Guidelines Supporting the Formulation of Design Principles

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Abstract

Design principles represent design knowledge and constitute a prescriptive component that is included in design theory. In design science research, the formulation of generalised and intelligible design principles that can be reused in new contexts is regarded as an important outcome. Our study has revealed that existing design principles vary in terms of structure, content, and level of abstraction. This variation and inconsistency may obstruct the reusability of the design principles. The purpose of this study is to suggest support for the formulation of design principles. In order to enhance the support for the formulation of design principles, we have suggested three guidelines, which are based on analyses of theoretical statements, existing guidelines, and existing design principles. The guidelines are illustrated by using material from a design science research project.

Keywords Design principles, design theory, guidelines, design science, design science research.

1 Introduction

The discipline information systems (IS) is concerned with designed artefacts (Orlikowski and Iacono (2001). Baskerville et al. (2018) add that the artefact should be a focal point in most IS research. Within the IS discipline, this concern has been paid attention to within the field of design science research (DSR) (e.g. Gregor and Hevner 2013). Venable and Baskerville (2012 p.141) define DSR as "Research that invents a new purposeful artefact to address a generalized type of problem and evaluates its utility for solving problems of that type". One purpose of DSR is to develop design knowledge. Design knowledge can be represented in different ways and forms at different levels of abstraction. These representations include constructs, technological rules, models, methods, design principles, or full-blown design theories (Gregor and Jones 2007; Gregor and Hevner 2013; Chandra et al. 2015). In this paper, we have focused on the formulation of design principles. The reason is that design principles constitute a common research contribution within the IS domain. Gregor and Jones (2007, p.325) state that design principles "… define the structure, organization, and functioning of the design product or design method". In other words, their purpose is to guide the design and evaluation of artefacts (Sein et al. 2011). Moreover, design principles should be generalised in order to solve a class of problems rather than a specific set of systems features to solve a specific problem (e.g. Walls et al. 1992; Hevner et al. 2004; Sein et al. 2011). Consequently, one purpose of design principles is to communicate design knowledge that can be reused in new situations.

Our literature review has revealed that there exists a vast amount of design principles that support various kinds of artefact development (e.g. Sein et al. 2011; <*removed for refereeing*>). A closer look reveals that they differ in the way they are formulated concerning structure, content and level of abstraction. This variation may obstruct appropriate reuse of the design principles due to lack of consistency and omission of important content. This variation may also obstruct comparison of design principles developed for the same purpose and/or the possibility to build further on them. Chandra et al. (2015) report two problems concerning the formulation of design principles: the problem of inconsistency (inconsistency in orientation towards action or material) and the problem of imprecision (incomplete or misleading). Consequently, their reusability cannot be taken for granted (Chandra Kruse and Seidel 2017). Moreover, existing design principles are rich in tensions and contradictions (ibid.).

Our literature review has also revealed that there exist few guidelines concerning the formulation of design principles (Walls et al. 1992; van den Akker 1999; Goldkuhl 2004; van Aken 2004; Heinrich and Schwabe 2014; Chandra et al. 2015) (see section 5). We claim that existing guidelines often suffer from an explicit and transparent theoretical and empirical grounding. Goldkuhl (2004) claims that grounding means presenting arguments in favour of this knowledge so actors can be more confident in using the knowledge. The need for an analysis of design principles is emphasised by Chandra et al. (2015, p.4039) who state "Although frameworks about the formulation of design knowledge or design theory have been proposed … the formulation of design principles has not been given its deserved attention". Another statement reads: "Despite their obvious relevance, however, there is a lack of convention as to how design principles should be formulated and what exactly a design principle is." (p.4039). Consequently, there is a need for more rigorous guidelines concerning the formulation of design principles. We make a difference between design principles per se and support for the formulation of design principles. We use the term 'design principles' when we refer to support for the design of artefacts, while we use the term 'guidelines' when we refer to guidelines for the formulation of design principles. The purpose of this paper is to present guidelines which can be used to formulate design principles. The research question we ask reads: what guidelines can support the formulation of design principles with regard to structure, content, and level of abstraction?

