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# Blending Practices to Facilitate Grounded Design Research: A Praxeological Research Perspective

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**Abstract.** In this paper, we reflect on the experiences from two Grounded Design (GD) research projects conducted by a multidisciplinary group of researchers between 2019 – 2021 and highlight the methodological foundations and related obstacles for iterative designing. Both projects investigate the phenomena of knowledge sharing and crisis-related learning in business organizations under the GD paradigm, which has been increasingly adopted within the Computer-supported Cooperative Work (CSCW) community. During these projects, the researchers with backgrounds in computer science, business informatics, software engineering, and sociology experienced the need for systematization to transition between the stages of GD. Looking back, we realize that our teams arrived at this systematization by blending the prior knowledge from team members' original educational backgrounds. While blending practices most likely happens intuitively in interdisciplinary projects, as is often the case of the user-centered design initiatives seen in CSCW and Human-Computer Interaction, little can be found on how this usually happens and its implications. In this paper, we respond to this literature gap by discussing how this blending can facilitate the realization of GD projects and lead to a praxeological information science research perspective, which has 'methods appropriation' as key to systematizing abstraction, broader traceability, and flexibility of research methods.

# Introduction

Practice-centered traditions existing within sub-fields of Human-centered Computing (HCC), as is the case of Computer-supported Cooperative Work (CSCW) and Human-Computer Interaction (HCI), lie in the fact that a pool of designers or developers does not imagine problems and their respective solutions. Instead, solutions should be grounded in the social aspects of human and organizational behaviors (Kuutti and Bannon, 2014; Wulf et al., 2015). Understanding the contextual needs around a specific problem is implicated in extending the boundaries of human and organizational capabilities by creating new and innovative artifacts. These traditions gave birth to Grounded Design (GD) which advocates a praxeological and pragmatic perspective in the design lifecycle, asserting that the changes in the design must be guided by purposefulness and knowledge of the social practices under investigation (Goldkuhl, 2012; Rohde et al., 2017). The turn to practice and praxeology in GD underlines that information technology (IT) artifacts are adopted and activated for effective use in the organizational context with behavioral purposefulness and, therefore, different (new) social practices emerge as a result of technology adoption and appropriation (Brödner, 2009; Stevens et al., 2010). This practice-centered approach has been receiving increasing attention in the CSCW community and has been used to predicate many and various studies and design initiatives, which have been advancing the state of the art considerably (Rohde et al., 2017; Wulf et al., 2015; Wulf et al., 2018).

The design approaches commonly used in practice-centered computing under GD have a similar set of activities from three to five stages, as will become evident across the paper. GD asserts the iterative and evolutionary nature of practice-centered IT design as a multi-layer intervention in an organization's social practices to better cope with the problem of self-referentiality (Rohde et al., 2017). The self-referential nature of IT design emphasizes that as the prototype is designed to be evaluated and appropriated by and with the users, it also changes the social practices for which the artifact is being created. This leads to frequent changes in user needs and requirements, and therefore, an iterative mechanism must incorporate the changes. GD research ensures this continuity in context and appropriation studies while the design study is subject to alterations. While this view resonates with the user-centered design (UCD) views from HCI and CSCW (Benyon, 2019; Sharp et al., 2019; Harper et al., 2008), it contradicts the design-centered view in information science (IS), computer science (CS), and software engineering (SE) traditions where formal specifications for design can be gathered beforehand and can be reflected in the artifact following a sequence of steps in the design lifecycle (Baskerville et al., 2018; Chandra et al., 2015; W. Kuechler and Vaishnavi, 2012).

The multistage design approaches in the context of GD always own a level of abstraction and, thus rightly so, provide the researchers a wide-open ground to try different techniques within the stages of research. However, the evolutionary nature of GD blurs the boundaries and segregation between the steps of the applied design approach, causing the transition between these stages with a reasonable probability of unsystematic actions causing wastage of research resources. Also, these design approaches can be challenging for researchers with different academic and methodological training transitioning into practice-centered research. It may be due to their lack of in-depth comprehension of diverse, overlapping disciplines that make up the epistemological foundations of practice-centered computing or the shortcomings of the established development lifecycle methods in their parent disciplines. Further obstacles to handle cover, e.g., coping with the incoming knowledge about practices in ongoing research and the lack of mechanisms for systematic transition between stages in the applied design approach. Based on that reflection, we ask: "How can blending practices of researchers from disciplines with dissimilar training in methods facilitate Grounded Design (GD) projects?"

In this paper, we set out to answer this question by presenting experiences from two GD projects implemented respectively through design thinking (Brown, 2008) and Design Case Study (DCS) (Wulf et al., 2015; Wulf et al., 2011). The projects were undertaken by researchers with backgrounds in business informatics (BI), CS, and sociology. By carefully reflecting on our experiences, we argue that the methodological flexibility and the evolutionary nature of GD approaches demand a systematization in methods selections, which is heavily influenced by the prior methodological training of the people working on the project. Our conclusions suggest that the background knowledge of the researchers guided the 'method appropriation' to systematize the transition between the context study and design study stages of the applied design approaches. Furthermore, we state that systematization led to traceability between project stages and results, which is critical for the success of GD projects. We offer, therefore, a methodological contribution to the field, which can support researchers and practitioners engaging in GD projects to avoid potential hurdles as they move forward with their initiatives.

