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Design of Goal-Oriented Artifacts from Morphological Taxonomies: Progression from Descriptive to Prescriptive Design Knowledge

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Abstract. Morphological Taxonomies are a widely popular tool in Information Systems to systematically deconstruct an artifact into designable dimensions and characteristics. Subsequently, these taxonomies have engraved in them knowledge about the design of artifacts, i.e., descriptive design knowledge. Most studies producing morphological taxonomies refrain from giving prescriptive advice about the design, i.e., the specific morphological configuration of an artifact, but rather stay descriptive. The paper proposes a framework for knowledge and artifact transformation originating in morphological taxonomies and ending in design principles. We develop a framework that assists researchers and practitioners by showing clear paths on transforming descriptive design knowledge engraved in taxonomies to prescriptive knowledge as design principles.

Keywords: Taxonomy, Design Principle, Morphology, Design Knowledge

1 Introduction

Accumulating prescriptive design knowledge is the chief purpose of *design science research* and a vehicle to ensure transferability of instance knowledge to additional application scenarios [1–4]. Design knowledge, *per se*, is "(…) knowledge that can be used in designing solutions to problems (…)" [5 p. 225] and diverges dichotomously between *descriptive* and *prescriptive* design knowledge [6, 7]. Descriptive design knowledge explains the "what," and prescriptive design knowledge the "how" in artifact design [7, 8]. While both kinds of design knowledge have merit, there is little research on transforming one into another. For example, [6, 9, 10] explain that the dominant transformation mechanism is the introduction of a *goal*, which presents a desirable goal that an artifact is supposed to fulfill. The study picks up from this point and illustrates knowledge transformation of two types of artifacts that are representations of either kind of knowledge, namely morphological taxonomies (*descriptive design knowledge*) and design principles (*prescriptive design knowledge*) [6, 8].

Taxonomies are useful and widely used artifacts to structure a domain of knowledge [11]. In contrast to the conceptual, deductively derived *typology*, *taxonomies* are usually generated empirically [12, 13]. They are used to represent *descriptive knowledge* about a domain of interest or classify objects into categories [14] and can be the basis for analytic theory [15]. Frequently, researchers visualize taxonomies as morphological boxes [16, 17] that comprehensively, illustratively, and intuitively explain and visualize the form or shape (i.e., the design configuration of an artifact [18] or the *Gestalt*[1] [17, 20]) as combinations of design dimensions and design characteristics (e.g., see [21]). In the paper, if we address taxonomies, we mean morphological taxonomies that have a sound empirical basis and illustrate dimensions and characteristics morphologically (e.g., see [21] or [22]). Yet, most taxonomies refrain from advising on which configuration of dimensions and characteristics is better suited to achieve a particular goal [23] (e.g., see [24–27]). The lack of prescriptiveness is even more relevant, as one of the primary goals of design science is the accumulation of prescriptive design knowledge regarding the design of artifacts that achieve specific *goals* [4, 28, 29]. In terms of usefulness for practice, prescriptive guidelines provide instruction rather than mere description and are easier to instantiate [23]. For example, [30] find that only a few taxonomies recommend configurations of artifact design. A suitable tool to formulate, communicate, and codify prescriptive design knowledge for reuse in other instances other than that of their origin are design principles [31–33]. Thus, we ask ourselves whether these two types of artifacts (for that matter, design principles are a meta-artifact [34]) could be conceptually linked to cover a more comprehensive spectrum of design knowledge in artifact design.

Because of the above, we see the need for a framework that bridges that gap and supports researchers and practitioners to extend descriptive knowledge engraved in taxonomies into prescriptive knowledge formulated as design principles. Our paper addresses precisely that issue and aims to uncover how morphological taxonomies can be used to generate prescriptive knowledge about the design of an artifact. Because of the above, our paper pursues the following research objective:

Research Question (RQ): How can descriptive knowledge about an artifact (morphological taxonomies) be transformed into prescriptive knowledge about its design (design principles)?

To close the gap, we draw from the concept of descriptive and prescriptive design knowledge [7], which we will use to illustrate links between the constructs of both morphological taxonomies and design principles. Additionally, next to the transformation of the underlying knowledge, we will explain pathways to change from a generic description of an artifact to a goal-oriented target artifact.