The following section presents definitions and arguments for why design principles are an important component in design theory. Then, in section 3, we describe the research approach. Section 4 presents statements identified in theory concerning the formulation of design principles. In section 5, we present an analysis of existing guidelines and section 6 includes an analysis of existing design principles. In section 7, we present the main result of this paper, which consists of enhanced guidelines concerning the formulation of design principles. Section 8 contains a number of examples of design principles based on the guidelines. Finally, in section 9, conclusions are drawn.

2 Design principles: What and Why

Hevner and Chaterjee (2010) state that design principles are clear statements of truth that guide or constrain actions. Baskerville and Pries-Heje (2010) add that they are prescriptive in nature, and constitute the basis for action. Moreover, design principles represent design knowledge and constitute a prescriptive component that is included in the design theory (Chandra et al. 2015). Meth et al. (2015) claim that

design principles can be interpreted as explanatory statements, which help explain why a prescribed action leads to a specific goal. Seidel and Watson (2014) claim that design principles are essential in order for the theory to be applicable in practice. <*removed for refereeing*> add that one purpose of design principles is to support designers in their tasks by informing them what to do and how to do it. Kolkowska et al. (2017) claim that design principles can be used by both practitioners and researchers. Another purpose of design principles is to communicate findings to both technology-oriented and management-oriented audiences (Hevner et al. 2004). Chandra Kruse and Seidel (2017) state that design principles are now a predominant form to capture, accumulate, and reuse design knowledge. Moreover, "One important vehicle to convey design knowledge that contributes beyond instantiations applicable in a limited use context is that of a *design principle"* (Chandra et al. 2015, p.4039). Consequently, design principles should include knowledge about creating instances of a class of artefact (Sein et al. 2011). This means that design principles can be formulated on different levels of abstraction. The level of abstraction and needed amount of detail are depending on the context (Chandra et al. 2015). As stated in section 1, the reusability of design principles cannot be taken for granted. In order to enhance the reusability, it is recommended to offer rich contextual descriptions of implementations based on the principles (e.g. Chandra Kruse et al. 2016; Lukyanenko et al. 2017).

3 Research Method

We regard guidelines supporting the formulation of design principles as a type of design knowledge. Goldkuhl (2004) states that design knowledge should be justified by theoretical, internal and empirical grounding. Theoretical grounding utilises existing external theoretical knowledge, which constitutes warrants for the emerging theory. Internal grounding includes an evaluation of knowledge cohesion. This means to check how different parts of the emerging theory are related to each other, and that there is logical consistency. Empirical grounding responds to the question 'Is the prescribed action really successful in practice?'. This means that the emerging theory is observed in practical use and after that evaluated. We have adopted these recommendations, and more specifically we have analysed statements in theory concerning the formulation of design principles, analysed existing guidelines, analysed existing design principles and examples provided of the suggested guidelines by re-interpreting empirical data from a DSR project. Our research method has followed the research process suggested by Webster and Watson (2002): 1) identify relevant literature, 2) structure the review, 3) theory development and 4) evaluation of the theory.

1) Identification of relevant literature. We have analysed the eight top IS journals according to the AIS Senior Scholar's Basket of Journals: European Journal of Information Systems (EJIS), Information Systems Journal (ISJ), Information Systems Research (ISR), Journal of Association of Information Systems (JAIS), Journal of Information Technology (JIT), Journal of Management Information Systems (JMIS), Journal of Strategic Information Systems (JSIS) and, Management Information Systems Quarterly (MISQ). Moreover, we have analysed relevant articles that are cited in these journals. We have searched for 'DSR' and 'design principles', 'DSR and 'guidelines', and 'DSR' and 'principles'. We have limited the literature review to include literature in the field of DSR that is related to guidelines and design principles. We have also limited the review to include formulations of design principles that are oriented towards designers or developers of artefacts.

2) The structure of the review. In order to gain knowledge that can support the development of guidelines, we have organised the literature review in three sequential steps: analysis of statements identified in theory concerning the formulation of design principles, analysis of existing guidelines, and analysis of existing design principles. In all the steps, we have been especially interested in knowledge concerning structure, content and level of abstraction. A 'concept' should be understood as a component of a design principle, while 'structure' defines the arrangements of and relationships between the concepts viewed from the perspective of the whole rather than from a single part. The 'level of abstraction' refers to whether the design principles can be regarded as high-level principles or more concrete context-bounded principles.

