The script for the service design work included work activities intended to further learning from various interactions, that is, to create knowledge in interaction with client and end-consumer stakeholders as well as with visual material and discursive representations. This learning was in essence experiences from knowledge creation in terms of what the project manager called “gut feeling” and “triggered empathy.”

During a meeting, the project manager described the service design work to the two external participants (employed in the client organization) as well as to the two trainees and the newly hired service designer. The project manager said that in design work they should “establish some kind of empathy, or gut feeling” in interactions with end-consumers. Moreover, he said that the end-consumer interactions were largely about “becoming inspired” and that “much of the creative work happens out there.” Through these word choices, the project manager indicated that there was no clear point at which the work was complete, but rather that the work was about creating knowledge of end-consumers and their desires until the designers’

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20 To be precise, activities cannot really be repeated, according to practice epistemology. Each new undertaking of a habitual activity includes a new situation that makes it a somewhat new activity. However, it is reasonable to assume that practitioners can mobilize history in terms of previous but similar activities to a greater or lesser extent. When I claim that an activity is repeated, what I actually mean is that the practitioners mobilized habitual knowing to a greater extent.
gut feelings told them that they had created an understanding for the end-consumers and their desires.

The experiences from the knowledge creation transpires as stories and quotations from end-consumers about various aspects of the transition service, about the service-providing organization, as well as about the current and upcoming IT systems expressed in visual, material, and discursive representations.

The design work also included activities for synthesizing experiences from the interactions. It was during these synthesizing activities that ambiguity of the open-endedness of work emerged: The extensive and dispersed material about end-consumer desires was to mediate the creation of proposals for possible design outcomes. This ambiguity transpired in a number of ways, as described below.

First, the ambiguity transpired in the polysemy of the material, that is, the various experiences from the interactions. The end-consumers were not a homogenous group but rather conveyed what can be described as contested (i.e., various), temporal (i.e., varying), and emergent (i.e., vague) desires as a basis for the transition activities. This implies that the experiences of end-consumer interactions were not straightforward, but required interpretation, knowledge creation, prioritization, and judgment.

Second, the ambiguity transpired in the activities to translate the experiences of end-consumer interactions into design proposals. Accomplishing such translation implied establishing certain design proposals as remedies for certain interpretations of end-consumer desires. Characteristics of these design proposals may be hypothesized to attune to certain end-consumer desires, but it is impossible to establish with certainty.

Third, the ambiguity transpired in the results. There are extensive opportunities to create various design outcomes given the vast, equivocal, and open-ended material to work with. The ambiguity of the results emerged in knowing what characteristics of a design proposal that could attune to interpretations of the objective to be fulfilled.

The ambiguity of the open-endedness of design work continuously manifested in interpretative and analytical dialogues in the work. The dialogues seemed never-ending, with discussion of one service concept or end-consumer group leading to discussion of another concept or group.
The following excerpt is drawn from a workshop in which the participants were developing drafts of service concepts to be evaluated by end-consumers in a second round of interactions. The dialogue was initiated to address the intended stepwise transition between the systems, that is, groups of end-consumers to be transitioned sequentially.

SSD: Some end-consumers seem to think that it’s a bad idea that it’s stepwise, if somebody one is helping is transitioned earlier, one won’t be able to function as telephone support. Others seem to think that it’s good if the family is transitioned stepwise, because then someone still has the old system, which one knows how to handle.

PM: Maybe that’s something that we should test. If we make a draft, we could ask “is this something you need? Or how would you manage otherwise?” They could, for instance, answer “I would be able to guess while talking on the phone!”

External 1: I would like to know whether it’s those [end-consumers] who would sign up for “I want to be first,” because then maybe they can solve the problem for us.

Researcher: If [those individuals] use the same service provider!

External 2: And if [those individuals] do not use the same service provider, would they expect to be able to see what the new [interface] looks like?

In the dialogue, the discussion mainly concerned the fact that many end-consumers either get IT support from or provide it to family members. Many end-consumers raised this issue as a possible problem in relation to the stepwise transition to the new system, during the first round of end-consumer interactions.

The senior service designer (SSD) suggested that a stepwise transition might be a bad idea, justifying this by what end-consumers had told her (lines 1–3); she also proposed a counterargument to her suggestion, relying on what other end-consumers had said (lines 3–6). The project manager (PM) then proposed checking with end-consumers in the next round of interactions (lines 8–11). The discussion continued with questions and reflections from the two external participants (External 1 and 2, i.e., that
participated in the design work but were employed in the client organization) and the researcher doing participatory observations (me).

In the discussion, External 1 referred to another concept when he mentioned “I want to be first” (line 13). That concept concerned the idea that end-consumers could sign up for early transition, as some had expressed a desire to function as beta testers or VIPs. In other words, External 1 linked the dialogue to another concept, adding a possible needs group to that concept by suggesting that end-consumers who function as private IT support might choose to transition early.

The excerpt also illustrates how suggestions, such as the one the PM proposed in lines 8–11, were met with many different views and questions (lines 12–18). This is just one, short example, but it is characteristic of the entire ongoing design work. Similar examples could be drawn from most observed and recorded dialogues. In this and similar dialogues, the ambiguity of the open-endedness of the design work transpired: the work activities never reached a unanimous end, as each suggestion for a design outcome was met with alternative interpretations.

7.2 Negotiating activities

The negotiating activities in the service design work are described in this section. The intention is to provide empirical glimpses into the design work practice to illustrate the descriptions of the many negotiating activities. In other words, a storyline that portrays the ongoing design work per se is not provided, but rather snapshots from the observed design work will be presented.

The activities undertaken to negotiate ambiguity have been categorized into six overarching groups: (1) continuously constructing points of reference, (2) mediating between perspectives, (3) anchoring in experience, (4) disarming future resistance, (5) making do, and (6) enacting talk in representations.

7.2.1 Continuously constructing points of reference

The service design work largely focused on creating, attuning, discarding, and replacing categorizations constructed as temporary reference points, functioning as footholds in negotiating the ambiguities emerging in the
work. As the design work continued, prior points of reference became obsolete and were discarded.

These reference points were continuously constructed in the service design work, in five main ways: (1) comparing, differentiating, categorizing, and labeling; (2) establishing intersections; (3) communicating deeply and recursively; (4) identifying recursive patterns; and (5) creating shared visions. These five negotiating activities are described in the following subsections.

**Comparing, differentiating, categorizing, and labeling**

The negotiating activities of comparing, differentiating, categorizing, and labeling are illustrated with empirical snapshots from the early workshops, during which the design work activities were initiated and the ambiguous starting conditions were addressed.

The first workshop from which an empirical illustration is drawn was called the pinpoint workshop by the design consultancy. Before this workshop, the client stakeholders had been invited to participate and engage in the design work by answering a few preparatory questions. The client stakeholders were prompted to answer based on their experience in various parts of the client organization. The empirical storyline told in the following descriptions is drawn from the detailed notes taken during the workshop.

The pinpoint workshop began with the client representatives taking turns proposing answers to the questions, from their individual perspectives. The various answers were summarized as keywords or phrases written on Post-It notes.

The various keywords were then compared with one another, to seek similarities and differences among them. This was done both verbally and by physically moving around the Post-It notes. Keywords deemed similar to one another were clustered by grouping the respective notes close together. All participants in the design work during the workshop gathered Post-It notes and started posting them in clusters on the wall. The number of categories was not predetermined, nor was there much verbal communication about what unified the keywords in each cluster of Post-It notes. The clusters materialized organically with the posting of the notes on the wall.
Someone started sorting their own keywords by sticking the Post-It notes to the wall with a certain arbitrary distance between them. Others followed suit, reading the keywords on the already attached Post-It notes and deciding whether any of their own keywords attuned with them. The common denominators or unifying characteristics of each cluster emerged as more notes with keywords were added to each cluster. This led to some other Post-It notes being moved, since they no longer fit the emerging unifying characteristics of their clusters.

The designers tried to establish similarities and differences among the clusters by discussing them, primarily among themselves, but also with the client stakeholders. With only a few minutes remaining in the time scheduled for the workshop, the project manager started to summarize the common denominators of each cluster.

Labels for the categories emerged in discussions, mainly between the project manager and the senior service designer. The project manager posed questions such as “What more categories do we have?” The questions were answered tentatively, for example: “This seems to be something internal” or “Isn’t this about communication?” The markers of tentativeness, such as “seems” and “isn’t this about,” opened up for dialogue and contradictions.

As part of the category labeling, some of the notes were rearranged when their keywords or phrases no longer fit in the emerging categories to which they were initially assigned. One designer acted as the note carrier and facilitated the cluster formation. Some keywords, which were ambiguous or did not clearly fit in any of the categories, received extra attention and were discussed more thoroughly. Through these discussions, these keywords were reinterpreted so that they eventually fit in at least one of the categories. During the workshop twelve clusters emerged.

As one may derive from the description of the design work activities in the pinpoint workshop, the comparing, differentiating and labeling was a situated activity: in dialogues, the keywords were combined and separated mediated by moving Post-It notes around, assigning labels, and restructuring the clusters.

The clustered categories could overlap in terms of what they referred to. For example, two of the categories were labeled “tools for managing change” and “dialogue with end-consumers.” Many of the keywords in
these categories could have fit well in either cluster, so the categories intersected. This was not problematized in the design work. It seemed to be important that all keywords be included in at least one cluster, but less attention was paid to creating clearly differentiated clusters. This seemed to be anchored in professional design practice, connected with the tradition of not narrowing the scope of a design outcome too much, too early in the work. Also, the category descriptions were often elusive or equivocal. For example, an expression such as “this seems to be something internal ...” was a way of assigning a label to a category without being assertive or definitive (e.g., compared with “this is internal”).

The inability to make unanimous interpretations of various cues in the design work was continuously negotiated by constructing points of reference through comparing and differentiating. Some of these comparing and differentiating activities were intended to create and label categories. There are endless examples of situations during which activities were undertaken in the design work in order to compare, differentiate, categorize, or label. These were recursive negotiating activities in the design work.

Another example of a situation during which ambiguous material was compared, differentiated, categorized, and labeled was the creation of end-consumer groups. This was an activity for negotiating the ambiguity emerging in having multiple stakeholders. The inability to make unanimous interpretations of endlessly varying end-consumer desires and attitudes was reduced by generalizing and categorizing end-consumers into four stereotypical groups, and then clustering their desires in eight overarching categories. This allowed the creation of a design outcome with a few generalized variations, instead of having to design for never-ending variations of end-consumer characteristics and attitudes. It is important to note that though such categories may seem blatantly obvious in retrospect, their construction was less straightforward, requiring knowledge creation.

These four end-consumer groups had been created by the senior service designer and the project manager, who then presented them in a work meeting. This work meeting was to have created these groups, but the senior service designer and project manager had, by their own account, already gone ahead and done the work. They had been talking about the design work and this dialogue led them into distinguishing end-consumer attitudes. Before they knew it, they had created four end-consumer groups,
distinguished based on three dimensions: (1) an illustrative quotation capturing “typical” end-consumers in that group, (2) behavior or attitude, and (3) desires. These end-consumer groups were labeled: *enthusiastic, unconcerned, reluctant, and anxious/apprehensive*.

It is important to note that the senior service designer and project manager recognized that a single end-consumer could exhibit different behaviors depending on factors such as the specific part of the transition service, point in time, etc. This means that the end-consumer groups were not to be understood as aimed at mirroring personality types, as someone who is enthusiastic about one part of the service may very well be reluctant about another part.

**Establishing intersections**

The ambiguity emerging from having multiple stakeholders was partly negotiated by establishing intersections between the various categorizations in the design work. These intersections become points of reference for continuing the knowledge-creation work.

More often than not, an end-consumer journey is created in the service design work, so also in the studied work. The end-consumer journey was made up of a series of interaction points between the end-consumers and the service-providing organization. Figure 5 illustrates how an end-consumer journey could be enacted and visualized that incorporates all end-consumer groupings. As the design work continued, the initial enactment of the journey was revised and extended by adding phases and distinguishing between the end-consumer categories. As mentioned in the previous section, the project manager (PM) and senior service designer (SSD) had already established the end-consumer groups before the meeting. They had also conceptualized a tentative end-consumer journey as illustrated in Figure 5.

The end-consumer journey, in this case, was materially mobilized as a timeline running from left to right. This timeline, in turn, was discursively mobilized as possible interaction points between the end-consumers and the service-providing organization during the transition from the old to

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21 The designers called this a customer journey, the common term used in the practice of professional design work; however, for intelligibility and consistency, throughout the dissertation I will call it an end-consumer journey.
new service systems. The end-consumer journey was created at the aggregate level of the transition service. The SSD visualized the customer journey on a whiteboard before a workshop, by drawing and naming the phases of such a journey (see Figure 5).

![Figure 5. The end-consumer journey, as visualized in the design work.](image)

The illustration of the end-consumer journey became a visual representation of the transition service being designed. The labels of the phases (“before,” “shortly before,” “during,” and “after”) discursively represented the transition. The specification that “before” should be approximately six to twelve months in advance of the transition was based on experiences of the end-consumer interactions. Many end-consumers had said that a reasonable timeframe for receiving some kind of preliminary information about the transition of the online IT system would be within that timeframe.

For each phase of the end-consumer journey, the SSD and PM briefly theorized about what the transition service could offer the end-consumers, as follows: “1st info: that the transition will come,” “2nd info: a scheduled date & detailed information,” “Getting started: problems? & telephone queue?,” “Continued use: guide to explore.” Also, these hypothesized service offerings were discursive and material translations that had been enacted by mobilizing history and recalling experiences of end-consumer interactions.

The end-consumer journey was further detailed later in the design work, when the participants concluded that it should be divided into additional phases. The whiteboard image of the end-consumer journey was redrawn
to incorporate the additional phases. As such, the visual representation was updated to match the development of the design outcome. New concepts were discussed and presented on new A3 sheets that were then posted on the whiteboard for the end-consumer journey phases and end-consumer categories to which they were attributed. This weaving together of cues in the work established intersections as episodic reference points that would later be up for revision and reconsideration.

Communicating deeply and recursively

The ambiguous objective was partly negotiated by communicating deeply and recursively with the end-consumers. In each recurrence of end-consumer interaction, the communication became more specific and to the point. The PM described how all created design outcomes were strengthened by communicating them to end-consumers and asking for evaluations: “It is the user who determines whether [the service design outcome] is good, but it is not statistically [measured].”

The purpose of the first round of end-consumer interactions was to learn about the end-consumers’ desires and attitudes. The intention was then to generalize and categorize from this, to construct a few points of reference about the end-consumers’ desires and attitudes. To achieve this goal, the design work included an interview technique that entails asking “why” a number of times. This interview technique, which is anchored in professional design practice, enables probing into the underlying reasons for the given answers. The interactions enabled deep communication that facilitated empathy with the end-consumers.

The other part of communicating deeply with end-consumers is to interact recursively with them. It is seldom the same specific individuals who participate in the repeated interactions. Instead, different individuals are interacted with as the service designers seek to verify the value of changes and check off chosen directions.

To cite an empirical example, the service designers were discussing whether to provide “a picture of what [the new service system] will look like,” with reference to the type of communication desired by end-consumers during the transition. The dialogue more specifically concerned what such a picture might look like. The discussion concerned that they did neither know whether the client organization would allow the distribution of such a picture, for security reasons, nor what end-consumers would like
to see in such a picture. They concluded that they should verify with the client contact person and check with end-consumers in the next round of interactions. Checking with end-consumers was achieved by making a visual representation of the new system and documenting the end-consumers’ responses to it. The reactions and responses from the repeated end-consumer interactions were then used to inform the service designer about what kind of information the end-consumers would want from the transition service, in order to understand how the new IT system would function.

“Let’s try!” seemed to be the PM’s standard response when it came to settling on how to interpret and treat the end-consumers’ desires. The service designers considered the end-consumers as experts, as knowledgeable about how to value ideas and concepts. Simultaneously, the service designers referred to themselves more as mediators in the context of interaction between the end-consumers and the design concepts.

After having established that they were unsure of the end-consumers’ preferences regarding a concept being discussed, many discussions ended up in the conclusion “Let’s try,” or the like. Some of the PM’s many suggestions to detail and specify tentative design concepts in further interactions resembled these three examples of statements: (1) “Until the next loop, we’ll make a short news item saying ‘Changes underway—do you want to be first? Sign up here’ to find out what people think about it”; (2) “Maybe we should try … in the next loop”; and (3) “We’ll run another loop, and then we’ll see which word is suitable.”

These examples reflect the overarching attitude prevalent in the design work, perhaps especially during what the script calls the ideation and creation of concepts. The first quotation relates to a desire to verify whether certain end-consumers would want to be among the first to transition to the new IT system. The second is a question often voiced by the PM. The third is at a more detailed level, concerning the specific choice of words for an information text in the transition service. These three quoted statements were chosen to illustrate the increasing level of detail in which the end-consumer interactions were utilized in the design work. Each “level” was constructed as a point of reference that was reconsidered and further detailed for each new level of detail.
Identifying recursive patterns: interpreting, structuring, and categorizing

Yet another way of continuously constructing points of reference in the design work was to identify recursive patterns by interpreting gut feelings, structuring divergent themes, and categorizing immeasurable amounts of data.

Gut feelings, and interpretations of them, were often mentioned in the design work. One service designer described these when discussing the analytical activity called clustering, talking about interpreting the end-consumer interactions: “All the gathered information anchors in the individuals. Even if it is documented, it is embedded in the individual. When we start clustering, we sift out the ones that aren’t credible, for example, if it seems like someone only wants to please you [by answering ‘correctly’].”

What the service designer implied in the above quotation was that any understanding of the material from the end-consumer interactions was embedded in experience, i.e., from having been there. Although the work was structured, documented, etc., part of it was personal and embedded in the individuals. Certain desires communicated by end-consumers were not valued as credible. Such end-consumer narratives were sifted out from the others and not used as a basis for creating a design outcome. In other words, some responses were judged to be less authentic, based on “feelings” (i.e., “it seems like”).

The PM was using the same line of reasoning when he said: “We always gather our own data, we can’t read up on someone else’s data. ... We must trigger empathy, or gut feelings. ... To a large extent, it’s about becoming inspired. ... A lot of the making and creating happens out there.” This quotation is drawn from a meeting during which the PM was informing the inexperienced design work participants about the work to come. In this quotation, the PM touched on gut feelings as part of the work.

The SSD continued along this line of reasoning, saying: “We talk about saturation. We take notice of when there are many [individuals] talking about the same thing. We want to generalize as much as possible. We are not interested in one person’s diverging opinion.” This quotation expresses a different perspective from that of the service designer. What the service designer talked about was interpreting gut feelings, structuring divergent
themes, and categorizing data after the fact, i.e., interpreting and structuring material from the interactions. What the SSD instead described was identifying recursive patterns by interpreting gut feelings even during the ongoing interactions.

This quotation illustrates the underlying purpose that continuously mediated the end-consumer interactions. End-consumers interpreted and categorized as outliers (based on their expressed desires) were paid less attention, while those who rephrased previously expressed desires were considered more “important.” “Important” here indicates that “mainstream desires” (i.e., more frequently occurring) take precedence in interpreting the multivocal goal.

The following snapshot is based on detailed notes from a workshop in which the design work focused on analyzing and creating clusters of knowledge created in the insights workshop. This empirical example illustrates the emergence of categories. When the clustering activity came to an end, the design team should ideally have created an overview of the needs, expectations, drivers, and fears of many end-consumers in relation to the transition service.

During the clustering activity, the design team categorized the keywords and phrases into groupings. These clusters were not standardized between projects, but rather were constructed in dialogues about the desires that might underlie the keywords and phrases. The objective of the clustering activity was to produce categories that summarized and structured the multiple end-consumer desires.

The clustering activity was a verbally intense and interactive workshop lasting about five hours, divided into two sessions. The workshop was initiated by the PM, who started the session by describing what the collective of participants were to do during the clustering activity.

During a first, shorter phase of the workshop, the Post-It notes were to be transferred from a pile on a table to a nearby wall. This was to be done one Post-It note at a time: the team members were to take turns picking up a note, reading the keyword or phrase aloud for the other participants to hear, and then placing the note on the wall.

During a second phase of the workshop, the Post-It notes on the wall were to be sorted (i.e., clustered) into categories. This was to be done by rearranging the Post-It notes based on discussion of what the participants
theorized might be the underlying reasons for the end-consumers’ various claims. This second phase was also to include going through each constructed cluster in greater depth to analyze whether each category made sense, or perhaps should be split into two, merged with another category, or otherwise changed. Finally, the second phase also included labeling each category with short phrases to pinpoint the essential drivers.

When the transferring and sorting activities were undertaken the two theorized phases were intertwined, there being no clear separation between transferring the notes from the table to the wall and sorting them into clusters.

Two of the team members had not been present during the prior workshop, the insights workshop, due to other obligations. The PM claimed that these two participants’ interactions with end-consumers would probably not differ substantially from those of the other design team members. The team therefore agreed to continue with the clustering activity and that the members who had missed the insights workshop would add insights or pose questions along the way if they perceived that something had been overlooked.

During the clustering activity, the members who had been absent heard the keywords and phrases, bringing them up to speed with the work. They also had the opportunity to add their views, make suggestions, and initiate discussion if they noticed that something had been left out, according to what they learned during their end-consumer interactions.

For each Post-It note taken from the table and read aloud, the team discussed the possible underlying drivers of the keyword or phrase. It was primarily the PM and SSD who initiated dialogues about various possible underlying drivers. The PM posed questions such as “What is the underlying reason for this?” The other team members eagerly discussed the possible underlying drivers, continuously mobilizing history by citing experiences of the end-consumer interactions.

The PM moderated the discussion while the team members took turns picking up Post-It notes, reading them aloud, and posting them on the wall. Throughout the workshop, the participants grouped Post-It notes thought to represent similar drivers in close physical proximity to one another. The clusters emerged organically during the discussions. More than once, a note that had already been placed near some other Post-It notes was moved
to another cluster. This happened when the discussion concluded that the essence of a cluster was actually slightly different from the previously constructed meaning. Such slight changes in the basis of a cluster would make certain keywords or phrases less fitting. These keywords or phrases might better fit in another grouping of Post-It notes or even require the creation of yet another cluster.

In other words, various categories were proposed and workshop participants tried to make sense of them. Some of the clusters were kept intact while others were split into several or merged with other clusters. When the team agreed on the essence of a cluster and managed to label the category, the SSD wrote the label of the cluster on an A3 sheet, which she then fastened to the wall.

The PM steered the dialogue toward an area on the wall where many Post-It notes, relative to other groupings, formed an as-yet unlabeled cluster. These keywords and phrases represented concerns, expectations, hopes, and reflections concerning the transition to the new service system. The team engaged in discussion and started to make suggestions about the underlying drivers that could function as common denominators of the notes in this cluster. They divided these Post-It notes into several groups, constructing several more coherent clusters.

This lengthy description of the becoming, reconsideration, and recreation of various clusters illustrates how points of reference were created, reconsidered, and reconstructed in the design work. Recursive patterns are constructed through approaches to structuring themes and categorizing data, but also anchored in subtler dimensions such as gut feelings.

**Creating shared visions**

Shared visions were created in the design work in order to establish future-oriented points of reference. These visions were created both in activities to construct a language for the future design outcome and in interacting with visual representations to capture what escapes language.

The use of visual representations to create shared visions is briefly illustrated with a snapshot from creating the questionnaire, before the end-consumer interactions. The working meeting for constructing the questionnaire began with the SSD showing the less experienced team members a questionnaire from a previous project. This enabled the
newcomers to share a vision of what was to be accomplished during the working meeting.

The construction of language to create shared visions requires a somewhat longer empirical illustration in order to be intelligible. The following empirical description is drawn from what is called an ideation workshop in the service design work script. In the workshop, any suggestions (i.e., ideas) about the design outcome were summarized as keywords or short phrases and written on Post-It notes.

Many of the keywords drew on existing competitive or complementary consumer products or services. Throughout the discussions, the team members cited examples of existing products, searched the web for inspiring images, and drew parallels to the end-consumers’ suggestions.

Metaphors were also continuously used as discursive representations of what was intended by various suggestions. One such example was a Post-It note with the word “Puff” written on it. This specific note was placed in the box intersecting the enthusiastic end-consumers with the time indicator before the transition, in a matrix on a whiteboard (see Figure 6). “Puff” in this context referred to the social media function whereby someone receives a discrete notification of some kind. The underlying idea, expressed by one of the team members, was that the end-consumers who are interested in the new service system could receive early notification. This would also include the possibility to obtain more information, for example, by following a link. The note with the word “Puff” on it illustrated how experience was enacted, and the suggested function of the transition service being designed had roots in social media systems. This experience was mobilized in the context of the transition service as a way of articulating part of the design outcome.

![Figure 6. A matrix representing the end-consumer journey (in the columns) separated per end-consumer category (in the rows).](image-url)
Another expression written on a Post-It in the ideation workshop was “Do you want to go first?” The question of whether an end-consumer wanted to be first referred to the possibility of becoming an early adopter of the IT service transition—one possible way to accommodate enthusiastic end-consumers before the transition. Enthusiastic end-consumers would be able to transition early on, giving the service-providing organization valuable feedback from these engaged users of the new IT system. This illustrates how the design work wove together the knowledge created by mobilizing experiences of client stakeholder and end-consumer interactions with the context of the transition service being designed.

7.2.2 Mediating between perspectives

The service design work, and also the design outcome, was continuously observed and judged by many individuals who brought with them their own agendas, assumptions, and desires. One negotiating activity to embrace the ambiguity emerging in having multiple stakeholders with multiple demands was to mediate between perspectives in the ongoing design work.

During the service design work, the mediating between perspectives was enacted in five ways: (1) assuming various stakeholder perspectives, (2) “playing Jeopardy” to change perspectives, (3) taking the voices of stakeholders, (4) establishing commonalities, and (5) mediating between categorizations. These five negotiating activities are described in the following subsections.

Assuming various stakeholder perspectives

The most prevalent activity for negotiating ambiguity was to assume various stakeholder perspectives. This included familiarizing oneself with the desires and attitudes of various client and end-consumer stakeholders. In essence, assuming various stakeholder perspectives entailed evaluating tentative design concepts by alternating between viewpoints, rather than taking sides when desires seemed to be conflicting.

This negotiating activity largely related to the ambiguous objective to “create an understanding of how to make the transition … as pleasant as possible for [the end-consumers].” By repeatedly alternating between various stakeholder perspectives, such an equivocal and open-ended
objective was negotiated, as the design work created knowledge of what would or would not make the transition “pleasant.”

The pinpoint workshop provides an empirical illustration of how various perspectives were assumed and utilized in the design work. The pinpoint workshop was the first working meeting in the design project, and is useful for illustrating how the designers used whatever was at hand to create knowledge of the eventual design outcome. In this empirical illustration, the client stakeholders were discussing the end-consumers.

Before the workshop, the client stakeholders had received an e-mail with a few preparatory questions (described at length earlier). The empirical example presented here draws on a discussion about these preparatory questions. More specifically, that a client stakeholder from the customer care department foresaw the risk that some end-consumers might think that the new service system was a fake page when logging into the new system. The client organization provides services that are dependent on advanced security measures. The end-consumers were aware of this and actively participated in ensuring that it was safe to use the service system.

Given that the new service system would provide a different user interface from that of the old IT system, it was assumed that some end-consumers would think that the service provider had been hacked. The client stakeholder from the customer care department drew on experience in making such a claim: Previously, many worried end-consumers had contacted the customer care unit about even minor changes in the old service system, to confirm that the system was still secure and safe to use.

From this story, the designers could infer that some end-consumers were (overly) cautious, and that if the transition was not designed well, the customer care department might become overburdened with calls from worried end-consumers. Although this aspect concerned the end-consumers, the knowledge was created from the client stakeholder perspective.

This aspect helps us understand why the project was important to the client organization: certain parts of the organization risked becoming overburdened with work during the transition, i.e., if the end-consumers thought that the new system interface might be fraudulent and flooded the customer care department with calls.
This discussion during the pinpoint workshop also addressed an important aspect concerning the end-consumers: An indefinite number of end-consumers might suspect fraud, becoming worried or anxious. Such end-consumers should preferably be informed of the specifics of the changes before the transition, and this might become an important consideration when designing the transition service. Until the pinpoint workshop, however, the hypothesized end-consumer reactions were based only on the client stakeholder perspective. As the design work shifted focus toward the end-consumers, this issue would be raised yet again to be strengthened or discarded from an end-consumer perspective.

After the pinpoint workshop, the design work participants reformulated what they had learned into a questionnaire in which one question related to the security of the migration. This security issue was included as part of an information snippet in a design concept that was to be used as trigger material in the end-consumer interactions, i.e., to trigger responses and reactions.

The workshop to create a questionnaire was followed by end-consumer interactions. This sequence of events made it possible to shift between and compare the client stakeholders’ and end-consumers’ perspectives. After the end-consumer interactions had been performed, the design team reconvened to interpret and analyze what they had learned from these interactions in a two-day workshop. The following excerpt illustrates how the security aspects of the transition service reemerged.

The dialogue is scattered with many blanks because many aspects were being discussed simultaneously. The focus in this excerpt, however, is on the comments relating to the security aspects of the transition service.

The PM first raised the security matter in relation to that the new system would be more secure. This aspect was not initially captured in the dialogue, and many other aspects were discussed instead. Later, the PM reintroduced the security aspect of the transition between the systems. The design work participants then joined in and started discussing the security matter.

The PM referred to a tentative design concept in which a pop-up window would emerge on the login page, allowing the end-consumers to proceed to a secure transition to the new system (lines 5–6). One of the external participants responded according to one end-consumer’s perspective and
expressed opinion (lines 8–9). Yet again, the discussion continued by expressing associations with the ongoing dialogue. The PM tried to summarize what had been said (lines 11–12), prompting the other external participant to refer to and quote yet another end-consumer (lines 14–15). The SSD concluded that the tentative design concept being discussed might have the opposite effect from what was desirable from the client organization’s perspective (line 16).

This excerpt illustrates how the security aspect reemerged in the design work from various perspectives. The designers assumed various stakeholder perspectives in the dialogue in order to compare and mediate between them.

In sum, by assuming various stakeholder perspectives, the ambiguous objective and the ambiguous demands could be simultaneously negotiated. The various perspectives were compared, differentiated, and mediated in order to reduce the number of possible interpretations of what would make “the transition as pleasant as possible.” By assuming various stakeholder perspectives, knowledge was created regarding various interpretations of “pleasantness.”
“Playing Jeopardy” to change perspectives

“Playing Jeopardy” refers to activities to translate experiences from the client stakeholder interactions into questions to ask the end-consumers. “Playing Jeopardy” became a way of mediating between the various stakeholder perspectives, an activity with which to negotiate the ambiguity of having multiple stakeholders with ambiguous demands.

The “playing Jeopardy” activity was organized as a work meeting with the goal of formulating a questionnaire for interacting with end-consumers. The result of the work meeting was a list of approximately 10–12 short open-ended questions and a few visual representations. The expression “playing Jeopardy” refers to the game show in which participants are expected to pose questions in response to given answers. In this simile, the learning from the client stakeholder interactions is seen as comprising answers, in response to which the design work participants posed questions. These questions would later be posed to another stakeholder group, the end-consumers. The questionnaire was intended to be used as a material artifact mediating the interactions with end-consumers.

The basis for constructing the questionnaire was the categories resulting from the participation of the client stakeholders in the design work. The keywords, phrases, and illustrations on the Post-It notes as well as the overarching labels mediated the discussions as material artifacts that enacted history. Based on these keywords and phrases, discussions were held about what might be considered unclear in relation to the categories, and what the designers would need to ask the end-consumers. The discussions continuously made connections and skipped between categories.