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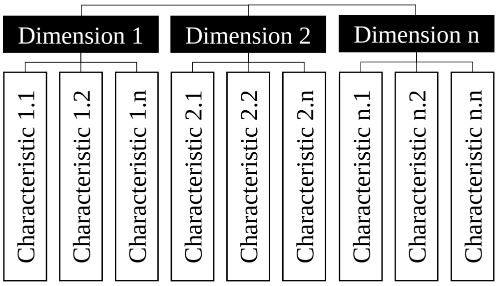
[1] *Gestalt* refers to „(…) the arrangement and connectivity of parts of an objects, and how these conform to represent a whole (…)“ [19 p. 7].

Our paper is structured as follows. After the introduction, we explain the background to our work, i.e., foundations of morphological taxonomies and design principles. Subsequently, we will present our rationale for linking both artifact types by utilizing descriptive and prescriptive design knowledge. Afterward, we introduce specific steps that practitioners and researchers can follow to generate design principles from morphological taxonomies epistemologically sound. Lastly, we address contributions, limitations, and avenues for further research.

2 Background

2.1 Morphological Taxonomies

There are multiple ways to visualize taxonomies. Studies investigating taxonomic research in IS literature find various visualization options, for instance, *mathematical sets*, *hierarchies*, *matrices*, *visually*, or *textually* [30]. Each visualization option can be better suited for a specific task [16]. For example, hierarchies are well-suited to generate tree structure, which enables classification (e.g., see [35]), while mathematical sets have a high degree of formalization (e.g., see [36]). Lastly, researchers visualize taxonomies as morphologies, which are "(…) concerned with the structure and arrangement of parts of an object, and how these conform to create a whole Gestalt." [20 p. 793]. **Figure 1** illustrates hierarchies and mathematical sets as visualization options for taxonomies.

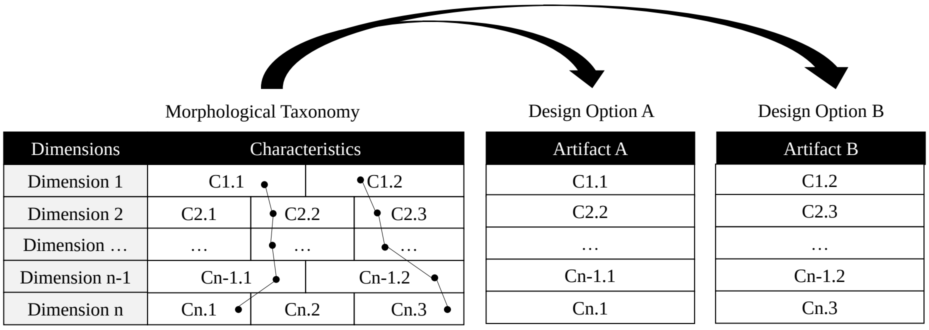

Hierarchies

Mathematical Set

T = {Dimension 1 (Characteristic A, Characteristic B), …{…,…} }

Figure 1. Options for visualization of taxonomies based on [16].

As the study focuses on artifact design and morphological characteristics, we focus on those taxonomies derived empirically and visualized morphologically that give intuitive, visual aid in discerning central designable elements of an artifact, i.e., their *Gestalt* [17, 37]. In the paper, we consider designable dimensions, as they, rather than mandatory dimensions (e.g., see [38]), are potentials for choosing design options. Our understanding of design task-specific morphological taxonomies is best expressed through the notion of *design phenomenology*, which describes "(…) the study of the form and configuration of artifacts" [18 p. 8] and includes taxonomies [39]. That notion is especially useful as finding (supposedly useful or even optimal) design configurations (i.e., patterns) of artifacts is not a straightforward task but requires the exploration of design options, especially if the underlying problem is ill-structured rather than well-defined [40]. Finding design configurations is the quintessential task of a designer, i.e., to choose design options from a variety of possible alternatives [41]. Thus, morphologies are often used to represent sub-components of artifacts and reflect design configurations of design variables [23, 42] (see **Figure 2**). Finding problem-solving combinations of these design dimensions lies at the heart of designing artifacts and is a “(…) game of combinatorics (…)” [41 p. 247]. In the case of taxonomies, for each dimension, there need to be at least two characteristics [43].