The forthcoming sections include related work about methods in practice-centered design traditions and other dissimilar research and design fields, the explanation of the research contexts and experiences in our two GD research projects, and building on that foundation, the discursive contribution of method appropriation as implications for GD research, followed by a conclusion.

# About methods: Related work

Since our contribution refers to blending practices from different fields and traditions, we find it relevant to provide an overview and contextualization of the methods and approaches we refer to as we construct our contribution. We start with a brief historical account of the approaches used in HCI and CSCW across the years and then address some approaches from CS and IS, highlighting some methods from SE on which we drew during the cases that we present.

## Design approaches in HCI and CSCW

Since its inception, HCI has put considerable effort into devising approaches to address the design of computer technologies from a human-centric perspective. An essential characteristic of these approaches is the use of methods from disciplines like psychology and sociology, where the roots of the field can be found. CSCW, which emerged from the change from a human factor to a human actor perspective to HCC (Bannon, 1995), shared many of these approaches, especially concerning the use of qualitative methods to understand and react to the socio-technical aspects of the design. In turn, GD has been proposed as a paradigm for HCC computing, providing a set of ontological and epistemological assumptions to guide design research in learning about the users, their world, and their needs (Rohde et al., 2017). It adds the evolutionary stance to HCI and CSCW design research to be conducted in an agile manner incorporating the emergent changes in social practices that were a result of appropriating and using IT artifacts, hence organizing the practice and technology development as an integrated process (Wulf et al., 2011; Rüller et al., 2021).

While GD has been proposed as a paradigm for HCI and CSCW research and practice, DCS have been proposed as a framework for GD projects (Wulf et al., 2011; Rohde et al., 2017; Wulf et al., 2015). The framework is organized in three steps: in a *pre-* or *contextual study*, predicated on qualitative methods like observations and interviews, that provides researchers with a first-hand opportunity to learn and better understand users' behaviors and interactions within a particular context. Quantitative methods can also be employed in this phase in a mixed methods approach, though they are not that common. The results of the data analysis form the basis for design implications and, later, for prototyping. The *design* phases usually follow a participatory design (PD) approach, which entails the active engagement of the users in the conceptualization of the design ideas using various methods, like (collaborative) prototyping at different fidelity levels, co-development, card games, contextual enquire, to name but a few (Muller and Kuhn, 1993).

In the *appropriation*, a stable version of the prototype is tested with the users in their natural organizational settings for the appropriation and usage of the prototype

and its transformative impact on the focused everyday practices and the design of the prototype itself. The collected data during this phase is again analyzed and is transformed into further design implications for the improvement of the prototype. Although the DCS phases initially occur in sequence, as one step depends on the results of previous stages, these phases partly coexist across the GD initiatives.

While DCS has been traditionally associated with GD, it is not the only approach that can be used to implement GD initiatives. Any CSCW and HCI approaches that allow for the understanding of practices and the use of such understanding for the design and assessment of computer technologies conform with the premises of GD. An example of it is *design thinking* (Brown, 2008). In fact, the five phases of design thinking – *empathize, define, ideate, prototype*, and *test* – can be easily mapped to the first two phases of DCS: *pre-study:* empathize and define; *design:* ideate, prototype, and test. Nevertheless, the appropriation phase falls out of the scope of this framework – although some would argue that the test phase can also be implemented as an appropriation study. DCS can also be easily mapped in other design methodologies, such as the ISO 13407 UCD process and associated interaction design processes that have been proposed over the years consisting of iterative process for evolutionary development (Benyon, 2019; Sharp et al., 2019). UCD process provides the baseline template for iterative development to incorporate the feedback and changes in requirements from the users, pointing out the stages in UCD being affected by these alterations but does not elicit a structured way to achieve this evolutionary process. This hinders the practice of UCD as an end-to-end design methodology due to restricted scalability and high level of abstraction for practitioners (Mao et al., 2005).

All these methods and frameworks have been beneficial – at least in theory – to help HCI and CSCW professionals to engage with the many issues concerning the field seriously. Nevertheless, as we argue across this paper, there is a fair amount of flexibility and abstraction in these instruments that, although positive in some cases, can be negative in other cases, especially regarding less experienced researchers, who can have difficulties instantiating the appropriate methods in their projects.

