Uncovering Strategies of Design Principle Development

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Abstract. The development of design principles is an important ingredient in design science research. Design principles capture and formalize lessons learned from a situational design endeavour to guide both academics and practitioners alike in building similar artefacts. Although the development procedure is highly iterative and creative, it requires a certain degree of systematics, in order to ensure rigor. Against this backdrop, this short paper reports on our ongoing project in which we interview DSR paper authors and ask them to reflect on their actual design path to extract general activities and abstract strategies. In doing this, we (1) complement prior conceptual work with empirical insights and (2) present an initial set of four strategies for the development of design principles, structured along with the deductive and inductive modes of theorizing.

Keywords: Design Principle, Empirical Analysis, Development Strategy.

1 Motivation

Design principles are one of the prevailing forms of capturing and formalizing design-relevant knowledge that guides researchers and practitioners in how to create new (IT) artifacts, for which reason it is classified as 'how to knowledge' [1]. These design principles synthesize knowledge that is collected, for instance, in purely academic settings as well as close academic-practice collaborations across several years and beyond disciplinary boundaries. Thereby, they comprise prescriptive statements that help designers to draw on previously gained experiences and to, ultimately, not make the same mistakes but participate in success stories [2]. Given the great potential of design principles, they have been developed for numerous purposes and in diverse environments, such as fraud detection and market manipulation [3], environmental sensemaking and sustainability [4], business model innovation [5], and citizen engagement [6].

Although researchers can build upon the rich body of design science research (DSR) methods and tools (e.g., procedure models [7], frameworks [8], and evaluation techniques [9]) as well as principle-specific guidance, such as to formulate design principles [1] or to specify the origin of design principles [10], we observed that design teams – especially novice researchers – often struggle in planning and executing projects that

aim to derive abstract design knowledge. This is supported by previous research that emphasized the need for appropriate guidance on the actual process of developing design principles (e.g., Möller et al.'s [11] visual inquiry tool to structure corresponding projects) and the great heterogeneity of underlying development approaches [12], as well as own experiences collected during several DSR workshops with doctoral students and researchers in particular. To advance the emerging research stream that seeks to provide guidance for the development process of design principles, this research in progress-paper raises the following question: *What overall strategies do researchers employ in developing their design principles?*

In pursuing to answer this, we conducted ten interviews with design principle developers who have successfully published their results. In doing this, we aimed at unboxing the actual path that researchers have followed to learn from their reflections on mistakes and worthwhile activities. Our insights complement the available body of DSR knowledge by (1) providing a set of empirical-grounded strategies and (2) contextualizing (see vom Brocke et al.'s [13] modes of knowledge accumulation movements) general DSR strategies (e.g., as proposed by Ivari [14]) for design principles.

2 Research Approach: Empirical Identification of Strategies

To collect empirical data about how design principles have been successfully built and communicated, we conducted interviews with authors who have recently published design principle projects. Therefore, we created a literature sample of design principle articles from the IS discipline by (1) updating the Top Basket sample of Gregor et al. [1] and adding articles from conference proceedings of ICIS, ECIS, DESRIST, and PACIS. Based on this sample, we invited authors of Top Basket articles which have been published in the last three years to ensure a higher capability of reflecting on experiences and lessons learned across their design projects. This was complemented by inviting selected conference article authors from our own networks. In total, we performed ten interviews with the following main attributes:

- *Author's experience in years:* <3 years = one author; 3-5 years = five authors; 5-10 years = three authors; >10 years = one author.
- *Author's underlying procedure:* ADR = three authors; DSR = seven authors.

All interviews were conducted virtually via video-conference tools with a pre-defined and pre-tested interview guide that comprises a set of open questions structured along with areas about the project setting, the problem space, the actual development process, the evaluation, and room for additional aspects of the interviewee. Hence, we classify our method as semi-structured interviews. We collected a total of 394 minutes (~ 6,5 hours), transcribed them, and coded for activities (e.g., research steps and methods applied), inputs, and outputs that are mentioned in each interview. The coding was conducted by one researcher and verified afterward by two other researchers. Since there were no bigger disagreements, we are confident that the coding results are robust and valid. Also, we incorporated the author's original article to complement and align the interview insights with the available publication.