Dimensions	Characteristics		
Dimension 1	C1.1	C1.2	
Dimension 2	C2.1	C2.2	C2.3
Dimension …	…	…	…
Dimension n-1	Cn-1.1	Cn-1.2	
Dimension n	Cn.1	Cn.2	Cn.3

Artifact A
C1.1
C2.2
…
Cn-1.1
Cn.1

Artifact B
C1.2
C2.3
…
Cn-1.2
Cn.3

Figure 2. Extracting design options from morphological descriptions of artifacts.

2.2 Design Principles

Quintessentially, design principles are formalized and codified prescriptive statements that support designers in realizing design more efficiently [31]. Rather than being a guarantee for success, they require, if instantiated, contextualization with the user's experience and the environment that they are supposed to work in [28]. In terms of theory, design principles belong to the category of *design and action*, which, rather than being explanatory, predictive, analytical, or a combination thereof, strives to produce meaning through accumulating and communicating *prescriptive design knowledge* [15]. The literature provides various templates to formulate design principles linguistically [44], e.g., see [31, 45]. An integral part of design principles is the formulation of prescriptive statements that guide the designer in instantiating the artifact [9, 31, 46]. **Table 1** gives two examples of design principles.

Table 1. Examples of design principle formulation.

Design Principle	Source
"Provide features for an (initial) assessment of a business model (element) to represent the current state and identify improvement potential."	[47 p. 6]
"Provide the system with the ability to query data from multiple sources, so users can retrieve a comprehensive sample, given that, in the specific search context, relevant contributions are scattered over different data source”	[48 p. 98]

3 Bridging the Gap between Taxonomies and Design Principles

3.1 Domain Constructs

To start our investigation, we first clarify relevant constructs that constitute both artifact types. **Table 2** gives descriptions of the constructs that are relevant to link both artifacts types conceptually. In *design science research*, constructs are the conceptualization and shared language of a specific domain [49]. As there is no standard set of constructs in both fields, we draw from established literature.

Table 2. Domain constructs of taxonomies and design principles tailored to artifacts.

Artifact	Construct	Description
Design Principles	Solution Objective	The goal an artifact is supposed to achieve [46].
	Meta-Requirements	Requirements addressing a class of artifacts rather than a single instance alone [50].
	Boundary Conditions	An environment that design principles should be applicable in [31]. Boundary conditions are part of the design principles' *context* [8].
	Material Property	Describes what the artifact consists of [31].
	Activity	Describes what the artifact should be able to do [31]. Activities are part of the *mechanisms* to achieve goals [8].
Taxonomy	Meta-Characteristic	The purpose of the taxonomy, from which dimensions and characteristics must be derived [43].
	Dimension	Designable dimensions that consist of at least two characteristics [43].
	Characteristic	The specific manifestation of a dimension [43].

The focal question of the paper that needs to be answered to develop design principles out of taxonomies is what type of link exists between the two artifacts. For that purpose, we draw from the theory of knowledge; more specifically, we draw from the notion of *design knowledge*. Design knowledge is knowledge about artifacts, i.e., how they are designed and what they should be able to do [51]. For our purposes, we explicitly draw from the dichotomous division of design knowledge into *descriptive design knowledge* and *prescriptive design knowledge* [6]. Descriptive design knowledge refers to descriptions of the *status quo*, i.e., usually at a fixed point in time, the fundamental morphological characteristics of an artifact. On the other hand, prescriptive design knowledge represents design knowledge that is supposed to guide designers on what should be [7].

In terms of knowledge contributions, taxonomies (and classifications in general) are descriptive, while design principles (and design theory in general) are prescriptive [6, 7]. As both types of artifacts are highly useful in their respective field and frequently published in IS publications, and both do concern the design of artifacts at different levels of design knowledge contributions, we ask ourselves how they can be linked and used to yield more useful results. Additionally, intertwining both artifact types enables better coverage of the design knowledge spectrum ranging from descriptive to prescriptive knowledge. Using design knowledge as the primary linking mechanisms, we investigate how the constructs of both artifacts interlink with each other.