## Prominent design approaches in other design traditions

Design methods and approaches have evolved considerably in CS/SE since Dijkstra's idea of top-down *structured design* disintegrated the application's functionality iteratively into multiple layers of sub-functions until the hierarchy of subroutines rather than an assembly of computer instructions is achieved (Dijkstra, 1968). As an alternative, Hoare (1971) presented a four-stage method of *formal specifications* focusing on translating the requirements into the semantic logic detecting the defects before software development. These efforts were parallelly met with the formulation of software development life cycle methodologies with a

project management perspective, initially by Royce (1970), who introduced the *waterfall model* with stages like requirements analysis, design, development, testing, and maintenance. Customer satisfaction as a factor in the design life cycle was introduced by Basil and Turner (1975) in an *iterative development method* that solicited developing one component at a time and improving the design by incorporating early user feedback. The concept of *rapid prototyping* by Luqi (1989) further elevated the notion of iterative development, which included the customer requirements into a prototype at first, that can be evaluated and refined, later to be developed as the final product. The success of rapid prototyping techniques and the proliferation of Internet-bound applications encouraged the development of *agile methods* following the stages of rapid prototyping in parallel and overlapping design iterations with short-term and version-bound product releases (MacCormack et al., 2001).

In this respect, such design and development methodologies were influenced by project management perspectives of fast-tracking an error-free product to market. The users were considered, but the social practices of users were not given the center of attention as it is done in practice-centered computing. On the other hand, disciplines like IS and Design Science (DS) pursued the ideology of '*learning through the act of building*' that emphasizes creating a design theory through the process of developing and testing IS artifacts which is inextricably bound to the testing and refinement of its kernel theory (Gregor, 2006; W. Kuechler et al., 2005). Keeping in view the traditions of IS research, Kuechler and Vaishnavi extended the activity framework of DS research by incorporating a cyclic knowledge flow between the steps of their design method to facilitate the theory creation by addressing the constraints in the design process (B. Kuechler and Vaishnavi, 2008; W. Kuechler and Vaishnavi, 2012). The method consisted of five steps: *awareness of the problem, suggestion, development, evaluation,* and *conclusion*. The *awareness of the problem* construes conceptualizing the problem space, the goal, and the scope of the DS research project. The knowledge gained informs the *suggestions* for the *prototype,* which is to be *tested* and *evaluated* with the users. The *conclusion* step finds the results to support the next design iteration.

Feine et al. (2020) elaborated the *suggestion* step of W. Kuechler and Vaishnavi's method by conducting a formalized requirements engineering for a systematic transition into the development stage. The illustration of this adaptation can be seen in Figure 1. They systematized the suggestion step by reviewing their empirical data to conceptualize *crude requirements* for the artifact design. Based on the requirements, they drew *design principles* following the definition of Chandra et al. (2015), introducing "statements that prescribe what and how to build an artifact to achieve a predefined design goal" (p. 4040). Finally, the linkage of requirements and design principles is further extended into concrete *design features* as per Seidel's notion of substantiating technical specifications into concrete design elements for the prototype (Seidel et al., 2018).

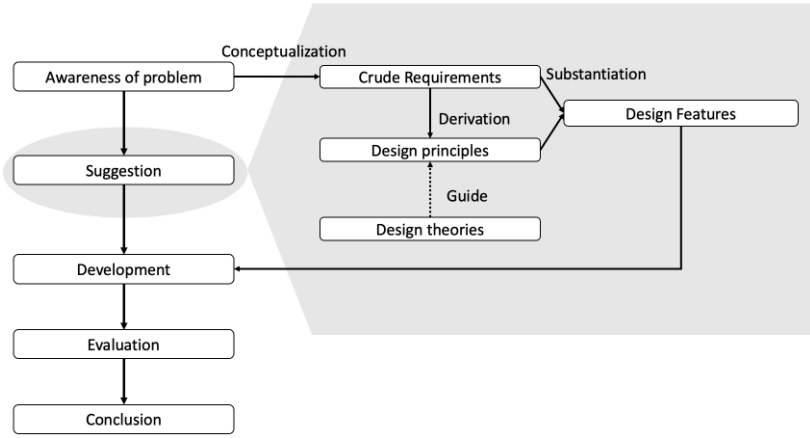


Figure 1. Adaptation of W. Kuechler and Vaishnavi's method for systematic transition between problem and development (Feine et. al., 2020).

The task to systematize the knowledge flow between problem and design also resulted in formalized methods in BI by Balzert. According to Balzert (2010), the requirements analysis is based on a two-stage procedure in which first the crude *requirements* and then the functional *specifications* are created. The crude requirements are abstract conceptualizations of evidence-based justifications for design based on the problem statement. They hold the visions, goals, design concepts, and framework conditions to be developed after refinement through operationalization. The refinement of crude requirements substantiates the specifications, which are the concrete design features for development. In it, the specific functional and non-functional requirements, such as quality requirements, are formulated based on the crude requirements. The illustration of the method is shown in Figure 2.

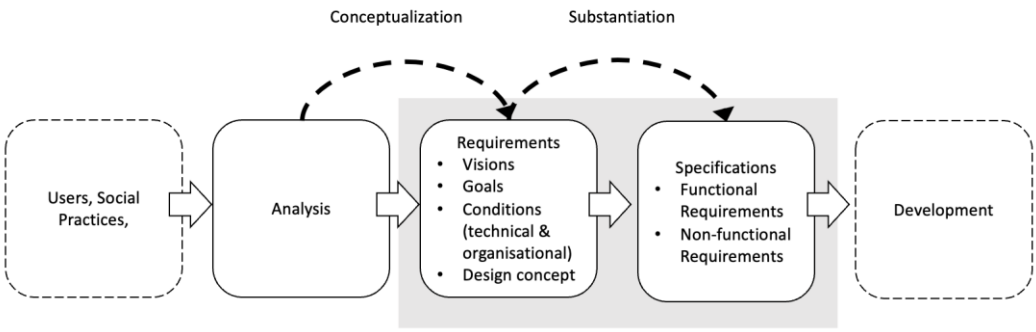


Figure 2. Balzert's method of requirements elicitation from crude requirements to specifications for design and development.