For example, one of the many topics discussed was the possibility that end-consumers could seek help and receive information via several of the customer care channels in the service-providing organization. This specific example is included here to illustrate how categories resulting from the client stakeholder interactions were linked to the end-consumer perspective.

The discussions among the design work participants were continuously mediated by discursive, visual, and material representations. This specific dialogue was mediated by several keywords and phrases, which in essence were related to three of the established categories: “dialogue with end-
consumers,” “internal communication in advance,” and “communication during transition.”

The rationale for discussing these three categories together was an established hypothesis among the client stakeholders that the end-consumers would expect to receive information and help concerning the transition via all of the client organization’s channels (i.e., channels for interaction between end-consumers and the organization). This hypothesis had been derived from the categories (in the quotations above) in that the client organization should prepare all interaction channels with information prior to the transition so that all channels could enter into dialogue with end-consumers about the changes during the transition. Given the size of the organization, one challenge that the client stakeholders discussed was that of disseminating material to inform all parts of the organization, so that the end-consumers could receive help and information from all channels on equal terms.

During the translation activities, the underlying assumptions of the discussion during the client stakeholder interactions were also challenged. For example, one dialogue concerned whether it would be important for all customer contact channels to be aware that the transition had started and that they should be able to help the end-consumers with the ongoing transition. One related matter was whether the staff in the physical office facilities really needed to be able to help with the online service system. Some queries raised in the discussions concerned whether end-consumers having trouble with the online service system might go to a physical office for help rather than, for example, posing a question through a chat program or making a phone call.

Such discussions were not intended to provide definitive answers. Rather, questioning the client stakeholders’ assumptions was part of constructing open-ended questions that did not take the client stakeholder perspective for granted when interacting with end-consumers. The discussion merely concluded that it was unknown whether the end-consumers would expect to use all channels for support and information. In other words, the takeaway from such a discussion was that end-consumers should be asked about what they would do if they needed help.

Simply stated, the questionnaire workshop was organized to discuss and question what was learned from client stakeholders. Such discussions culminated in translating the client stakeholders’ assumptions into
questions to be posed to, and verified by, end-consumers. The questions posed concerned what, when, where, and how end-consumers would expect to receive information and support about the transition service.

**Taking the voices of stakeholders**

Taking the voices of stakeholders is a negotiating activity similar to assuming various stakeholder perspectives. The difference is that taking the voices of stakeholders is much more specific in actually speaking on behalf of, and in the voice of, certain stakeholders.

This was done in three ways. First, references were continuously made to particular individuals, for example, by quoting end-consumers. The designers discursively mobilized the end-consumers’ experiences by verbalizing quotations from them. For example, the PM said “Deborah didn’t think that that was a problem,” referring to what one specific end-consumer had told him.

Second, references were made to personae that were either generalizations of end-consumers into groups (e.g., claiming that “the anxious end-consumers would want...”) or to client stakeholders as generalized representatives of the organizational unit to which they belong (e.g., the customer care employees).

Third, references were made to end-consumers by speaking in the first person from the end-consumers’ perspective. This adoption of the stakeholder’s voice is exemplified in the following excerpt. The brief dialogue, extracted from a few minutes of talk during the clustering workshop, exemplifies how the end-consumer’s voice is taken by speaking in first person (i.e., as if the speaker were the end-consumer).

The dialogue contains many clues to the design work. First, the formativeness of a label for one of the categories is exemplified throughout the discussion. The PM, SSD, and one of the external participants (External 2) drew on experiences of the end-consumer interactions. The PM and SSD even went as far as to talk in the first person, from the end-consumers’ perspectives (i.e., in lines 1, 10, 16–19, 20–23, 24–25, e.g., “don’t bother *me* in my life”).

Second, the importance of semantics in talking about parts of the design work comes through in the dialogue. The speakers seemed to be searching for the words to capture this “something,” causing the PM to feel that
something was missing (lines 14–15). At the end of the discussion (lines 24–27), the speakers agreed on an expression (‘adapt to my life’), though it might be changed later, at least reflected the essence of what they wanted to capture. Even the resulting label was expressed in the first person in this example.

PM: I keep nagging about this—‘Don’t bother me in my life!’

SSD: Should I write that as a label? Would that make you happy?

PM: Yes, that would make me feel at ease.

SSD: But what do you really mean? I understand what you mean, but I don’t really understand it.

PM: I probably don’t understand it myself. That’s why it’s not a label yet.

SSD: Because I mean … Which “life”? Do you mean that one doesn’t want or isn’t interested in any contact [with the service provider]? Is that what you mean? “We are not friends!”

External 2: Isn’t it more that [the transition] should happen without interference?

PM: I don’t know what it is. It’s just a feeling that we are missing, or that we are not including something. …

SSD: Is it about “I don’t want to change just because [the service provider] is changing?” “I still want to …” … Or “I don’t want to …” … “I don’t want to adapt myself to this change, I want the change to adapt to me”.

PM: Yes, I wrote “minimal impact on my life,” but that is not good either … “change on my terms.” We keep coming back to this, that everything should happen “on my terms.” “Adapt to me,” “understand me” …

SSD: Yes, what about “adapt to my behavior”? Could that be it?

PM: Yes, write that down. Then at least we have captured the idea. […]

This negotiating activity of taking the stakeholder’s voice became a way of discussing and unraveling interpretations and articulating gut feelings.
Establishing commonalities: finding common ground

To mediate between various perspectives, commonalities were established between the various needs groups. The activities to find common ground between stakeholders transpired as recursive interactions alternating between end-consumers and client stakeholders. Establishing commonalities by finding common ground was, for example, enacted as an end-consumer journey, which visualized interaction points between the service provider and the end-consumers for the service being designed.

As mentioned several times, client stakeholders were invited to participate in the design work early on. These stakeholders did not just participate in this first workshop, however. A few client stakeholders, namely, the contact person, the contact person’s manager, and two employees of the client organization (i.e., the external participant who joined in the entire design work project), were actively participating continuously or recursively in the design work.

The end-consumers were also invited to participate in the design work. According to the service design script, the end-consumer interactions constituted a recursive knowledge-creating activity throughout the design work. These interactions were mostly undertaken as interviews, sometimes supplemented with observations of end-consumer behavior.22

The number of required end-consumer interactions depends on how extensive the project is and may therefore range from ten to nearly 50 interviews per interview round.23 The number of end-consumer interactions also relates to the type of service being designed. If the design work is aimed towards a specific kind of service with a fairly homogenous group of end-consumers, fewer interviews are considered to be needed. Similarly, in the case study, the service (i.e., a transition between systems) concerned a heterogeneous group of end-consumers using the old system in various ways, necessitating more interviews in order to create a fuller picture.

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22 No observations of end-consumer behavior were included in the studied IT service transition project, so no such material was included in the observations underlying this research.
23 Several activities in the service design work script were repeated several times during the course of a client contract. The end-consumer interactions are one such work phase. The number of interviews is expressed per each repetition of the end-consumer interaction activity.
Mediating between the parties partly entailed finding common ground between the end-consumer groups and the client organization. For example, it was crucial that the client organization should be able to utilize the categorization of the end-consumers. An excerpt is cited to illustrate this challenge and illustrate how the mediation emerged.

This excerpt is drawn from a description by the PM and SSD in response to a question about how the design work would continue after the end-consumer interactions and the categorization of their results. The example illustrates the establishing of intersections between the service-providing organization and the end-consumer groups (lines 3–6), as well as pointing to mediating efforts between the parties (lines 9–11).

In particular, the SSD said (lines 3–4) that it would be nearly impossible for the service-providing organization to identify the established end-consumer groups before the transition. This was because the established end-consumer groups did not adhere to any parameters that the service-providing organization could use to target them (e.g., age, income, or usage pattern). Therefore, as the SSD continued to imply (lines 5–6), it would probably be pointless trying to create entirely different service concepts for the end-consumer groups. Rather, the organization needed to create a flexible design outcome that would somehow cater to all the various end-consumer desires (lines 7–11). The SSDs description is confirmed and summarized by the PM (lines 12–14), in his statement that they are now about to create one end-consumer journey.

| PM: | It feels like it is very difficult to find demarcated needs groups. … |
| SSD: | The greatest difficulty will be for [the service provider] to find … It’s impossible to find these groups in advance, and understand what needs there are, and then target information to those who are [in a certain way]. That will cause mistakes. So, it feels like that … What we’ve talked about is drawing a hypothetical journey, for what we think is the best way for this transition to happen. […] It might be one solution, but with several levels. Or there might be two solutions and [the end-consumers] get to choose. […] |
| PM: | So the next step is to draw a hypothetical [journey] based on what we know. “This is how I think the journey will be.” Then, we’ll ideate a lot of ideas on “how can we achieve this?” … |
These descriptions of the difficulty of attuning the end-consumer groups with the client organization’s segmentation models theorize about the continuation of the design work. To mediate between these stakeholder groups, the design work must find common ground among the various end-consumer groups and create scalable design concepts that can be offered to all end-consumers.

Yet another empirical example will be cited to illustrate how the studied design work approached the matter of aligning the various opposing end-consumer groups with the client organization’s perspective.

The example is drawn from the ideation workshop, in which possible design concepts were discussed for every end-consumer group and every phase of the formulated end-consumer journey. The aim of the workshop was to intersect the desires (identified for each end-consumer group) with the phases (established in the end-consumer journey). Before the part of the workshop presented in the empirical illustration, the discussion had concerned the end-consumer group labeled the enthusiastic end-consumers.

After having created ideas for design concepts for each phase of the end-consumer journey for the enthusiastic end-consumer group, the discussion shifted focus to the anxious/apprehensive end-consumers, in accordance with the service designer’s suggestion, motivated by the hypothesis that these differed the most from the enthusiasts.

The procedure was repeated for the anxious/apprehensive end-consumer group: the PM described the key characteristics of the group and moderated a discussion. The whole team then discussed and suggested ideas for each box in the row representing the timeline. The discussion continued by treating the end-consumer group at the other end of the spectrum, because the designers wanted to work on the most contrasting ideas before turning to ideas for the less extreme groups.

An example of a keyword for the anxious/apprehensive end-consumer group was “demo.” This keyword represented the suggestion to make it possible for typically anxious end-consumers to test the new service in advance by providing demos. The hypothesis underlying this suggestion was that a demo would make the anxious end-consumer feel more confident about the transition to come.
The suggestion mobilized experiences of end-consumer interactions in which several end-consumers had talked about demonstration videos as a way of learning to use the new IT system. The design work wove together this suggestion with the needs of one of the established end-consumer groups and with a phase of the end-consumer journey. By doing so, the designers took a step toward formulating the design outcome and partly negotiating the ambiguity of establishing a fit between the objective and the design outcome.

The procedure was then repeated for all phases of the end-consumer journey for the remaining two end-consumer groups. Eventually the team managed to fill the whole whiteboard with keywords, phrases, and illustrations on Post-It notes. Figure 7 depicts the visual representation of the achievements of the ideation workshop. The illustration reflects the results of the studied project in that more notes were clustered in the leftmost column in the upper and lower end-consumer groups, representing the two extremes of the end-consumer categorizations. In other words, comparing these extremes also highlights the most conflicting cues to be negotiated between.

![Figure 7. The visual representation produced in an ideation workshop.](image)

As in traditional brainstorming techniques, the suggestions were not evaluated based on feasibility or compliance with one another during the ideation workshop, and as such were anchored in the professional practice of design work. All ideas, however disparate or farfetched, were conveyed on Post-It notes and placed on the whiteboard. The suggestions were not presented in much detail but rather were vague, first drafts.
Mediating between categorizations

In addition to shifting perspective and finding common ground between stakeholder groups, the design work also negotiated ambiguity by mediating between categorizations. This was a negotiating activity that mainly targeted the conflicting functional requirements and conflicting implications of end-consumer interactions.

Evaluating suggestions and mediating between conflicting cues continued in activities to translate the various design concepts into coherent design outcomes.

Many of the suggestions made during the insights workshops, as discussed above and illustrated in Figure 7, differed greatly from one another, at times even conflicting. The reason for such differences was that the concepts targeted various and very different end-consumer groups. As previously discussed, however, it would have been nearly impossible for the service-providing organization to differentiate and target the end-consumer categories according to the characteristics they had been ascribed. The creation of end-consumer groups was rather intended as an explanatory model for understanding the multivocality of end-consumers and their needs, than as some kind of market segmentation. This in turn meant that the design outcome could not attune to one specific end-consumer group but had to cater to all end-consumer groups simultaneously.

The following dialogue, drawn from the ideation workshop, illustrates activities undertaken to mediate between categorizations. The aim was to translate the results of having analyzed the material from the end-consumer interactions into proposals for design outcomes.

The dialogue depicts the emergent and open-ended nature of the knowledge-creation work during the workshop. The PM and SSD engaged in inventing their way of doing as they went along (with an insertion from the service design trainee SDT), for example, discussing how to do the work while doing the work (lines 26–29). In conjunction with this, the PM assumed the role of note-taker and started drawing a rough outline of a concept based on the discussions.

The visualized matrix mediated the talk, as the matrix was interacted with as a basis for translating the notes from desires into design proposals. During the workshop, the previously visualized suggestions from the
ideation workshop were combined and translated into design concepts that assumed a materialized form.

1 PM: *How do we achieve this?*
2 ...
3 SSD: *Couldn’t we start with this* [indicates the matrix of Post-It notes, with the end-consumer groups on the x-axis and end-consumer journey on the y-axis]. *We’ve done a lot already!*
4 PM: *Okay, let’s approach one square at a time.*
5 SSD: *“Before”* [indicates the top-left square, enthusiasts before the transition], *they talked about this at the meeting yesterday* [refers to meeting with client organization]: *“These are the ones we would like to give a preview”* [quoting a client stakeholder from the meeting]. *How can we make the enthusiasts feel noticed and special? While still not* [raising their expectations too high]? Let’s see what we have said—*couldn’t we just go through [the matrix]?
6 PM: *Yes.*
7 SSD: *Ehm … “Do you want to be first?”—a question. Voluntarily that is, if* [the end-consumer] *would like to sign up to be first. And,*
8 I don’t know … *Where does that [question] come from? […] Where would the enthusiastic end-consumer receive such an offer? Where does one see such information?*
9 PM: *Spontaneously, I would say in the online IT system.*
10 SDT: *Or Facebook?*
11 ...
12 SSD: *Okay, let’s say Facebook. What about this: “Track through Facebook”. Finding [end-consumers] who have been active on Facebook and expressed opinions or asked questions? …*
13 PM: *You know what? Move that Post-It over here!* [indicates an A3 sheet, on which he starts writing a heading]
14 SSD: *Yes, we should move these around so that we create some kind of clusters. [Write] something like “possibility of being VIP” or “beta testers”*[suggesting a heading to the PM]. …

The talk was so embedded in the context of the ongoing design work that it barely makes sense to an outsider; therefore, clarifications have been included in brackets for much of the talk. The SSD elicited memories of a
meeting with client stakeholders (line 8–9) and even quoted something said in the meeting (line 9–11) to highlight the importance that the client attributed to the end-consumer group being discussed.

Furthermore, the work was anchored in experience as it was continuously mediated by the Post-It notes that represented the outcomes of earlier work activities. Questions were posed in relation to the notes (i.e., lines 17–19 in relation to the note read on line 15). Such questions were discussed and answers were tentatively suggested (lines 20, 21, 23–25).

In this empirical illustration, conflicting cues were mediated almost in passing. The dialogue flowed in the directions where there was least resistance (i.e., where they did not get stuck into details) and was mediated by the various categories, notes, and keywords (see lines 15 and 23–24). The ambiguity of the conflicting cues was negotiated by concealing the conflict and dialoguing in which direction the talk flowed to somehow circumvent and disarm the strongest antagonisms. Yet the ambiguity of the conflicting cues was reduced as the design work constructed common ground and intersected the categories via detours.

### 7.2.3 Anchoring in expertise

The studied service design work was undertaken to create a transition service between two IT systems with which the designers were not particularly familiar with. During the ongoing design work, the designers displayed little interest in learning about the specific differences between the two systems (i.e., about the differences in functionality and user interface). Instead, they focused on the end-consumers’ opinions and perceptions of the two systems and the transition between them.

The design work was anchored in experience and expertise, and the specific knowing of the designers included knowing in whom to have confidence, i.e., assessing the credibility of various end-consumers. The design work was also to some extent anchored in the expertise of the stakeholders.

In essence, the anchoring in expertise was accomplished in two ways: (1) integrating client stakeholders into the design work; and (2) inviting the end-consumers as experts.
Integrating client stakeholders into the design work

The service design work began with inviting client stakeholders to participate in the design work. Integrating the client stakeholders into the design work by inviting them to participate in and contribute with experience in a joint workshop made them involved in interpreting the ambiguous objective. The client stakeholders, who came from various departments of the client organization, did not usually interact much during their daily work. They were invited to participate in the design work based on their various organizational belongings, experiences, and educational backgrounds. While participating in the design work, the client stakeholders anchored their suggestions, experiences, etc., in the work practices in which they participated in their daily work (e.g., customer care and IT systems development).

A joint workshop was organized with client stakeholders, representing the initiation of knowledge-creating activities in the design work. In other words, studying the design work during the workshop gave an indication of what activities were undertaken to negotiate the ambiguous starting conditions.

The design team as well as stakeholders from various parts of the client organization participated in this joint pinpoint workshop. The integration of client stakeholders was a way for the design work to be kick started by making use of the client stakeholders’ experience and understanding of the design purpose. The term “pinpoint workshop” refers to pinpointing (i.e., a way of creating knowledge) the most important aspects of the design objective from the various client stakeholders’ points of view.

Client stakeholders and design consultants jointly participated in the knowledge-creating activities. The design work was continuously mediated by discursive and material representations. The actions of the design work participants differed, however, although all participated in the same interwoven design work.

The design consultants mainly facilitated the client stakeholders’ activities by discursively eliciting experiences in dialogues and in writing. The consultants did so by anchoring the workshop in the professional practice of design, mobilizing traditions for undertaking design work; for example, the use of Post-It notes in communicating knowing is well established in industrial design.
The integration of client stakeholders enabled sociomaterial interactions in terms of dialogue between designers and client stakeholders and in terms of mediation of the work via discursive and material representations (in the form of keywords expressed on Post-It notes).

The participants in the design work during the workshop were to describe and discuss their experiences verbally, summarize their viewpoints as keywords, and represent these materially on Post-It notes. The participants were also supposed to cluster the keywords according to emerging common denominators.

The PM briefly explained what was to be done and what the purpose was both in design work in general and in the workshop in particular. This explanation was primarily for the benefit of the client stakeholders, in order to anchor the knowledge-creating activities in professional design practice, with which the client stakeholders were not familiar. As the PM theorized about professional design practice, he simultaneously invited the client stakeholders to participate in the knowledge-creating activities.

The descriptions were quickly transformed into discussions as more participants reflected aloud on what was being said. The PM merely asked for clarifications at times, but mostly let the discussion emerge freely without moderating it.

During the discussions, the client stakeholders discursively mobilized their experiences of interacting with end-consumers, their talk being mediated by examples from situations in which the service-providing organization had made changes to the old service system. The client stakeholders also verbalized end-consumer reactions from previous interactions. Given that the client stakeholders came from and represented different parts of the large client organization, they often presented complementary perspectives.

When the workshop was completed, based on the client stakeholders’ communicated experiences and hypotheses, the designers had learned about the complexities and challenges of creating a transition service. The client stakeholders also knew more about the design work and the parts of the client organization that might be affected by the design work.

Integrating client stakeholders into the design work negotiated the ambiguous starting conditions by reducing the multiplicity of interpretations of the stakeholder desires to be met upon finalizing the
design work project. Integrating client stakeholders was a way of making do, that is, working with whatever is at hand. Client organization was one of the few established parameters, so the design work was initiated by interacting with individuals in the client organization. In doing so, more cues as to the continuation of the work emerged, which enabled the ongoing work.

Inviting the end-consumers as experts: empathizing with various end-consumers

The design work was largely anchored in end-consumer experience. The end-consumers were integrated into the design work as experts on the desires that the design outcome should attune to. It was not that individual end-consumers had a decisive role in the design work; rather, generalized end-consumer opinions strongly influenced the work.

The involvement of client stakeholders in initiating action in the design work has just been described, so the nature of these interactions will not be described again. What is worth reiterating, however, is that these interactions enabled knowledge-creating activities anchored in the client stakeholders’ varied experience. Through these interactions, empathy for and understanding of the client stakeholders’ points of view were established in the design work.

The following empirical snapshot tells a story of interacting with end-consumers, illustrating the detailed knowledge-creating activities to learn from and empathize with end-consumers. The example further illustrates how the interactions were diversified in order to interact with various end-consumers who could potentially give voice to differing desires.

During their interactions with end-consumers, the designers mobilized an interview technique that was anchored in the professional practice of design work. The interview technique was in essence intended to enable the designers to probe into the underlying reasons for the end-consumers’ communicated desires. This was achieved by asking several “why” questions when following up questionnaire items.

The dialogues between the designers and end-consumers were initiated with a short introduction about the purpose of the interaction. The designers described the purpose in vague terms, to avoid putting words into the end-consumer’s mouth. For example, during one of the
introductions, the SSD said to an end-consumer: “On behalf of [the client organization] we are conducting an inquiry into [the online service system]. Do you have a few minutes to spare while waiting?” This specific scenario occurred in the client organization’s office facilities as a face-to-face encounter. The end-consumer had just taken a queue ticket and was waiting for his turn.

After establishing that the end-consumer was willing to participate, some background questions were asked, for example, about how the end-consumer currently used the client organization’s services. More specific questions were then asked, directing the dialogue toward the service being designed. The end-consumer interactions did not each include all the questions prepared for the questionnaire. Rather, the designers posed a few of the questions to each end-consumer, leaving time for probing deeper by asking follow-up questions about each question.

These many short interviews were intended to complement each other by covering different questions. Some end-consumers were very engaged during the interactions and wanted to participate as much as possible. These end-consumers were asked more questions and given more time.

There was no generalized standard for deciding which kinds of end-consumers would be asked what questions. Rather, the choice of subsequent questions was derived from the end-consumer’s initial answers and anchored in the designers’ gut feelings. The dialogues generally started with a question about how the end-consumer was currently using the client organization’s services. If, for example, the end-consumer did not use the client organization’s online banking services at all, the interview tended to differ greatly from those with end-consumers who only interacted with the client organization online.

End-consumers who did not use the online service system were asked why they did not use the service and what, if anything, would induce them to do so. End-consumers who claimed to make great use of the online service system were instead asked about what kind of information they would like to receive, when and how, about the new service system as well as about the timing of the transition itself.
A conversation between the PM and one of the external participants, reported below, somewhat clarifies how the “why” technique was used. The PM’s description of the technique (lines 3–6), in response to a question from one of the two external design team participants (lines 1–2), both theorized about the practice and mobilized history by drawing examples from experience.

| External 1: But how do we gain insight into the transition if we
| always talk about the new service system during the interviews?
| PM: It’s all about asking “why” a sufficient number of
| times in order to find the causes for concern, that is all it boils down
| to. For instance, worrying about “not being able to [deliver on time
| in conjunction with the transition].”

The PM’s example of a potential end-consumer driver (lines 5–6) discursively mobilized history by reflecting on the activity of the interview technique while situating it in the emerging context of the current project. “Why” was asked several times in a row, letting the end-consumer’s previous answer function as the basis for further explanations. The PM further theorized about the interview technique and said that, based on such interactions with end-consumers, they could establish “some kind of empathy or gut feelings.”

This interviewing technique as used in dialogue with an end-consumer could be something like the following example, drawn from a longer conversation. There was more speech between the quoted lines, but for clarity, this material has been edited out.

Conversations such as the one below convey several assumptions on the part of the end-consumer, providing a basis for further exploration in the design work. First, in line 2, the end-consumer assumed that the changes would not have any major effect on the system users (i.e., the end-consumers). Second, the end-consumer said that it took a lot of clicks and was difficult to navigate the old system, and concluded that these drawbacks might be eliminated (lines 4–5). The end-consumer continued to say, however, that the current user drawbacks were not likely the reason for the transition; rather, the service provider (i.e., the client organization) was likely changing the system to make it better for themselves internally
lines 7 and 9). Finally, the end-consumer verbalized the concern that the change might make the service more expensive for the users (line 10).

The below exchange illustrates how the interviewing technique delves deep into the underlying reasoning (see lines 1, 3, 6, and 8). By continuously asking the end-consumers to justify their answers, interlocutors may learn a lot about end-consumers’ assumptions and expectations. This becomes clear when one compares the answer on line 2 with the other answers offered.

If the dialogue had not continued past the answer on the second line, one might assume that the end-consumer just thought that not much would change. By probing deeper, however, one could learn that the end-consumer held a rather negative image of the service-providing organization and that the end-consumer assumed that the service provider was only optimizing internal processes. Such answers not only created a basis for empathizing with the end-consumers but also highlighted a challenge connected to the design purpose. Specifically, the negative image of the service-providing organization challenged the objective of “making the transition pleasant.”

In contrast to the cited conversation, another end-consumer claimed that a change in the way one navigated the system would make it more difficult for the users given that they would have to relearn the system, regardless of whether the change could be seen as an “improvement.” In other words,
the end-consumers’ responses and reactions varied greatly between individuals, even with reference to similar changes in the online IT system.

It is partly from this polysemy of end-consumer desires that the ambiguity of having multiple stakeholders emerges. The negotiating activity of empathizing with end-consumers sustains, or even strengthens, the ambiguity of the various desires. Simultaneously, the ambiguity of having multiple stakeholders is somewhat reduced in this activity. Before the interactions with end-consumers, the nature of their various desires was unknown. The interaction activity reduced the ambiguity regarding the end-consumers’ desires in relation to the service to be designed. At the same time, the interaction activity sustained or strengthened the ambiguity of the multiple cues mediating the design work.

7.2.4 Disarming future resistance

Although ambiguous situations cannot be foreseen and are thus impossible to offset in advance, some negotiating activities were intended to at least reduce the likelihood of ambiguities emerging in the ongoing design work to come, by disarming such future resistance. Anchored in experiences of former design work projects, the designers knew that the end-consumer interactions could well present conflicting desires, especially given the large number of end-consumers.

In the studied service design work, future resistance was disarmed as regards the ambiguous objective. More specifically, future resistance, in the form of unforeseen end-consumer desires or client stakeholder demands, was disarmed as far as possible by broad communication. This broad communication interacted with many stakeholders with the aim to include the most salient desires.

Communicating broadly: including the most salient desires

One activity to disarm future resistance in the design work was to communicate broadly, interacting with a large number of stakeholders. Broad communication was thought to increase the likelihood of including the most salient end-consumer desires and most prevalent client stakeholder demands. In turn, including various stakeholder considerations early on was thought to reduce the likelihood of future resistance in the form of conflicting stakeholder desires.
The client contact person asked about the lack of statistical analysis in the service design work. This triggered dialogue between the designers with varying, yet complementary, answers. The following quotation from the PM summarizes the designers’ response to the client contact person’s question regarding statistical significance: “It is the user\textsuperscript{24} who determines whether [the service design outcome] is good, but it is not statistically [measured].”

In other words, the design work did not include any statistically verifiable methods for learning from the end-consumers. Rather, an arbitrary number of end-consumers was interacted with during the design work, to learn from them and construct a design outcome that was “good.” In other words, the activities for communicating broadly refer to gathering extensive and detailed qualitative material rather than aiming for statistical significance.

The script for undertaking service design work included interactions with end-consumers as an essential part of creating what was called “end-consumer-based service design.” The ambiguous objective of “creating an understanding of how to make the transition ... as pleasant as possible for [the end-consumers]” was partly negotiated by communicating broadly.

As discussed previously, the end-consumer base was extremely large, which made the endeavor of designing “for the end-consumers” ambiguous. In other words, the emergence of and negotiating with this ambiguity were interwoven with the ambiguity of having multiple stakeholders: the ambiguity of meeting the equivocal objective emerged in having multiple stakeholders.

The design work activity of “interacting with end-consumers” was described by the PM as follows: “here we try to learn about the end-consumers’ needs and desires’. “The end-consumers” were not specified further; rather, all or most end-consumers were intended. In other words, the design work had a broad aim by interacting with a large number of end-consumers, and then qualitatively generalizing across the individual end-consumers.

The following empirical example illustrates how the interactions with end-consumers were organized. The example conveys how broad

\textsuperscript{24} “User” refers to the end-consumer who will eventually use the service.
Communication was achieved by interacting with diverse end-consumers in various locations.

In the studied service design work, end-consumers were interviewed both face to face and by telephone. The face-to-face interviews were conducted in the client organization’s office facilities where the end-consumers interacted with the client organization (the end-consumers could also interact with the client organization online or by phone).

The face-to-face interactions took place while the client organization was running its ordinary operations in the facilities. End-consumers were approached while queuing for the client organization’s services; after a short description of the purpose of the interaction, they were asked to participate. The face-to-face interviews were kept short to make it easier for end-consumers to participate without losing their place in the queue. The interviews often lasted until it was the end-consumer’s turn to be served by the client organization, but sometimes continued even afterwards. This was dependent on whether the end-consumer had sufficient time and interest to continue.

In the studied project, the design team split into two work groups when conducting the face-to-face interactions. A few of the team members stayed in Stockholm, while the others traveled to Eskilstuna, a town about an hour from Stockholm. The team was split in order to cover greater variation in end-consumers. It was suggested that end-consumers living in a smaller town, outside Sweden’s capital, might have reactions and responses differing from those of end-consumers in Stockholm. The reasons for such possible differences were not discussed by the designers, nor were these possible differences claimed definitely to exist. Instead, the team split seemed to be a tactic for playing it safe: if there were any differences, it would be important to include such variations.

The structure of the telephone interviews and the questions asked in them were similar to those of the face-to-face interviews. The interactions between designers and end-consumers were generally brief, with team members spending between 30 seconds and ten minutes on each interview. The shorter ones, closer to 30 seconds long, were short because, for example, the approached end-consumer did not use the online service system or showed signs of being uncomfortable with the interview situation.
The telephone respondents were randomly selected from the client’s customer database. The sample was not completely random, however, as some end-consumers chose not to participate. In preparation for the telephone interviews, the end-consumers were first contacted and asked whether they would consider participating. If the end-consumer was willing, the interviewer and the respondent scheduled a time for the interview. The telephone interviews often lasted longer than the face-to-face ones, because the respondents had scheduled them and were therefore assumed to have more time available.

The above describes how broad communication, i.e., with many stakeholders, was accomplished in the design work. By communicating broadly, the intent was to include the most common end-consumer desires and achieve what is called “saturation.” The intent was to ensure, as far as possible, that no major end-consumer desires were overlooked. This, in turn, was a way of disarming future resistance by reducing the risk of major changes in the demands imposed on the work. This was a way of negotiating the ambiguities transpiring in having multiple stakeholders.

7.2.5 Making do: unraveling the net of multiple interpretations

There were situations in the service design work in which the anchoring in the professional practice of design work was unclear. In such situations, the design work found little guidance in established “rules” for undertaking the work, i.e., in process descriptions or the like. Such situations concerned, for example, unraveling the net of multiple interpretations of end-consumer desires. These ambiguous situations were negotiated by making do, i.e., working with whatever was at hand to make the most out of the situation, in unraveling the net of multiple interpretations.

The emergence of the work activities, of the design outcome, and of the empathy for the stakeholders’ desires all united in the negotiating activities of making do. In other words, the negotiating activities of making do were undertaken in three ways: (1) improvising with what was at hand, (2) one step at a time, and (3) verbalizing gut feelings to compare empathy.