2a) Analysis of statements identified in theory concerning the formulation of design principles. The purpose of this step was to collect claims and statements concerning formulations of design principles. This analysis has been 'concept-centric' (Webster and Watson 2002), which means that we have grouped similar concepts presented by different scholars into categories. This step resulted in knowledge about the formulation of design principles that is theoretically informed and should be considered when developing guidelines (see section 4).

2b) Analysis of existing guidelines supporting the formulation of design principles. The purpose of this step was to gain knowledge of how to formulate enhanced guidelines by analysing existing guidelines.

The result of the analysis of existing guidelines was compared to the categories identified in step 2a. The purpose of this comparison was to confirm or extend the categories identified in step 2a (see section 5).

2c) Analysis of existing design principles. In this step, we was inspired by the analysis conducted by Chandra et al. (2015) who analysed the eight top IS journals according to the AIS Senior Scholar's Basket of Journals, from the start of the journals to the year 2013, concerning formulations of design principles. They have coded the content of design principles and claim that design principles are either materiality- or action-oriented or both. We have extended their literature review by analysing the same journals for the years 2014-2017. In this respect, our approach has been cumulative. We have explicitly searched for the term 'design principle'. The first screening resulted in 43 publications. We could filter out 26 papers because they were either in press, did not present any design principles or the term 'design principle' was only mentioned in the reference list. This elimination process resulted in 27 remaining papers. Instead of using the predefined codes (materiality-oriented, action-oriented) identified by Chandra et al. (2015), our analysis was open-minded. We analysed the identified design principles by asking the questions: "What concepts are included in this principle?", "What is the structure regarding arrangements between different parts of the design principle?" and "What is the abstraction level?". In this way, we were able to induce categories from formulations of existing design principles. Walsham (1995) claims that, in interpretative approaches, the analyst makes various decisions about how to comprehend the data. Such risk can be reduced by involving two or more researchers when searching for and analysing the data (Seuring and Müller 2008). Consequently, the analysis of the design principles was individually conducted by two researchers. Then, the individual analyses were jointly compared and reconciled. Finally, we compared the result of the analysis to the identified categories in step 2a and 2b, in order to confirm existing categories or extend them (see section 6).

3) Theory development. The theory development included suggestion enhanced guidelines. The formulations of the guidelines were based on the categories identified in steps 2a-2c. This highly creative process was not linear. Rather, it was iterative, since we needed to go back and forth between the earlier steps in order to gain insights about how to formulate the guidelines (see section 7). This section includes the main result of this paper.

4) Evaluation of theory. To illustrate the application of the guidelines, we have re-interpreted a DSR project, which contains rich material that can be used to conduct a retro-perspective analysis. We have re-interpreted and re-formulated a design principle suggested in that DSR project by applying the enhanced guidelines suggested in this study. This re-analysis revealed a few critical changes concerning how the design principles were presented in the DSR project. In this way, we were able to provide concrete examples based on empirical findings gained from a previous DSR project (see section 8). The research project was reported in <*removed for refereeing*>.

4 Analysis of Statements Identified in Theory

The purpose of this section is to present statements identified in theory that can advise the development of guidelines concerning the formulation of design principles. As mentioned in section 1, the purpose of design principles is to support artefact development. Consequently, we have excluded statements that concern general development of design theory. The categories and the statements are presented in Table 1. In order to support traceability, we have added a reference to each statement. We have identified nine categories which are: action/process, building, evaluation, purpose/goal, artefact, artefact properties, boundary/context, justification, and level of abstraction. 'Building' and 'evaluation 'are regarded as subcategories of the category action/process.

Category	Statement
Action/ Process	"The design process is a sequence of expert activities that produces an innovative product (i.e., the design artifact)." (Hevner et al. 2004, p.78).
	"Design science consists of two basic activities, build and evaluate." (March and Smith, 1995, p.254).
	"In general, a professional will make … a *process-design*, i.e. *t*he professional's own plan for the problem-solving cycle, or, put differently, the method to be used to design the solution to the problem." (Van Aken, 2004, p. 226).
Building	"Building is the process of constructing an artifact for a specific purpose." (March and Smith, 1995, p.254).