When noting these crude requirements and functional specifications, Balzert's method follows a fixed notation scheme:

/**Letter Number**/ *Description of the requirement*

The *Letter* refers to the type of requirement. At the same time, a unique *Number* is assigned consecutively for each new requirement (e.g., **/F10/** ***The application should always be accessible via the Internet or the intranet***). This pseudonym scheme systematizes transitions between development stages by linking the specifications to crude requirements and further back to problem statements.

The 'systematization of knowledge transition' as a bridge between problem and development stages in the methods of Balzert and the adaptation of Kuechler and Vaishnavi serve as a guiding ideology for 'method appropriation' in Project 1 and Project 2, respectively, which are explained in the section below. These methods appropriation is with noticeable differences as per GD research that the awareness of the problem in our case is generated by an inductive ethnography of social practices over an extended period. The underlying design approach is iterative, and the research is evolutionary.

# Methods Appropriation: A Projects-based Exploration

Our contribution is based on two GD projects (labeled Project 1 and Project 2) undertaken by a group of researchers and designers with a multidisciplinary background. Both projects were parts of a larger interdisciplinary research project, situated in an IS department at a German university. The larger project dealt with determining the conditions for maintaining continuity and supporting resilience in small and medium-sized enterprises (SMEs) and designing IT solutions to support the SMEs in enhancing their resilience against crises. The sub-projects were undertaken by teams of two and three researchers from the research group while employing the design thinking approach and the DCS framework, respectively, with a common GD research mindset. During these projects and as problems emerged, a series of research methods have been appropriated, i.e., they have been adapted and fit to the working practices following integration in the process (Dourish, 2003). An abstraction of the design approaches, method of data collection, analysis, prototyping, and evaluation is shown in Table 1.

We describe the two projects' outlines and the applied methods and practices in the following. This builds the foundation for our methodological implications. As this paper does not focus on the domain-specific thematic and design implications within the two projects but presents the methodological implications for using, adapting, and appropriating design approaches under GD, the explicit domain-specific findings about the designed artifacts (solutions) are mentioned concisely, enough to generate understanding about the research contexts.

Table 1. Overview of methods applied and outcomes in the two projects

| **Project 1: Platform for crisis knowledge sharing** | | | |
|---|---|---|---|
| Design thinking approach | | | |
| | **Empathize and ideate** | **Design and prototype** | **Evaluation** |
| **Methods** | - Semi-structured interviews<br>- Observations<br>- Thematic analysis<br>- Brainstorming | - Evolutionary prototyping<br>- Design workshops | - Pluralistic walkthrough<br>- Thinking aloud method |
| **Outcomes** | - Interview transcripts<br>- Observation protocols<br>- Codes and themes<br>- Mind maps<br>- Design implications | - Low fidelity prototype<br>- High fidelity prototype | - Implications for appropriation |
| **Project 2: Application for crisis learning** | | | |
| Design case study framework (DCS) | | | |
| | **Pre-study** | **Design** | **Appropriation** |
| **Methods** | - Open and semi-structured interviews<br>- Observations<br>- Thematic analysis | - Evolutionary prototyping<br>- Pluralistic walkthrough | - Pluralistic walkthrough<br>- Follow-up interviews |
| **Outcomes** | - Interview transcripts<br>- Observation protocols<br>- Codes and themes<br>- Design implications | - Low fidelity prototype<br>- High fidelity prototype | - Implications for appropriation |

## Project 1: Platform for crisis knowledge sharing

This first sub-project took place for a year between 2020-2021 and was carried out by a team of two researchers (Ph.D., Masters) having CS and BI backgrounds, respectively. They explored the phenomenon of knowledge sharing for crisis preparedness in a metal structures construction and maintenance company. Here, design thinking (Brown, 2008) was chosen as the overall approach to understand the problem space in the company. The approach was employed considering the premises of GD and its praxeological orientation, focusing on improving the social practices and corpus of situated design cases subject to meta-analysis (Rohde et al., 2017). In particular, the stages of design thinking were done in a non-linear and iterative fashion to support the evolutionary research based on this project.

## Research context and empirical study

The pragmatic nature of GD requires that practice is grounded in background knowledge that is not entirely explicit and relates to emotional and motivational elements (Kuutti and Bannon, 2014). Therefore, we drew on an inductive approach with reference to ethnography and, more precisely, observations and semi-structured interviews with stakeholders of this context (Silverman 2011; Flick 2018; Strauss and Corbin 1998; McDonald 2005). The overall project objectives (topics of crisis management and knowledge-sharing) worked as guidelines for the interviews and in some abstract way as background for the observations.