Improvising with what is at hand

Although there was an established script for undertaking the service design work, the emergence and situatedness of the work prompted improvisation and making do with whatever was at hand. This continuous emergence of
the work is illustrated by a snapshot of an ambiguous situation in which the design work was improvised by taking off from whatever points of references there were.

Similar examples could be drawn from many different situations during the design work. Citing more examples would be repetitive and add little depth to our understanding of the improvisation and making do, however. The chosen example illustrates the emergence of the design work, as the participants interacted to create what was happening.

The first quotation is drawn from the initiation of design work activities to create design proposals in discussions of possible outcome characteristics, during what the designers called an ideation workshop. The PM’s talk about practice theorized about what the design work was to address in that phase of the work: “My idea is really that I can start as a moderator. I’ll suggest a few ideas that we can ideate about.” From this quotation, it is clear that the ideation workshop was not shaped by rules prescribing certain sociomaterial interactions (i.e., with specific artifacts or humans). Rather, “doing while inventing the way of doing” comes through in this talk about how to organize the design work.

It was known at that time that four end-consumer groups and four phases of the end-consumer journey had been established. The PM drew a four-by-four matrix on a nearby whiteboard. Each of the four horizontal rows represented an end-consumer group, while the four vertical columns represented the four identified phases of the end-consumer journey. Both the end-consumer groups and end-consumer journey were depicted on the whiteboard.

The PM first described the dominant characteristics of one end-consumer group. As he started describing the next end-consumer group, the service designer asked him to stop. She suggested that the discussion should instead continue to create design outcome proposals for the first group, before they shifted focus to the other groups. Again, the design work was invented “on the fly.”

In accordance with the suggestion to continue focusing on the first group, the discussion was moderated toward suggesting design concepts for each end-consumer journey phase, starting with the enthusiastic end-consumer group. The discussion was mediated by the end-consumer journey, as the dialogue merged into each of the four established phases (i.e., “before,”
“shortly before,” “during,” and “after” the transition). The PM first presented some ideas, then asked questions (e.g., “What would the enthusiastic end-consumers want to know before the transition?”) and cited examples of other similar services that could suggest how to create a design outcome that attune to the desires of the enthusiastic end-consumers.

In this dialogue, history was mobilized by drawing on experiences of end-consumer interactions, both in the current project and from evoking memories of previous projects and services. The PM continuously moderated the dialogue by asking questions and requesting clarifications, such as: “Can we harness their enthusiasm?” and “What do you mean by that?”

**One step at a time …**

Taking “one step at a time” recalls “improvising with what is at hand,” but with a slight change in focus. While “improvising with what is at hand” concerns the doing and the knowledge-creating activities undertaken in the moment, “one step at a time” instead refers to the design outcome and its becoming. The design work was accomplished by making minor improvements and continuously creating the design outcome in greater detail, feeling one’s way forward.

An example is drawn from a discussion of the purpose of the work to come, as one step at a time was taken. The PM reflected on the tentative design outcomes of the ideation workshop and what needed to be done in connection with them: “We haven’t gone as far as to be able to say what we should do, I mean ‘How should we solve this?’ It’s more like ‘Let’s include a puff.’” The PM theorized about the material created thus far in the design work, and hypothesized about what was to come next. By mobilizing experience and referring to design proposals already established (e.g., a puff), the PM indicated that they needed to attune the proposal (i.e., a puff) to the objective (i.e., how to make the transition pleasant for the end-consumers) in order to hypothesize about how the proposals from the ideation workshop (e.g., a puff) could be included in the design outcome.

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25 A “puff” in this context refers to the social media function in which an individual receives a discrete notification of some kind. The italicized words indicate the project manager’s emphasis.
In response to the PM’s reflections on what now needed to be done, the SSD also mobilized history and rephrased the objective when talking about a possible approach to translating the various proposals into coherent design concepts, saying: “We should look at what would make [the end-consumers] very satisfied. What’s the critical point? Or what needs are there that we must address? Because if we don’t do that, they will be very dissatisfied. I think that is what we must try to understand.” In talking about practice, she also referred to the knowing aspects of the practice, by theorizing about what knowledge she thought that they should create.

What these two quotations primarily illustrate is how the design work was to focus on a greater level of detail. The empirical example is drawn from what the service design script calls “conceptualizing.” Before conceptualizing activities, the design work had focused on end-consumer desires during the end-consumer interactions. The difference in this recursive activity was that the end-consumer desires were now mediated by tentative design proposals. In other words, this empirical illustration sheds light on the more detailed focus that the design work went into.

Since the detail level of the design concepts continuously increased in the ongoing work, another situation from a later stage will be described to illustrate the difference. An illustration of the recursive detailing of concepts is drawn from a situation in which the design work was to translate tentative design proposals into coherent design concepts. Such concepts were then to be materialized as mock-ups, illustrations, or the like. The material representations were to mediate further interactions with end-consumers, to get their feedback on the more detailed concepts.

This example comes from a dialogue about offering end-consumers the opportunity to voluntarily transition to the new service system early. Regarding this offer, a discussion was held on whether it would be beneficial to limit this opportunity to a small number of end-consumers. The idea of such a suggestion was that those who did transition early would feel special or chosen, like VIPs. This discussion did not end in an either/or decision to limit the number of early transitioners. Instead, as in many other discussions, they agreed to suggest the offer in the next round of end-consumer interactions, to learn what the end-consumers considered reasonable.

The team also discussed the channels by which the enthusiastic end-consumers would be invited to transition early. This discussion mobilized
history by referring to the early interactions with the client stakeholders, during which the designers learned about the various communication channels the service-providing organization used in its customer care operations. Some of the suggested communication channels were the service provider's Facebook page, being invited when visiting the service provider's offices or when logging into the old service system, etc. Someone said that one might not feel special or chosen if asked simply when logging into the service provider's system. On the other hand, the end-consumers might consider it frivolous to be contacted by the service provider via Facebook. These are the kinds of issues that the designers considered in dialogues, hypothesizing about the end-consumers’ reactions and responses, situating arguments in the context of the current project, and exemplifying from the client organization’s point of view.

As can be seen in this second empirical illustration, the level of detail had become much greater. The dialogues now concerned channels for delivering information about the service transition, the specific end-consumer to whom certain offers should be directed, etc. In other words, at this time, the design work was making do with a much more detailed understanding of the design outcome being created.

**Verbalizing gut feelings to compare empathy**

More aesthetic dimensions, for example, concerning gut feelings, were included in the design work by being verbalized. These verbalized and compared gut feelings became a way of empathizing with end-consumers. Such empathizing negotiated the ambiguous objective (“create an understanding of how to make the transition ... as pleasant as possible for [the end-consumers]”) by increasing the possibility of making interpretations of the end-consumers’ perceptions of “pleasantness.”

The following example is drawn from what the service design script calls an insights workshop, and illustrates the emergence of the design work as it is made sense of by verbalizing gut feelings and comparing empathy. This snapshot was mainly constructed from detailed notes about the knowledge-creating activities during the observations, but also includes a quotation from the PM.

During the insights workshop, the designers discursively mobilized experiences of both the end-consumer interactions and previous design projects. The purpose of the workshop was for team members to verbalize
and discuss “gut feelings,” “triggered empathy,” and outright quotations from the end-consumer interactions. They discussed viewpoints, perspectives, and desires that had either been expressed or implied by the end-consumers during the interactions.

A service designer described the underlying reason for this workshop: The stories and gut feelings had become embedded in individuals during the end-consumer interactions and now had to be shared among the team members. As the design team participants had interacted with different end-consumers, they might have encountered different responses and reactions from them. By discussing and comparing their gut feelings and experiences from the end-consumer interactions, they shared their individual understandings of the end-consumers’ desires and could draw conclusions about the interactions that they were unable to infer individually.

The PM initiated the workshop by moderating a discussion of the categories defined when formulating the questionnaire. The goal was to discursively mobilize experience of the end-consumer interactions and to materialize these experiences by writing down the insights related to every category. The following illustrates the PM’s talk about the importance of verbalizing gut feelings (lines 1–2) when comparing and establishing empathy.

1 The challenge is to create some kind of order out of the insights,
2 or all the fragments, that we have gathered. We started
3 yesterday, and began by reading a question out loud and a
4 statement [in answer to that question]. This, in turn … Because
5 you have a lot of … One remembers things at the back of one’s
6 mind—everything that [the end-consumers] have said.
7 So, one reads [a question] out loud and then one discusses it—
8 “Yes, but I heard this.” Then someone else says, for instance,
9 “Yes, but I also got the feeling that some log on [to the online IT
10 system] four times a week to check” and blah, blah, blah.
11 So, we wrote down all of those insights and gathered them here
12 on the table. We have also gone through all the [spreadsheet]
13 insights that we have. [We] skimmed through them and said,
14 “Okay, did we include … is all this included in the notes at the
15 table?” So this is our yield from yesterday.
In this description, the PM was mainly talking to the two external project participants, who did not have the opportunity to participate in the insights workshop the day before, due to other obligations. In this talk about practice, one finds many clues about what knowing the designers mobilized (i.e., remembering on lines 5–6, and feelings on line 9) when undertaking the insights workshop, as well as a narrative about how the questions enacted the knowledge-creating activities.

Particularly in lines 4–6, one sees how the PM struggled to theorize about what knowing that was enacted during the insights workshop. To convey how the workshop participants discursively mobilized history by drawing on experiences of the end-consumer interactions, he went on to illustrate how such a dialogue between the designers emerged (lines 7–10).

### 7.2.6 Enacting talk in representations

A final negotiating activity was to enact talk in visual, discursive, and material representations, which mediated the ongoing work by enacting and embodying talk so that it might be seen and felt. Enacting talk in representations was both a negotiating activity in ongoing work as well as a way of summarizing interim results, serving as points of reference in the ongoing design work activities.

Talk was enacted in representations in two main ways: (1) representing discursively and materially; and (2) representing visually. These are described in the following subsections.

#### Representing discursively and materially

The ambiguous nature of the design work seemed to be continuously negotiated by representing the more elusive aspects of the work in discursive and material summaries, such as keywords and phrases on Post-It notes. This negotiating activity was included recursively in the design work. Many empirical examples of this may be drawn from the studied work. Here, a longer empirical illustration is drawn from the first so-called pinpoint workshop. During this workshop, the design work went from knowing very little about the transition service being designed to having discursively and materially represented twelve possible focus areas.

During the pinpoint workshop, the participants were asked to summarize their answers to the preparatory questions (described in the preparatory e-
mail, see Figure 3) by writing representative keywords on Post-It notes. These Post-It notes then became ways of communicating knowing through materially and discursively mobilizing summarized experiences.

The PM initiated and moderated a discussion of the client stakeholders’ answers to these questions. The script for the workshop called for all participants to discursively summarize their answers to the preparatory questions on Post-It notes, which functioned as material representations in the design work. Summaries were also enacted in visual representations by drawing illustrations on Post-It notes.

The small size of the Post-It notes called for short keywords or simple illustrations, while the sticky patch on the reverse of the notes enabled the structuring and restructuring of the notes into the emerging clusters. The Post-It notes combined two traditions of professional design work practice: discursively mobilizing experiences in short punchlines, keywords, or illustrations and communicating these in material representations.

The use of keywords, key phrases, and illustrations on Post-It notes fulfilled yet another purpose of the design work. Not only did the representations summarize the work, but they also mediated the knowledge creation with regards to creating an understanding for how end-consumers and their desires could be categorized. The differentiation and combination of individual notes in categories was continuously mediated by the visualization of the emerging categories: notes were physically farther from or closer to one another, visualizing the emergence of the categories.

The Post-It notes, both individually and collectively, came to life during the work by visualizing the becoming of the clusters. The mediating role of the representations became clear in the following example, extracted from the first workshop in a knowledge-creating activity to categorize and sort the Post-It notes, based on their keywords, key phrases, and illustrations, into clusters sharing some non-predicted unifying traits.

As Post-It notes were stuck on the wall various physical distances from one another, the emergence of clusters was continuously visualized. One cluster clearly outgrew the others in terms of the number of Post-It notes. The PM, SSD, and one of the trainees paid extra attention to these notes and the implied meanings of their content. They read these notes, discussing and trying to communicate the possible unifying dimensions of
the cluster, saying things such as: “Isn’t this really about ...” or “But this [i.e., indicating one Post-It note] is from the client organization’s perspective, while this [i.e., indicating another Post-It note] concerns the end-consumer.” Finally, and in unison, they concluded that the cluster should be divided into two: one about internal misgivings and another about external misgivings.

Before the pinpoint workshop was finalized, all the Post-It notes had been assigned to one of the clustered categories, as follows: (1) target groups, consumer segments, and behaviors; (2) tools for managing change; (3) expectations; (4) internal misgivings; (5) external misgivings; (6) functions and improvements; (7) dialogue with end-consumers; (8) internal communication in advance; (9) external communication in advance; (10) communication during transition; (11) communication after transition; and (12) customer journey and drivers of change. The categories were understood as groupings of possible challenges to be addressed in creating the transition service.

Other examples of discursive and material representations included in the work could be drawn from nearly any part of the service design work. The design work was discursively and materially represented in the questionnaire, in the insights workshop, during the clustering activities, during the ideation workshop, etc. In other words, this is a negotiating activity that truly permeates the design work.

The discursive and material summaries enacted the results of the service design work, and constructed the space for action for the work to come. The PM put this into words in the following quotation from his summary of a workshop that resulted in a number of categories: “These are starting points, but they may also be used as a checklist—do we address these?” In other words, the categories that had been constructed could mediate the work to come, by both framing the starting conditions and functioning as a checklist.

**Representing visually**

The end-consumer interactions were materially mediated largely by visual representations. The designers presented visual representations throughout the interactions to elicit reactions among end-consumers. These visual representations were called trigger material, due to the
embedded intention of eliciting reactions. The trigger materials’ aesthetics varied, depending on how they were to be used.

The visual representations recursively mediated the establishing and testing of hypotheses concerning the characteristics of the design outcome. The knowledge creation in stakeholder interactions was enacted in visual representations. Such visual representations could, for example, be what the designers called trigger material in their script for undertaking design work, drawings of the end-consumer journey, or depictions of the end-consumer groups using smiley faces.

The PM described the purpose of the trigger material as follows: “It is important to remember that we are not really testing these exact concepts. Rather, we are testing a hypothesis of ours and we are using this material as a basis for discussion.” This quotation conveys how the visual representations anchored the dialogues with end-consumers by creating shared points of reference for the discussions. By extension, this became a way of negotiating the ambiguous purpose of “making the transition pleasant” together with the end-consumers.

At times the trigger material was to be used by the end-consumers as a basis for hypothesizing and further developing efforts. Such visual representations could signal that a proposal was unfinished, for example, by materializing as a hand-drawn pencil sketch. At other times the trigger material was intended to be perceived as something much more sophisticated and finished, such as a finalized proposal for the new service system. Such visual representations embodied a very different aesthetic, taking the form of computer-generated functional illustrations.

The aesthetics of the trigger material was often intentionally equivocal. For example, an illustration of an informative text concerning the transition to the new system could be presented without a clear context. Such an ambiguous visual representation triggered the end-consumers to make assumptions as to whether the information text was, for example, printed on physical paper, sent in an e-mail, or published on a website. In this way, the designers could dialogue with the end-consumers from which they learned, for example, about the end-consumers’ expectations about receiving information, reactions to such information channels, and when they would expect to receive such information.
Another example is an illustration of part of a webpage in the new service system showing unspecified and thus ambiguous functions (see Figure 8). Given the many graphic symbols that resemble clickable links, most end-consumers assumed that illustrations similar to those in Figure 8 were parts of a website. The discourse that the designers mobilized by using this visual representation was tentative and made use of the ambiguous implications of the trigger material. Jointly with the end-consumers, the representations were interpreted using probing questions in dialogues.

![Figure 8. Trigger material used in the design work. This is not the actual image used in the design work, as the material would reveal the service-providing organization's identity.](image)

On showing illustrations such as the one in Figure 8, the designers would ask questions such as: What would you do if you needed help? Would you use any of these functions? What do you think would happen if you clicked on the question mark? Do you find this at all useful?

Also, the dialogues regarding the trigger material were based on asking “why” (or something synonymous to that) a number of times in conjunction with the above questions. A typical dialogue is summarized in the below composite conversation.

In this conversation, the designer and the end-consumer were talking about an illustration that functioned as trigger material and mediated the conversation. In the cited composite conversation, the talk was mediated by the visual representation in lines 1, 13, and 16. In these three lines, the questions referred to the visual representations, either explicitly (e.g., line 26)

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26 For the sake of transparency, I would like to emphasize what I mean with a composite conversation: this is a typical example of a conversation. However, it is not a quote from one specific dialogue, but rather a combination of several. I have chosen to present the empirical material here in this way for two reasons. One, the end-consumer interactions were not audio recorded, which has left me with few quotes of exact wordings during longer conversations but with many notes of shorter questions and answers to those. Secondly, I saw this as an opportunity for combining several examples of what the designers may learn, in one conversation, thus highlighting to the reader the main discourses from the interactions, combined into one conversation.
Through dialogues such as this one, the designers could create knowledge about the interpretations of “making the transition pleasant.” To cite a few examples based on the above conversation: (1) some end-consumers ask for help from personal contacts, who function as “private IT support” (lines 5–6, and 8); (2) some end-consumers would assume that the video camera symbol enabled them to enter a video archive with instructional videos (lines 19 and 21). Regarding the latter, other end-consumers might think that the video camera symbol enabled them to share their screen with an IT-support function, or perhaps engage in video chat with the customer care department.
This hypothetical, composite conversation also illustrates how the technique of asking “why” mobilizes history by prompting the end-consumers to justify their answers in such a way that experiences transpire (see the answers to lines 4, 7, and 20).

The opportunities to draw conclusions about “making the transition pleasant” were very different after the probing of the end-consumer’s initial answer. In the cited dialogue, the later part of the conversation actually contradicted the first part, as the end-consumer said that she would, in fact, find some of the visually represented support functions useful. Although a composite conversation, similar contradictions did emerge in the end-consumer interactions.

Mediating the dialogues via visual representations was also important in the telephone interviews, although it was accomplished somewhat differently. During the telephone interviews, both the designers and the end-consumers were stationed at a computer. The designers either e-mailed a link or gave the end-consumers the URL so they could enter a website where the trigger material had been published and numbered before the interview. During the end-consumer interaction, the designers asked the end-consumers to open certain numbered pages. The questions concerning these visual representations resembled those asked in the face-to-face interactions.27

In other words, the visual representations were deeply embedded in the end-consumer interactions in order to learn from them and possibly establish common ground between different end-consumer groups (i.e., establishing characteristics in the visual representations that cater to several end-consumer groups).

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27 It was impossible for me to observe any of the answers given by end-consumers during the telephone interviews, as I heard only one side of these dialogues.
8 Findings from the technical design work

Many of the ambiguous situations and many of the activities to negotiate such situations emerged in parallel. However, describing everything in parallel would not only be challenging in terms of writing technique, but would also make for complex reading. Instead, the descriptions of ambiguities are presented first and then followed by a section about the activities to negotiate such ambiguities.

The empirical findings in this chapter are based mainly on the design work undertaken in one studied design project in the Technical Design Consultancy. The project was in many respects typical of the design tasks the Consultancy is hired to undertake. The objective was to design and develop a casing for a chemical product.

The chemical components of the future product were to be partly developed by the client organization in parallel with the Technical Design Consultancy’s project. Moreover, the chemical product was targeting a somewhat new market, which meant that the client organization was unsure about details of the product’s future use and of the conditions under which it would be used. These two aspects meant that certain product requirements were partly settled during the ongoing design work.

Among the product requirements were that the casing should be electrically conductive in some places and insulated in others, and that it should be possible to scale the size of the casing. Both the Consultancy and the client organization considered the specifics of the aesthetics and functionality of the design outcome to be of a sensitive nature, due to intellectual property rights and competitiveness in the industry. Therefore, few details of the product are specified. At times, comparable snapshots from other design projects are cited to exemplify the emergence of ambiguity or the activities to negotiate ambiguities.
8.1 Emergence of ambiguities

The following sections introduce the emergence of ambiguities in the technical design work. The intention is to provide snapshots of the technical design work that illustrate the emergence of ambiguities in the work practice.

8.1.1 Product ambiguity

Product ambiguity—that is, the inability to make univocal interpretations of the product being created—emerged in three prominent ways in the technical design work. First, ambiguity emerged in the objective of the work, i.e., in making interpretations of what to accomplish with the design work. Second, product ambiguity emerged in the technical content of the design work. Third, ambiguity emerged in conflicting product requirements. These three ambiguous situations are elaborated on in the following subsections.

Ambiguity in the objective of design work

Ambiguity emerged in an inability to make unanimous interpretations on how to understand the objective of the design work in terms of a design outcome. Given the newness of the product being created, the design work had few similar products to serve as benchmarks. Although the objective included descriptions of “hard” and “soft” values (i.e., functional and aesthetic ambitions) that the design outcome should meet, the design outcome itself did not exist and was more or less unknown during the design work.

The ambiguity of creating this partly unknown product emerged in that there were few set dimensions to grasp as points of reference. The challenge resided in the many factors that had to be balanced and set against each other.

Part of the ambiguity of creating an unknown design outcome was that the characteristics of the future product were also unknown to the client, which made it challenging to unanimously and clearly predefine them. In other words, the ambiguity of creating the unknown in design work partly transpires in the vagueness of the client’s desires (in relation to the design outcome and objective of practice). As the client learns from tentative
results in the design work, the client’s desires or ability to express them may change.

Ambiguity in the technical content of design work

Ambiguity emerged in an inability to make unanimous interpretations of the technical content in two ways. First, ambiguity regarding the technical content emerged in an inability to make unanimous interpretations of the functional characteristics of the product-to-be. This ambiguous situation transpired, for example, in the product definition in which functional requirements were to be set. Second, ambiguity regarding the technical content emerged in an inability to make unanimous interpretations of the essence of the problem in cases in which a product concept did not function as intended.

The first ambiguous situation, relating to the technical content, that emerged in the technical design work transpired in ongoing efforts to set technical requirements. Such requirements were initially described in what was called a product definition. In the ongoing design work, the described technical requirements were continuously questioned and refined by approaching the product concepts from various perspectives. The design work continuously balanced between, on one hand, having overly vague functional specifications and, on the other, limiting the degrees of freedom regarding the technical content to such an extent that it was overdetermined. More specifically, there was an inability to make unanimous interpretations of whether various technical requirements would contradict one another.

This kind of ambiguity, manifesting in overdetermined or overly vague requirements, did not emerge when the requirements were being established, but later when these requirements were to be met with a functional product concept. In other words, this ambiguity emerged when enough was known about the design outcome characteristics to realize that the particular combination of requirements could not be met in a single product.

In essence, this ambiguity transpired in the discrepancy between the established, materialized proposal for the design outcome (described in the product definition document) and the characteristics of the materialized design outcome (enacted in a prototype or the product itself). This meant that the outcome might be fully functional, but still not meet all the
requirements. It might also be impossible to construct a functional outcome, given that the product definition imposed overly strict requirements.

The second ambiguous situation also transpired in a discrepancy between proposals for the design outcome characteristics and learnings from materializing such product concepts as the technical content was increasingly specified. Such ambiguities might emerge, for example, when making two-dimensional prototypes (e.g., sketches and drawings) or three-dimensional mock-ups (e.g., CAD, scale, or functional prototypes).

In other words, technical ambiguities concerning the function of the future design outcome might emerge already “at the drawing table” or later when testing physical prototypes. These ambiguities transpired in an inability to make unanimous interpretations of why a proposed design outcome did not seem to be functional when translated into and tested as a prototype.

An example of an ambiguity that emerged in relation to the technical content (in another design project at the Consultancy) had to do with a nozzle for a sparkling water maker. The ambiguity arose in the physical tests of a three-dimensional prototype of the sparkling water maker. Before the testing of the prototype, the design work had produced drawings, CAD models, and calculations. However, the technical issue that emerged in the physical testing had not been encountered or foreseen.

Upon testing the prototype, it turned out that the carbonic acid froze when passing through the nozzle, which was not a desired result (the product was to make carbonated water). In this example, there was clearly a technical problem with the product, given that it did not function as intended. This might seem like a minor technical challenge that would be easy to fix. This was not the case, however, as there was an inability to interpret the nature of the technical challenge. Due to little experience of similar problems, it was unknown whether the technical problem resulted from a faulty production technique, inappropriate material choice, inappropriate nozzle dimensions, etc.

Due to this ambiguity, the design work was redirected from almost having produced a finalized product toward how to overcome the problem of the freezing carbonic acid. For example, competitors’ products were dissected for clues and interactions with the client and suppliers were increased. The product development strategist explained that it took three months of
investigative work to conclude that the production technique chosen for the nozzle was to blame for the freezing.

Drilling a hole into a solid piece of material created a very small rim encircling the inside of the nozzle. This rim was enough to interfere with the carbonic acid flow, causing it to freeze. The rim was so small that it was invisible to the naked eye, so the key to identifying the cause of the problem was interactions with experts in production and in carbonic acid properties. The ambiguous situation emerged in that the design team did not know beforehand that the production technique might have such an effect when used for a product interacting with carbonic acid. This stood to blame for the prolonged negotiating activities, since they were investigating many possible contributors to the problem.

In retrospect, it might seem to have been a simple technical issue that was resolved by changing the technique for producing the part. During the ongoing project the situation was ambiguous, however, given that the designers did not know whether the problem was anchored in production technique, material characteristics, the nozzle dimensions, the physical design of the nozzle, etc.

**Ambiguity in prioritizing between dual dimensions of the product**

In the technical design work, ambiguity emerged in the void between two aspects of the product understood as imposing different more or less compatible requirements. Although not fully separable in the ongoing work, these two aspects are often referred to as “hard” and “soft.” The “hard” aspects concern the technical requirements of the product, such as functionality and the technical content of the design outcome. The “soft” aspects, on the other hand, refer to the aesthetic characteristics of the design outcome, as well as usability considerations, such as the value the product should create for the end-user.

These dual requirements were not necessarily discursively specified in formal documents or the like, nor were they defined by the client organization. Rather, the “hard” and “soft” aspects were established in the design work as interpretations were made of end-user needs and the technical content. Throughout the technical design work, these two sets of requirements needed to be compared and prioritized.
One of the consultants was educated in both industrial design and mechanical engineering. He alternates between these roles in various projects, but prefers not to change roles within a single project. The reason for this relates to the different foci of the two roles as guardians of either of the dimensions. That consultant described the difficulty of balancing these dimensions, based on his dual competencies, as follows:

Given that I’ve had the role of engineering designer in this project, *it is more appropriate and better that I work as an engineering designer throughout the project, and that someone else works on the industrial design. It would be more difficult to work as both engineering and industrial designer ... It would be asking for trouble, trying to do both and having two areas of responsibility. I would be in charge of the technical design, making sure everything works and constructing a technical solution. In that, I would bear the primary responsibility for the user and their experience and all these softer values.*

This quotation highlights the different perspectives of the two dimensions and the void that emerges between safeguarding the best interests of both dimensions. The “hard” aspects concern the technical and functional requirements of the product-to-be, while the “soft” aspects instead relate to the users and their experience of the product-to-be.

The following exchange exemplifies such a situation in which the technical design work called for greater attention to the details of the “soft” factors. In the example, the industrial and engineering designer (IED) initiated dialogue with the project manager (PM) during a pulse meeting. In the Technical Design Consultancy, a pulse meeting referred to regular meetings during which the design work participants reported on the latest progress in their work. The IED inferred that it was about time to focus the work on aspects closer to the industrial designer’s responsibility.

In the following example, the IED suggested involving the industrial designer in the work to come (lines 1 and 2). The IED justified this suggestion by describing the kinds of issues they need to work on (lines 2 and 3) as well as posing a rhetorical question (line 4). In line 10, the PM agreed with the suggestion, yet claimed that he was unsure about the timing (lines 10–11). In the PM’s opinion, it was not clear whether the industrial design work phase should be initiated already (lines 11–12), or whether it is up to the client to make the decisions (lines 12–14).
In this dialogue, ambiguity emerged in balancing hard and soft values. This ambiguity transpired in several ways that come through in the assumptions on which the IED and the PM base their talk. The IED and the PM expressed varying opinions about whether it was time to focus on soft aspects, given that they interpret the status of the work on the hard values in different ways. More to the point, the PM suggested that the soft values could be compiled into a few requirements added to the technical solution (lines 15–18), reducing the industrial design work to “looking over” the aesthetics of the product. The IED, on the other hand, talked about the industrial designer’s work as facilitating knowledge creation about the user aspects of the product by moderating “some kind of exercise” (lines 19–22).

The “hard” and “soft” dimensions must not be in conflict with each another, in order for both to be attuned in the design outcome, though they seem to require different ways of approaching the design work. One of the
consultants explained that these two idealized dimensions are focused on optimizing different aspects of the design outcome.

The ambiguity of balancing the “hard” and “soft” values emerged from the conundrum that optimizing the technical content might entail a less-than-optimal user experience. The project manager’s talk during a pulse meeting exemplifies a situation in which such ambiguity emerged. As per the client organization’s request, the design work had been focusing on the technical content of the product for some time. The client had also requested that they continue to focus on the technical content. In relation to this, the project manager verbalized a concern that the then current product concept might not be compatible with “good fixtures,” i.e., a soft aspect that would be advantageous from an end-user perspective: “But that means taking a risk. In the worst case, if it turns out to be difficult to make good fixtures for the [product stack]. [Then] we have painted ourselves into a corner by having a nearly completed solution.” In essence, what the project manager implies, is that if they continue to focus on the hard aspects they might do so at the expense of the soft aspects.

8.1.2 Market ambiguity

The technical design work was also subjected to what the theoretical framework calls market ambiguity. Market ambiguity emerged two ways; (1) in an inability to make interpretations about who the stakeholders were; and (2) in an inability to make unanimous interpretations about the external stakeholders’ demands on the design work.

Ambiguity emerged in having unknown stakeholders

The technical design work was partly undertaken with the stakeholders being partly unknown. The reason for this connected to the complexity of the product being designed: the design work was undertaken with an aim to create a casing for a chemical component that the client organizations was developing in parallel. The combined casing and chemical component was to be sold to companies that produced and sold certain machines. These other companies were to integrate the product into their machines. The machines, in turn, were to be sold onwards to other companies, who would have employees operating the machines.

The chain of companies involved before the casing being design comes into use is quite long. All links in this chain may express varying demands about
the casing, from their specific perspective. For instance, the employees operating the machines might want easy access to the casing for maintenance and repairs. The companies providing the machines might instead desire easy installment and light weight, etc.

The matter of who the stakeholders may be is also complicated further since the chain of stakeholders may not be unanimously interpreted. Given the newness of the chemical component, the future market is unpredictable, new areas of utilizing the chemical component may emerge at any given time. Thus, future users or resellers of the combined chemical component and mechanical casing may act in various industries, develop and distribute different machines and have various demands about the size and functionality of the product.

From such an ambiguous application area of the final design outcome the technical design work was solely tuned to interpreting and constructing stakeholder needs based on the client organization’s perspective. As part of this, the design work included presenting open-ended questions as to how this product could possibly be applied by their future customers etc.

**Ambiguity in changing demands/conditions**

As mentioned previously, the objective of the studied technical design work was to construct a casing for a chemical component. Many of the demands imposed on the product-to-be stemmed from the characteristics of this chemical component. The chemical component was still being tested, verified, and refined by the client organization when the Consultancy initiated the design work for the casing.