Evaluation	"Its products are assessed against criteria of value or utility – does it work? Is it an improvement?" (March and Smith, 1995, p.253).
	"… evaluation is the process of determining how well the artifact performs." " (March and Smith, 1995, p.254).
	"… evaluation is primarily concerned with evaluation of design science outputs, including … design artefacts." (Venable et al. 2016, p.77).
Purpose/ Goal	"Design theories must deal with goals as contingencies" (Walls et al. 1992, p.40)
	"… what the system is for" or the set of meta-requirements or goals that specifies the type of system to which the theory applies …" (Gregor and Jones, 2007).
Artefact	"Purposeful artifacts are built to address heretofore unsolved problems." (Hevner et al. 2004, p.78).
	"…the framework is based on design science research outputs or artifacts: constructs, models, methods, and instantiations." (March and Smith 1995, pp.255-256)
	"… the term artifact is used in this paper to refer to a thing that has, or can be transformed into, a material existence as an artificially made object (e.g., model, instantiation) or process (e.g., method, software) (Goldkuhl 2002, p. 5). "(Gregor and Hevner, 2013, p.340).
Artefact properties (form and function)	"… the principles that define the structure, organization, and functioning of the design product or design method" (Gregor and Jones, 2007. P.325).
	"it [design theory] explains what properties an artefact should have" (Walls et al. 1992, p.41).
	"… principles governing the development or selection of system features." (Markus et al. 2002, p.186).
	"These principles can be of a 'substantive' nature, referring to characteristics of the intervention (what it should look like) …" (Van den Akker 1999, p.5).
Boundary/ Context	"The precision can be achieved by outlining boundary conditions, within which the design principle applies. The boundary conditions can be explained through a statement of relevant use context or intended user group." (Chandra et al. 2015, p.4045).
Justification	"… the value of that knowledge will strongly increase when justified by theoretical arguments, well-articulated in providing directions, and convincingly backed-up with empirical evidence about the impact of those principles." (Van den Akker 1999, p.9).
Level of abstraction	"… it is important that a design principle is formulated sufficiently abstract to leave some space for different instantiations in different contexts that share the defined boundary conditions. This, in turn, reduces the limit of generalizability previously lamented." (Chandra et al. 2015, p.4045).
	"…the prescription is to be used as a *design exemplar*. A design exemplar is a general prescription which has to be translated to the specific problem at hand; in solving that problem, one has to design a specific variant of that design exemplar." (van Aken 2004, p.227).

Table 1. Statements supporting the formulation of design principles

5 Analysis of Existing Guidelines

In total, we have identified six publications that suggest guidelines to support the formulation of design principles. The guidelines per se have constituted our analysis unit. We recognise that there often exists background knowledge, which can be explicit or implicit. The reason for not including background knowledge in our analysis is that the users of guidelines should be able to use them as stand-alone objects and not have to read the entire publications. We also recognise that several authors of guidelines did not have the purpose of suggesting extensive or complete guidelines. However, the identified literature constitutes existing knowledge concerning guidelines for the formulation of design principles. First, we present the existing guidelines and then we conclude with a summary (see Table 2).

Walls et al. (1992, p.41) discuss guidelines in terms of design rules and suggest the following design rule: "If you want to achieve goal *X*, then make *Y* happen". The rule explicitly includes 'goal' which corresponds to our category with the same name. The phrase "then make *Y* happen" corresponds to the category 'action/process'. Moreover, the conjunction 'then' creates an explanatory relation between 'goal' and 'process'.

Van den Akker (1999, p.9) suggests the following meta-design principle: "If you want to design intervention X [for the purpose/function Y in context Z], then you are best advised to give that intervention the characteristics A, B, and C [substantive emphasis], and to do that via procedures K, L, and M [procedural emphasis], because of arguments P, Q, and R." Our interpretation is that the concept 'intervention' corresponds to the category 'artefact', 'purpose/function' corresponds to the category 'goal', 'characteristics' corresponds to the category 'artefact properties', 'procedures' corresponds to the category 'action/process', and 'argument' corresponds to the category 'justification'.