One of the researchers went for a full-time four-month internship in the company to carry out observation through shadowing (Quinlan, 2008). The researchers collaboratively conducted six semi-structured interviews with employees in the company on topics like crisis communication, crisis knowledge accumulation, and sharing. The internship was done within the company to analyze and participate in the design process of the knowledge-sharing system within the action context of users (McDonald, 2005). The focal point of the internship was more general from a knowledge sharing point of view, but we agreed with the management to use knowledge-sharing for crisis as a use-case for the whole internship. During the internship, the researcher shadowed the knowledge workers in the company, including the document control manager, senior trainer, and security manager. The internee also kept fieldnotes observing the employees in action and recording the formal and informal exchanges between different employees in the company concerning knowledge-sharing and documentation (David Silverman, 2011; Quinlan, 2008). The interview data were transcribed, and the whole data set (including the field notes) was analyzed using inductive thematic analysis (Braun and Clarke, 2006) with the software MAXQDA® (Kuckartz and Rädiker, 2019). The authors collaboratively performed open coding to find initial codes and themes which were analyzed further for specific interaction patterns and socio-technical factors impacting the individual, team-level, and organizational practices.

The analysis of knowledge-sharing about crises was crucial to understanding the users' real problem space and its intricacies. But despite being very elaborate, the findings of the analysis left an expansive room for interpretation. The themes did offer perspectives and implications for ideation and design. Still, there was a possibility of several design features for prototyping, all grounded in the practice context of the users. The research team and the partners from the company decided upon the key design elements for the first prototype. Furthermore, extending the design functionality of the prototype iteratively afterwards by utilizing the knowledge from analysis and appropriation.

## Systematization for iterative research

The evolutionary nature of the prototype prompted the need to systematize the knowledge transition between analysis and prototype design. This systematization was necessary due to the openness of the extracted knowledge from field research and the interpretative margin the analysis provides for the design implications. The motivation which led to using a systematic approach between empathize/ideation and design/prototype phases of the design thinking approach was to be able to forward and backtrack the design decisions to the design implications and empirical knowledge to facilitate the evolution of the prototype during later appropriation cycles as per GD research.

During brainstorming for ideas to achieve systematization, the *prior background knowledge* of the researchers from the CS and BI fields guided the decision to apply the requirement elicitation method from Balzert (2010), which is suitable for small projects and is also tested in practice (Hatterscheid and Schluter, 2018; Lohrmann and Reichert, 2016; Majchrzak et al., 2018). The method proposes a two-stage model to extract formal and design-specific requirements from abstract and interpretative knowledge. The thematic analysis of the collected empirical data resulted in abstract and non-systematic requirements for the prototype design in themes, design implications, and ideated mind-maps. Balzert's method was used to generate systematic functional and non-functional requirements and framework conditions for the prototype, which can be evolved in the iterative process (see the method in the related work section).

Initially, the crude requirements were generated by conceptualizing the design implications and ideas into the vision of certain design concepts, goals to be met with design decisions, and later substantiating the concrete specifications with functional, non-functional, and quality requirements. The requirements elicitation provided means to backtrack the design decisions to the knowledge generated during empathizing and ideation stages of design thinking and to make informed decisions for design and prototyping. The illustration of blending design thinking with Balzert's method is shown in Figure 3.

This blending of methods seemed essential as the evaluation of the prototype influenced the extension of the prototype further towards system development following the iterations. For example, a consensus between the researchers and the tentative users inspired an initial design of a wiki-based knowledge-sharing platform but with the possibility to adapt, scrutinize, customize, and revert the design features in the prototype as per users' feedback. The need for systematization became evident while incorporating the feedback after the first evaluation cycle, which altered the initial design decisions of having an open, collaborative space for knowledge creation, management, and sharing, to a mechanism with version control and role-based knowledge creation and management. The systematization offered by method appropriation allowed us to address the challenge of incorporating the understanding of altering user needs and

practices (self-referentiality) as the users were also defining new practices and changing the old ones while testing the design iteratively. It allowed us to backtrack the design decisions into analysis and extend the design implications with respect to interconnected components of design.

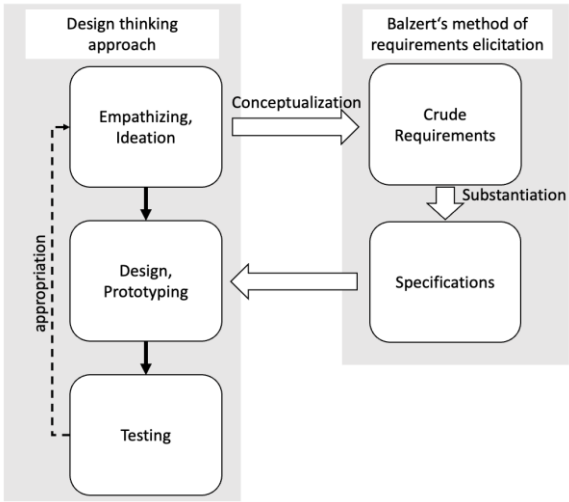


Figure 3. Blending Balzert's method of requirements elicitation within stages of design thinking.