Given that the characteristics of the chemical component were still in flux, the design work was subject to changing conditions and demands from the client organization during the work. It is not uncommon for the client and the Consultancy to co-develop a product based on their expertise in different fields. It is often the case that the client is an expert concerning a specific technology, but has less experience in design and NPD work. For example, in the design work project to construct a sparkling water dispenser, the client was a market leader in selling carbonic acid, but had little expertise in developing mechanical products.
The following discussion sheds light on a situation during which the emergence of possibly changing demands from the client organization was noticed by the team.

<table>
<thead>
<tr>
<th>PM:</th>
<th>I have compiled a requirement profile. ... They’ve put numbers on almost everything, which is a bit uncommon. ... We received more concrete prerequisites so to speak. Which is good. Something about pressures, clamping forces, the temperature has gone up, and the outer dimensions…</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED:</td>
<td>... have been reduced?</td>
</tr>
<tr>
<td>PM:</td>
<td>Yes, slightly. And what is somewhat new is this clamping force during assembly …</td>
</tr>
<tr>
<td>IED:</td>
<td>What clamping force?</td>
</tr>
<tr>
<td>PM:</td>
<td>Well, I mean, one compresses the entire stack [with this clamping force].</td>
</tr>
<tr>
<td>IED:</td>
<td>Yes, but we have an endpoint. You don’t press with a certain force, but until a certain height [at which the endpoint is reached].</td>
</tr>
<tr>
<td>PM:</td>
<td>In [concept Z]?</td>
</tr>
<tr>
<td>IED:</td>
<td>Yes …</td>
</tr>
<tr>
<td>…</td>
<td></td>
</tr>
<tr>
<td>IED:</td>
<td>One can interpret it in different ways, but I claim that we are going to compress everything to a height of [X] millimeters, right? And then the force will be [Y] kilos per square centimeter.</td>
</tr>
<tr>
<td>ED:</td>
<td>True, if you press more it will be [different].</td>
</tr>
<tr>
<td>IED:</td>
<td>It is this [X millimeters] that we are controlling, we can’t say that we are pressing with a certain force.</td>
</tr>
<tr>
<td>ED:</td>
<td>No.</td>
</tr>
<tr>
<td>IED:</td>
<td>Right?</td>
</tr>
<tr>
<td>PM:</td>
<td>I think one should interpret these [i.e., the requirements] like this [a clamping force]. We will have to ask about this actually. … What they are really [after].</td>
</tr>
</tbody>
</table>

In this case, the change transpired when the team was talking about the unit for measuring clamping force (lines 7–14). This discussion exemplifies
the emergence of an inability to make a unanimous interpretation of the client organization’s demand.

The project manager (PM) described the new, more detailed demands from the client organization (lines 3–5), from which dialogue involving the industrial and engineering designer (IED) as well as one of the engineering designers (ED) emerged.

This discussion of how to measure the pressure exerted on a stack might not seem to make any crucial difference. For the objective of constructing a new product, however, such a difference may play a crucial role in how the design outcome is aesthetically and functionally created. The client’s answer to the question that the PM poses (lines 26–28) could potentially have serious consequences for the design outcome.28

This conversation not only addresses how conditions may change, but also gives an indication as to how such issues were initially handled. The PM implied that they must interact with the client to ask about the specifics of the demands (lines 27–28), to understand the underlying need that the client intended this requirement to fulfill.

8.1.3 Process ambiguity

Examples of situations subject to process ambiguity—that is, an inability to make unanimous interpretations of the work activities—also emerged in the technical design work. One ambiguous situation in particular stood out as it led to a “Catch 22.” This ambiguous situation regarding the starting conditions is described in detail in the following subsection. The description is not based on the studied technical design work, but on interviews about other design work projects. This kind of process ambiguity seems to have been common in many previous design work projects.

Ambiguity in the starting conditions of the design work

The starting conditions of technical design work are often ambiguous, as there is an inability to make unanimous interpretations of what tasks to perform. More specifically, this ambiguous situation emerged in relation

28 Pressing until a certain distance (lines 18–20) implies that the distance will always be the same, but the force may differ. Pressing until a certain force (line 11–12) implies that the distance (and as such the size of the stack) may differ.
to the kind of knowledge-creating activities to be undertaken. The Consultancy organization prefers to start with what is called a prestudy project, during which they analyze business-related aspects, such as the potential of the intended market.

The sought-after kinds of contracts, i.e., business-focused product development projects, theoretically include a prestudy during which the business-focused aspects are analyzed and a product definition is settled. Such a prestudy project may last up to three months. The consultants considered the prestudy crucial to constructing what they call “successful” products, that is, making products that take account of business aspects such as market opportunity. It is during the prestudy that the consultants analyze and learn about competitors’ products and market trends and hypothesize about likely technical challenges.

In this an ambiguity emerged, even before initiating the design work: The consultants’ experiences inform them of the value of the prestudy, and the Consultancy must convince the client of the need for this quite long, and thus costly, prestudy phase.

Given that the prestudy phase has yet to be performed, the consultants cannot base their arguments on the kind of learning the prestudy phase will support. More to the point, they often cannot cite examples of previous prestudy projects to which the client can relate, because previous clients often include a professional secrecy clause. The ambiguity thus results in a “Catch 22” given that the value of such a study is primarily conveyed in retrospect, although the convincing to undertake one must be done beforehand.

### 8.2 Negotiating activities

The following subsections describe the negotiating activities in the technical design work. Here snapshots of situations that illuminate specific activities are provided, rather than presenting a storyline that follows the ongoing design work.

The various activities are categorized into four overarching groups: (1) constructing points of reference, (2) mediating between perspectives, (3) grounding in experience, and (4) disarming future resistance.
8.2.1 Continuously constructing points of reference

Some negotiating activities constructed points of reference, which should not be understood as set in stone. Rather, the reference points materialize interpretations and hypotheses about the product-to-be that will be questioned and evaluated in the ongoing design work. However, the points of reference do provide some tentative stability for the design work.

In the studied technical design work, points of reference were constructed in three main ways: (1) limiting the degrees of freedom, (2) offering interpretations of the product-to-be, and (3) producing a language. These are described in the following subsections.

Limiting the degrees of freedom: the contract and the product definition as points of reference

Before the design work began, a contract and specifications were established between the Consultancy and the contact persons in the client organization. The activities involved in formulating the contract were not addressed in this research, because the sales process was neither undertaken by the same individuals who later undertook the technical design work nor was it done during the collection of empirical data. One could of course argue that the sales process is a kind of knowing-work. In this research, however, it is considered a distinct kind of work, with possibly different challenges and ambiguous situations from those of design work. Although the sales activities are not considered, the contract is included as a material artifact that set the stage for the design work and mediated the ongoing work.

Part of formulating a contract is to specify both the delimitations and what is to be done, jointly with the client. The contract with the client includes three parts that limit the degrees of freedom by triangulating the design work project to be executed: (1) descriptions of organizational resources to be used during the work (in terms of financial and human resources); (2) definition of the market to target (in terms of end-consumer groupings, timing of launch, sales price, etc.); and (3) definition of the product to be constructed (in terms of its performance, cost of production, etc.).

The first part of a contract with a client specifies the consultants’ hours and the financial resources budgeted for the undertaking. The planned resource consumption is based on estimates of the extent of the work to be
done. These estimates may be changed during the progress of the work due to the ambiguous nature of planning known-work. These estimates enable the Consultancy and clients to share an understanding of the approximate need for resources. This first part of a contract might reduce the emergence of ambiguities pertaining to organizational resources during the subsequent design project. This part of a contract is outside the scope of this research, however, as it does not specifically relate to ambiguities emerging in the design work but rather relates to the management of the project.

The second part of the contract, i.e., the definition of market segments to target, is formulated in cooperation between a Consultancy manager and client representative(s). The targeted market segments are specified to define the kinds of end-consumers who are hoped will find value in the product-to-be. This is defined along the lines of criteria such as the target price of the product on the market, when and where the product should be sold, as well as who the typical end-consumer will be.

The third part of the contract, i.e., the definition of the product-to-be (in terms of its performance), reflects a special take on how to describe a product’s performance before the product has been created. The product development strategist said that it is commonplace in the professional practice of design and new product development work to create technical specifications. Such specifications include the product’s characteristics described in both technical terms and absolute values.

The studied Consultancy instead establishes what it calls a product definition together with the client. In this definition, the desired product performance is jointly defined, but without specifying too many technical details. The product definition is based on an analysis of the potential opportunities and drawbacks that the intended product may encounter.

Although the client might decline a lengthy prestudy project, at least a minor investigation into the nature of the product-to-be is conducted when making specifications and delimitations in the contract. Such an investigation is often undertaken by the product development strategist jointly with a project manager and one or more design consultants.

The project manager and the design consultant(s) engaged in the early investigation often participate in the design work once the contract is agreed to. The product development strategist said that such an
arrangement is beneficial in terms of bridging the experiences from the early investigation into the design work. The investigative activities include analyzing and dissecting competing products to learn about materials, production techniques, technical components, etc., and analyzing the client organization’s demands to learn about their competencies and how the product-to-be could fit into existing product ranges.

Based on this early investigation, the consultants define critical business factors and the intended product’s future market potential, as well as evaluate whether the product-to-be addresses both the client organization’s and the end-consumers’ demands and desires. Specifying targeted market segments precedes the manifestation of market-related ambiguities in the design work. This means that some of the degrees of freedom related to ambiguities of market opportunities may be kept from even emerging in the subsequent design work.

The product development strategist described how all this gathered and analyzed material helped them define a window of opportunity including an assumed market and market size, a pricing strategy, and key characteristics of the product-to-be settled on with the client. This window of opportunity becomes the objective of the design practice, and specifies what the design work should fulfill. The product development strategist considers the specifications of the window of opportunity critical for the successful development of the product-to-be.

They avoid setting too many or too detailed requirements, since having an overdetermined set of requirements to design for creates an inability to interpret how to attune the conflicting requirements.

Benchmarking the design work’s technical progress against strict technical specifications may lead to an excessive technical focus and to sub-optimization based on technical considerations. The product definition, in contrast, summarizes the key characteristics of the intended product in terms of performance, while specifying little technical functionality. This definition therefore sustains ambiguity regarding the specific technical characteristics of the intended outcome, while aiming at avoiding an ambiguous objective, or at least reducing the number of possible interpretations of an equivocal objective.

In other words, the design contract specified during the sales work and the early investigative work sets the stage for the design work to come. This is
done in such a way that the degrees of freedom are limited to create some initial points of reference. In particular, the second part of the contract, i.e., the product definition, continuously mediates the ongoing design work.

Although the sales work is not covered in this research, some of the activities involved in setting up a contract may be considered part of the design work. Moreover, the outcome of such work (i.e., the contract) is involved in the design work as a material artifact that mediates the work.

The design work activities for limiting the degrees of freedom when setting up a contract (e.g., dissecting competing products and learning about the client organization) are involved in negotiating the multiplicity of interpretations on the characteristics that the product-to-be could have, and the demands that might be imposed on the design outcome. In other words, product and market ambiguities are negotiated by limiting the degrees of freedom.

**Offering interpretations of the product-to-be: points of reference in flux**

During the ongoing design work, the product definition is not seen as a static description of requirements, but rather as a moving target subjected to evaluation, reconsideration, and continuous negotiation. As such, the product definition serves as both a symbolic and material artifact that mediates the knowledge-creation activities during the ongoing design work.

As the designers learn by creating knowledge during the design work, the product definition is continuously challenged and at times revised. In other words, the product definition is established as a point of reference enacted in a document that mediates the design work. Simultaneously, the knowledge-creating activities during the design work mediate the content and interpretations of the product definition.

Any contradictions to what was established in the contract, or any doubts as to the implications of the contract, call for interaction with the consultant manager, client contact person, and possibly others. Doubts about implications of the contract can, for example, stem from ambiguous formulations that may give rise to multiple interpretations or stem from the ongoing nature of the work, which makes it appear that something
specified in the contract does not quite apply to the emerging product-to-be in the design work.

One of the engineering designers mentioned that during the ongoing design work, for example, when physically testing a three-dimensional model, they may learn that “this [solution] doesn’t work because it is electrically conductive.” Such a finding may not only cause setbacks in the ongoing design work, but may also instigate negotiations of how to interpret the product definition, for example, if the product definition specifies a certain material or material cost consistent with the electrically conductive material.

It is not only the product definition that functions as a point of reference in constant flux, however. As the product concepts emerge and become more detailed in the work, these concepts become points of reference in the work that further ideas or suggestions for changes may be attuned to or diversified from.

The following exchange presents an example of a chicken versus egg dilemma embedded in the work (line 19). The paradox was anchored in that certain estimates were needed from a supplier in order to set the requirements for a part provided by the supplier. Simultaneously, the supplier needed to know these requirements in order to provide the estimates. The cited dialogue conveys not only the dilemma, but also how emerging conditions were negotiated by treating all interim results (e.g., product concepts and prototypes) as reference points open to discussion and alternative interpretations. The dialogue was initiated by the industrial and engineering designer (IED), and unfolded in unison with the project manager (PM).

The discussion was initiated by the IED questioning whether they should contact the supplier yet again (line 1) to ask whether they could get an estimate of the solidity of a component (lines 2–4). The PM answered (lines 5–8 and 11–13) from the supplier’s perspective by theorizing about why it would likely be difficult for the supplier to give such an estimate.
Throughout this dialogue, the need to combine forces with the supplier emerged. From the IED and the PM’s talk it was evident that they had to create knowledge of the design outcome jointly with the supplier. Or rather, the IED and the PM’s talk mirrored that the supplier could not give an estimate without the requirement specifications from the design work, and the designer could not create requirement specifications without the estimates from the supplier. This “Catch 22” is well summarized by the PM as “this chicken versus egg [dilemma]” (line 17).

**Producing a language: vocabulary as a point of reference**

In the ongoing design work, a language for speaking about the characteristics of the partly unknown future product was emerging. In dialogues, the team members constructed various new, or borrowed existing, words and expressions to communicate with one another. In essence, they were producing a language in order to speak about the more or less unknown design outcome.
This new language came through in the dialogues between team members and in their use of tentative language followed by expressions such as “so to speak” etc. These implicit strategies may be summarized into four approaches.

First, “Swenglish” expressions were created based on loanwords from English (although the working language is Swedish) combined with Swedish. For example, in the design work, the word “stacken” was used to refer to a stack of plates that was part of the product being designed. “Stacken” represents a combination of Swedish and English in which the English word “stack” is used with the Swedish suffix “en,” which acts as the definite article.29

All the design consultants were fluent in both Swedish and English, so words merging the two languages were understood by all team members. As such, “stacken” became an established word within the group. In this example, the word was constructed to refer to a part of the product for which there was no established term.

Second, the dialogues were fueled by the use of metaphoric language to capture the elusive nature of what was being discussed. For example, the project manager referred to a can of sardines at one time, likening the risk of excessively increasing the internal pressure in the product to over-pack a can of sardines.

The problem of over-packing a sardine can had been used metaphorically before, which was why the project manager could understandably use it in a question (line 4). The metaphor was used to summarize what one of the engineering designers (ED) had just said (lines 1–3) and to question whether the project manager (PM) had understood it correctly.

29 The native Swedish speaker may object that “stacken” is also a Swedish word meaning “the anthill” or “the heap.” The product-to-be had nothing to do with either anthills or heaps, however. The team constructed the word as described, merging Swedish and English, to refer to a stack of plates that does not have an equivalent word in Swedish.
Third, the design work produced a language used continuously for labeling the conceptual ideas representing various possible design outcomes. At times these labels were only based on numbering the various concepts and at other times they had more to do with the basic ideas on which the concepts were based.

Fourth, discussions were at times summarized in short expressions or single words on which the team agreed. For example, in summarizing a dialogue about the possibility of rotating the product casing 90 degrees, the project manager said: “I’ll write ‘lying on the side,’ do we understand what we mean by that?”

As implied by the above examples, producing a language was a continuous activity that mainly negotiated the product ambiguity by devising a vocabulary for the unknown, future product. The emerging vocabulary became a way of communicating about a product that did not yet exist, by reducing the possibilities for making multiple interpretations of what was being said.

8.2.2 Mediating between perspectives

A common denominator among some activities was that they in one way or another negotiated ambiguity by mediating between various perspectives. The various perspectives were approached as possibly opposing one another, such as end-users versus clients or aesthetics versus functionality. The negotiating activities to mediate between perspectives included dialoguing by taking turns in proposing arguments, balancing an emphasis on one perspective with a later focus on the other perspective.

In the technical design work, perspectives were mediated in three main ways: (1) dialoguing between “hard” and “soft” aspects; (2) balancing aesthetics and functionality; and (3) unifying perspectives. These three negotiating activities are described in the following subsections.

**Dialoguing between “hard” and “soft” aspects: taking turns in proposing arguments**

The design consultants mentioned multiple times that a substantial issue in their work was balancing what they called “hard” and “soft” factors, the former being considerations regarding the technical content and functionality of the product, the latter relating to usage considerations and
aesthetic dimensions. The consultants defined the “hard” aspects as the engineering designers’ responsibility, while the industrial designers were responsible for the “soft” aspects.

Technical design work is often initiated by an industrial designer creating a product identity for the outcome to be constructed. This product identity is a representation of the specifications set forth in the contract. The industrial designer interprets the product definition and the market to be targeted and then creates an image of the future outcome. This image can be communicated both through visual representations (e.g., sketches and the like) as well as through descriptions and metaphors (e.g., bright sunlit colors to create a sense of freshness).

For example, in designing a sparkling water dispenser, the intended market segment might be “normal” wage earners. The industrial designer may infer that the sparkling water dispenser should fit in a mid-sized, modern kitchen not much older than seven years. This has implications for the visual design aspects of the outcome in terms of style (e.g., it should look neither cheap nor like a luxury product) and product usage (e.g., it should be dishwasher safe and fit in a standard dishwasher).

Such “soft” aspects must be weighed against “hard” aspects that might be requirements in the product definition. These “hard” aspects instead define such things as the product’s lifetime (e.g., be useable 2000 times or for three years) and price, and matters such as production technique and number of parts (e.g., many small parts are more expensive to assemble than are fewer and larger parts).

As the engineering design work went on, the industrial designer was regularly (but not continuously) integrated into the work to ensure that the product identity was followed and that the basic ideas of the design outcome’s style were retained. The industrial designer also participated in the final parts of the work, making the finishing touches and ensuring that the outcome was useable (e.g., adding handles and changing/adding soft material to top layers for comfortable use).

The integration of industrial designers into the technical design work was achieved on an as-needed basis determined by the then current participants in the design work. Because the industrial designers were integrated into the work at regular intervals, but not continuously, voids emerged in their awareness and understanding of the progress and content
of the design work. Consequently, the industrial designers asked questions in order to understand what had been happening in the engineering design work between their own episodes of participation.

The following dialogue occurred between the industrial designer (ID) and the industrial and engineering designer (IED) during a work meeting to prepare for a joint workshop with the client to be held the next day. The purpose of this workshop was to hold a dialogue with the client to learn about how the product was to be used by the client’s end-users. The client was more knowledgeable about such matters, given that they had met with end-users to discuss their interest in using the product. The ID would be leading and moderating the talk during the workshop. During the preparatory meeting, the industrial designer posed some questions to the other team members (lines 1–4) in order to understand what had been done in the project up until that time.

In this dialogue, the balance between hard and soft values emerges. The ID referred to soft factors, such as usage and handling, in the question expressed in line 1–2 and in the clarifications in lines 2–4. The IED replied that the focus on these (soft) factors had been weak (lines 5 and 9–10), qualifying this by describing the focus on hard factors, i.e., making the product functional (line 6–7). The making of a functional product was also clarified in terms of what this implied in the current project, i.e., making it airtight and handling the cooling (line 8).

1  ID: How much have you discussed these questions earlier in the project? I mean, this [matter] of the carrying handle has been discussed a few times, and ehm … fastenings and such things [have been discussed].
2  IED: Very little really. [...] Way too little actually, I would say. Because the project has been about making the [product] functional, and finding a technical solution to this [module], to make it airtight, to handle the cooling etcetera. And all these other functions [carrying handle, fastening, etc.] therefore had to take a back seat.
3  ID: Mm.
4  IED: And now it’s the real deal and we must solve all of these functionalities.
Between and during the industrial design work insertions in the technical design work, the engineering design work was undertaken to construct the technical design, which constituted most of the work. The reasoning was that the technical design was top priority, given that the “product must be functional.” The project manager theorized about this as follows: “So this was put aside, in order to prioritize the [product’s] function. And that is important, I mean that’s number one, to get the [product] to work so that the investors see that there is a basic design at the very least, that one may develop further.”

Throughout the ongoing design work, there was a continuous balancing act to do justice to both the hard and soft values. The design consultant with both an industrial design and engineering design background (IED) theorized about the possibility, or rather difficulty, of assuming both roles within a single project in the following comment about practice: “The dialogue is important. ... If one is to assume both roles one must be able to alternate somehow—‘Now I’m an industrial designer and think like this’ and ‘Now I’m an engineering designer and do like this.’ More to the point, if one is going to have a dialogue, one will have a dialogue with oneself.”

In the next quotation, the IED described the importance of dialogue and how it could be a way to balance the values represented by the industrial and the engineering designers. The IED continued, describing the interplay between hard and soft values as follows: “You could get in your own way, because you want to make as good a product as possible. On one hand, you want to find a route to a possible technical solution. On the other, you want to find a good design direction. Therefore, you could obstruct the design by thinking that ‘I also have to find a technical solution [for this].’ Then you consider these matters in parallel.”

From this comment about the difficulty of assuming both roles in parallel, one may infer the importance of the collective and of being able to have dialogues during which different individuals represent and advocate different perspectives (i.e., hard and soft values). The IED also described how it might in fact be suitable to have both competencies in smaller projects, increasing the efficiency and making it possible to include fewer consultants who all need time to become attuned to the purpose of the project.

Dialoguing as a design work activity is important for mediating the robustness of the balance between the hard and soft characteristics of the
design outcome. The design work participants engage in dialogue in order to gauge the anchoring of a characteristic, to determine whether something is set in stone or up for discussion. In taking turns proposing design outcome characteristics, based on alternately hard and soft aspects, the ambiguity of prioritizing between dual product dimensions is negotiated.

**Balancing aesthetics and functionality: artifacts as mediators**

The aesthetics and functionality of the product-to-be were continuously balanced by alternately focusing on one or the other. The dimension currently not in focus set the stage for the work, as they were treated as delimiting the dimension currently under scrutiny. Early on, the industrial designer analyzed user needs and created an aesthetic profile of the product-to-be. The design work continued with more extensive attention to the technical content, by prototyping, calculating, making drawings, testing, and the like. The industrial designer regularly intervened, however, to benchmark the emergence of the product in line with the aesthetic profile. This turn-taking became a way of negotiating the two dimensions.

Much of the technical design work entailed the integration of visual representations to handle the interplay and trade-off between aesthetics and functionality. The following dialogue illustrates talk in practice between the industrial designer (ID), industrial and engineering designer (IED), and the project manager (PM). The example is drawn from the same working meeting as the two previous quoted dialogues. The ID, IED, and PM were preparing for the workshop to be held with the client the following day. They discussed the possibility of using visual representations in the workshop to mediate the discussions.

The ID initiated the conversation by asking whether it would be possible to obtain a visual representation to use in the workshop (line 1). The ID did not ask for just any visual representation; rather, it is evident from his choice of words that he would prefer a physical, three-dimensional representation. The project manager tried to figure out what kind of physical representation would be suitable by posing questions (lines 2 and 4).

From this conversation one may infer that the ID did not really know what physical representation he was after (lines 4 and 7). This uncertainty stemmed from that he did not know what physical representations were available to choose from, even though he knew how he would like to use
them (lines 10–13). Simultaneously, the PM probed which of the physical representations the ID would prefer (lines 2–3, 5–6, and 15–17), without really describing the alternatives.

This discrepancy between their understandings did not seem to stem from mistrust, but rather from differences in experience. The PM knew more than did the ID about the current status of the material artifacts. The IED, used to assuming the role of either industrial designer or engineering
designer, mediated the conversation (lines 8–9) by bridging the gap between their pre-understandings, clarifying that the design model and prototype are quite similar. During the dialogue, the PM, ID, and IED constructed a shared view of what the physical representation should be used for: this three-dimensional material artifact should mediate the discussions between the hard and soft aspects, doing so by offering a common reference point that could be shown, felt, touched, pointed to, and lifted.

The hard aspects were already partly or fully embedded in the physical prototype, while the soft aspects were to be introduced yet again. The inclusion of the soft aspects implied changes in the hard aspects. Likewise, the already established hard aspects could impose delimitations on the softer aspects, i.e., in terms of usage. These and other aspects gave rise to challenges that in essence anchored in the ambiguity of creating something unknown.

**Unifying perspectives**

The design work unified perspectives with the client organization during the ongoing practice. The following dialogue conveys how to achieve a unified perspective with the client. During the discussion, the industrial and engineering designer (IED) and the project manager (PM) advocated two activities to unify their perspective with that of the client organization.

The dialogue occurred during a pulse meeting, when the team was planning the work to come. In this example, the subject matter concerned how the product should be handled by the end-users. Before this dialogue, the PM had just suggested asking the client to “think it through” and prepare to report on their view of the matter.

In this conversation, the IED and PM discussed different requirements that the product identity and usage aspects were thought to impose on the work. In particular, they discussed how the industrial designer (ID) should go about unifying these aspects. The PM considered the product identity to be in line with the user aspects (line 23). The IED, on the other hand, believed that these aspects could differ and that it was during the design work that they would become unified (lines 24–29).

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30 Such pre-understanding might also be assumed to anchor in different educational backgrounds, into which the IED had insights into both of the others’ educations due to his own double degree.
In this passage, the IED subtly expressed the advantages of creating knowledge in unison with the client (lines 1 and 3–6). The IED’s stance, as he theorized about the work to come, was that perspectives were best unified by conducting joint work activities (lines 3–6). The IED expressed this in response to the PM’s suggestion to ask the client to prepare a
In essence, the PM’s suggestion was that the client should be asked to report on how they perceived the product’s intended use. Such one-directional reporting was disputed by the IED, as he thought that the consultants and the client would be more likely to achieve a “good” result by arranging some kind of “exercise.” In such an exercise, assumptions about how the product would likely be used would emerge in interaction between the consultants and the client representatives.

The PM agreed with the IED, and went on to mention a workshop (lines 7–12). Simultaneously, he suggested that the client should prepare by thinking things through beforehand (lines 8–10). They both agreed that the industrial designer should lead such a workshop (lines 11–13).

A friendly dispute then emerged. The PM believed that the workshop about the handling and usage aspects of the product should be based on the product identity (line 14), understood as the industrial designer’s previous interpretation of the product definition. The IED, on the other hand, believed that the workshop should be based solely on usage and handling from an end-user perspective (line 15–16). To bolster the argument, the IED presented several questions that such a perspective could address (lines 16–18 and 20). The PM thought that these two perspectives should be the same (line 23), while the IED cited the risk of ambiguity emerging in the void between the two perspectives (lines 24–26).

From the IED’s comments one may infer that the product definition included claims that the outcome should be easy to use (line 27). The product definition and usage aspects did not seem contradictory regarding that matter. The product definition included more aspects than just being easy to use, however. Combining certain functionality requirements with how the end-users would want to handle the product could be ambiguous. In this situation, it was also unclear how to make the product “easy to use,” so the purpose of the workshop was to learn how to do so. In essence, the IED’s argument was that an industrial design job done well should negotiate between the two sets of requirements (lines 24–29) enacted in the product definition and emerging in the usability workshop.
8.2.3 Anchoring in expertise

One way of negotiating ambiguity in the design work seemed to be to anchor discussions, opinions, and trade-offs between experience and expertise. It was mainly the more senior design consultants who were asked for and who made comments grounded in prior experience. This kind of negotiating activity mainly transpired in the design consultants’ talk, as they spoke from experience. A second way of anchoring the technical design work in expertise was to invite stakeholders and borrow their expertise.

Speaking from experience

The design work was continuously mediated by eliciting experience. The activity of speaking from experience mediated making considerations in dialogue, by weighing various factors, especially when there was no clear either/or decision to be made, but rather considering a range of alternatives.

The following excerpt from a work meeting illustrates several actions taken to address technical challenges. The technical challenge in this excerpt was anchored in making trade-offs between the aim of making a certain product component as small as possible, while having it withstand an unspecified amount of external force.

The designers elicited experience, and the project manager created a hypothetical future, by citing examples of possible solutions (lines 14–15) to a technical challenge and encouraging the others to react to such a hypothesis.

This dialogue is largely embedded in knowing-work, making it challenging for an outsider to follow. The participants were discussing the interconnectedness between a manufacturing technique (die-casting, line 4) and the component dimensions in a specific product concept (the dimensions of the “gas-check bands,” lines 4–5).

The project manager (PM) asked how a specific part of the work was progressing (lines 1–2). This question was posed to the industrial and engineering designer (IED), the most seasoned technical designer in the team. Specifically, the PM sought the IED’s opinion about the latest progress of the design work and the choice of production technique connected to the concept (lines 6 and 14–17).
The IED answered by referring to a combination of production technique and a component of the product being designed, namely, the gas-check bands (lines 3–5). The IED’s talk was mediated by experience, which comes through in the expressions used, for example: “I would like them [i.e., the gas-check bands] to be” (lines 4–5), “I don’t see it as a problem if” (lines 12–13), and “I don’t think you will” (line 19). All these expressions may be seen as referring to previous experiences expressed in the present but intended to construct the future.

In the cited dialogue, another theme for handling technical challenges emerged: the participants discussed designing within a margin of error (line 9) and in what parts of the outcome such margins are tolerable (lines 7–11 and 12–13) or not (line 11–12). The IED claimed that there would be some margin of error (lines 7–8), which one of the engineering designers (ED) thought that the client would have to accept (line 9). On the other hand, the IED claimed that part of the design outcome (i.e., “solution X”)
could not be offset by even half a millimeter, given that it concerned gas seals (lines 11–12) and that a leak might result.

Ambiguity was even more clearly negotiated and reduced when experiences concerning the characteristics of various production techniques were combined with experiences concerning stress and strain resistance and material properties. The clearest example of this is perhaps the IED’s comment that “if we are going to die-cast these, then ... I would like the gas-check bands to be three millimeters thick” (line 3–5).

In this quotation, the IED anchored his argument regarding a particular dimension (which in turn took account of stress and strain resistance, as opposed to the limited physical space for the casing) in consideration of the production technique. This quotation illustrates the detailed knowing-in-practice that goes into speaking from experience.

Although complex considerations were being made, few “hard facts” were cited to bolster the arguments about the dimensions of the product. These dimensions would affect both the physical size of the casing (which ideally should be as small as possible) and its resistance to the force exerted by the internal gas pressure (the resistance should ideally be as large as possible).

As the design work participants were speaking from experience, they were mediating the ambiguity of equivocal alternatives in the technical content. The numerous alternatives available when choosing from a range of possibilities were somewhat reduced, as they knew from experience what alternatives were more or less plausible.

**Inviting stakeholders: borrowing expertise**

The design work was continuously mediated by the work of other stakeholders, including the client organization, suppliers, and technical experts. Some of these, such as the various technical experts, were hired to carry out computations about the loads, stress endurance, etc., of a conceptual product. Other stakeholders, such as the client organization or materials suppliers, often participated in the knowledge-creating activities in the work, i.e., discussions of the feasibility of various material choices for the product-to-be.