The meta-design principle suggested by Goldkuhl (2004, p.63) reads: "Perform act A in order to obtain goal G". We interpret that the concept 'act' corresponds to the category 'action/process' and that 'goal' corresponds to our category with the same name. Similar to Walls et al. (1992), there is a relationship in terms of cause and effect between 'act' and 'goal'. Inspired by Goldkuhl (2004), Heinrich and Schwabe (2014) suggest that design principles should be structured to include value grounding (corresponds to the category 'goals'), conceptual grounding (relationship between constructs and domain objects), explanatory grounding (explanation and justification), and prescriptive statement (formulation of action applicable in design). Their suggestion focuses both on structure and content but does not offer an explicit meta-design principle.

Another meta-design principle similar to the suggestions of Walls et al. (1992) and Goldkuhl (2004) is presented by Van Aken (2004, p.227). The meta-design principle reads: "If you want to achieve Y in situation Z, then something like action X will help". The terms 'achieve Y' corresponds to the category 'goal', situation Z corresponds to the category 'boundary/context' and 'action X' corresponds to the category 'action/process'. The expression 'something like' emphasises that the prescription is to be used as a design exemplar which is a general prescription that has to be translated to the specific problem at hand (ibid.).

The final identified meta-design principle is presented by Chandra et al. (2015) and reads: "Provide the system with **[material property—in terms of form and function]** in order for users to **[activity of user/group of users—in terms of action]**, given that **[boundary conditions—user group's characteristics or implementation settings].** The concept 'material property' prescribes "*how* an artefact should be built or *what* it should comprise" (p.4042), while 'action' refers to prescriptions about *what* actions the artefact allows for. We interpret that the term 'material property' corresponds to the categories 'action/process' and 'artefact'. The term 'action' corresponds to the category 'goal'. Besides the material- and action-oriented content, the meta-design principle explicitly includes 'user/group characteristics' which we interpret as being an important part of the category 'context'. Chandra et al. (2015, p.4042) define user/group characteristics as follows: "the system should allow users to do this or that".

Our analysis shows that the categories 'action/process' and 'purpose/goal' are represented in all the suggested guidelines. It also shows that the categories 'building' and 'evaluation' are not represented in any meta-design principle. One can claim that these two categories are implicitly included in the category 'action/process'. We claim that these two categories represent the core of DSR and therefore they are significant to DSR and should be explicit. This claim is supported by Hevner et al. (2004), who states that "Much of the work performed by IS practitioners, and managers in general ..., deals with design" (p.78), and that "Evaluation is a crucial component of the research process" (p.85). Based on the statements identified in the literature review, we also consider all the other categories (artefact, boundary/context, justification, level of abstraction) important when formulating guidelines. These other categories are occasionally represented in the existing guidelines. We claim that guidelines that are not detailed enough can be too limited. A guideline such as a meta-design principle needs to be informative in order to lead and determine the course of action (<*removed for refereeing*>). Below, we present a summary of the six suggestions described above. The symbol 'X' means that the category is represented in the meta-design principle while the symbol '-' means that the category is omitted. We can conclude that the analysis of existing guidelines confirmed the categories identified in section 4, and did not result in new categories with respect to structure, content and level of abstraction.

	Walls et al. (2004)	Van den Akker (1999)	Goldkuhl (2004)	Van Aken (2004)	Heinrich and Schwabe (2014)	Chandra et al. (2015)
Action/ Process	X	X	X	X	X	X
Building	-	-	-	-	-	-
Evaluation	-	-	-	-	-	-
Purpose/ Goal	X	X	X	X	X	X
Artefact	-	X	-	-	-	X
Artefact properties	-	X	-	-	-	X
Boundary/ Context	-	X	-	X	-	X
Justification	-	X	-	-	X	-
Level of abstraction	-	-	-	X	-	-

Table 2. Summary of representation of categories in existing guidelines

6 Analysis of Existing Design Principles

Our analysis of existing design principles has revealed that they vary with respect to structure, content and level of abstraction. This variation includes design principles: a) between different studies and b) within the same study. We can also conclude that the existing guidelines (see section 5) have not explicitly been adopted in order to develop design principles.