This blending process within the design thinking frame not just permitted to systematize the extraction of formal requirements for a working prototype but also invoked more clarity in the minds of researchers with the confidence that how certain design decisions were supported by empirical evidence and the user needs to be originated through field research. This inductive method guided the researchers through the openness between the design implication or findings of empirical research and the prototyping stage of the research but also turned out to be a more inclusive experience as it aided in bridging the gap between the researcher's prior knowledge from their respective disciplines and newly learned methods in practice-centered design research.

## Project 2: Application for crisis learning

The second sub-project focused on crisis-related learning and training processes in business organizations, especially small and medium-sized enterprises. It was undertaken between mid-2019 till mid-2021 and involved a research team of three researchers (Postdoc and Ph.D. candidates) with backgrounds in sociology and CS. The epistemological research interest in this sub-project was an ethnographic approach, covering different qualitative methods for two years. It was realized with the DCS as the principal frame of reference (Wulf et al., 2015). Besides the research interest in gaining insight perspectives about crises experiences and related learning and training practices from the companies, a second goal was to design with the

companies to enhance resilience by improving bottom-up coordination between employees and the management.

## Research context and empirical study

Following the pre-study stage of DCS, the researchers started with data collection initially via open and later semi-structured interviews in different local small and medium-sized companies. The interviews were done with employees from the executive to labor positions in the companies. They covered the topics of crisis experiences and management, preparedness, and learning and training practices. In 2019, the interviews were carried out on-site in an open interview format with a pair of researchers from the team (Flick, 2018) and as a contextual inquiry (Holtzblatt and Jones, 2017), i.e., they were also accompanied by tours in the company, which often resulted in observation sessions and informal, spontaneous interactions with the company's employees. In the first nine months, three companies were part of the study, with regular sessions of participatory observations (Silverman, 2011; Flick, 2018; Emerson et al., 2011).

This process became frozen in early 2020 when the Covid-19 pandemic started to evolve. All the companies were suddenly confronted with a real crisis and had to prioritize their crisis management; many had to shut down for months. The several stages of the pandemic with various measures prevented the research team from realizing the planned long-term observations. Like many other researchers, the methodological tool kit was adapted (Self, 2021), and the interviews were done entirely in digital format, using communication tools like Zoom® or Skype®. In addition to the three companies from the pre-pandemic research phase, nine companies were interviewed (semi-structured interviews) over the course of one and a half years (March 2020 – August 2021).

Parallel to the data collection (mid-2019), the researchers started analyzing the transcribed data material by means of thematic analysis (Braun and Clarke, 2006) for fine-grained design implications and broader themes with MAXQDA® (Kuckartz and Rädiker, 2019). The analysis followed an inductive method (creating codes openly from the data, Strauss and Corbin, 1998) and later, with a further developed code scheme, an interplay between inductive and deductive coding. The researchers analyzed the data material in regular data analysis meetings to remove bias and gain inter-subjectivity. After halfway through the project, when the analysis results accumulated meaningful descriptions of the crisis-related learning and training phenomena, the researchers began the prototyping phase of the DCS. The initial obstacle was to translate the thematic understanding of the problem into design implications. Secondly, due to the ongoing research (following GD and DCS guidelines), an evolutionary method was required which could accommodate the upcoming thematic and design guidelines.

## Systematization for iterative research

After a series of deliberation and discussion cycles based on *prior knowledge* about methods in DS and CS, keeping in view the application of the methods in successful projects (Chandra et al., 2015; Feine et al., 2020; Seidel et al., 2018), the requirements elicitation of Kuechler and Vaishnavi's adaptation of design science research approach (W. Kuechler and Vaishnavi, 2012) was chosen. The agile nature of the method and the backtracking mechanism it offered from design features to design principles and a further step backward to the requirements in the empirical evidence were the motivating factors behind choosing the method as a transitional approach between pre-study and prototyping. This method's forward and backtracking mechanism supplied means to upscale the prototypical mock-ups during a long-term qualitative empirical study and the DCS appropriation loops. It was necessary to support prototype appropriation with incoming design contexts simultaneously from the data analysis sessions and the evaluation with users. The illustration of blended DCS with Kuechler and Vaishnavi's approach is shown in Figure 4.