Stakeholders were continuously invited to participate in the design work. The invited stakeholders were both users and business partners, such as the client organization and material suppliers. Decisions as to what
stakeholders to involve were made based on the expertise needed at the time. In other words, inviting stakeholder input was an alternative to hiring expertise in all needed areas in the relatively small Consultancy. In interaction with stakeholders, the product concept could be refined or verified without having all the expertise in-house or having to learn all the peculiarities of the chosen production technique, etc.

In the studied project, the client was still developing the chemical component for which the design work was to construct a casing. The Technical Design Consultancy is usually contracted to design products for mass production, which has implications for making changes during the work. During the design work, the designers continuously worked with suppliers that, for example, provided tools for mass production or molds for casting components. The suppliers contributed to the knowledge-creating activities by providing expertise on production and assembly. This way of inviting stakeholders and “borrowing” their expertise was a way of negotiating product ambiguity. By interacting with stakeholders, the design work participants negotiated their inability to make unanimous interpretations of the product concept, functional requirements, and price, as well as the technologies involved in its production.

The following excerpt from a pulsed meeting is a dialogue between the project manager (PM) and industrial and engineering designer (IED) in which they were discussing the next week’s work and how their design work was contingent on the client’s progress.

Already in lines 1–2 it is obvious that the design work was integrated with the work of others, in this case, the client’s testing of a product concept, “Solution X,” that might be part of the final design outcome. The design work was awaiting client tests in order to be continued. Several work activities needed to be done to change or improve the concept being tested, but doing so might waste time and resources if the client tests did not provide positive results. The excerpt also illustrates the continuous integration of the client into the work (lines 15–18). What was being done, and when, was continuously checked with the client contact person.

This was partly so that the client could control the costs, given that they were invoiced per hour. Another reason was to learn early on about changes in requirements so that any new information could be integrated as early as possible. For example, the client’s tests might impose certain new or changed requirements that the designers must take into account.
This example also clearly illustrates how material aspects mediated the work. During testing, the materials and their properties “talk back,” presenting new situations in the design work that might impose changes or bolster prior decisions.

The entwinement with the client also comes through in the following excerpt. The dialogue presented below is drawn from a pulse meeting. This discussion concerned inviting a supplier to a meeting initially planned to include the consultants and the representatives from the client organization. One of the engineering designers (ED2) talked about his work, highlighting the importance of getting “the right competences” from the supply organization to participate in the meeting (lines 7–8).

This statement (lines 7–8), echoed by the IED (line 9), reflected a desire to communicate with suppliers so that collective knowing about the materials in the product could be created in unison with the supplier (line 1, and 3–6). The suppliers were production and assembly experts, while the consultants were experts in design work. The intention of the meeting was
to communicate regarding choices of material and production techniques, based on the various areas of expertise.

| 1 | PM: *We must simply prepare for a material discussion.* |
| 2 | ED1: *But that is if [the supplier] is able to come.* |
| 3 | PM: *Yes, because it will also take time from our meeting, so to speak. ... Otherwise, one could plan for a separate production and assembly review. For instance, at the [supplier's] office, a few days later.* |
| 4 | ED2: *Maybe that's our best shot, so we get the right competences from the [supplier].* |
| 5 | IED: *Yes, that's important.* |
| 6 | ED2: *That we have the meeting in their office, because that is central.* |
| 7 | PM: *Yes, I can discuss it with [the client]. Then we'll see what they say about it.* |

What is also evident in the above dialogue is that, although the discussed meeting was to be scheduled with a supplier, the client would still be informed about what is going on (lines 12–13). This reflected an explicit strategy of the Technical Design Consultancy to assign ownership to the client and continuously integrate them into the work, not just during steering committee meetings.

### 8.2.4 Disarming future resistance

The fourth main way of negotiating ambiguity in the design work was to disarm future resistance by anticipating trouble. Of course, a problem with ambiguity is that it is unpredictable and cannot be prevented. Yet based on experience, the design consultants knew that changes are often needed and inabilities to make unanimous interpretations of the technical content were likely to emerge. Negotiating activities intended to cause ambiguities concerning the technical content to emerge sooner rather than later were included in the design work. Moreover, as a precaution, the client organization was continuously assigned ownership by being integrated into strategically important decisions. Doing so was to ensure that the
client representatives shared responsibility in case changes had to be made.

The negotiating activities intended to disarm future resistance have been clustered into two categories in this research: those (1) continuously assigning ownership and those (2) “looking for trouble.”

**Continuously assigning ownership**

Although client representatives were invited to participate in the design work at regular intervals, they did not continuously participate in the knowledge-creating activities to produce a design outcome. The client organization was assigned a prominent role throughout the project, however.

In the ongoing work practice, the client always made all strategically important decisions. Many of the consultants justified this outspoken strategy by arguing that it ensured that the client representatives would feel committed to the final design outcome by perceiving a sense of ownership of the final product. In other words, in the design work, the consultants were assigning ownership of the design outcome to the client representatives, also during its creation.

One of the engineering designers said, “We have ongoing follow-ups with the client.” He continued, explaining what they do to integrate the client representatives into the decision making in the design work: “We often make recommendations and are in the habit of always having multiple concepts. ... One should not choose on behalf of the client, but present all the facts necessary for the client to choose.”

An advantage of assigning ownership to the client was that it facilitated making changes. As one project manager put it, such changes might occur in response to the client’s emerging demands: “We try to be flexible and responsive to the client’s perspective throughout our projects.” The need for changes could also emerge from learning in the knowledge-creating activities during the ongoing design work. Regardless of the reason for making changes, the client representatives were not only familiar with previous decisions but also shared responsibility for potential misjudgments. Moreover, regular integration of the client made them familiar with the continuous becoming of the product-to-be and better able to understand the necessity of making changes.
The management team considered it advantageous to price the projects per hour, for both themselves and their clients. This pricing strategy incentivized the Technical Design Consultancy to do a thorough job on behalf of the client: if an unforeseen problem arose, for example, it would be in the best interest of the Consultancy team to inform the client about the issues. With a fixed pricing strategy, hiding the problem or solving it with the least possible effort instead of setting aside time to solve it thoroughly would instead be incentivized. One project manager described it as his duty to alert the client to any unforeseen issues and setbacks so that they may decide what actions to take in unison. Such an approach also favored the clients, who were continuously involved and could therefore ensure that the outcome was high in quality and fitted with their existing strategies and product range.

Assigning ownership to the client also entailed limitations, as the client had the final say on all strategic decisions. Clients do not usually have specific expertise in technical design work (which is why they hire the technical design consultants to do the design work in the first place), but despite this, make all strategically important decisions. As previously mentioned, however, the consultants try to “present all the facts necessary for the client to choose.”

The clients learn along the way as they join in creating knowledge of the particulars of the developments in the contracted project. As the clients learn, they might also want to impose changes. Moreover, in cases such as the studied one, the client is working independently on other parts of the product in parallel to the design team, which may also result in changing conditions that affect the design work.

Although the clients were assigned ownership of the design work throughout the design contracts, they were not responsible for the technical design work per se. In the following excerpt from a meeting, the project manager (PM) explained that they were about to initiate formal transfer of responsibility for the product from the Consultancy to the client. The PM described how the Consultancy’s project management work would be phased out over time (lines 1–7), but that their technical design work services would probably be needed for up to another year (lines 10–11).

In the following excerpt, the PM was updating the design work participants about upcoming changes decided on in the latest steering committee meeting. Except for the project manager, the design work participants did
not participate in the steering committee meeting; rather, the meeting involved the consultant manager who initially sold and was responsible for the project, as well as the client contact person(s).

The PM explained that formal ownership would progressively be transferred to the client organization in later phases of the design project. Before the formal change, however, the client representatives were continuously being assigned ownership in the ways described above.

The continuous assigning of ownership became a way of negotiating changing conditions and demands. In essence, the reason for continuously assigning ownership was anchored in anticipating trouble. Based on experience, the Consultancy knew that changes would likely be needed. By continuously assigning ownership, future resistance to making changes was disarmed, as the client organization shared responsibility for any decisions that might have to be changed.

“Looking for trouble”: provoking technical challenges

In design work, the Technical Design Consultancy actively “looks for trouble”, by trying to provoke technical challenges to emerge sooner rather than later. When formulating a product definition, a technical prestudy is undertaken when the intended product-to-be is thought to entail technical grey zones. Technical grey zones here refer to ambiguity related to possible
technical functionalities of the product-to-be. Projects that show signs of many technical grey zones are not initiated by the Technical Design Consultancy without a thorough prestudy to ensure, as far as possible, that technical challenges may be handled.

Early on in technical design work, visual representations are created of parts of plausible product concepts. First, the team create conceptual ideas for potential design outcome characteristics of various subsets of the product-to-be. The focus is entirely on characteristics of the design outcome relating to the technical content. This subdivision of the design outcome is based on the various functional parts of the product.

In this case, the researched design work project had undergone a technical prestudy long before this observation study began. The following description is accordingly anchored in observations of a technical prestudy in another design work project initiated during the ongoing observation study.

During the knowledge-creating activities in the technical prestudy, there was no consideration of whether the subsets of technical components would be functional when combined. Instead, the aim was to come up with as many alternatives as possible for each subset of the design outcome. The prestudy workshop was introduced by the project manager, who briefly described what defined need or difficulty of the intended end-users the product-to-be was to address. The industrial and engineering designers then started discussing the product collectively and sketching it individually.

During the dialogues in the workshop, technical components were exemplified by pointing to sketches and making comparisons with other products on the market. There was a predefined timeslot for this discussion and sketching, rather than letting the activity last until all opinions or ideas for alternatives were exhausted. The various alternatives identified in the workshop were summarized before the workshop officially ended.

The project manager drew the alternatives on a matrix on a whiteboard: each subset had its own row, and the alternative technical components went into the columns. Similar approaches were taken to each subset of outcomes, eventually rendering a matrix filled with visual representations of alternative technical components (subsequently to be combined).
After the columns were filled with multiple alternative technical components for each subset of the product-to-be, the design work activities focused on combining the alternative components into conceptual design outcomes. Through this activity, the number of alternatives was greatly reduced, as some would not be functional in combination. However, all alternatives were documented by taking pictures of the drawings and the whiteboard itself. In other words, during these structured activities, the ambiguity of the technical content and the objective was negotiated by reducing the number of alternative interpretations of the objective the design work could and should aim for.

A second prestudy workshop was held to transform the two-dimensional visual representations into three-dimensional, physical representations. In this workshop, the design work was continuously mediated by materialized artifacts in the form of typical craft materials such as pipe cleaners, straws, fabric, paper, and glue. The results of the first workshop (i.e., combinations of alternatives) were used as a basis for making simplified functional models in the second workshop, the craft materials being formed into three-dimensional representations of the combined alternatives. This was done to evaluate whether the conceptual design outcomes were feasible in terms of function, or whether certain technical challenges had been overlooked in the earlier knowledge-creating activities, working with two dimensions only.

The two workshops in combination became a way of successively testing more detailed hypotheses, “looking for trouble” by provoking technical challenges to emerge early on by increasing the level of detail quickly. This successive hypothesis testing was continuously mediated by artifacts, first in the form of symbolic representations on paper and whiteboards, then in the form of three-dimensional, physical representations materialized from craft materials.

In the above example, ambiguity pertaining to having too many, and possibly conflicting, functional requirements for the outcome was partly fended off before it emerged through the way the workshop participants specified their product definitions. In other words, the degrees of freedom concerning the performance of the product-to-be were reduced, while the many possible interpretations of the specific technical components were sustained. The design work thus focused on creating knowledge of various technical functions that could fulfill the targeted performance.
9 The emergence of ambiguity and activities to negotiate them: an empirical analysis

This chapter presents an empirical cross-case analysis comparing the ambiguous situations and negotiating activities that emerged in the two empirical studies. The cases are compared to portray both similarities and differences between the natures of the ambiguous situations and the kinds of negotiating activities that were part of the knowing-in-practice.

The empirical findings have shown that inabilities to make unanimous interpretations emerges in design work, although the intensiveness of such inability varies. Even upon finalizing the design work projects, many ambiguities still prevailed. The ongoing interpretative and analytical work activities were part of creating knowledge to mobilize various possible interpretations, rather than reducing ambiguity by eliminating all but one interpretation.

The two cases point to various ambiguities emerging in the design work as well as a number of activities to negotiate ambiguity. At the same time, the two cases differ as well. The technical design work project had been ongoing for much longer than the service design work, and was also longer in total time commitment. The technical design work was undertaken for a small company with 10–15 employees, while the service design work was undertaken for a client with several thousand employees.

The market for and characteristics of the design outcomes also differed greatly. The technical design outcome was to be a physical casing for a chemical product. The combined product, i.e., chemical component and casing, was to be sold to large-scale manufacturing companies as part of their manufactured products. The service design outcome instead targeted private individuals in the form of the client’s customers, i.e., the end-consumers. The service design outcome was not to be sold as a separate service, but was intended to make the transition between two IT systems more convenient for the end-consumers (by making it “pleasant”) and the
The empirical material was replete with examples of ambiguities that emerged during the design work. In general, these ambiguous situations did not seem to interrupt the ongoing work or cause much hesitation among the participating individuals. Rather, the design work seemed to continue, and the designers mobilized various negotiating activities to facilitate the ongoing work. Here, the various examples of ambiguities described at length in the empirical findings chapters are summarized and compared in a cross-case analysis.

The empirical analysis of the emerging ambiguities is structured according to the categories in the theoretical framework, namely: (1) product ambiguity, (2) market ambiguity, and (3) process ambiguity.

9.1.1 Emergence of product ambiguities

Ambiguities that related to an inability of making unanimous interpretations of the design outcome emerged in both the service and the technical design work. In each case, three examples of product ambiguity emerged in relation to: (1) the objectives, (2) the functional requirements, and (3) the intersections.

Ambiguous objectives

In both cases, ambiguity emerged in interpreting the objective towards which the design outcome should be attuned. In the service design work,
the qualifier for what to achieve was subjective (i.e., making the transition “pleasant for the end-consumers”). The designers may never know for certain whether the transition service they created will eventually be perceived as pleasant. Furthermore, the end-consumers were several million individuals, meaning that the qualifier was ambiguous in that it conserved the inclusion of multiple interpretations.

In the technical design work, ambiguity instead emerged in relation to the objective, in that the qualifier for what to achieve was in flux. In the technical design work, the objective was to construct a mechanical design for a casing, which was intended to enclose a chemical component. The characteristics of the chemical component were not settled before the design consultancy’s involvement, however, so the demands imposed on the casing by the chemical component were somewhat ambiguous.

The two objectives were as such both ambiguous, but in different ways. In the service design work, the wording of the objective was settled. However, this fixed discursive representation of what was to be achieved included an ambiguous qualifier and could continuously be interpreted in multiple ways. In the technical design work, the objective was based on a changeable qualifier that could be interpreted differently at different times.

**Ambiguous functional requirements**

Ambiguous functional requirements refer to somewhat different situations in the two cases: various and conflicting requirements from the end-consumers in one, and the unpredictability of the technical content in the other.

In the service design work, the ambiguity that emerged in relation to the functional requirements concerned the various, and sometimes conflicting, desires derived from the end-consumer interactions. The inability to make unanimous interpretations of the end-consumer desires persisted in the design work, i.e., the ambiguity could not be eliminated, since accomplishing that would mean making the many end-consumers change their opinions. Instead, end-consumer desires were considered true, yet multiple, requirements imposed on the transition service to be created. As the service design work project was concluded, the multiple interpretations of the functional requirements had been categorized, labeled and mediated. In such negotiating activities, the endless interpretations had been generalized and reduced.
The ambiguous functional requirements in the technical design work instead emerged in relation to the technical content of the design outcome. There was an inability to make unanimous interpretations of the level of detail at which to specify product characteristics, i.e., balancing between overdetermining the product-to-be and defining it too vaguely. An overdetermined design outcome would cause an inability to meet the requirements in a single product. Having a too vaguely defined design outcome would invoke an inability to interpret whether the contract with the client has been fulfilled according to the client organization’s desires. Upon finalizing the technical design work project, all such ambiguities had been negotiated and reduced.

Yet another dimension further complicates the matter, manifested in the assumption that the functional requirements specify a sought-after functionality. One such example is the malfunctioning of the nozzle of a sparkling water dispenser, in which the carbonic acid froze even though the prototype otherwise attuned to the product definition, i.e., concerning price range, cost of production, style, and aesthetics (except that it did not produce carbonated water). The opposite may also happen: the product could be fully functional, yet not meet the set requirements.

In summary, ambiguity emerged in relation to the functional requirements in both of the empirical examples. However, the nature of the ambiguities differed: in the service design work the end-consumer desires were considered as non-negotiable truths, in that the design work should not aim at changing end-consumer opinions. Instead, the multiple end-consumer desires could only be negotiated by attuning the transition service to the many desires.

In the technical design work, the functional requirements for the technical content were continuously negotiated and under revision. As the design work participants created knowledge of the design outcome characteristics, the technical content was challenged.

**Ambiguous intersections**

Ambiguous intersections with regard to the design outcome emerged in both empirical cases. In the service design case, the ambiguous intersection concerned matching the design outcome with the objective. In the technical design case, the ambiguous intersection instead emerged between the technical characteristics and the usability aspects.
In the service design work, an ambiguous intersection emerged between the work objective and the design outcome. The design work was undertaken with a due date and a goal specifying (1) when a design outcome should be delivered to the client organization and (2) the objective that the design outcome should meet. Upon finalizing the design work, ambiguity emerged in establishing a fit between the objective and the design outcome. More specifically, there was an inability to make unanimous interpretations of when the design outcome was considered to have meet requirements and demands in what they called a “good enough deluxe” way. In other words, it was unclear when the created design outcome was considered to have met the client organization’s expectations, which were ambiguously defined in the objective. However, the intention was to reduce this ambiguity as far as possible, so that the objective and design outcome would match.

In the technical design work, an ambiguous intersection emerged between the dual dimensions embedded in the product-to-be, i.e., the “hard” and the “soft” aspects. The “hard” aspects referred to technical characteristics, while the “soft” aspects were anchored in aesthetics and the usability of the design outcome. The tension between these two aspects imposed different requirements on the product-to-be. This ambiguous void between the two dimensions should preferably be reduced as far as possible upon finalizing the design work.

To conclude, although the nature of the ambiguous intersections differed, the intention in both cases was to reduce this ambiguity in the design work to create a design outcome that matched the objective and fulfilled both the aesthetic and functional dimensions.

9.1.2 Emergence of market ambiguity

Ambiguities relating to an inability of making unanimous interpretations of the stakeholders and their demands emerged in both empirical cases. Three examples of ambiguous situations have been drawn from the service design case, while the technical design work provides two examples of such situations. These five examples are categorized into two analytical categories of market ambiguity regarding (1) stakeholders and (2) demands.
Ambiguous stakeholders

The ambiguities that emerged in relation to the stakeholders transpired in opposing challenges: the stakeholders were either “all” or “none.” In one case, the stakeholders constituted a large proportion of the entire population of Sweden, and ambiguity emerged in the conflicting implications of the end-consumer interactions. In the other case, there was an inability to identify who potential stakeholders could be to begin with.

In the service design work, an ambiguity emerged in relation to that there were multiple stakeholders. Referring to this ambiguity as emerging in having “multiple” stakeholders is close to an understatment. The service design work was undertaken on behalf of a large client organization in which many departments stood to gain or lose from the work. Moreover, the end-consumers (i.e., the client’s customers) with a stake in the design work represented a fair share of the Swedish population. An inability to make unanimous interpretations of the desires and characteristics of the stakeholders emerged from this multiplicity, an inability that was not easily remedied. However, this ambiguity was negotiated in the service design work by making generalizations through comparisons and categorizations as well as assuming various perspectives.

A second market ambiguity also emerged in relation to the stakeholders in the service design work. More specifically, this second ambiguous example concerned the conflicting implications of the end-consumer interactions, i.e., making interpretations of the many end-consumers’ needs and desires in relation to the transition service. This ambiguity partly manifested itself in a “Catch 22,” since it would be difficult for the end-consumers to communicate what they desired without seeing and trying the transition service, while it would be difficult for the design work participants to create the transition service without knowing what end-consumer desires to consider. This stakeholder ambiguity primarily transpired in that various end-consumer categories communicated incompatible desires. This ambiguity was continuously negotiated by communicating broadly, taking one step at a time, etc.

In the technical design work, the ambiguity that emerged in relation to the stakeholders instead transpired in an inability to make unanimous interpretations of who the stakeholders were. This inability to define future stakeholder groups emerged in that the design outcome was to intersect with the chemical component in a composite product. This composite
product, in turn, was to be integrated into certain kinds of machines. These machines, in their turn, was to be operated by various kinds of users and maintenance would be performed by yet other individuals. All in all, the complexity of the use of the design outcome resulted in a chain of stakeholder organizations and users, of which all were not known. The client organization could thus not univocally communicate to the consultancy who the future users would ideally be, given that they did not know the scale of opportunities for the new product. In other words, this ambiguity could not be reduced to unanimously interpret who future users would be and attune the design outcome to these specified groups. The ambiguity of not being able to identify potential stakeholders was instead negotiated by making the design outcome more variable and adaptable to disparate needs and desires.

In summary, despite the differences between the ambiguous stakeholders, the consequences were approximately the same: there was a continuous inability to make unanimous interpretations of who the stakeholders were and what their desires would be.

**Ambiguous demands**

Ambiguities emerged in relation to the demands in both of the studied cases. In the service design work, the ambiguity transpired in the multiplicity of demands from the client organization. In the technical design work, the ambiguous demands emerged in changing conditions.

In the empirical material from the service design case, ambiguity emerged in the multiplicity of client demands. In the large client organization, several departments were invited to engage in the design work. These departments expressed differing demands and expectations of the design work, based on their perspectives.

In the technical design work, there was an inability to make unanimous interpretations of the demands given that these were themselves changing. The casing was to enclose a chemical component that was still being developed in parallel with the technical design work. As the characteristics of the chemical component emerged, the conditions for the casing changed. This ambiguity was continuously negotiated by inviting the stakeholders and continuously assigning ownership to the client.
The nature of the ambiguous demands differed somewhat between the two cases. In the service design work, the ambiguous demands transpired in the multiplicity of expectations, while in the technical design work, the ambiguous demands emerged in changing conditions.

9.1.3 Emergence of process ambiguity

Process ambiguities emerged in the empirical material of both cases. Two examples of process ambiguity were drawn from the service design work, while one example of process ambiguity emerged in the technical design work. These three examples are described in two categories: (1) ambiguous guidance from rules; and (2) ambiguous interim design outcomes.

Ambiguous guidance from rules

Ambiguities emerged in relation to the guidance from rules in both empirical cases. In the service design work, there was an inability to make interpretations of when to finalize (interim) activities. In the technical design work, there was an inability to make unanimous interpretations of the starting conditions of the work.

In the service design work, an ambiguity emerged in making univocal interpretations of when to consider a work activity complete. Although the script for the service design work included such notions, it provided little guidance in the practical accomplishment of the work. This recursive ambiguous situation relates to an inability of establishing means–ends relationships between the undertaken work activities (i.e., means) and the sought-after knowledge in terms of end-consumer interpretations, design outcome prototypes, etc. (i.e., ends). This kind of ambiguity emerged recursively in the service design work and was continuously negotiated.

In the technical design work, the ambiguous guidance from rules emerged in the starting conditions of the work. Although the Technical Design Consultancy had several tools and methods for undertaking the work, it initially had to guess which knowledge-creating activities would best initiate the design work. In this, an ambiguity emerged in convincing the client that a prestudy would be beneficial, while the value of such design work could only be shown in retrospect.

In summary, ambiguous guidance from rules emerged in different ways in the two empirical cases. In the service design work, there was an inability
to make unanimous interpretations of the finalizing of (interim) activities. This ambiguity was negotiated largely by relying on the recursive nature of the service design work: inability to claim that an activity had fulfilled its purpose was downplayed by arguing that it would be repeated once more in due course, and could then be complemented. In the technical design work, there was instead an inability to make unanimous interpretations of the commencing of the design work. This ambiguity was initially negotiated by inviting stakeholders to participate, assigning ownership, and limiting the degrees of freedom.

**Ambiguous interim design outcomes**

In the service design work, yet another process ambiguity emerged. This ambiguity transpired in the open-endedness of the work, as few characteristics of the tentative design outcome were ever established as fixed in the ongoing service design work. By constantly being able to change any aspect of the design outcome, the service design work was continuously open ended as few points of reference were treated as fixed. This ambiguity was continuously sustained in the design work, as it enabled the design work to make late changes as knowledge was created.

A comparable ambiguous situation did not emerge in the empirical material from the technical design work. One possible reason for such a difference is that it was more difficult to make changes to the tentative design outcome in the technical design work, which continuously represented the tentative product in three-dimensional and physical prototypes. The increasing level of detail in making material representations meant narrowing the degrees of freedom and reducing the open-endedness, in the technical design work. In contrast, the prototypes in the service design work were instead discursive or visual representations that were easily challenged and changed.

**9.1.4 Summarizing the ambiguities that emerged**

The ambiguities that emerged the empirical material have here been compared under the headings from the theoretical framework, namely, product, market, and process ambiguity. In essence, various ambiguous situations have been bundled together based on their characteristics, guided by the analytical categorization of ambiguities. Based on cross-case
comparisons, a number of subcategories have been created that detail the categories of ambiguity from the theoretical framework (see Table 5).

Product ambiguity is described as having three subcategories, i.e., ambiguous objectives, ambiguous functional requirements, and ambiguous intersections, based on examples from both cases (see Table 5). In the service design work, the objective was multivocal and thus open to multiple interpretations. In the technical design work, the objective was unclear as it referred to a changing qualifier. In the service design work, the conflicting functional requirements were anchored in multiple end-consumer demands for functionality. In the technical design work, ambiguity emerged in setting up functional requirements for the technical content. In the service design work, establishing a fit between work objective and design outcome was ambiguous. In the technical design work, ambiguity emerged in the intersection between “hard” functional aspects and “soft” aesthetic aspects.

Market ambiguity is described as having two subcategories, i.e., ambiguous stakeholders and ambiguous demands, based on examples from both cases (see Table 5). In the service design work, ambiguity emerged in relation to having multiple stakeholders and in the conflicting implications of the stakeholder interactions. In the technical design work, ambiguity emerged in relation to having unknown stakeholders. Ambiguous demands, on the other hand, emerged in the multiplicity of client demands in the service design work, and from changing conditions in the technical design work.

Process ambiguity was described as emerging in two ways, i.e., ambiguous guidance from rules and ambiguous interim design outcomes. The latter was based on empirical examples from the service design work, while the former was anchored in both cases (see Table 5). The ambiguous guidance from rules emerged in the finalizing of (interim) activities in the service design work. In the technical design work, the starting conditions of the design work were ambiguous, leading to the “Catch 22” of having to convince the client that a prestudy was needed. Additionally, process ambiguity emerged in the open-endedness of the service design work in that the design outcome was always open to revision.
Table 5. Summary of the ambiguities that emerged in the empirical material.

<table>
<thead>
<tr>
<th>Type of ambiguity</th>
<th>Subcategory</th>
<th>Service design work</th>
<th>Technical design work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ambiguous objectives</td>
<td>• Multivocal objective</td>
<td>• Changing objective</td>
</tr>
<tr>
<td>Product ambiguity</td>
<td>Ambiguous functional requirements</td>
<td>• Conflicting functional requirements</td>
<td>• Detailing the technical content</td>
</tr>
<tr>
<td></td>
<td>Ambiguous intersections</td>
<td>• Establishing a fit</td>
<td>• Prioritizing between dual dimensions</td>
</tr>
<tr>
<td></td>
<td>Ambiguous stakeholders</td>
<td>• Having multiple stakeholders • Conflicting implications of end-consumer interactions</td>
<td>• Having unknown stakeholders</td>
</tr>
<tr>
<td></td>
<td>Ambiguous demands</td>
<td>• A multiplicity of client demands</td>
<td>• Changing demands/conditions</td>
</tr>
<tr>
<td>Market ambiguity</td>
<td>Ambiguous guidance from rules</td>
<td>• Finalizing (interim) activities</td>
<td>• Starting conditions of the design work</td>
</tr>
<tr>
<td></td>
<td>Ambiguous interim design outcomes</td>
<td>• The open-endedness of the work</td>
<td></td>
</tr>
</tbody>
</table>

9.2 Negotiating activities

Describing the activities involved in negotiating ambiguity entails discursively representing the ordered accomplishment of scenes of action, which are subjected to an inability to make unanimous interpretations. From having studied the two empirical cases, with their manifold scenes of action, several patterns of how ambiguity was negotiated emerged. These five patterns are described in the following subsections.
9.2.1 Constructing points of reference

Points of reference were continuously constructed and reconstructed in both empirical cases. Although these negotiating activities were undertaken in ways that differed somewhat between the cases, they did include similarities that enabled bundling of the distinct negotiating activities into generalized negotiating activities to construct points of reference. In general, the activities to construct points of reference focused on certain aspects while temporarily disregarding others. The multiplicity of interpretations is tentatively restricted to create focus, which is later dissolved by zooming out.

Points of reference were constructed in several recursive negotiating activities: (1) imposing tentative structures; (2) narrowing the focus; (3) constructing common denominators; and (4) revising the points of reference. These four ways of constructing points of reference are described in the following subsections.

Imposing tentative structures

One way of constructing points of reference was to impose tentative structures on the work. This negotiating activity emerged in both empirical cases. In the service design work, tentative structures were imposed in two ways: by comparing, differentiating, categorizing, and labeling as well as by identifying recursive patterns. In the technical design work, tentative structures were instead imposed by offering interpretations of the product-to-be.

Comparing, differentiating, categorizing, and labeling were recursive activities in the service design work. These activities negotiated the ambiguities of multiple interpretations, i.e., the ambiguities of having multiple stakeholders with various desires. The negotiating activities included making summaries in keywords and phrases, and enacting these in discursive representations on Post-It notes. Such discursive representations were compared and differentiated to establish similarities and differences by both verbal communication and physically moving Post-It notes. The Post-It notes were categorized and labels emerged in discussions. This way of imposing structure was tentative: established categories could be reconsidered and changed, and new categories could be created by imposing other tentative structures, for example, anchored in end-consumer attitudes instead of client experiences.
A second way of imposing tentative structures in the service design work was to identify recursive patterns by interpreting, structuring, and categorizing. This is similar to the imposing of tentative structures in the service design work, but with a slight difference. Recursive patterns are instead identified by interpreting gut feelings anchored in experience, i.e., from having “been there.” The intent is to negotiate the indefinite variations of end-consumer desires, by achieving what is called “saturation.” In other words, by interpreting, structuring, and categorizing gut feelings, the ambiguity of the end-consumer demands is reduced by identifying a few recurring characteristics.

In the technical design work, interpretations of the product-to-be are offered continuously as a way of imposing tentative structures. The earliest tentative structure imposed on the work is what is called the product definition, which is a discursive representation of interpretations of the product-to-be. The product definition then becomes an artifact that mediates the ongoing design work. Although the product definition is treated as fixed, it becomes a point of reference in flux, because interpretations and understandings of the content emerge and change in the ongoing work. Offering interpretations of the product definition to be enacted in the product-to-be negotiates the ambiguous objective of the technical design work.

In summary, imposing tentative structures was a way of constructing points of reference to be challenged and reconsidered later in the work. There was no intention to make structures to be seen as fixed and immutable. In imposing such tentative structures on the design work, the inability to make univocal interpretations was negotiated by temporarily settling on certain interpretations that were later challenged and reconsidered.

**Narrowing the focus**

A second way of constructing points of reference in the studied design work was to set delimitations to narrow the focus. In the service design work, delimitations were set by establishing intersections. In the technical design work, the narrowing of focus was enacted by limiting the degrees of freedom.