We have found that design principles are often presented as a set of design principles (e.g. Kolkowska 2017). However, we have observed that design principles included in the same set address different artefacts (e.g. Spagnoletti et al. 2015). For example, one design principle could guide process development and another could guide the development of the properties of a digital tool. We state that the rationality behind presenting design principles as a set is that they have a common ground or purpose. We claim that the common ground for a set of design principles is the artefact they address. Consequently, all the design principles that are members of the same set should address the same artefact. Individually, each design principle could be directed towards different aspects of the same artefact. In this way, the design principles that are included in the same set are logically connected and form a congruent wholeness.

We have also found that design principles that are included in the same set have different structures. One example is the study conducted by (Lukyanenko et al. 2017) who presents a set of design principles where some design principles are presented on a format similar to the meta-design principle suggested by Walls et al. (1992): "If you want to achieve goal *X*, then make *Y* happen", while other design principles just include the 'action' and omit the 'goal'. The problem of inconsistency is also reported by Chandra et al. (2015). However, they refer to inconsistency in the orientation of design principles, while we add that there is inconsistency concerning the structure of design principles.

With respect to content, we have found that design principles often include two basic parts: a short name and a description (Lee et al. 2018; Liu et al. 2017). The purpose of the name is to support the identification of the design principle, and the purpose of the description is to support an understanding of how to apply the design principle. We have also found that the most frequent categories included in the description part are: action/process, purpose/goal, artefact and justification. The other categories presented in sections 4 and 5 exist occasionally. The analysis of the design principles did not result in new categories. The analysis has also identified that the existing design principles include modal auxiliary verbs such as: 'could' (grants permission), 'should' (indicates a recommendation), and 'must' (indicates a requirement) (ISO 2018). These modal auxiliary verbs correspond well to the prescriptive nature of DSR.

With respect to the level of abstraction, we have found that a majority of the design principles are formulated on a high-level of abstraction. For example, Lee et al. (2018, p.74) state that "… our design principles can be regarded as a top-level prescriptive design specification". One purpose of presenting

design principles on a high-level of abstraction is: "An artifact that is presented with a higher level degree of abstraction can be generalized to other situations and is more interesting than a simple descriptive case study of what happened in one situation." (Gregor and Hevner 2013, p.352). The identified design principles on a high-level of abstraction provide general knowledge but lack detailed information or examples of how the design principles could be manifested in the artefact. We have also identified design principles formulated on low-levels of abstraction (e.g. Lukyanenko 2017). These design principles provide rich contextual descriptions and illustrations that support an understanding. Consequently, they are intelligible, but there is also a risk that they are too limited to the specific context and that they do not support reusability in other contexts. To summarise, most design principles include *either* high-level abstractions *or* low-level abstractions. We claim that an interplay between formulations on high- and low-level of abstraction supports the understanding. Consequently, *the combination* of high- and low-level abstractions complement each other concerning generalisation and reusability vs intelligibility and contextual understanding. In other words, we claim that the possibility of reusing design principles increases if both abstraction and concretion support them.

The analysis of existing design principles extended the categories presented in sections 4 and 5. The following new categories were identified: logical connection, congruency, consistency, and, high and low levels of abstraction.

7 Enhanced Guidelines

In order to guide the formulation of design principles, we have formulated three guidelines. The guidelines have been created by using the knowledge gained from the analyses, including the identified categories, in sections 4-6. We claim that the guidelines together form a wholeness, which means that they all should be considered when formulating design principles. Moreover, we recognise that the suggested guidelines can be adjusted according to the situation at hand.

Meta-design principle 1: Content

In order to formulate design principles for the purpose of gaining informative, intelligible and transparent content, the design principles should include prescriptions of:

- The purpose/goal of the artefact, justified with argument(s).
- The action/process concerning the building of the artefact, justified with argument(s).
- The boundary/context specifying where the artefact can be used, justified with argument(s).
- The artefact properties, justified with argument(s).
- The action/process concerning the evaluation of the artefact, justified with argument(s).

Meta-design principle 2: Structure

In order to formulate design principles for the purpose of creating a homogenous structure, the design principles should be:

- Congruent (directed to the same artefact).
- Logically connected (directed towards different aspects of the artefact that together form a wholeness).
- Consistent (having uniformity).

Meta-design principle 3: High- and low-levels of abstraction

In order to formulate design principles for the purpose of increased understanding and to support reusability, the design principles should:

- Be formulated on both high- and a low-levels of abstractions (including examples).
- Explicitly describe the class and the instance of the artefact.