3.2 Knowledge Transformation

The primary transformation mechanism between descriptive and prescriptive knowledge is introducing a *goal* that the artifact should fulfill [6, 9, 10]. Fundamentally, mere description, *per se*, does not require a goal. For example, business model taxonomies (e.g., see [25]) frequently shy away from prescribing specific configurations and only describe that generic arrangements exist. While descriptive research is valuable, prescribing configurations to achieve specific goals is highly demandable. The first step for us is to investigate what a *goal* means in the respective domains.

A suitable starting point for that investigation seems the concept of the meta-characteristic in taxonomies, which describes the conceptual origin of all dimensions and characteristics [43]. Insofar, it describes the goal of a taxonomy, an example for a meta-characteristic can read as "(…) relevant for the description of an analytics-based service (…)" [52 p. 5]. Yet, there is no indication that the meta-characteristic must have any reference to a specific purpose or quantification of success. Also, focusing a meta-characteristic too narrowly on a particular purpose for an artifact might pre-empt configurations from the outset and hinder the freedom and completeness of the range of possibly useful configurations. Thus, the meta-characteristic is better suited to guide generic structuring of possible design configurations in artifact design and delimit, generally, what type of artifact the object of investigation is. For the meta-characteristic above, we can stipulate that the generic artifact is an analytics-based service.

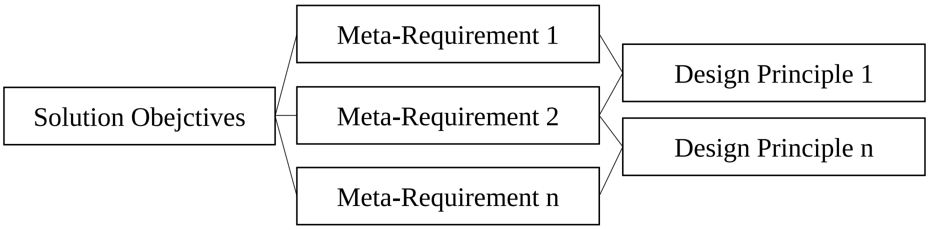


Figure 3. The intersection of Solution Objectives with Design Principles through Meta-Requirements.

Next, what comes most closely to a traditional goal in design principles is the *solution objective*. The solution objective describes what the artifact-to-be-designed should be able to achieve [46]. Analogueley to the meta-characteristic, the solution objective should be the origin for design principles, from which meta-requirements are derived, and ultimately design principles formulated [46] (see **Figure 3**).

Thus, we can view the meta-characteristic of taxonomies as the generic delineation of the type of artifact that is under investigation. At the same time, the solution objective explicitly details what the artifact should be able to achieve. Extending the example given above, the solution objective could assign the generic artifact of the service to a target. For instance, the service is assigned to a specific industry or use case. The solution objective needs to be formulated in the borders of the meta-characteristic and derived from the goal. For example, if the meta-characteristic is expressed as follows:

Meta-Characteristic: Key dimensions and characteristics of **[type of artifact]**.

The solution objective, correspondingly, should integrate the meta-characteristic using the type of artifact specified in it. For example, the solution objective could read as follows:

Solution Objective: How to design **[type of artifact]** to fulfill the **[goal]**?

If we take a more in-depth look at the individual constructs of both domains, we can argue for similarity and transferability. **Table 3** juxtaposes contextualizable constructs of both domains and gives short argumentations on how and why they are linkable. Drawing from [8], we use the notion of *mechanisms* as the dominant vehicle to interweave both concepts (see **Table 2**).

Table 3. The interweaving of domain constructs of taxonomies and design principles.

Taxonomy	Design Principles	Linking Rationale
Dimension	Mechanism	**Mechanisms** delineate **design dimensions** of design mechanisms, i.e., those activities that need to be executed to achieve a goal.
Characteristic	Sub-Mechanism	**Sub-dimensions** correspond to design characteristics as lower-threshold **sub-mechanisms**. Mechanisms contextualize a set of activities.
-	Activity	A specific course of action, i.e., an **activity,** is central to prescriptive knowledge. Once a goal is introduced, the activity should fulfill **meta-requirements**.