Intersections were established in the service design work as a way of mediating between various categorizations, weaving together various
standpoints. One example was creating an end-consumer journey by intersecting end-consumer desires with a timeline for the tentative design outcome. These intersections became points of reference that made it possible to focus on details of the design outcome, before recursively stepping back and looking at the entire picture.

In the technical design work, the degrees of freedom were limited as a way of constructing points of reference. For example, the contract and the product definition, established with the ambition of not being changed later on, limited the degrees of freedom. However, what is discursively represented in the contract and the product definition must be interpreted. These therefore became tentative points of reference that were open to questioning, reconsideration, and reinterpretation. In other words, these early discursive representations mediated the ongoing design work by functioning as points of reference for negotiating the ambiguous functional requirements and demands.

In the empirical material from both design work cases, the focus was narrowed by zooming in on certain aspects while excluding others from view. In doing so, the excluded aspects became points of reference for the aspects in focus. If no aspects were treated as fixed, the design work would increase greatly in complexity by having to tend to multiple interpretations interacting with multiple aspects simultaneously. Instead, by narrowing the focus, some points of reference were created that temporarily reduced ambiguity by prioritizing between multiple interpretations.

**Constructing common denominators**

In both empirical cases, common denominators were constructed as one negotiating activity: shared visions were created in the service design work, while a shared language was produced in the technical design work.

Shared visions were created both in activities to construct a language and in interactions with visual representations to capture what easily escapes attention due to limitations of being verbalized. A language for sharing visions was constructed by making discursive summaries in keywords and phrases, often using metaphoric figures. The creation of shared visions was also mediated by visual representations, for example, when a questionnaire from another service design project was brought to the questionnaire workshop to serve as a common denominator for understanding what was to be achieved. By creating shared visions, the
ambiguities of finalizing (interim) activities and of the open-endedness of the work were negotiated in the service design work.

In the technical design work, a shared language was produced as a way of constructing discursive common denominators. A shared language was produced in four ways: (1) expressions were created by merging Swedish and English words; (2) metaphors were used to make descriptions clearer; (3) labels were introduced, for example, for various design outcome concepts; and (4) discussions were summarized into short expressions or keywords that were documented onto notes in order to be remembered. Devising a shared language facilitated making references to and discussing the various concepts.

Though these four ways of producing a shared language might not seem revolutionary, when combined, they powerfully create a vocabulary acting as a common denominator mediating the ongoing design work and negotiating the ambiguous technical content.

Common denominators were constructed in both empirical cases although in different ways. By creating shared visions and producing a common language, points of reference were continuously constructed. These negotiated the ambiguous nature of the design work by reducing the multiplicity of interpretations when communicating about the future design outcome.

**Revising the points of reference**

In the service design work, yet another way of constructing points of reference emerged, namely, communicating deeply and recursively. In essence, negotiating activities to communicate deeply and recursively emerged in end-consumer interactions that were undertaken repeatedly, becoming more specific and to the point with each repetition. In the end-consumer interactions, tentative points of reference were established in the form of generalized attitudes and desires. These points of reference were then revised as end-consumer interactions were undertaken once again. By communicating deeply and recursively, the ambiguous objective was negotiated by anchoring the transition service’s “pleasantness” in what end-consumers said about it.

Activities similar to revising of points of reference were not evident in the empirical material from the technical design work. On the other hand,
established points of reference were challenged and revised in the technical design work as well: The change was anchored in choosing to give prominence to new or different interpretations of the same points of reference, rather than actually changing the discursive or visual representation (i.e., the point of reference).

To conclude, this fourth way of constructing points of reference drew on the empirical material from the design work. By communicating deeply and recursively with end-consumers, earlier points of reference were revised in the service design work. In doing so, the service design work was negotiating the ambiguity of having multiple stakeholders, as well as the ambiguity of the open-endedness of the work.

9.2.2 Mediating between perspectives

In the empirical material from both cases, ambiguities were negotiated by mediating between any perspectives that could be positioned as opposing in some way. In the studied design work, such opposing perspectives included the characteristics of the design outcome (e.g., functionality and aesthetics) and attitudes of the end-consumers (e.g., anxious/apprehensive and enthusiastic).

Perspectives were mediated in four ways: (1) alternating between perspectives, (2) combining perspectives, (3) balancing perspectives, and (4) advocating for perspectives. These four negotiating activities in which perspectives were mediated are described below.

Alternating between perspectives

The design work in both empirical cases heeded various perspectives relating to both stakeholders and design outcome characteristics. Perspectives were compared in the service design work in two ways: by assuming various stakeholder perspectives and by “playing Jeopardy” to change perspectives. In the technical design work, different perspectives, such as the “hard” and “soft” aspects, were instead mediated in dialogue and material representations.

Assuming various perspectives was the basis on which the knowledge-creating activities in the service design work gained initial momentum. A pinpoint workshop was organized to interact with client representatives to learn from their experiences with end-consumers. In other words, the
project began by assuming one stakeholder perspective in order to “look at” the other groups of stakeholders. As the design work progressed, the designers evoked the experiences and insights from the various stakeholder interactions in conversations. In doing so they continuously evaluated tentative design concepts based on the various perspectives.

Another empirical example of comparing perspectives in the service design work is that of “playing Jeopardy” to change perspectives. The design work went from focusing on learning about various client stakeholder perspectives, to interacting with end-consumers in order to assume their perspectives. The experience of interacting with the client representatives was translated by “playing Jeopardy,” i.e., the “answers” from the client interactions were paired with questions to be posed to end-consumers.

In the technical design work, shifts between perspectives served to compare the product characteristics rather than stakeholder viewpoints. This negotiating activity to compare perspectives was enacted via dialogue mediating between “hard” and “soft” aspects: The technical design work activities alternated between focusing on the technical content and functionality and focusing on usage considerations and aesthetic dimensions. Iteratively shifting between these two foci became a way of creating dialogue by taking turns proposing arguments from the two perspectives.

Empirical examples of alternating between perspectives were drawn from both cases. Perspectives were constructed as opposing logics, for example, between characteristics of the design outcome or between generalized end-consumer personas. By alternating between perspectives, multiple interpretations were negotiated by first focusing on one and then on another aspect of the work.

**Combining perspectives**

Another prevalent way of mediating between perspectives was to combine multiple perspectives and consider them simultaneously. This differs from the negotiating activity described above, in which perspectives are compared by focusing on one at a time. In the service design work, multiple perspectives were combined by establishing commonalities between them. In the technical design work, perspectives were instead combined by unifying them.
Commonalities in the service design work were established by finding common ground among various needs groups. The negotiating activities to establish such common ground transpired in the recursive interactions that alternated between the many client and end-consumer stakeholders. Experiences of such interactions anchored the activities to combine perspectives when intersections between the perspectives were created. One way of establishing such intersections was to create an end-consumer journey, i.e., a discursive and visual representation of interaction points between the client organization (the service provider) and the end-consumers.

In the technical design work, perspectives were unified between the design work participants and the client organization representatives. The design work participants’ and the client representatives’ perspectives were mediated in, what they called, a creative exercise. This joint exercise was undertaken to reach consensus with the client representatives about the usage functionalities of the casing, i.e., how it should be carried, installed, etc. The unifying of perspectives was mediated by physical prototypes of the design outcome, which facilitated dialogue by acting as a unifying reference point.

Combining perspectives was a negotiating activity for mediating between various stakeholder perspectives in both cases. In the service design work, the focus was to establish commonalities among disparate end-consumer groups, while the technical design work sought to combine the client perspective with that of the design work participants. By combining perspectives, the multiple interpretations were negotiated by establishing intersections between them.

**Balancing perspectives**

In addition to alternating between and combining perspectives, there were also examples of balancing perspectives in both empirical cases. In the service design work, perspectives were balanced against one another by mediating between categorizations. In the technical design work, perspectives were instead balanced by weighing aesthetics and functionality.

The service design work continuously created and reconstructed categorizations that often had somewhat conflicting characteristics. These categorizations had to be mediated between to balance their weightings in
the design outcome. For example, the end-consumer groups in the service design work were established partly based on conflicting attitudes and desires regarding the transition service. It was necessary to negotiate this void between the end-consumer groups’ conflicting needs since it was deemed impossible to create different services to meet the varied needs of all these groups. The negotiations were enacted by mediating between the categorizations: An example of this was the creation of tentative design outcomes by combining desires from several needs groups in a single concept.

Aesthetics and functionality were recursively balanced in the technical design work in a negotiating activity recalling the dialogue between “hard” and “soft” aspects. There is a slight difference in focus, however: the dialoguing alternated between the two aspects, while the balancing considered both aspects simultaneously. Moreover, the balancing was a way of giving equal weight to the two aspects in the design outcome, rather than prioritizing one over the other. The negotiating activities to balance the perspectives were mediated by artifacts in the form of physical prototypes. These facilitated considerations of both the aesthetic and functional perspectives in parallel, by continuously mediating how a change in one aspect would affect the other.

The two ways of balancing perspectives were enacted in different ways, through mediating between categorizations in the service design work, versus balancing the aesthetics and functionality of the design outcome characteristics in the technical design work. Both ways of balancing perspectives negotiated multiple interpretations by constructing various interpretations as opposing, and then weighing them against each other. In other words, balancing perspectives entailed simultaneously considering several perspectives. Such simultaneous consideration did not mean merging or finding intersections between perspectives. Prioritizing between the perspectives of, for example, various end-consumer groups, was rejected in favor of considering perspectives as of equal weight.

**Advocating for perspectives**

In the empirical material from the service design work, yet another way of mediating between perspectives emerged, namely, taking the voices of stakeholders. The design work participants took the voices of stakeholders in three ways: quoting individuals, referring to personas, and speaking in
the first person on behalf of stakeholders. This negotiating activity emerged in dialogues advocating different perspectives. In this activity, multiple stakeholder categories and desires were mediated, at times to pinpoint and sustain the variations, and at times to reduce them.

Similar negotiating activities did not emerge in the empirical material from the technical design work. Although of somewhat resemblance, the dialoguing between “hard” and “soft” aspects was anchored in an ambition to consider how changes in one aspect of the design outcome would affect the other, in the technical design work. Taking the voices of stakeholders in the service design work was instead anchored in evaluating entire tentative design outcomes based on guesstimates about stakeholder responses to such design outcomes. In other words, dialogue mediating between “hard” and “soft” aspects negotiate the ambiguity emerging in product characteristics, while taking the voices of stakeholders negotiates the ambiguity of market demands.

9.2.3 Anchoring in expertise

The third general way of negotiating ambiguity in the studied design work cases was anchoring in expertise, which was enacted in two general ways in the empirical material from both cases: (1) evoking experiences and (2) inviting expertise.

Evoking experiences

The negotiating activity of evoking experiences was enacted by integrating client stakeholders into the service design work and speaking from experience in the technical design work.

Client stakeholders were integrated into the service design work. This was done to learn from their experiences. More specifically, the sought-after experiences were from the client representatives’ earlier interactions with end-consumers. The client representatives were assumed to be able to share experiences about how they had perceived the end-consumers’ attitudes and responses to prior changes. Integrating the client stakeholders made it possible to negotiate the ambiguity of having multiple stakeholders, the ambiguous objective, as well as the ambiguity of the multiple demands of the client stakeholders.
The technical design work participants evoked experiences in dialogues. By speaking from experience, the technical design work was anchored in expertise from having done design work before. The more senior design work participants were more often asked for opinions and more often spoke from experience, i.e., anchoring their statements in feelings or opinions. By speaking from experience the ambiguous technical content was negotiated and somewhat reduced. Enacting experiences somewhat reduced the endless possibilities of the technical content, since gut feelings mediate what is more or less plausible.

In summary, experience was evoked somewhat differently in the two cases. In the service design work, it was the client representatives that were encouraged to elicit experiences. This anchoring in experiences negotiated the ambiguity of having multiple stakeholders and the ambiguous multiplicity of client demands. In the technical design work, it was the design work participants that were eliciting experiences and in doing so the ambiguity of the technical content was negotiated. In other words, the evoking of experiences negotiated the inability to make unanimous interpretations of the stakeholders and their demands in the former case and of the characteristics of the design outcome in the latter.

**Inviting expertise**

A second way of negotiating ambiguity by anchoring in expertise was to invite expertise into the design work. In the service design work, it was the end-consumers who were invited as experts. In the technical design work, in the other hand, several stakeholder groups were invited as experts.

In the service design work, the end-consumers were invited as experts on user needs. The end-consumers were not asked to speak on behalf of others, but as the end-consumer interactions were analyzed, they were categorized and treated as representatives of certain needs groups. This negotiating activity of inviting the end-consumers as experts can arguably both sustain and reduce ambiguity. Ambiguity was negotiated, reducing the initial inability to make any interpretations of end-consumer desires and attitudes. Simultaneously, ambiguity was sustained in that there was still an inability to settle on a few certain and attuned conceptualizations of the end-consumer desires and attitudes: from inviting the end-consumers to participate as experts many desires and attitudes transpired.
In the technical design work, several stakeholder groups were invited to participate as experts, depending on the kind of expertise sought. In the studied technical design work project, expertise was borrowed from representatives of manufacturing and supply organizations as well as from client representatives. These stakeholder groups contributed expertise on the effects of various manufacturing techniques and the anchoring of functional requirements. In doing so, the ambiguous technical content and the ambiguity of prioritizing between the dual dimensions were negotiated.

In the design work in both empirical cases, experts were invited to participate. These experts represented various stakeholder groups, such as end-consumers, clients, and suppliers. The experts were integrated into the design work in such a way that they could evaluate and comment on tentative design outcomes, rather than teaching the design work participants about their expertise. The gut feelings and expressed opinions of the experts were included as truths, without asking for anchoring in theoretical facts for instance by showing calculations. Inviting expert participation anchored the design outcome in expertise, even in subject areas of which the design consultants themselves had little experience.

9.2.4 Disarming future resistance

In total, three activities for negotiating ambiguity by disarming future resistance emerged in the empirical material from the two cases. In the service design work, future resistance was disarmed by means of broad communication. In the technical design work, future resistance was disarmed both by the continuous assigning of ownership and by “looking for trouble.”

In the service design work, future resistance was disarmed by means of broad communication intended to capture the most salient end-consumer desires. Overlooked desires and attitudes emerging later in the work could possibly entice resistance, imposing changes or reconsiderations of various characteristics of the tentative design outcome. Broad repeated communication (i.e., with many end-consumers) negotiated the ambiguity of having multiple stakeholders and of establishing a good enough fit between the objective and the design outcome.

In the technical design work, future resistance was disarmed by continuously assigning ownership to the client representatives, inviting and integrating them into all strategically important decisions (e.g.,
choosing which tentative design outcomes to continue working on). Client representatives invited into the decision-making share responsibility for the final design outcome. As ownership is continuously assigned to the client representatives, the ambiguities of having unknown stakeholders and of changing conditions are negotiated.

A second way of disarming future resistance in the technical design work was to “look for trouble” by provoking technical challenges. This was done by for example making prototypes early in the design process, as such trying to ensure that it would be possible to create a design outcome that matched the functional requirements. In other words, by “looking for trouble,” the design participants disarmed future resistance by provoking it to emerge earlier rather than later. In doing so, the ambiguities of the objective and the technical content were negotiated.

Future resistance was disarmed in somewhat different ways in the two cases. The service design work disarmed future resistance by anchoring the work in end-consumer interactions. The design work participants communicated broadly, interacting with many end-consumers and negotiating the inability to make unanimous interpretations of whether the most prevalent end-consumer desires had been included.

The technical design work was instead anchored by integrating the client representatives and seeking to frustrate future technical challenges by “looking for trouble” early on. By continuously being assigned ownership, the client representatives became part of making strategically important decisions about what interpretations to emphasize (i.e., choosing between tentative design outcome concepts). Furthermore, future resistance was also disarmed by trying to provoke technical challenges to emerge early in the work.

9.2.5 Creating shared visions

Some of the negotiating activities that emerged in the empirical material from the service design work did not have counterparts in the technical design work. In the service design work, the practitioners were making do, that is, working with whatever was at hand. Moreover, talk was continuously enacted in representations in the service design work.

These negotiating activities together created somewhat of a shared vision among the design work participants. As the studied service design work
was initiated, the objective was ambiguous in many ways, and as the work was undertaken, ambiguities emerged and were continuously negotiated. Some recursive activities for negotiating the many ambiguities were improvising, taking one step at a time, verbalizing gut feelings, and making representations. In these activities, the design work participants were creating shared visions that mediated the multiple interpretations of the objective, design outcome, stakeholders, etc.

Negotiating activities similar to making do and enacting talk in representations did not transpire in the empirical material from the technical design work, and the reason for this has not been explicitly studied here. One possible reason is that the technical design work had already been ongoing for a longer period at the time of the study. The assumed effect of longer work in a design work project would be that some kind of collective, shared vision of what was to be achieved in terms of design outcome had already been created by settling on a product definition.

Making do

Several negotiating activities contributed to making do in the service design work, that is, the gradual unraveling of the network of multiple interpretations. The service design work participants were making do in three ways: (1) improvising with what was at hand; (2) taking one step at a time; and (3) verbalizing gut feelings to compare empathy.

In improvising with what was at hand, the service design work participants were interacting with one another to jointly create what was happening. By making do, the design work participants were doing while inventing the way of doing. This activity negotiated the conflicting implications of the end-consumer interactions, as making do was enacted in dialogues. In these dialogues, history was mobilized by drawing on experiences of end-consumer interactions. These experiences mediated the end-consumer interactions by offering interpretations that were strengthened or countered as other design work participants evoked other experiences.

The second way of making do was to take one step at a time. Although this negotiating activity resembles improvisation, there is a slight difference in that improvisation refers to work activities, while taking one step at a time refers to how the design outcome is approached. In essence, in taking one step at a time, the service design outcome was first enacted as several
possible overarching concepts. After interactions with stakeholders, such broad, vague concepts were further detailed. Several concepts, often not mutually coherent, were kept in play in parallel. By embedding ambiguous cues in the concepts, the design work participants could learn from the stakeholders’ responses in further interactions, which continued until a detailed design outcome had been created. In other words, ambiguities were both sustained and reduced in these negotiating activities.

The third way of making do was to verbalize gut feelings to compare empathy. In the negotiating activities of articulating empathic emotions and gut feelings, the design work participants were sympathizing with end-consumers. In doing so, they were collectively creating knowledge of possible end-consumer desires. Making do by verbalizing gut feelings negotiated the ambiguous objective. More specifically, the inability to make univocal interpretations of what would make the transition service “as pleasant as possible” for the end-consumers was negotiated. This ambiguity was both sustained and reduced in the negotiating: the dialogues verbalizing gut feelings articulate interpretations of end-consumer desires, transitioning from no to several interpretations of what would make the transition service pleasant. Simultaneously, the situation remains ambiguous, given that the participants now had to negotiate multiple interpretations of what would make the transition service pleasant.

**Enacting talk in representations**

In the service design work, talk was usually enacted in discursive, material, and visual representations. These representations functioned as ways of summarizing and mediating the knowledge creation. Representations were, for example, used to summarize dialogues in the form of keywords and phrases written on Post-It notes. This was a recursive activity that often reemerged in the work.

The summative representations both mediated the continuance of the work and visualized the becoming of categories. For example, Post-It notes were combined and differentiated by being physically situated closer or farther away from one another. In doing this, categories emerged and were visualized simultaneously.

Another way in which representations mediated the knowledge creation was as what the designers called trigger material, i.e., tentative illustrations
of what the final design outcome *might* look like. The aesthetics of the trigger material varied depending on whether the material was to signal a raw draft or a nearly finished prototype. These trigger materials were enacted as sketches, computer graphics, clickable PDFs, etc. The general intention of creating trigger material was that such visual, discursive, and material representations should trigger responses and reactions among end-consumers.

The aesthetics and vocabulary of the trigger material were often intentionally equivocal. The reason for opening the trigger material for multiple interpretations and assumptions, was to deepen and detail the understanding for what end-consumers would desire and expect from the transition service.

By enacting talk in representations, the service design work was negotiating the ambiguous nature of the design work. The enactment of talk did not specifically negotiate just part of the ambiguities, but rather was a negotiating activity that truly permeated the entirety of the design work.

### 9.2.6 Summarizing the activities to negotiate ambiguity

This chapter has mainly compared the two empirical cases to find similarities and differences between the negotiating activities. In essence, various design work activities have been grouped based on similarities in how ambiguities are negotiated in them. From this, five categories of activities for negotiating ambiguity in design work have emerged. The fifth category is anchored only in the service design work, while the first four draw on examples from both studied cases.

The five categories of negotiating activities that emerged from the empirical material were: (1) constructing points of reference, (2) mediating between perspectives, (3) anchoring in expertise, (4) disarming future resistance, and (5) creating shared visions.

Table 6 summarizes the negotiating activities. The two columns on the right list the design work activities presented in the empirical findings chapters; these activities for negotiating ambiguity are separated by case.

In the second column from the left in Table 6, one finds the generalized design work activities. These generalized activities categorize the design work activities by making claims about similarities between them. For
example, when intersections were established in the service design work and the degrees of freedom were limited in the technical design work, what they were both really doing was narrowing the focus.

In the leftmost column in Table 6 (next page), the generalized design work activities are combined into overarching negotiating activities. The patterns of these overarching negotiating activities emerged in the empirical material.

First, constructing points of reference continuously negotiated the ambiguity of multiple interpretations in the design work by alternating between treating various aspects as fixed or tentative. Second, mediating between perspectives negotiated the multiple perspectives in the design work, for example, between various stakeholders or between various aspects of the design outcome. Third, anchoring in expertise negotiated the multiple interpretations of the design outcome by prioritizing the expert voices. Fourth, disarming future resistance negotiated the ambiguous future by at least reducing the risk of not having included the most salient end-consumer desires or having overlooked certain challenges in the technical content. Finally, creating shared visions negotiated the open-endedness of the service design work and the ambiguous objective by structuring the work around whatever the design work participants could collectively agree on.
Table 6. Summary of the negotiating activities emerging from the empirical analysis

<table>
<thead>
<tr>
<th>Negotiating activities</th>
<th>Generalized activities</th>
<th>Design work activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Service design work</td>
</tr>
<tr>
<td>Constructing points of reference</td>
<td>Imposing tentative structures</td>
<td>• Combining, differentiating, categorizing, and labeling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Identifying recursive patterns</td>
</tr>
<tr>
<td>Constructing common denominators</td>
<td>Narrowing the focus</td>
<td>• Establishing intersections</td>
</tr>
<tr>
<td></td>
<td>Constructing common denominators</td>
<td>• Creating shared visions</td>
</tr>
<tr>
<td>Revising the points of reference</td>
<td>Revising the points of reference</td>
<td>• Communicating deeply and recursively</td>
</tr>
<tr>
<td>Mediating between perspectives</td>
<td>Alternating between perspectives</td>
<td>• Assuming various stakeholder perspectives</td>
</tr>
<tr>
<td></td>
<td>Alternating between perspectives</td>
<td>• “Playing Jeopardy” to change perspectives</td>
</tr>
<tr>
<td></td>
<td>Combining perspectives</td>
<td>• Establishing commonalities</td>
</tr>
<tr>
<td></td>
<td>Balancing perspectives</td>
<td>• Mediating between categorizations</td>
</tr>
<tr>
<td></td>
<td>Advocating for perspectives</td>
<td>• Taking the voices of stakeholders</td>
</tr>
</tbody>
</table>
THE EMERGENCE OF AMBIGUITY AND ACTIVITIES TO NEGOTIATE THEM

<table>
<thead>
<tr>
<th>Anchoring in expertise</th>
<th>Evoking experiences</th>
<th>• Integrating client stakeholders into the design work</th>
<th>• Speaking from experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inviting expertise</td>
<td>• Inviting the end-consumers as experts</td>
<td>• Inviting stakeholders</td>
<td></td>
</tr>
<tr>
<td>Disarming future resistance</td>
<td>• Communicating broadly</td>
<td>• Continuously assigning ownership</td>
<td>• “Looking for trouble”</td>
</tr>
<tr>
<td>Making do</td>
<td>• Improvising with what is at hand</td>
<td>• One step at a time ...</td>
<td>• Verbalizing gut feelings to compare empathy</td>
</tr>
<tr>
<td>Enacting talk in representations</td>
<td>• Representing discursively and materially</td>
<td>• Representing visually</td>
<td></td>
</tr>
</tbody>
</table>
It appears that the activities to negotiate ambiguity were not distinctly different from the practical accomplishment of everyday design work: as ambiguities emerged there was no evident discontinuity or breach to the ongoing design work.

The negotiating activities at times reduced the power of ambiguities. For example, by creating a design outcome that attuned to various end-consumer desires the power of the ambiguous objectives was seriously reduced in the service design work.

In other instances, the negotiating activities changed ambiguities from an inability to make any interpretations to instead increasing and embracing multiple interpretations. For example, making the design outcome variable in size and shape, so that it could be adapted in the future to emerging end-consumer desires, reduced the power of the stakeholder ambiguity (not knowing who future users and buyers could be) in the technical design work.

At yet other times, the multiplicity of interpretations was sustained and made use of, e.g., embracing the multivocality of stakeholder desires and using it as a generative force in creating concepts for the service design outcome.

In other words, upon finalizing the design work projects, ambiguities still persisted in the design work, but this was unproblematic in the studied cases. One possible reason for this was the interplay between the many ambiguities, with one ambiguous situation creating latitude for negotiating another ambiguity.

What should be understood from this example is that the multiplicity of ambiguities (i.e., inability to make unanimous interpretations of the product, market, and process) created maneuvering room that enabled various interpretations of the product, market, and process to interact with one another.
10 Discussing the intertwinement of ambiguity and negotiating activities in knowing-work

This chapter conveys a discussion on the empirical analysis in light of the theoretical framework. The literature has mainly portrayed ambiguities in design and NPD work as deviations either that require sensemaking and reflective practice (i.e., Simon 1973; Schön 1983; Weick 1995), or that should be mitigated or reduced, for example, by building trust or by imposing more structure on the work (i.e., Khurana & Rosenthal 1998; Brattström et al. 2013).

The empirical findings and analysis presented here have mainly portrayed ambiguities, and activities to negotiate them, as intertwined with knowing-work practice, however. Ambiguity was defined as emerging in an inability to make unanimous interpretations, while negotiating ambiguities refers to the actions taken to find a way past an inability to make unanimous interpretations, by reaching agreements or compromise in conversation.

The intertwinement of ambiguities and negotiating activities was taken seriously by adopting a practice epistemology. Doing so allows one to study the emergence and fading away of ambiguities in human sayings and doings (i.e., Souto 2010; Nicolini 2011; Gherardi 2012b). The empirical stories told here rely on material from two cases of design and NPD work.

The chapter is structured according to the two main foci of this research, namely, the emergence of ambiguity and the activities to negotiate ambiguity.

First, the ambiguities that emerged in the design work are discussed, drawing on the literature on the prevalence and changing nature of ambiguities in (knowledge-creation) work. This section concludes that ambiguities open up a space for action created in-between multiple interpretations and that ambiguities must not necessarily be mitigated or reduced upon finalizing a design work project.
Second, the intertwinement of negotiating activities in design work is discussed, pointing to negotiating activities make use of the generative and transformative power of ambiguities in knowing-work, by maneuvering in this space for action.

10.1 The intertwinement of ambiguity in design work

Ambiguities are not “there” when the work is initiated, but rather emerge in relation to situations and to the humans making interpretations. When the work was initiated and the interpretative work began, ambiguities emerged in the interpretations being either unclear or multivocal.

As noted earlier, with reference to, for example, Khurana and Rosenthal (1998) and Kim and Wilemon (2002), established theories often point to the early phases of design and NPD work as especially ambiguous or uncertain, referring to such work as “wicked” or discussing the “fuzzy front-end.” Subsequent work activities, it is thought, are intended to reduce and ultimately eliminate ambiguities and uncertainties, before finalizing the work.

This might be a useful explanatory model for simplifying and communicating knowing-work Such a linear narrative of moving from uncertainty and equivocality to some kind of complete, unanimous understanding is strongly questioned in this research, however. First, such a model is truisitic by definition: as time has gone by and work activities have been undertaken, one may more easily account for what has been done and what has been accomplished as compared to before having done the work.

Second, such an explanatory model is not consistent with practice epistemology: the notion that knowing-work is riddled with ambiguities prevails in practice epistemology (see, e.g., Souto 2010). The idea that ambiguities emerge in the early phases of work and are then subsequently and consciously reduced, as, for example, Kim and Wilemon (2002) would have it, is simplistic however. It fails to acknowledge that multiple interpretations naturally emerge in human sayings and doings in the ongoing work.
This was discussed earlier in this dissertation, with reference to practice-based research by Nicolini (2011) and Gherardi (2012b). As such, new ambiguous situations will inevitably emerge in the very work activities seeking to reduce the power of ambiguity.

Third, the empirical findings in this research indicate that ambiguities are much more dynamic and intertwined with the work than claimed in the literature distinguishing the fuzzy front-end from NPD work (Khurana & Rosenthal 1998; Kim & Wilemon 2002). In stating this, I also refer to some of the many contributions of Brun et al. that have previously considered ambiguity as dynamic, in that its presence increases and decreases during NPD work (see, e.g., Brun & Saetre 2008; Brun et al. 2008, 2009). These researchers have demonstrated that it may be beneficial to sustain ambiguity at times (Brun et al. 2008), but have also claimed that ambiguity in the “fuzzy front-end” should eventually be reduced so as not to hinder or impose costs in subsequent NPD work (Brun & Saetre 2008).

The picture transpiring here is somewhat different, as ambiguities emerged continuously in the ongoing design work. In activities to negotiate ambiguity, the created meanings changed character, in which new ambiguities emerged. As the design outcomes were consigned to the clients’ care and the design work projects ended, not all ambiguities that emerged in the ongoing design work had been reduced.

In essence, the generative power of the ambiguities was negotiated in three ways, being sustained, changed, or reduced. This meant that as the design work projects came to an end, the ambiguities either persisted, had been reduced, or had become obsolete.

The classical ideal that design and NPD work is initiated with many ambiguities that are subsequently and purposefully reduced is therefore questioned. When adopting a practice epistemology, one does not see a funnel of diminishing of ambiguities, but rather a more dynamic emergence and fading away of multivocal interpretations.

The following three subsections describe how the analytical categories of the product, market, and process ambiguities generally emerged and changed character in the studied empirical material. In a fourth section, the emergence of ambiguity in knowing-work is somewhat summarized. In a fifth subsection, the classical notion of that ambiguities may reduce the possibility of rationality is discussed and challenged.
10.1.1 The product ambiguities were changed and reduced

The ambiguities that emerged in the empirical material, which were anchored in the analytical category “product ambiguities,” have been described as ambiguous objectives, functional requirements, and intersections. In essence, the product ambiguities were negotiated so that they changed and were reduced.

Reducing product ambiguities here implies temporarily reducing the multiplicity of interpretations by synthesizing, generalizing, categorizing, etc. As such, the possibly endless variations of interpretations were reduced to a few generalized meanings. Furthermore, the multiple interpretations that persisted in the ongoing work became obsolete when the design work projects were finalized, as described below.

The ambiguous objectives became obsolete

Establishing objectives and functional requirements has often been portrayed as a balancing act between requirements that are too vague versus too specific (see, e.g., Khurana & Rosenthal 1998). The underlying idea is that one wants to be as specific as possible in setting requirements, in order to direct the work into sought-after trajectories without limiting the degrees of freedom in such a way that potentially beneficial, yet unconsidered, characteristics of a design outcome are unintentionally excluded (e.g., Kim & Wilemon 2002; Johannesson et al. 2013).