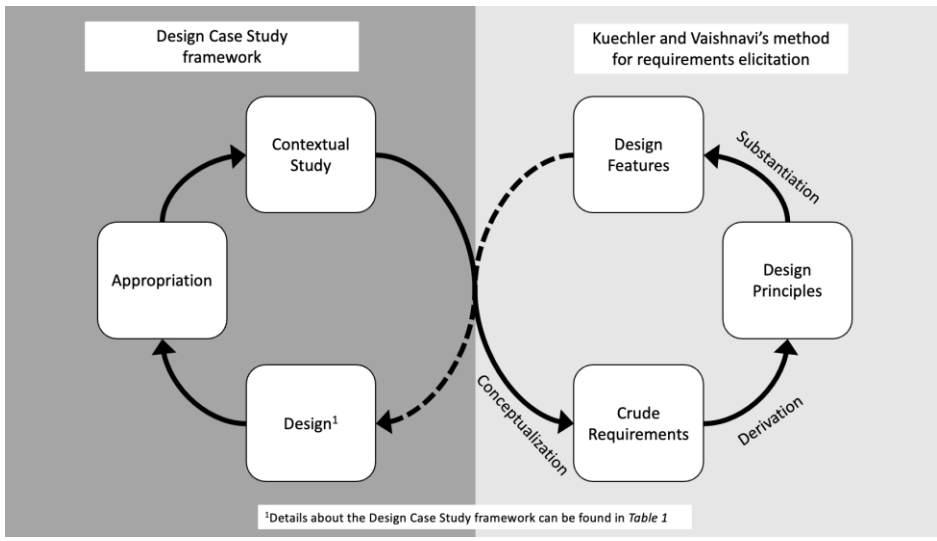


Figure 4. Blending adaptation of Kuechler and Vaishnavi's for requirements elicitation within stages of DCS.

For example, the initial findings from the analysis pointed out the elitist culture in the organizations, where the opportunity for crisis-related learning was designated for a selected few who were deemed responsible for crisis management. This gap instigated designing a platform with easy access to knowledge about crisis response which ensures equal opportunity for employees at all levels in the company. However, the first evaluation study resulted in the need to incorporate means for self-learning to inspire flexibility for crisis-related learning and a feedback mechanism between management and employees to address learners' inquiries about crisis response. These challenges were addressed by extending the

functionality of the initial prototype with design features like chatbot as a learning assistant and inquiry generation for expert-in-the-loop.

The blending of Kuechler and Vaishnavi's approach for a systemized and traceable transition between design implications and the evolutionary prototype eased the realization of interdependencies between existing and new design elements, hence the development of a fully functional high-fidelity prototype that was not just realizing a platform for mutual awareness but also a medium for communication and learning for crises preparedness. The evolution of this prototype between different fidelities and the changing requirements (with continued empirical work and parallel evaluation) expands the horizon of GD research, presenting a compelling case for sustainable development in ongoing research projects and underlines the importance of a traceable and systematic process of design.

# Methodological implications for design research: lessons and experiences

"Practice-orientation is a labor-intense, risky, and long-term research approach" (Wulf et al., 2011, p. 510). The GD paradigm highlights that the underlying problems of existing social practices are not obvious and often need to be shown by extensive observation and analysis (Rohde et al., 2017). It encourages the discourse of cross-sectional investigation across design cases, looking for patterns and similarities to ensure self-referentiality of social practices in long-term and evolutionary IS projects which can support appropriation in several contexts. The iterative nature of design approaches with GD mentality allows design and appropriation activities to intervene in a self-referential circle, meaning that technology and practice can evolve together. It smudges the boundaries between the salient stages of the applied design approach because the incoming knowledge from analysis of ongoing context and appropriation studies needs to be incorporated into the design recursively.

Without a clear transition between the salient stages of the applied design approach and apparatus to forward and backtrack design features and implications of the prototype into analysis and vice versa, leads to unsystematic evolution of the design, which is not self-referential to the changing social practices (Rohde et al., 2017). The first iteration in such GD projects is crucial because it lays the foundation of the evolutionary mechanism in the project for the upcoming iterations where constantly increasing corpora of knowledge about users' social practices need to be reflected in the design. This can be enabled by 'method appropriation' right from the beginning in GD projects. This systematization process can only be generalized as a research practice if the group involved in the GD project identifies the potential of going beyond the guidelines of design approaches and capitalizes

on the diverse epistemic palette of the researchers (in the group) as means to navigate through the long-term research objectives, the evolutionary spiral of the design process and inter-projects transferability of findings. We have achieved method appropriation by using our prior knowledge/training about methods/approaches to systematize the transition, as illustrated by the project experiences in the last section. This systematization and blending practices reflect three methodological implications for CSCW research to fully harness the potential of GD research.

These implications add to the conceptualization and realization of GD research promising structured evolution and propagation of knowledge about social practices. The first implication recognizes the flexibility of GD research with the allowance of scholarship from many interrelated disciplines as means to blend researchers' prior knowledge and training. The second implication addresses the abstraction of design approaches used in the GD projects emphasizing the need to systematize knowledge transition between the stages of design approaches to accommodate knowledge reusability and cooperation among stakeholders. Lastly, the third implication illustrates the traceability in GD projects which is also a percussion of systematized knowledge transition addressing the problem of self-referentiality in GD projects.