8 Illustration of Guidelines

In this section, we have evaluated the suggested guidelines by illustrating how they can be used to formulate design principles. We have reinterpreted the original design principle 'Design for co-problematisation' suggested by <*removed for reviewing*> which aimed to support the design of a digital service platform in the domain of IT Service Management (ITSM). The original design principle was formulated

on a high-level of abstraction. The re-interpretation of the design principle has been supported by empirical evidence extracted from project documentation concerning improved process efficiency in ITSM. Based on the guidelines, the reinterpreted design principle is presented in Table 3 and called 'Design a digital service platform supporting co-problematisation '. To support readability, we have chosen to present the design principle in the format of a table. We recognise that other formats can be used.

Category	High-level abstraction	Low-level abstraction	Justification of category
Artefact	The artefact belongs to the class of digital service platforms.	The instance of the artefact class is digital service platforms supporting co-problematisation.	To strengthen the relationship between service providers and customers, in order to support shared resources and value co-creation.
Purpose/ goal	Facilitate service innovation concerning the delivery of IT services that are based on a shared understanding of problems.	Utilise a service-oriented perspective (operand and operant resources, resource integration and value co-creation).	Gained competitive advantages for both service providers and service customers.
Action/ process for building	Review the literature. Collect data from all the actors involved.	Collect information concerning the different understanding of problems related to the delivery of IT services. Organise a workshop including all the involved actors to gain a shared problem understanding. Specify requirements of the artefact functionality. Collect feedback from the use of the artefact (iterative process).	A shared understanding of problems will create improved conditions for identifying solutions for an enhanced service delivery process (empirical argument), 2) the suggested action is supported by fundamental premises in service-dominant logic (e.g. Vargo and Lusch 2004) (theoretical argument).
Boundary/ context	IT Service Management.	ITSM is characterised by process and customer orientation where IT is claimed to be delivered as a service.	The choice of context is motivated by a problem (lack of digital artefacts facilitating service innovation) formulated by practitioners.
Artefact properties	Develop a digital support for joint customer and service provider co-problematisation.	Develop digital functionality supporting service providers and service customers to identify different opinions of a problem, concerning IT service delivery (e.g. incident management).	An increased understanding of different perspectives will tighten the relationships between service providers and service customers.
Action/ process for evaluation	Evaluate the implemented artefact properties in order to demonstrate utility, quality, and efficacy (c.f. Venable et al. 2016).	Use naturalistic evaluation episodes consisting of questionnaires and interviews.	An improved knowledge concerning the fulfilment of the goals will legitimise use of the digital service platform

Table 3. Design principle: Design a digital service platform supporting co-problematisation.

We claim that the reinterpretation of the original design principle has resulted in an informative design principle concerning content and prescriptions on high- and low-level of abstraction. Consequently, the use of the guidelines strengthened the design principle's reusability. The original design principle: did not include all the suggested categories, was only formulated on a high-level of abstraction and did not include justification. Due to limited space, the illustration includes only one example of a reinterpreted design principle. Consequently, we could not illustrate meta-design principle 2, since it guides a

situation where two or more design principles are developed. However, when several design principles are developed, we claim that they should be congruent, logically connected and consistent.

9 Conclusion

In this paper, we have developed guidelines to support the formulation of rigour and reusable design principles. We claim that our enhanced guidelines can be regarded as a response to the criticism provided by Chandra et al. (2015) who state that design principles show inconsistency and imprecision. Based on our analyses, we have drawn three conclusions:

- Existing design principles vary concerning structure, content and level of abstraction.
- Existing guidelines are promising: However, essential categories are omitted, and support for formulations on high- and low levels of abstraction is not included.
- The enhanced guidelines have improved formulations of design principles.

The conclusions are based on knowledge gained from statements identified in theory, existing guidelines, existing design principles, and from empirical illustration. Consequently, they rest on solid ground. As future research, we suggest a naturalistic evaluation (e.g. Venable et al. 2016) of the guidelines, including the collection of empirical evidence from the use of the guidelines. We suggest that the evaluation focuses explicitly on how researchers and practitioners interpret and use the guidelines in practice. We are also welcoming future research about how design principles can deliver more generalisable knowledge that can be used in order to apply them in new settings.

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