3 Findings: Initial Strategies for Developing Design Principles

Building upon the interview data, we explored general design project settings (e.g., interdisciplinary research teams, collaborations) and common design activities to derive strategies (i.e., typical configurations of the coded components). As a result of the inductive process of coding data and several iterations of discussions within the author team in recurrent virtual meetings every two weeks, we present the preliminary set of four strategies that have been applied by the researchers interviewed. For distinguishing these strategies, we outline five main characteristics, which are derived and refined during the analysis (see Table 1): *theorizing approach* (bottom-up vs. top-down), *entry point* (trigger and input), *primary outcome* (main results), *collaboration* (team composition), and *time of principle development* (point in time). Although additional characteristics might be worthwhile to specify the strategies in more detail, we believe that these help to understand each strategy's overall idea.

Table 1. Strategy key characteristics.

Strategy\ Characteristic	#S1 Problem-solving	#S2 Vision-oriented	#S3 Theory-driven	#S4 Reflective meta-analysis
Theorizing	Bottom-up (inductive)	Bottom-up (inductive)	Top-down (deductive)	Bottom-up (inductive)
Entry point	Practical problem	Vision of an organization, research team, funding party	Researcher's curiosity about the applicability of a theory	Design knowledge from several DSR projects
Outcome	Solved problem, situational artifact, design principles	Vision attainment, situational artifact, design principles	Theory testing, design principles, design theory	Design theory, design principles
Collaboration	Usually academia-practice collaborations	Academia collaboration, often transdisciplinary	DSR team from IS discipline	DSR team from IS discipline
Design principle development	Often after artifact evaluation	Often before designing an artifact	Often before testing a theory	Often after the meta-analysis

The first strategy (**#S1, problem-solving**) sheds light on practical problems and challenges in particular, for which reason research teams are typically engaged in close academia-practice collaborations. In the early stages of a project or even before the project has started, teams held joint workshops with interdisciplinary stakeholders, such as in the form of focus groups to discuss a certain topic, enterprise-research labs to reflect on current challenges, and open ideation spaces to exchange ideas for future development. For example, Interview 1 was engaged in *company-centric labs in which*

researchers and practitioners from a specific company meet recurrently to identify challenges that are worthwhile to pursue in small projects. *In those typically three-month projects with weekly sprints, the project team builds an initial software-based prototype which is evaluated afterward*. Within this strategy, the problem space plays an essential role and is constantly re-validated and re-formulated across an entire project. As an illustration, Interview 1 argued that they "[…] *began with two major problems that have been formulated by the industry partner*" and advanced this set of problems through continuous reflection (e.g., "[…] *the third problem occurs during the project. This was obtained after several weeks. I observed a problem and validated this through the industry partner.*"). Consequently, we position Strategy 1 as an inductive approach that starts with empirical data obtained from practice and then abstracts design knowledge during the actual project that is concerned with building a specific artifact.

Within the second strategy (**#S2, vision-oriented**), researchers are driven by ideas that are created by their own experiences made in other design projects, the willingness to explore the applicability of novel technology in a certain field or proposals of third-party funding. Thereby, researchers typically start with implementing initial prototypes, such as in the form of mock-ups, that help to transfer the idea to more tangible stages, which are evaluated afterward with experts to ensure practical need and relevance. For illustration, Interview 3 reported on a project start in which "*[…] we thought about how to implement virtual reality in different use case*" and Interview 6 stated that the start was not coined by a specific problem but "*rather a wish [to] explorative examining how novel technology can be employed in new contexts*". We extracted some codes that stress the fact that research teams reflect on their competencies, skills, and access to resources (e.g., data and technology) that help to create ideas but also check the feasibility already at early stages. Given the idea-grounded nature, we position Strategy 2 as an inductive approach that implements visions from a research team or individuals through specific artifacts and generalizes the collected design knowledge afterward.