Setting unambiguous criteria for a future, currently nonexistent design outcome is challenging to start with. Furthermore, it is the very essence of setting up requirements that the degrees of freedom of a design outcome are reduced, which pertains to excluding some potentially beneficial possibilities for design outcomes.

One may also ask what extensive work activities that goes into setting up such unambiguous objectives and requirements; would not that constitute an equivalent work effort as the design work itself? If so, the value of setting up objectives and requirements would be more similar to establishing early guestimates to be questioned and changed later. Here, research into the establishing of objectives in various kinds of knowing-work could benefit from ideas about goal-setting in project management research. For example, Engwall (2002) introduced the notion that goal-setting in project
management practice is for creating project beginnings, rather than predicting project ends (Engwall 2002).

This notion is in line with practice epistemology, and seems to have merit for considering the role of the ambiguous objectives in the studied design work: From initially being challenging to create any meaningful interpretations of the objectives, it later became possible to make multiple, simultaneous, plausible interpretations.

Upon finalizing the design work project, the still ambiguous objectives had become obsolete: it seemed unproblematic that the objectives were multivocal, since the design work had produced design outcomes well attuned to many possible interpretations of the objectives.

This indicates that several interpretations of the objective may be held simultaneously, without that necessarily being problematic, also upon finalizing design work projects. If a design outcome has been created that attunes well to some interpretation(s) of the objective, other possible interpretations may persist, but simultaneously become obsolete.

**The ambiguous functional requirements were reduced**

The ambiguous functional requirements were closely related to the objectives of the work. As already stated, the classical ideal is to set more or less unambiguous criteria for the design outcome (see, e.g., Khurana & Rosenthal 1998; Ullman 2003; Duimering et al. 2006; Johannesson et al. 2013). Part of this vision is that such criteria should then be met by creating a design outcome that “fulfills” the criteria (Ullman 2003).

Others have acknowledged that functional requirements will always at best be “more or less ambiguous statements” about the characteristics of the design outcome, which has been connected to the difficulty of managing this kind of work (Duimering et al. 2006, p. 239).

This thesis instead portrays a middle way between the two opposing views about whether it is possible to establish univocal functional requirements or not. It seems that in the studied design work, the functional requirements were not clearly specified and later changed, as Johannesson noted:

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31 In the service design work, the objectives and functional requirements were defined from the end-consumers’ perspective. In the technical design work, the objectives and functional requirements instead referred to the characteristics of the technical content.
et al.’s (2013) textbook suggests, nor did the ambiguous functional requirements noticeably obstruct the work by being too vague, as Duimering et al. (2006) claimed would be the case. Rather, it seemed as if the core of the work practice was attuned to making sense of ambiguous functional requirements.

The ambiguous functional requirements differed in character between the two cases. However, in both cases the ambiguities emerging in the functional requirements had been substantially reduced as the design work projects came to an end. The negotiations were, in a way, essential to the contracts, since the client would not have accepted a design outcome that was not functional or that did not fulfill the requirements.

Moreover, the ambiguous functional requirements became obsolete upon finalizing the contracts: as functional design outcomes had been created, and the design work projects were finalized and delivered, none of the exemplified functional requirements were relevant to consider any longer, as such becoming obsolete.

In other words, the classical ideas presented in the literature review are both strengthened and challenged by the present research. The ideal that one should avoid ambiguity by being explicit about the product concept, as expressed by, e.g., Khurana and Rosenthal (1998), is challenged and here considered impossible, given that the emergence of ambiguities relating to the functional requirements is outside the practitioners’ control.

The ambiguous intersections were reduced and became obsolete

Much extant literature is anchored in assumptions that NPD work activities may be organized and undertaken sequentially (Brown & Eisenhardt 1995; Eisenhardt & Tabrizi 1995; Hoberg 1998). This sequential view of the work connects to the widespread ideas of problem-setting and problem-solving, in which establishing criteria is part of the problem-setting and “fulfilling” criteria is part of the problem-solving activities (e.g., Schön 1983; Engwall & Westling 2004).

Such a sequential view of the work is challenged in this research, since it seems as if the work is much more intertwined. Of course, that may be a natural consequence of the chosen practice epistemology in which

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32 Although, for example Eisenhardt and Tabrizi (1995) compare with that at times NPD work must instead be organized to favor flexibility and improvisation anchored in experiences.
intertwinement is embraced. However, there seems to be something more than merely an effect of the practice epistemology. This research shows that objectives were not first defined and then “met” by a “fitting” design outcome; rather, interpretations of the ambiguous objectives were continuously intertwined with the becoming of an understanding for the design outcomes.

This research accordingly discusses intersections between interpretations of the objectives and of the design outcomes, rather than the aims of first establishing and then fulfilling objectives as extant literature often implies. What is then noticeable is that the ambiguous intersections between, for example, the interpretations of the objective and the design outcome, or between “hard” and “soft” aspects, is negotiated so that the void between various interpretations may be reduced. Upon finalizing the design work projects the ambiguous intersections had as such been reduced.

This also implies that the ambiguous intersections became obsolete in the design work: as the design outcomes were created the voids between different aspects were simultaneously narrowed. As the design outcomes had been established as fixed and finished, the tensions between objective and design outcome, and between aesthetics and functionality, had been mediated in such a way that various interpretations were attuned to one another.

10.1.2 The market ambiguities changed but persisted

The ambiguities considered in the analytical category of market ambiguities were ambiguous stakeholders as well as ambiguous demands. As a natural consequence of how stakeholders and demands have been conceptualized, it follows that these were deeply intertwined in the ongoing design work. Demands are understood as the many stakeholders’ various desires, expectations, needs, etc. In connection with this, one may also assume that the more ambiguous the stakeholders are, the more ambiguous it is to define their demands.

Part of the design work was to guestimate who the stakeholders might be and what demands they could be assumed to have. The ambiguities that emerged in relation to interpreting the stakeholders and their potential desires changed over time. Upon finalizing the design work projects, unanimous definitions of who the stakeholders were, or what their
demands might be, had not been established. As such, the market ambiguity persisted upon finalizing the design work project.

The stakeholder ambiguity was changed and reduced, yet persisted

As was shown in the literature review as regards market ambiguities, stakeholders have attracted considerable research attention in project management, design work, and NPD, although with varied foci. Project management and NPD researchers have mainly focused on identifying, evaluating, and managing stakeholders (see, e.g., Elias et al. 2002; Achterkamp & Vos 2008; Littau et al. 2010; or the simplified textbook descriptions by Maylor 2010 and Johannesson et al. 2013), while the design literature has mainly emphasized learning from stakeholders, usually with a distinct focus on end-consumers under the label of user-centered design (see, e.g., Kelley 2001; Stickdorn & Schneider 2010; Dunne 2011 in Cooper et al. 2011).

Although these research streams might be insightful when it comes to understanding how to consider stakeholders in a favorable way, none of them seem to consider situations when it is challenging even to “identify” who potential stakeholders are. In the literature review chapters, little was said about ambiguities emerging in relation to stakeholders, given that a lot of research focuses on stakeholder demands as potentially ambiguous.

In the present research, ambiguity emerged in relation to interpreting who the stakeholders could be in the technical design work. This ambiguity was anchored in the impossibility of predicting future users and buyers, as a radically new product was being created. To be fair, a few customers were already on board, though it was acknowledged that there could be many other potential customers in the future. Upon finalizing the technical design work project, this ambiguity persisted.33 In a way, this ambiguity became obsolete, as the inability to make any interpretations of the end-consumers intersected with a variable design outcome.

What has been acknowledged in the various streams of stakeholder research, however, is that multiple perspectives, needs, and desires emerge from the stakeholders, and that these must be considered (see, e.g., Littau et al. 2010; Cooper et al. 2011; or the textbook summaries by Stickdorn &

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33 Instead of negotiating this seemingly impossible ambiguity, the design work instead focused on making it possible to vary the size, handling, and characteristics of the product.
DISCUSSING THE INTERTWINEMENT

Schneider 2010 or Maylor 2010). This kind of literature has contributed with an understanding for how one may include and learn from various stakeholder perspectives. However, although stakeholders are acknowledged as a valuable source, the multiplicity of interpretations emerging from interactions with many stakeholders has been less problematized.

In the present research, ambiguity emerged in relation to the large number of stakeholders in the service design work. The many stakeholders presented different perspectives as well as various and sometimes conflicting desires. The negotiating activities unified, categorized, and labeled the end-consumers, clients, and expectations so that the nature of the stakeholder ambiguity became less disparate. Nevertheless, multiple interpretations of the stakeholders and their possible expectations still persisted upon finalizing the design work project.

The present research suggests, that a multiplicity of market ambiguity may persist upon finalizing the design work project without that being significantly problematic. In other words, knowing-work must not be aimed at reducing or eliminating all ambiguities to clear, unanimous interpretations of all aspects of the work.

This interesting finding goes against the many implicit assumptions that ambiguity must be reduced, a line of reasoning so deeply anchored in our minds that even proponents of the benefits of sustaining ambiguity still seem to assume that the multivocality of interpretations must be reduced upon finalizing a design work project (see Brun et al. 2008).

**The ambiguous demands were reduced, yet persisted**

It is common to discuss the handling of demands as a process of discrete tasks, including identifying stakeholders, evaluating or learning about their needs and desires, and managing them either by meeting their needs and desires or by managing their expectations. There are some common differences between how this is done in design research versus NPD research.34

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34 A possible reason for the difference between these two research streams could be their differing foci on stakeholders: design research mainly considers end-consumers, while NPD research mainly considers clients and other business partners.
Design research is more prone towards designing based on the expressed needs and desires, for instance, the anthologies by Stickdorn & Schneider (2010) and Cooper et al. (2011) presents a number of ‘tools’ for doing do, some of which were exemplified in the literature review. Extant literature on NPD work and projects, on the other hand, is more likely to advocate considering demands by prioritizing them as well as managing expectations among several stakeholder groupings (Achterkamp & Vos 2008).

This research has considered a classical example from each of these streams. The service design work would be a classical example in design research, in which mainly end-consumers are considered. The later phases of the technical design work would be a classical example in NPD research, in which mainly clients and business partners are considered. What is not found in either research stream, however, is a frame for understanding this difference.

To begin with, the criteria for whose demands will mainly be considered, happen to be the same as included in the ambiguous objective. In other words, the objectives point in different stakeholder directions. However, despite having a prioritized interpretative order already established in the objective, ambiguity still emerged in relation to the demands.

What is noticeable is that the continuous emergence of ambiguous demands in the studied work did not have bearing in the established theories for analyzing demands as a one-off endeavor in project management (e.g., Achterkamp & Vos 2008), or as a solely user-centered matter (e.g., Cooper et al. 2011). Instead, in the ongoing work, multiple demands emerged, were continuously sensed, interpreted, and negotiated.

By adopting practice epistemology in this research, the changing nature of the ambiguous demands came through. The ambiguous demands were sustained. In the service design work, the generative and transformative power of the ambiguous demands was made use of as an inspiration for creating design outcome characteristics. In the technical design work, ownership of the ambiguous demands was assigned to the client;

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35 The service design objective was to create a “pleasant” transition service for the end-consumers. The technical design objective was to create a casing for the chemical component that the client was developing in parallel.
simultaneously, degrees of freedom were designed into the design outcome so that it could potentially be varied later as new demands emerged.

What may be concluded from this discussion is that, despite certain differences between the cases, in both types of design work the ambiguous demands were not reduced upon finalizing the design work projects. Rather, the ambiguous demands were intersected with multiple interpretations primarily relating to the ambiguous design outcomes.36

10.1.3 The process ambiguities became obsolete

The process ambiguities37 that emerged in the empirical material were ambiguous guidance from rules and ambiguous (interim) design outcomes. These process ambiguities were negotiated in the ongoing design work, only to become obsolete upon finalizing of the design work projects and delivery of the design outcomes to the clients.

One could question the need to consider process ambiguities at all, if they eventually become obsolete anyway. The stance taken here is that process ambiguity may be sensed and negotiated more or less professionally. This, in turn, coincides with how professionally aspects such as what activities to undertake, when, why, and in what order (in which process ambiguity emerges) are considered in the ongoing work. Such considerations are intertwined with the knowledge-creation work and connected to the becoming of the design outcome.

The ambiguous guidance from rules became obsolete

From a practice epistemological perspective, participating in a work practice entails mediating the void between rules and rule-following with knowing-in-practice (Nicolini 2011; Gherardi 2012b). This is not considered problematic as such in practice-based studies, but rather is intertwined with doing professional work. However, in the empirically

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36 What is meant by “intersecting” is that numerous design outcome concepts were created to establish design outcome characteristics that catered more or less well to the multiple demands. The ambiguous demands were as such negotiated in the ongoing design work, changed character and upon finalizing the projects this ambiguity persisted, without that being problematic.

37 Although this analytical category originally stems from Brun et al.’s (2009) work, most of the framework for understanding process ambiguity relies on the work of Gherardi (2012b) and of Sandberg and Tsoukas (2016).
studied design work, there were situations in which the rule-following became challenging despite experienced professionals.

The theoretical framework conveys that the undertaking of design work (or any work practice for that matter) goes beyond the mere application of methods and tools, that there is a void between generalized rules and situated rule-following (Gherardi 2012b). It is in this void that knowing-in-practice emerges, i.e., the more or less professional doing of design work.

In the service design work, the ambiguous guidance from the generalized process description emerged in interpreting when to consider having reached what they called a “good enough deluxe” design outcome. This ambiguous guidance from rules emerged in having few similar experiences to draw on, since each new project took on a somewhat different objective.

In the technical design work, the ambiguous guidance from rules emerged in interpreting what activities to start with. This ambiguity was mainly anchored in the “Catch 22” of wanting to persuade the clients to start with a prestudy, the persuasive arguments for which were anchored either in gut feelings or in experiences of prior projects, which had often been undertaken with a secrecy clause.

Although process ambiguities may become obsolete after a design work project has been finalized, work activities in situations of ambiguous guidance from rules are at the fore of accomplishing ongoing design work practice.

There are two sides to what may be learned from the ambiguous guidance from rules. Traditional design work and NPD studies may learn about how the many models and methods are continuously enacted and negotiated in ongoing work. Practice-based studies may instead learn from these new kinds of examples for studying the negotiating of ambiguities in knowing-work practice (in which future design outcomes are created) in which ambiguities open up a grander space for action.38

38 In contrast, practice-based research often studies work organized as a continuous practice, for example, blue-collar workers in an assembly line (Gherardi 2012b), safety practices in construction (Gherardi & Nicolini 2002a), or diagnosing and treating patients in telemedicine (Nicolini 2011; Gherardi 2012a). This differs from the design consultancy logic of finalizing a design work project and then starting all over again, although with more experience.
The ambiguous (interim) design outcomes became obsolete

Making claims about whether the design work had accomplished a tentative design outcome attuning to the objective was continuously more or less ambiguous. This ambiguous open-endedness of the work was anchored in an ambiguous means–ends relationship between the work activities and their results, as discussed by Alvesson (2004).

In this regard, an ambiguity emerged in the service design work: it was continuously difficult to pin down whether the design work had created a (tentative) design outcome that allowed for finalizing the work activity.

The service design work was continuously open-ended in such a way that no dimensions were ever definitively settled and unchangeable. Interpretations were continuously made and reconsidered. Such ambiguities became obsolete as soon as the design outcome was presented and delivered to the client organization.

This open-endedness has been touched on in prior research. For example, as was explained with reference to Dorst (2011) in the theoretical framework, design work can be thought of as gathering clues, from which themes emerge: design work, like detective work, entails a search for something unknown. Moreover, Garud et al. (2008) claimed that design work was a work practice that would benefit from harnessing incompleteness, as opposed to the traditional striving for completeness.

The ambiguous (interim) design outcomes that emerged in the service design work were as such not surprising in their own right. Here, a comparison with the technical design work seems to be of value, given that this ambiguity anchored in prior literature but that no counterpart emerged in the material from the technical design work.

That it was impossible to draw a corresponding empirical example from the technical design work is not necessarily problematic or strange. It might even be that this difference naturally derives from the different characteristics of the work objectives in the two design projects.

A first suggestion could be that the difference is anchored in materiality. The emergence of materiality, i.e., the becoming of a physical or visual form, has been called formativeness by Gherardi and Perrotta (2013). The formativeness differed between the two cases in that the service design...
work was creating a two-dimensional, visual form of a conceptual design outcome.\textsuperscript{39} The technical design work instead created a three-dimensional, physical design outcome. This design outcome was to be enacted and communicated to the client in the form of physical prototypes of a functional and manufacture-ready product, as two- and three-dimensional drawings, instructions, and manuals.\textsuperscript{40}

A second suggestion could be that the difference was anchored in the maturity of the design outcome. The emerging and increasing lock-in into created knowledge and into choices already made were called a design paradox by Ullman (2003). The technical design work was studied during a time when the design work participants were detailing and refining three-dimensional drawings and conducting physical tests of various prototypes. By that time, it would be difficult to motivate the value in reconsidering the entire concept and having to redo months of work.

In other words, this difference possibly anchored in how long the work had been ongoing and how well detailed the design outcome needed to be. The technical design work had already advanced to making investments in physical representations, which are less easily changed and reconsidered.

\textbf{10.1.4 To be or not to be—is that the question?}

The short answer to the above rhetorical question would be “no.” This research suggests that ambiguities in design work are not an either/or matter. Rather, and in contrast to the literature’s emphasis on getting rid of ambiguities as a fundamental prerequisite for finalizing design work projects (i.e., Brattström et al. 2002; Brun et al. 2008), ambiguities seem dynamically intertwined with design work.

Practice-based studies have previously noted that ambiguities naturally emerge in knowledge-creation work (Souto 2010); the present research further demonstrates that ambiguities emerge in and are sensed and

\textsuperscript{39} Such a design outcome was enacted and communicated in illustrations, clickable PDFs, and verbal descriptions. All of these “communication channels” are easily and quickly changed without losing much valuable time.

\textsuperscript{40} Some of these “communication channels” are not easily changed without having to make costly and time-consuming revisions of the design outcome’s characteristics and physical representations.
negotiated by design work practitioners as the nature of ambiguous situations changes.

From generalizing about the changing nature of ambiguities in knowing-work, a pattern emerges indicating that not all ambiguities need to be eliminated in order to finalize design work projects—it is not an either/or situation. This finding counters the (often implicit) assumption in the literature that ambiguities are by definition undesirable and should be reduced or mitigated (i.e., Khurana & Rosenthal 1998; De Meyer et al. 2002; Brun & Saetre 2008).

Returning to the analytical categories of ambiguities, in general, the product ambiguities were reduced and became obsolete, the market ambiguities were changed but persisted, and the process ambiguities were continuously negotiated by both sustaining and reducing their power, and eventually became obsolete.

Of course, my claims are not anchored in any quantitatively studies, so it is impossible to make any statistically verifiable generalizations. On the other hand, the conclusions are anchored in detailed and particular descriptions of two studied cases. In other words, this research does make claims to that the renunciation of having to reduce ambiguity can be generalized across design work practice. In essence, what has been shown is that not all ambiguities need to be reduced or eliminated in order to finalize a design work project.

10.1.5 Ambiguity and the possibility of rationality

In Alvesson’s (2004) seminal research into knowledge-intensive work, also defined as ambiguity-intensive work, it was claimed that ambiguity seriously reduces the possibility of rationality, this theorized effect being mentioned as early as the introduction. In the same book, Alvesson (2004) described rationality as “clarifying means–ends relationship or exercising qualified judgement” (p. 49).

No matter how eye-opening the contributions of Alvesson’s research into the intertwinement of ambiguity in knowledge-intensive firms and work, the claimed reduced possibility of rationality under ambiguity is not mirrored in the present research. The studied design work may well be characterized as exemplifying ambiguity-intensive and knowledge-
intensive work. It did not, however, seem to be as disconnected from rationality as theory would have it.

In particular, the claim of a reduced possibility of *exercising qualified judgment* is questioned.\textsuperscript{41}

Alvesson’s (2004) reasoning is anchored in the notion that ambiguity, understood as unresolvable or irreconcilable uncertainty, reduces the possibility of acting rationally in response to something being interpreted. Given multiple interpretations, or the challenge of making any meaningful interpretations in ambiguous situations, Alvesson’s argument is that the possibility of making judgments is reduced.

This thesis has demonstrated that several negotiating activities were part of the design work. Although the work activities might not be foreseeable or might sometimes be ambiguously connected to normative models of how the work should be done, one could still claim that the design work participants exercising qualified judgments. Such judgments anchored in acting professionally in ambiguous situations by making-do with whatever was at hand, rather than making either/or-decisions.

This argument pinpoints a logical error in Alvesson’s (2004) line of reasoning, at least as applied to design work: here it is too simplistic to infer that ambiguity reduces the possibility of rationality. On the contrary, the possibility of rationality may at times be considered to increase with ambiguity, that is, many alternative interpretations for exercising qualified judgment may emerge.

No claims are made here that the emergence of ambiguity increases the possibility of rationality in *all* kinds of knowledge-intensive work of for *all* emerging ambiguities. The claim made here is that ambiguities *may* increase the possibility of rationality in knowing-work, rather than reducing such possibility at all times. In knowing-work, acting rationally does not equate acting in a predictive or optimized manner; instead, acting rationally is related to acting on and embracing opportunities in the emerging work practice.

\textsuperscript{41} The idea that the clarifying of means-ends relationships is challenging also echoes in practice epistemology, although the present research suggest that it must not be problematic that means-ends relationships are opaque.
This research has introduced the concept of negotiating ambiguity to capture the activities to create new and meaningful attuning between interpretations. In other words, negotiating activities may mediate the possibilities opening up in ambiguous situations. In this kind of ambiguity-ridden work, acting rationally entails negotiating ambiguity by harnessing its generative and transformative power and reducing its threats.

10.2 The intertwinement of negotiating activities in design work

Many negotiating activities were intertwined with the ongoing design work. Five types of negotiating activities were analytically distinguished, and in the ongoing design work, these activities were more or less continuously prevailing. The fickleness of negotiating activities made it impossible to attribute some activities as aimed at harnessing and others at reducing the power of ambiguity. Rather, each negotiating activity at times reduced and at times harnessed the power of ambiguity. Similarly, the intertwinement makes it impossible to identify means–ends relationships between specific negotiating activities and specific ambiguities; rather, the many ambiguities were negotiated by the many activities in unison.

Traditionally, actions such as reducing ambiguity (Brun & Saetre 2008) or mitigating uncertainty have been considered a “fundamental aspect” of this kind of work (Brattström et al. 2012: 743). Furthermore, it has been argued that it is essential to “avoid ambiguity” by being as explicit as possible about the product concept in the first place (Khurana & Rosenthal 1998, p. 69).

This thesis instead advocates broadening the picture by considering the negotiating activities a fundamental aspect of knowing-work, and proposes acknowledging and embracing that ambiguity cannot be avoided. Though this might seem like a slight difference, its consequences are significant: considering negotiating activities to be fundamental to the knowing-in-practice of doing design work means opening up for both reducing and harnessing the generative and transformative power of ambiguities. In other words, this acknowledges the neglected beneficial sides of ambiguities that also emerge in the work. Embracing that ambiguities...
cannot be avoided makes ambiguities come as less of a surprise and instead open up for sensing and negotiating them.

The five types of negotiating activities emerging from the empirical material and analysis highlight how the inability of making unanimous interpretations changes in the ongoing design work. These five analytically distinguished types were: (1) constructing points of reference, (2) mediating between perspectives, (3) anchoring in expertise, (4) disarming future resistance, and (5) creating shared visions. All five types of activities negotiated the ambiguous situations in somewhat different ways, which will be discussed after a short detour to consider the characteristics of the negotiating activities. Thereafter, a few noteworthy considerations will be raised and discussed.

10.2.1 Characteristics of the negotiating activities

The design and NPD literature has proposed a number of methods and processes for structuring the work. As mentioned in the introduction, the classic approaches include sequential activities undertaken either linearly or iteratively (e.g., Clark & Wheelwright 1993; Ulrich & Eppinger 1995). Such approaches have here been criticized for being intolerant of uncertainty and unforeseen events, possibly leading to costly, late changes.42

Systematic approaches to design and NPD work have been further developed to incorporate suggestions for flexibility and improvisation (e.g., Eisenhardt & Tabrizi 1995), such as that several competences should work in parallel or that the work could be planned in shorter, foreseeable sprints (Johannesson et al. 2013).

In both studied cases, the organizations had established generalized process models of how the work should ideally be undertaken.43 The process models in both cases were processes with sequential activities, some of which were to be iterated. When ambiguities did emerge in the ongoing design work, the work did not seem to be noticeably interrupted, the process methods were not questions, and it seemed as though the negotiating activities were intertwined with the activities to professionally perform design work.

42 This is something Ullman (2003) discussed with reference to the design process paradox.
43 These models and their contexts were described in the empirical settings chapter.
All in all, five negotiating activities have been described. What characterizes these negotiating activities is that they were all intertwined in the ongoing design work. In unison, these activities negotiated the emerging ambiguities and found ways over or through the multiple interpretations by reaching agreements or compromises. The negotiating activities were not characterized by clear beginnings or definitive ends; they happened all at once, yet were analytically separable from one another.

The intertwinement of the negotiating activities made it practically impossible to connect specific ambiguities with specific negotiating activities. Rather, the emergence and fading away of ambiguities and the activities undertaken to negotiate these ambiguities are two parallel stories. Note, however, that the two stories are not distinguishable by having too few intersections, but on the basis of being intertwined continuously in the ongoing design work.

10.2.2 Constructing points of reference as temporary interpretations

Constructing points of reference meant that temporary anchoring was continuously created. Such temporary reference points were constructed in relation to all of the analytical categories of ambiguities, that is, product, market, and process ambiguity.

In a way, the construction of reference points mimicked the delimitations often made in design and NPD work, with the difference that these reference points were provisional in nature. The points of reference did not just happen to become temporary, it was rather the ordinary way.

For example, the mimicked delimitations set product definitions or categorized and prioritized between stakeholders. The categorization and prioritization between stakeholders have been described with reference to the NPD and project management literature (e.g., Elias et al. 2002; Achterkamp & Vos 2008; Littau et al. 2010; Johannesson et al. 2013) as the analysis of what stakeholder categories to prioritize, depending on which ones are considered important according to various dimensions. In the studied design work, however, the stakeholders were categorized and prioritized, only to challenge and revise such groupings several times. The design work zoomed in on one or a few stakeholder groupings, only to change and focus on others in other situations.
The generalized activities for constructing points of reference

The construction of reference points included a number of activities that in various ways created unanimous interpretations from which the continued work could depart. This research has pinpointed four activities in which such points of reference were constructed, namely: (1) imposing tentative structures, (2) narrowing the focus, (3) constructing common denominators, and (4) revising the points of reference.

Imposing tentative structures meant that the design work participants were continuously structuring and categorizing multiple interpretations of situations, statements and artifacts, such as the clients, end-consumers, objective, and design outcome.

Narrowing the focus meant that they were zooming in on various aspects of the work, by establishing intersections or probing into limited degrees of freedom. Such intersections or delimitations became frames of reference for directing attention.

Constructing common denominators meant that they were establishing unanimous baselines in creating language and sharing visual references. The creation of language was accomplished by using metaphors, summarizing and labeling discussions, and establishing new vocabulary by merging English and Swedish terms.

Revising the points of references meant that the design work participants were communicating deeply and recursively, that is, they were dialoguing with stakeholders repeatedly. As the design outcome concepts were continuously refined and detailed the dialogues became continuously deeper and more detailed.

What these activities illustrate when combined is a fairly straightforward negotiating activity in continuously constructing temporary points of reference. This was done by creating provisional shared language and shared attention by temporarily attuning unanimous understandings. This negotiating activity mimicked systematic processes and structures in order to mitigate uncertainty, as foretold by Brattström et al. (2012), but the mitigation was only temporary and continuously changed.
10.2.3 Mediating between perspectives to attune interpretations

The studied design work continuously had to take into account various perspectives and aspects. Several opposing logics were portrayed as ambiguous in the design work, for example, between aesthetics and functionality and between various end-consumer demands.

Prior research has acknowledged that there are often many stakeholders with various demands in design and NPD work (e.g., Achterkamp & Vos 2008; Littau et al. 2010; Cooper et al. 2011). A common approach to take account of the various perspectives is to make a stakeholder analysis of the individuals or organizations taking an interest in the work (e.g., Elias et al. 2002). Another often proposed approach is to analyze the stakeholders’ demands, for example, by shadowing and conducting contextual interviews with stakeholders (e.g., Stickdorn & Schneider 2010).

Similarly, Duimering et al. (2006) acknowledged that product requirements are always more or less ambiguously defined. Johannesson et al. (2013) further acknowledged that the product requirements (which they call product specifications) should be developed as an understanding of the product-to-be emerges.

Although the above literature does propose methods for learning from various stakeholder groups and for considering the product requirements as open to change, it is less informative about what to do with conflicting product requirements or with the fragmented material from stakeholder interactions.

Mediating between perspectives portray the negotiating activities to attune interpretations, for example, of varying and sometimes even conflicting stakeholder demands and of different and sometimes even opposing product requirements (e.g., aesthetics vs. functionality).

The generalized activities for meditating between perspectives

Mediating between perspectives was a kind of matchmaking game in which various interpretations of various perspectives in the design work intersected and were weighed against one another. This research has described four types of activities in which perspectives were mediated, namely: (1) alternating between perspectives, (2) combining perspectives, (3) balancing perspectives, and (4) advocating for perspectives.
Alternating between perspectives meant that they were shifting between perspectives, focusing on one perspective at a time; these perspectives referred to either various stakeholder groupings or various characteristics of the design outcomes.

In combining perspectives, design work participants considered several perspectives simultaneously by establishing commonalities and unifying perspectives.

Balancing perspectives meant that they were weighing the arguments for various perspectives against each other, not necessarily prioritizing one over another, but making sure both “sides” were heard and considered.

In advocating for perspectives, the participants spoke on behalf of certain perspectives, assuming the voices of and speaking for stakeholders.

What these four types of activities illustrate is that certain perspectives were not simply prioritized over others. For example, one stakeholder group was not given interpretative precedence over another; rather, the design work went to great lengths to take account of and interweave all perspectives. This differs from traditional ideas of how to analyze and relate to stakeholders, each of whose interests are prioritized and valued differently (i.e., Elias et al. 2002; Achterkamp & Vos 2008).

Mediating between perspectives is important, since failing to do so could have serious consequences for the design work. Consider, for example, a situation in which some stakeholders are unjustifiably prioritized over others. Such unfairness could jeopardize the entire design work effort, for example, if the design outcome is praised by end-consumers but is not economically viable for the client (or vice versa). Similarly, one could potentially create a design outcome that is aesthetically pleasing but nonfunctional (or vice versa).

10.2.4 Anchoring in expertise to base inarticulate interpretations

As has been thoroughly shown by now, there are many established ideas on how to engage with stakeholders in a structured way in order to become aware of and address their demands (e.g., Achterkamp & Vos 2008; Cooper et al. 2011).

An approach situated between the two opposing logics of NPD project literature and design work literature was described in the introduction of
the present work, which cited an empirical example presented by Lester and Piore (2004) concerning the architect’s recursive interactions with the client. The architect and client were jointly engaged in knowledge creation, co-developing an understanding of the characteristics of the future building.

Although anchoring in expertise recalls architects’ interactions with their clients, it seemed to go much further and deeper in the two studied cases: various stakeholders were interacted with throughout the ongoing design work, and not only in the early phases of the projects to establish their demands, or a repeated number of times to report on progress. Instead, the client stakeholders were assigned continuous ownership of the work and were invited to share their experiences, while end-consumers were integrated as experts to evaluate the becoming design outcome.