## Flexibility to blend prior knowledge of researchers

Researchers from various fields join CSCW and HCI disciplines for doctoral and post-doctoral research. The researchers are primarily trained in the methods from their respective studies or often learn them in previous jobs (Mydin and Surat, 2021). Adopting the norms and practices of the new discipline is considered crucial for research to progress and publish the work done in research projects effectively. In this contribution, we assert that prior training and experience of the researchers come in handy while learning new methods and doing actual research. This can lead to the adoption and adaption of the methods in HCI and CSCW with a personalized flare in a research framework that can be agile and self-supporting. The examples of method appropriation for design approaches by blending the prior methodological knowledge and training of researchers in this research is an epitome of our stance. This kind of inter-method marriage or focused blending of methods can make research projects flexible and inclusive for interdisciplinary research. Likewise, such flexibility demands and builds on *reflexivity*, emphasizing the role of the researcher – who they are, what they do, and how they shape their own practice, which is an important aspect for the successful conduct of evolutionary research and iterative design processes (Mauthner et al., 2003; Frost 2016). This is entirely in accordance with the GD research initiative of contextualized inter-project coordination and learning for social practices (Rohde et al., 2017). Promoting flexibility in research projects by providing creative space for

researchers to bring along their experiences and knowledge is also in line with building affordances for research through cognition and actualization of prior research practices (Bernhard et al., 2013). As the researchers go on appropriating methods with prior knowledge and experience, they associate themselves with the research on a deeper level, knowing that they can control the evolution and iterations of a long-term process.

## Systematizing abstraction in design approaches

The two design approaches in the research projects mentioned above point towards a certain level of abstraction in their organization to provide a guideline for research (Gaver, 2012; Hoök and Lowgren, 2012). Abstraction is a necessity to leave room for adaptation and out-of-the-box thinking. However, the subjective nature of ethnographic research applied to understand social phenomena and practices contextualizes the abstraction. This contextualization is highly reliant on the type of research methods and researchers' perspectives of the phenomenon under investigation (Frost, 2016; Frost et al., 2010; Flick, 2018). The use of well-structured concept-driven methods to communicate the design constructs through the design of artifacts can systematize abstraction (Stolterman and Wiberg, 2010). Then again, the design propositions generated in the ongoing analysis through iterations can inform different and even conflicting design decisions. This subjective decision-making process on behalf of researchers often gets exploited due to the openness of the applied research methods. It can lead to DS projects often not delivering sufficient benefits and newly developed information systems underperforming the expectations (Rohde et al., 2017). GD's evolutionary nature aims to transcend across various iterations of a project and extend the evolving corpora of social practices learned as a part of project scholarship, reflecting the need for systematization.

Systematizing abstraction does not propagate the project management mentality for maximum monetization as in business and software engineering traditions but to mechanize knowledge acquisition and incorporation. The involvement of users in the research projects during pre-study, design decisions, evaluation, and appropriation loops in long-term projects require coordination with the users using different deliverables from various stages of the design approach. Systematizing abstraction between stages of the design approach with added deliverables such as requirements specifications (Balzert, 2010) or design principles and design features (Feine et al., 2020; B. Kuechler and Vaishnavi, 2008; W. Kuechler and Vaishnavi, 2012) can lead to better coordination and cooperation between stakeholders in a long-term project. This level of systematization supports the goal of GD research that allows the researchers in other contexts to reuse the knowledge from different projects to reconfigure or extend the developed artifacts in other research endeavors.

### Broader traceability supporting iterative design

Rohde et al. (2017) alerted about the problem of self-referentiality in GD and pointed out the need to organize the design process to incorporate the growing understanding of the social practices because of the long-term research project.

> *"The design of IT artifacts is a reflexive endeavor in the sense that the artifacts' appropriation and use change the organization's social practices … Design methodology must therefore cope with this inescapable fact and organize design and implementation processes in a reflexive and evolutionary way with iteratively revised and improved versions of the artifact each time leading to a new social practice"* (Rohde et al. 2017, p. 166).

In this contribution, we second the point made by Rohde et al. and bring forward our practical experiences through two GD projects that a mechanism to forward and backtrack information flow between different iterations of analysis and design is an effective means to support the reflexive and evolutionary nature of GD research. The systematization between design approach stages with the induction of structured requirements elicitation methods from IS and BI as applied in the above-mentioned project exhibits invoke a sense of broader traceability in the GD research project. The traceability originates as the design features can be backtracked to analyze social practices and their evidence in empirical data and vice versa. As the project takes its course following iteration with the ongoing context study (examining users' social practices), as well as the appropriation study (evaluating the prototype and analyzing the feedback to be incorporated into the design), the design study needs to include the knowledge about social practices coming from these multiple sources. The traceability originated as the blending of structured requirements elicitation practice between stages of the design approach can ease up the knowledge incorporation into the design. This traceability also offers a self-reflexive point of view on the research methods applied by the researchers by providing means to track decisions and rectify errors along the way.

## Conclusion

This research presents the experiences of two GD research projects to expand the conceptual and practical understanding of GD research practices. It builds upon the notion of the evolutionary and iterative nature of design approaches in the context of GD and highlights the obstacles in dealing with growing knowledge of social phenomena during the research and design process. The incoming continuous knowledge needs incorporation in design and hence requires a systematized knowledge transition to accommodate changes in design iteratively. We suggest method appropriation from dissimilar fields of design like BI and software engineering to systematize knowledge between the analysis and design stages of GD projects. Through this contribution, we demonstrate that this systematization

of knowledge expands the horizon of GD research, affirming the flexibility and creative liberty promised by its praxeological framework. It further supports the abstraction in design approaches and addresses the methodological challenge of self-referentiality in long-term research projects.

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