In contrast to the aim to solve specific problems, the third strategy **(#S3, theory-driven**) is concerned with learning from theoretical knowledge (e.g., kernel theories from social and natural science [15]) and translating this into prescriptive statements, such as design principles. Those endeavors tend to be inspired by a researcher's curiosity about the applicability of a certain theory, the overall objective of testing theories, and providing theory-ingrained artifacts that make use of general knowledge. Common activities include the derivation of meta requirements (or design requirements) from theoretical input, the development of design principles that meet those requirements, and the instantiation of the design principles in a situational artifact (e.g., software prototype). For instance, Interview 9 argued: "*Actually, we first tried to conceptualize [the specific] class of information systems. Start to conceptualize it using the kernel theory. [And then] formulated the design principles based on kernel theory*". Accordingly, we position Strategy 2 as a deductive approach that draws on abstract knowledge and translates this into design principles that are evaluated by means of situational instantiations.

The fourth strategy (**#S4, reflective meta-analysis**) is coined by retrospect in which researchers reflect on projects to formalize knowledge ex post or integrate different studies to arrive at a more general level of design principles. As an example for the latter, integration of available studies, Interview 4 referred to a situation in which they

recognized that another study within an adjacent domain had simultaneously published comparable artifacts, which were, however, based on completely different groundings. By recognizing this, the authors began a collaboration and jointly reflected on their projects to derive design principles that capture relevant knowledge across both studies. In the words of Interview 4, "*[…] we had two completed studies. Two different studies in different cultures [but] both ended up with a method for digital transformation*." In terms of ex post formalizing, Interview 10 described an overall procedure in which initially an artifact has been built and "*[…] the design principles are streamlined ex post because we had the feeling that the message [of the artifact] is hard to communicate, we need to formalize it, synthesize it […]*". In consequence, we map this strategy to inductive theorizing, which might build upon deductive-driven completed design projects to advance design knowledge in a certain field of application.

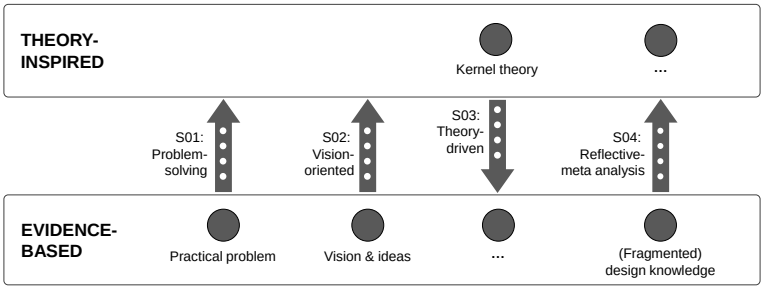

Fig. 1. Summary of general design principle development strategies.

4 Discussion, Research-in-Progress and Outlook

We report on preliminary findings obtained from an ongoing project on design principle guidance. Based on several expert interviews, we extracted activities and resources to derive overall strategies that can be followed when organizing design projects. With this, researchers and practitioners can make (more) informed decisions in terms of planning and executing design principle development endeavors, which are generally driven by situational choices (i.e., context in which a project takes place). Our work responds to the call for process-driven approaches to understanding how design knowledge can be generated (e.g., [12]) and complements the body of DSR methods (e.g., [7-8]) by presenting contextualized strategies for design principles in particular based on empirical data. In addition, our work seeks to explore fundamental activities that help to shape a minimum standardization of the creative and sometimes messy process.

Continuing our project, we will derive a nuanced overview of these strategies, including their main mechanisms, events, inputs, outputs, and actors, based on data collected from the expert interviews as well as from additional sources, such as the expert's publications and further articles on design principles. Also, illustrations with the sample of design principle articles will be provided to ensure the completeness and applicability of the results as well as the strategy's usefulness will be evaluated through workshops in which designers are asked to apply the artifact and provide feedback.

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