Looking at the various conceptual elements of both taxonomies and design principles, one can see similarities. For example, the design principle should give prescriptive knowledge, i.e., guidelines on designing a specific design dimension of an artifact, which, in turn, would represent its mechanisms. Subsequently, as design characteristics are a specification of design dimensions, they, on the other hand, can be translated to lower-threshold sub-mechanisms that the artifact should be designed to be able to let the user fulfill an activity. To illustrate and visualize that way of design principle formulation, we adapt the framework of [31] and integrate the elements *mechanisms*, *sub-mechanisms*, and *activity* (see **Table 3**). We define three fix points to rationalize our framework, i.e., the *prerequisites*, the *transition threshold*, and the *prescriptive guidelines*. First, the *prerequisite* for our framework is the existence of a morphological taxonomy that describes, comprehensively, designable dimensions, and characteristics of an artifact. Next, the *transition threshold* defines the border between descriptive and prescriptive knowledge through the introduction of goals. Lastly, we show how our framework assists in *formulating prescriptive knowledge*, for which we will use design principles.

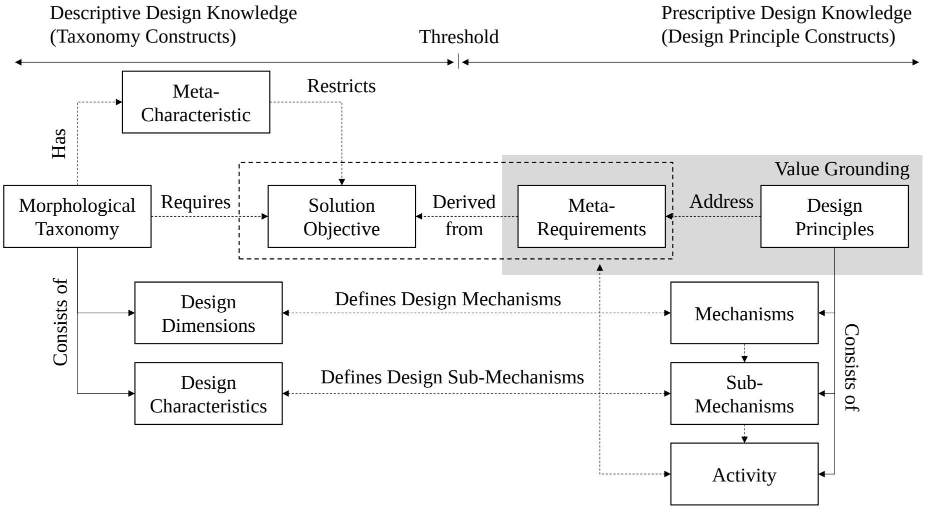


Figure 4. Entanglement of constructs of morphological taxonomies and design principles on design knowledge level.

3.3 Artifact Transformation

As explained above, the morphological taxonomy hosts a variety of unrealized, potential artifact configurations. A particular configuration, i.e., the final arrangement of all of its parts, is the *Gestalt* of the artifact [17]. In the previous section, we have argued for the transferability of constructs of both domains on a design knowledge level. Yet, as that transformation process also affects the *Gestalt* of the artifact, i.e., its transformation from a generic description to a goal-oriented one, the present section argues how that transformation happens on an artifact level. Thus, as to transform artifacts, we term that state as the *generic Gestalt* of an artifact that resides in the *descriptive design knowledge space*. That *generic Gestalt* consists of design dimensions, which, in turn, consist of design characteristics. On the other side, in the *prescriptive design knowledge space* resides the *target Gestalt*, i.e., a yet unrealized artifact configuration that the designer tailors to achieve a pre-determined goal. The goal must serve as a conceptual starting point to derive solution objectives

Figure 5 visualizes the interdependencies in the transformation process, conceptually. The individual fragments are no procedural model, but a conceptualization of interlinking mechanisms and are as follows:

(1) The *descriptive design knowledge space* hosts the unrealized finite number of possible artifact configurations, i.e., the generic *Gestalt* of the artifact. It consists of morphological design dimensions, which, in turn, includes more detailed design characteristics. The morphological description requires to be comprehensive so that it is a sound basis to derive goal-oriented configurations.