Furthermore, the anchoring in expertise in design work seems to be more complex than the similar interactions found in the example from architecture. Lester and Piore (2004) described an architect interacting with one client in order to establish demands. In contrast, the anchoring in expertise observed here meant that the design work participants were interchangeably interacting with one another, clients, end-consumers, and suppliers, depending on which expertise or experiences that were thought to be needed.

The generalized activities for anchoring in expertise

The negotiating activities for anchoring in expertise included several different activities to base inarticulate interpretations, such as gut feelings and experiences. The two generalized activities for anchoring in expertise were evoking experiences and inviting expertise.

*Evoking experiences* meant that those with experiences concerning the objective, were asked to voice their opinions and reflections. In the service design work, the client stakeholders were considered to be experienced about various, prior end-consumer reactions to changes in their services. In the technical design work the senior design consultants were considered to have valuable experiences of technical considerations.

*Inviting expertise* meant that the design work participants were locating and inviting expertise amongst stakeholders, in order to ask for their opinions. It was not always the case that they wanted to understand the
underlying arguments and considerations for expressed opinions. When the designers had to act on the opinions expressed by the experts, however, they went at great length to understand the underlying logics.

These two ways of anchoring in expertise show that neither the clients nor the end-consumers were interacted with merely to establish demands in order to set the frames for future design work. Moreover, the clients and end-consumers were not interacted with recursively merely to learn about their demands and to receive their evaluations and feedback (which is the general idea in Lockwood 2010; Stickdorn & Schneider 2010).

Instead, the anchoring in expertise meant that client stakeholders were integrated into the work, that the design work participants could speak from experience themselves, and that end-consumers were invited to participate as experts—in short, the design consultants sought expertise and experience as needed, rather than following a strict protocol for whom to interact with when.

10.2.5 Disarming future resistance by provoking interpretations

Disarming future resistance was not as prevalent in the work as were the other types of negotiating activities. Nevertheless, there were negotiating activities in both cases that justified making “disarming future resistance” its own category.

This category may at first seem incongruous after having argued for the unpredictable and haphazard nature of ambiguities (with reference to March & Olsen 1976) and having claimed that design work is an emerging work practice (with reference to Markus et al. 2002) and thus that ambiguity cannot be avoided. The incongruity would be anchored in the discrepancy between suggesting a future-oriented negotiating activity while having claimed that ambiguities cannot be foreseen.

Disarming future resistance was not about foreseeing and taking preventive action before ambiguity emerged, however. Rather, disarming future resistance was anchored in that the practitioners knew from experience that ambiguity would likely emerge, but did not know what

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44 Which is the general idea in much prior literature, see, e.g., Elias et al. 2002; Lester and Piore 2004; Achterkamp and Vos 2008; Johannesson et al. 2013.
kinds of ambiguities would emerge, when ambiguities would emerge, or what the effects of such ambiguities would be.

Knowing from experience that ambiguities often emerged with regards to certain aspects in the work, the negotiating activity of disarming future resistance in essence meant trying simulating these situations.

In the service design work, the most imminent future resistance that would probably cause the most trouble was unknown and disregarded end-consumer desires. Thus, they were from start communicating broadly, with as many end-consumers as possible, to ensure (as far as possible) that they included the most abundant desires.

In the technical design work, the most imminent future resistance, which would probably risk the entire project and its interim results were technical malfunctioning and unknown and disregarded demands. For example, technical challenges often emerged when shifting attention from two-dimensional sketches to three-dimensional models. Therefore, this shift in attention was simulated by making simplified physical functional models using crafts material with sketching, i.e. long before having mature concepts to prototype. They also continuously assigned ownership to the client by integrating the client stakeholders into the work so that changes in demand could be sensed early.

The negotiating activities to disarm future resistance were not intended to foresee future ambiguities, but to seek to entice any ambiguities that might inevitably emerge to do so sooner rather than later.

10.2.6 Creating shared visions for continued interpretations

Some research has theorized about how to take action in ambiguous situations. As described in the third literature review chapter, “play” has been introduced as a metaphor for the innate balancing between rule-following and openness to emergent properties (Styhre & Börjesson 2011), while sensemaking has been portrayed as at the core of design work (Krippendorff 1989).

Creating shared visions included activities for negotiating ambiguity that set the stage for ongoing interpretative work efforts. However, the activities undertaken to create shared visions did not really adhere to descriptions of play: although these activities were open to emerging properties just as
play is, they did not seem as rule-bound as “playing” in theatrical performances, which Styhre and Börjesson (2011) cited as an example.

**The generalized activities for creating shared visions**

Lester and Piore (2004) instead discussed design and NPD work using the metaphor of a conversation that emerges without a clear predetermined direction. This recalls one of the design work activities for creating shared visions, namely, making do with whatever is at hand. *Making do* entailed sensing and responding to the emerging work by improvising, taking one step at a time, and comparing empathy by verbalizing gut feelings.

However, creating shared visions was also achieved by *enacting talk in representations*, which meant that they were creating shared visions in its most literary sense, creating two- and three-dimensional artifacts to look upon. That is, the design work participants used material, discursive, and visual representations that made it possible for them to attune their multivocal understandings of various ambiguous situations, statements, and artifacts.

Interacting with visual and material artifacts is seen as an innate part of working, from a practice epistemology. This was discussed in the first literature review chapter with reference to Nicolini et al. (2003). Practice-based studies often rely on empirical material from continuous work practices.45

The focus here is instead on knowledge-creation work intended to create a new, future design outcome organized as separated projects with start and finish times. It is reasonable to assume that the artifacts to relate to are much more ambiguous in knowledge-creation work, in that they do not yet exist, than, for example, the ambiguity of evaluating the quality of a battery plate that one may sense, feel and touch.

The implications of choosing not to negotiate ambiguity by creating shared visions is that the work may become random, the practitioners may work in various uncoordinated directions, and the communication may be subject to misunderstanding.

45 As has been described earlier, such work practices have included medical practice, blue-collar work, and construction safety (e.g., Nicolini 2011; Gherardi 2012a; Gherardi 2012b).
The negotiating activities to create shared visions were not about establishing and writing down an intended goal of the design work. Rather, the creation of shared visions became baselines of attuned understanding from which the continued collaborative work could take off from. This recalls the idea of goals as creating project beginnings, which was discussed in the theoretical framework with reference to Engwall (2002). Engwall (2002) refers to the initial goal formulation as creating project beginnings. In this research, however, the creating of shared visions was not a one-off endeavor to create starting conditions, but rather was ongoing.

10.2.7 Peculiar aspects of negotiating activities

The described negotiating activities are not to be understood as the traditional toolkits mentioned in classical design and NPD research. That research has largely theorized about the rules imposed on the work, that is, the generalized, normative process descriptions and structured approaches for how to practically accomplish the work.

As argued throughout this thesis, rules do not suffice as explanatory models of the professional practice of “doing” design work: an ambiguous void emerges between rules as generalized descriptions and situating these in use. In making this statement, I rely on a long tradition of studying rules and rule-following, beginning with Wittgenstein in the early 20th century. In practice epistemology, Gherardi (2012b) has taken a particular interest in what she described as the void between generalized rules and the situatedness of knowing the rules.

From the five negotiating activities, a number of peculiar aspects of the changing nature of ambiguities in knowing-work may be discussed. These aspects refer to the literature on ambiguities in knowledge-creation work and practice-based studies, yet neither quite mirror nor contradict the prevailing views. In other words, these aspects illustrate other dimensions of negotiating activities in design work.

Ambiguities and negotiating activities did not disrupt the design work

As described at length in the third literature review chapter, Gherardi’s (2012b) notion of negotiating ambiguity referred to blue-collar workers’
collective understanding of battery plates as “soft” in a particular case. In cases in which the negotiations concluded that the quality was poor, a script for reducing the production quota was initiated (Gherardi 2012b).

This story is retold because in it the negotiating of ambiguity was distinguishable from the ongoing work practice: the blue-collar workers shifted focus, and at times the negotiating activities led to the initiation of certain actions. Such a description differs from the ambiguous situations that emerged in the design work studied here, however.

As ambiguities emerged, the design work was not noticeably disrupted, and plans and systematic approaches were not inevitably reconsidered or changed. This implies that design work, and potentially also other kinds of knowing-work, is not necessarily disrupted by emerging ambiguities. Also in line with this is the finding that the studied negotiating activities were not distinctly different from, but rather intertwined with, the ongoing knowledge creation.

**Negotiating activities were not rushed**

A second unusual finding that does not clearly support or refute the literature is that there was no rush to reduce ambiguity. As ambiguities emerged, the design work participants took their time to negotiate ambiguity and, in doing so, either reduced or harnessed the generative and transformative power of multiple, simultaneous interpretations. This is not explicitly discussed in the empirical findings or in the analysis, but is rather a pattern that emerges from reading between the lines.

Although the aspect of time, and whether ambiguities should be reduced hastily or not, has not been discussed in the literature on various efforts to reduce ambiguity (e.g., Khurana & Rosenthal 1998; Brattström et al. 2012), it does seem to matter. Given the negative connotations of ambiguity that transpire in efforts to reduce it (Khurana & Rosenthal 1998) or to mitigate it (Brattström et al. 2012), it is reasonable to assume that such efforts should be undertaken sooner rather than later. If one considers it crucial to manage uncertainty as it is thought to impede learning (De Meyer et al. 2002) or stand in contrast to creativity (Brattström et al. 2012), then one would want to eliminate it as soon as possible.

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46 Ambiguity emerged in evaluating the quality of the plates as poor, i.e., “soft.” The negotiating activities included coping with ambiguous interpretations, implicatures, and implementations of action.
Judging from the many activities to negotiate ambiguity, which were also undertaken for extended periods of time in the ongoing design work, there was no rush to reduce ambiguity. The empirical material in this research instead indicates that if ambiguities are considered natural they neither come as surprises nor demand immediate full attention and reduction.

**Negotiating activities maneuvered in the space between multiple interpretations**

It seemed that the ambiguities opened up the work by allowing it to deviate from the paths it was already pursuing. The emergence of multivocal interpretations became rooms for maneuvering in-between the many interpretations.

The negotiating activities maneuvered in this space between multiple interpretations: the sensing and negotiating of ambiguities offered a possibility for sustaining and making use of the multiple interpretations. In the design work, this meant postponing judgment and, for example, simultaneously working on several design concepts as possibly attuning to various interpretations of the ambiguous objective. Making use of multiple interpretations also meant making tentative decisions in constructing points of reference that were later challenged and changed.

This way of maneuvering in the space created between multiple interpretations counteracts what Ullman (2003) called the design process paradox. In other words, the generative and transformative power of ambiguities may be understood as enabling one to break from the trajectories of earlier interpretations. The negotiating activities as such become the means for maneuvering in the world of possibilities opening up in such ambiguous clearings.

This continuous open-endedness might be beneficial, as it for example provides a possibility to adapt the design concepts to the judgement of stakeholders, whilst providing the stakeholders with graspable suggestions to evaluate. In other words, the negotiating activities mediate the “Catch 22” of seeking the stakeholders’ opinions on design outcomes that have not yet been created.
10.3 Synthesizing the positioning of the discussion

This thesis has argued that the more traditional design and NPD literature often describes this kind of work using a reasoning based on sequential and predetermined work activities (e.g., Clark & Wheelwright 1993; Brown & Eisenhardt 1995; Ulrich & Eppinger 1995; Ullman 2003; Stickdorn & Schneider 2010; Johannesson et al. 2013). Others have differentiated between such predictable processes and more adaptive processes which allow for responses to unpredictable uncertainty (e.g. the “experiential strategy” in Eisenhardt & Tabrizi 1995, or “play” in Styhre & Börjesson 2011).

Either way, when ambiguities inevitably emerge, they appear to be unexpected and negative deviations that must be “handled” as they challenge the creation of a design outcome, either by stricter planning of the predictable work or by openness to improvisation for unpredictable processes.

If, on the other hand, the emergence of ambiguity was expected and embraced, if ambiguity did not come as a surprise, and if the work was not noticeably interrupted by it, then ambiguity would not have to be seen as a threat to be avoided or mitigated with haste. Instead, ambiguities could be sensed and negotiated, which include reducing it at times as well as harnessing its generative and transformative power when the multiple interpretations creates a room for maneuver. That is, the power of ambiguity may be embraced and harnessed when they open up a space for action that allows one to break free from delimiting interpretations.

Yet other literature has truly acknowledged the ambiguous nature of knowledge-creation work, often going to the other extreme by fully embracing sensemaking or creation of meaning (i.e., Schön 1983; Krippendorff 1989; Weick 1995; Krippendorff 2006). When work inevitably emerges in activities intended to create and deliver design outcomes, these theories give little guidance for how to organize the work and how to undertake activities.

A middle road has also been pursued in research that has sought both systematic approaches to design work and to handle ambiguities. It is in much of this literature that the controversies between ambiguity and various beneficial aspects of the work has been portrayed, such as
ambiguity standing in contrast to learning or creativity (i.e., Khurana & Rosenthal 1998; De Meyer et al. 2002; Brattström et al. 2012).

By adopting practice epistemology, it has been possible to study ambiguities as they emerged and faded away in ongoing design work from a more neutral perspective: ambiguities were studied as they were sensed and negotiated in the human actions constituting the design work. The practice epistemology also allowed for studying the negotiating activities as continuous and intertwined with the work activities.

What may be concluded based on practice epistemology is that the emerging ambiguities did not drastically or even noticeably interrupt the ongoing work, and did not even surprise the practitioners. “On paper” the work activities continued to enact the generalized process models, yet ambiguities were continuously negotiated. 47

Few earlier scholars have researched ambiguity using practice epistemology: ambiguity is seen as natural in any work practice, according to practice epistemology, which might be part of the reason why it has attracted so little attention to date. One exception is Gherardi (2012b), who discussed the ambiguous void between rules and rule-following as well as how practitioners negotiate these ambiguities from a practice perspective. Gherardi’s (2012b) cited examples rely on highly standardized work practices.

The research presented here focuses specifically on knowing-work and relies on empirical examples from design and NPD work, which is a less standardized work practice, given that they create different kinds of design outcomes in the various projects. Another difference between the kind of work studied here and the typical examples cited in practice-based studies is that knowing-work is creating knowledge for an unknown future design outcome, in contrast to assembling yet another battery, as a copy of every other battery produced in the production line.

In the studied design work, the activities to negotiate ambiguities were continuously intertwined in the ongoing work practice. This was partly a precondition for practice epistemology, but also partly a conclusion of it. It

47 Intersecting the design work with negotiating activities was not similar to initiating a script on the basis of having sensed ambiguity as in Gherardi’s (2012b) description of coping with soft plates in battery production; rather, the negotiating activities were intertwined in the ongoing design work.
was a precondition in that ambiguities naturally emerge and must be handled, i.e., negotiated.

It was a conclusion in that this research has demonstrated that negotiating activities were not only part of the design work, but were also intertwined with the knowing-in-practice of professionally performing it, i.e., negotiating ambiguity is part of skillfully doing knowing-work. To establish this, I relied on Gherardi’s (2012b) notion of knowing-in-practice, which is how ordinary work is practically accomplished despite the ambiguity of rule-following. The present research has also shown that the activities to negotiate ambiguity are not only intertwined with the work practice but also inseparable from the knowledge-creating activities, i.e., the design work activities create knowledge and negotiate ambiguity in one.
11 At the heart of design work

Ambiguity is at the heart of design work. Mastering to negotiate ambiguity is of the essence in knowledge-creation work: to sense when it is a threat and when it is a resource, and when it is something to reduce or something to embrace, is part of the knowing-in-practice of doing design work.

I argue that the generative and transformative power of ambiguity becomes visible when researching design work as knowing-work, by adopting a practice epistemology. This generative and transformative power refers to the space for action that ambiguities open up in the design work. Such a space for action emerges between a multiplicity of interpretations and breaks from established paths. The generative and transformative power of ambiguities is anchored in that ambiguities enable the reinterpretation and mediation of many situations, artifacts, and statements.

Utilizing practice epistemology in this research meant studying the design work in its becoming, as interactions between humans, symbols, and artifacts. Understanding the sensing of and activities to negotiate ambiguities in knowing-work from a practice epistemology implied considering how people faced and handled inaccuracies of making unanimous interpretations in ongoing work.

To distinguish between the various characteristics of the emerging ambiguities in the empirical material, an analytical distinction was made between product, market, and process ambiguity. All of these analytical categories were represented in the empirical material.

In this way, ambiguities were studied as they emerged, were sensed, and were negotiated in interactions between humans, symbols, and artifacts in a situated context. The descriptions that empirically anchor this research were drawn from ongoing design work in two consultancy organizations, focusing specifically on one consultancy project in each organization, as well as from engaging in dialogues with employees and managers.
11.1 Contributions

The conclusions indicate that the very essence of design work revolves around the emergence and fading away of ambiguity. I argue that the sensing of and activities to negotiate ambiguity are part of the knowing-in-practice that goes into the practical accomplishment of design work, and that this negotiating may be done more or less professionally.

It is in the activities to sense and handle ambiguity, by reducing or harnessing its power, that collective knowledge is created, mediating the becoming of the design outcome. Interpretations were continuously made and negotiated in the design work, not so much to eliminate ambiguity as to clarify, delimit, distinguish, and compare multiple interpretations.

In the following subsections implications for both research as well as for practitioners are described.

11.1.1 Implications for research

This research has applied a new perspective to studying ambiguity, which has enabled a focus on the emergence of ambiguity and the activities undertaken to negotiate it. By doing so, the present research has also created a vocabulary for the elusive phenomenon of ambiguity and for talking about activities in ambiguous situations (i.e., sensing and negotiating ambiguity to harness or reduce its the power).

Practice epistemology contends that in every new undertaking (be it a repetition of an activity or an entirely new project), the work is situated in a new historical, social, and cultural context (Nicolini et al. 2003). In each new design work project, a (most often) new client contact person and new organization are establishing a new (ambiguous) objective for a new (ambiguous) group of stakeholders. All this ambiguous newness is to be attuned to a new design outcome.

What the present research favors is an understanding for how design work is professionally practiced despite the ambiguous voids between generalized ideas for how to do the work and the situated practice of doing

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48 In design work, which is organized as time-limited projects undertaken on behalf of external client organizations, the matter of new context is an especially distinct characteristic.
the work anew. The present research makes two main contributions, one regarding ambiguity and the other regarding negotiating activities.

**Ambiguities open up a space for action**

The first contribution challenge the view that ambiguities are undesirable. Doing so enables us to break free from a long tradition of approaching ambiguities as deviations to be mitigated, avoided, handled, and reduced (e.g., March & Olsen 1976; Khurana & Rosenthal 1998; De Meyer et al. 2002; Brun & Saetre 2008; Brun et al. 2009; Brattström et al. 2012). Instead ambiguities, of all three analytical categories, may open up the work and create a space for action. The space for action enables new interpretations to emerge with regards to the design outcome, its intended market and the process of its creation.

The discussion also illustrated how ambiguities could change in ongoing design work, while not necessarily being reduced upon finalizing the design work projects, which extant literature has implied, as shown earlier. In the two studied cases, the analytical categories of the ambiguities generally changed according to the following patterns.

The generative and transformative power of the product ambiguities were harnessed in the ongoing work, as they opened up a space for multiple interpretations of the design outcomes, objectives, etc. Such generative and transformative power was reduced upon finalizing the projects (for example by having attuned a design outcome to interpretations of the objective) and in essence became obsolete.

Interpretations of the market ambiguities were continuously negotiated; the power of the multiple interpretations being reduced by grouping stakeholders and interpretations of their varied and opaque desires. Even so, as the design work in the project was finalized, market ambiguity persisted. This did not seem troublesome however, as the generative and transformative power of market ambiguities had been harnessed as to inspire the creation of design outcomes that attuned to many stakeholders and demands.

The process ambiguities were continuously negotiated in that action was taken also in situations with little guidance from their established design work methods: the practitioners were making-do. When the design work projects were finalized, these ambiguities became obsolete as the work
activities had been finalized. In essence, the generative and transformative power of process ambiguities was sustained and made use of by harnessing the possibilities for working with whatever was at hand in the emerging work.

**Negotiating activities maneuver in the ambiguous space**

The present research also advances an academic understanding of the activities that go into negotiating ambiguity by portraying these in the unfolding work practice (as such building on, e.g., Simon 1973; Schön 1983; Krippendorff 1989; Weick 1995; Brun et al. 2008).

The second main contribution to research adds to the notion that negotiating activities are intertwined with knowing-in-practice, that is, are part of practically accomplishing design work.

More specifically, the contribution is that the negotiating activities becomes a way of maneuvering in the space for action that opens up under ambiguity. This research has illustrated how negotiating activities were continuously mediating between interpretations as such making use of the generative power of ambiguity.

Five negotiating activities have emerged in the research, namely: (1) constructing points of reference, (2) mediating between perspectives, (3) anchoring in expertise, (4) disarming future resistance, and (5) creating shared visions. These negotiating activities exemplify five ways in which ambiguities may be approached either to reduce or harness their generative and transformative power. These negotiating activities are not intersected with specific ambiguities or either with the reduction or harnessing of ambiguities. Rather, the negotiating activities were continuously intertwined with the emergence and fading away of all analytically separated ambiguities, at times reducing and at times harnessing the potential of the room for maneuver in ambiguous situations.

The present research contributes to design and NPD research by portraying several negotiating activities to illustrate an alternative approach to sensing and handling ambiguities. This points to the power of practice epistemology in the study of design and NPD work. This is important, as it opens up new ways of considering ambiguities in knowing-work that call for sensing and handling ambiguities so as to harness their
generative and transformative power in addition to reducing it when it is considered a threat.

This research also contributes to the body of literature on ambiguities anchored in practice epistemology. By drawing on a different kind of work, which focuses intensively on creating knowledge and is analytical and interpretative in nature (Souto 2010), this research adds to the understanding of the becoming and fading away of ambiguity in ongoing work practices that are less straightforward and less recursive as compared to, e.g., blue-collar work in production.

This expands the view of ambiguities in practice epistemology as not only anchored in the void between rules and rule-following in highly standardized work practices, but also as emerging in the interpretations and activities in knowing-work. This is important, as it portrays a prominent part of the knowing-in-practice that goes into the practical accomplishment of professional design work.

11.1.2 Implications for practitioners

One reason why ambiguity is so important in design and new product development work is that this work is creating unknown, future design outcomes, and is as such intertwined with the emergence of multiple, and at times conflicting, interpretations of what to achieve, how and when.

The present research has pointed to the inevitability of encountering situations in which prior experiences in taking on design work as consultancy projects. Simultaneously, this research suggests that the knowing-in-practice of professionally doing design work is intertwined with sensing and negotiating ambiguity, that is, to know when multivocal interpretations are a threat and when they are something to make use of.

Discussing inabilities of making unanimous interpretations has not been intended to imply any personal shortcomings among the practitioners. Instead, this inability of making unanimous interpretations signify that the practitioners acknowledge that something may be interpreted in multiple ways and that settling on unanimous interpretations would imply jumping to conclusions. The implications for practitioners from this research is fourfold.

First, ambiguities emerge naturally in design work. Embracing their naturalness may lower the threshold for sensing and handling ambiguous
situations as they emerge. In essence, this implication boils down to that acknowledging that ambiguities will emerge and that these cannot be avoided implies that it may be more beneficial to learn what can be done in ambiguous situations, rather than stubbornly trying to foresee the unforeseeable. Like the proverb states if you can’t beat them, join them!

Second, ambiguities are not innately good or bad; They emerge in-between multiple interpretations and are noticeable in human sayings and doings. If ambiguities are negotiated one may both harness and reduce their generative and transformative power for one’s own purposes.

Third, negotiating activities can be intertwined with the ongoing design work, rather than being responses to unexpected events that markedly change the direction and activities of the work. This means that negotiating ambiguity must not interrupt the ongoing work, but can rather be part of the daily work activities for creating a design outcome.

Fourth, this research has identified five activities for negotiating ambiguity from which one may take inspiration. The take-away from the five exemplified negotiating activities are in essence that (1) points of reference can be constructed temporarily, instead of jumping to conclusions by making delimitations to the objective, the work activities or the intended market too early, (2) various perspectives can be mediated and balanced, instead of making strict prioritizations between stakeholder groupings or product characteristics, (3) the inclusion of design work participants can be varied with the ongoing work to include sought-after expertise and experiences, (4) future challenges can possibly be disarmed by enticing common, inevitable challenges to emerge earlier rather than later, and (5) creating shared visions may be useful for both making retrospective summaries of discussions and work thus far as well as for creating unanimous understandings of future-oriented hypothesis by, for example, visualizing potential design outcomes.

All in all, the four implications suggest that sensing and negotiating ambiguity in a professional way anchors in considering the handling of ambiguity a matchmaking game. The described negotiating activities point to five ways for attuning interpretations in such matchmaking game.
11.2 Suggestions for future research

Several aspects of ambiguity not considered here would make for interesting future research. In essence, four suggestions for future research are hereby presented.

11.2.1 Studying rule-following and the acquiring of skill

This research has considered the void between rules and knowing the rules, or rule-following, by relying on Gherardi (2012b). However, no consideration has been given to whether the more experienced, senior design consultants interpret and follow rules differently than the less experienced junior design consultants.

Rule-following has often been studied in relation to skill. A salient contribution to an academic understanding of skill and skill acquisition was Dreyfus and Dreyfus’ (1980) report, “A five-stage model of the mental activities involved in directed skill acquisition.” In this report, they theorized about a model comprising five stages of acquiring skill: starting from novice, going through competence, proficiency, and expertise, and ending in mastery. They argued that as more skill was acquired, one would rely less on abstract principles and more on concrete experience.

Future research could benefit from intersecting the practice-based perspective on ambiguities in knowing-work, with research into acquiring skill or experience. One could potentially learn about differences in how ambiguities are sensed and negotiated between more and less experienced practitioners from this. The more experienced practitioners potentially have more experience of following rules according to abstract principles, as well as more concrete experience of sensing and negotiating the ambiguous void between generalized rules and their situated use. These more experienced practitioners might therefore handle deviations from the abstract principles, i.e., negotiating ambiguity, in a more professional way.

11.2.2 Studying other kinds of knowing-work

Knowing-work is aimed at constructing some kind of result. In some kinds of knowing-work practices, the outcome to be achieved is more materially intense, i.e., in terms of physical form and appearance than in other knowing-work practices (Gherardi et al. 2013).
This research was anchored in empirical material from studying one case of service design and another of the design of a physical good. The difference in the intensity of materiality of the intended design outcome was not specifically considered here. Given the difference in the sought-after results between the examples, one could possibly study the relationship between the nature of the emerging ambiguities and the intensity of materiality of the intended result.

There were also other differences between the cases both in the emerging ambiguities and in the activities to negotiate them. However, this thesis has not considered whether the reason for such differences is anchored in having studied different phases of the knowing-work, in having studied work with different kinds of design outcomes, or in something else. This opens up for future research.

This research has an obvious delimitation in that it is based on two cases only. Future research could benefit from broadening the perspective by considering empirical examples of ambiguity in other kinds of knowing-work, such as architecture or business development. Architecture and business development are examples of knowing-work with other aims: business development implies creating new business value from customers, for example, while architecture instead focuses on the design of physical buildings. Making comparisons with these two knowing-work practices, or with other examples for that matter, could demonstrate the general applicability of the present findings.

### 11.2.3 Studying other kinds of organizations

Consultancy firms have been framed as knowledge brokers (Hargadon & Sutton 1997; Hargadon 1998), that is, as organizations that engage in and learn from various client contracts in various industries, and that broker such knowledge. Consultants have also been described as continuously adapting their work to client wishes, the circumstances of the work, the type of undertaking, etc. (Visscher 2006, cited by Souto 2013).

Design consultants have, more specifically, been described as language-brokers who undertake semantic and semiotic introspection, new meaning development, language scouting, and language translation (Dell’Era et al. 2011). Clients have been found to hire design consultants for various reasons, such as: a need to legitimize innovation by cooperating with professional innovators; a desire to learn from the consultants’ creative
processes; or a need for help in interpreting a local market (Abecassis-Moedas et al. 2012).

A possible inference from research into the characteristics of consultancy work in general, and design consultancy in particular, is that the nature of the emerging ambiguities might differ between consulting and in-house design work. Similarly, the activities undertaken to negotiate these ambiguities may differ, as might which ambiguities are harnessed and which are reduced. A potential follow-up study could compare the emergence of ambiguities and the activities to negotiate them between in-house and consultancy design and NPD work. Such research could improve our understanding of whether there seem to be certain generalizable contextual differences in knowing-work undertaken as consulting versus in-house design work.

11.2.4 Studying ambiguity and creativity

Creativity has been mentioned in passing throughout this thesis, although it has not been thoroughly discussed. Yet, design consultants are at times hired for their aesthetic and creative abilities (Dell’Era et al. 2011). Many individuals who are said to be creative time and again acknowledge the collective nature of creativity (Hargadon & Bechky 2006; Bissola & Imperatori 2011), which attunes to practice epistemology.

The characteristics of creativity intersect with the connotations of ambiguity. In making this statement I rely on Csíkszentmihályi’s (1996) description of creative people as interpreting and perceiving the world in unusual ways, thus: ambiguity implies the emergence of multiple interpretations and creativity means acknowledging and harnessing a multiplicity of interpretations.

“Practical creativity” has moreover been introduced in practice-based studies as a concept to capture the intertwinement of knowing and aesthetics in work practices (Gherardi & Perrotta 2013). Gherardi and Perrotta (2013, p.2) relied on studies of craftsmanship for their proposed “non-linear vision of the creative process,” concluding that five aspects “may explain how meaning and matter are intrinsically entangled in forming.” It would be relevant to study how such aspects of practical creativity relate to negotiating activities. Such research could potentially contribute with an understanding of the role of practical creativity for negotiating activities that harness the generative power of ambiguities in
knowing-work. Doing so might be beneficial for demystifying creativity, by portraying it as a natural aspect of knowing-in-practice that may be learned, practiced, and communicated.

11.3 Concluding remarks

Ambiguity is at the heart of design work. If all future design outcomes, their intended markets, and their process of creation could be interpreted in well-defined, univocal, best ways, there would be little need for the knowledge-creating activities that make up the knowing-work. Given that ambiguities emerge naturally in design work, yet cannot be foreseen or avoided by using more detailed plans or structured approaches, they must be sensed and considered as they emerge.

This research contributes to an understanding of how ambiguities emerge and are negotiated, i.e., how they become and fade away in ongoing knowing-work. Ambiguities intersect and influence design work, which makes it important to be able to sense them, harness their generative power, use them to enhance the work, and reduce them when they are unproductive.

Sensing and negotiating ambiguity in a professional way implies knowing when they become a threat and when they are something to make use of, as well as mastering to maneuver in the space for action that emerges between the many interpretations in ambiguous situations. This research contributes to an understanding of how to take action in ambiguous situations. Such a contribution can be part of developing skills to sense and negotiate ambiguity.

Sensing and negotiating ambiguity in a more professional way may deepen our understanding of situations in which there is an inability to make unanimous interpretations, increase the quality of participation, and improve the quality of the design outcome by harnessing the power of ambiguities at times and reducing it at others. If emerging ambiguities are not sensed or negotiated in a professional way, the risk is that the work may become unproductive, confused, and uncreative. Furthermore, if not harnessing the generative power of ambiguities by sustaining them and mediating between a multiplicity of interpretations the knowing-work might require more energy and attention to make up for mistakes than would have been required in negotiating ambiguity in the first place.
References


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