(2) The *prescriptive design knowledge space* consists of the overarching goal that determines the ultimate purpose the artifact should be able to fulfill. Solution objectives for the artifact must be derived from the goal. In terms of the *Gestalt*, the *prescriptive design knowledge space* entails knowledge about how to configure the artifact to achieve the goal **(Solution Patterns)** and prescriptions for how to instantiate each design element **(Design Principles)**.

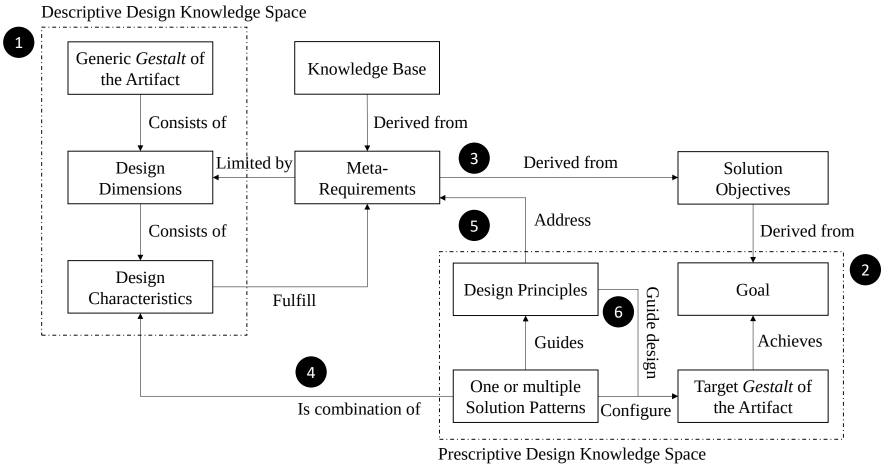


Figure 5. Framework for artifact transformation from a generic description to a target artifact.

(3) The meta-requirements are derived from the solution objectives. Yet, they must be delimited by one design dimensions (and each design dimension must be addressed) to ensure a comprehensive design that describes the artifact fully. Each meta-requirement must be derived from a suitable knowledge base (e.g., theory, literature, interviews, or case studies [53]). That ensures argumentative strength and reasoning that the meta-requirements originate in a sound foundation.

(4) Finding the solution pattern or a range of potential solution patterns, i.e., a goal-achieving morphological combination is selecting the correct combination of design characteristics. Drawing from organizational configurations, the decision whether an optimal or several *equifinal*[2] solution patterns exist requires evaluation through the designer [55, 56]. In that context, a correct combination is a combination of design characteristics that ensure that the artifact fulfills each design dimension's meta-requirements.

(5) Lastly, once the solution pattern is identified, to give more detail, that just which design characteristics to select, but, more so, to also prescribe how they should be instantiated, design principles must be formulated. There should be at least one design principle for each design characteristic that, per the concept of value grounding, addresses at least one meta-requirement [9, 46].

(6) Finally, if both the solution pattern and design principles are available, the designer should have adequate prescriptive assistance both in selecting design characteristics and corresponding prescriptions on how to instantiate them. As the designer is the user of the design principle, addressing each design dimension is paramount so that comprehensive design is possible [31].

3.4 Synthesis

Given the interweaving of domain constructs, we can now synthesize what one would need to do to formulate design principles from morphological taxonomies and to reach a goal-oriented target *Gestalt* of an artifact.

Step (1): Generate a generic **morphological taxonomy** that comprehensively illustrates the compositional structure of artifacts in design dimensions and corresponding characteristics. It is recommended to follow the method of [43], as it is the *de facto* standard in taxonomy development in Information Systems [14]. That morphology hosts the untapped repository of a finite number of design options, i.e., different configurations and resulting patterns.

Step (2): If a morphology is present, it should represent, generically, i.e., free from a too narrow purpose, the *generic Gestalt* of an artifact. If that is the case, one must formulate a *solution objective* that specifies what an artifact of a type covered by the meta-characteristic of a possible configuration should be able to achieve. That solution objective needs to be derived from a goal. For example, if the morphology illustrates design options for *digital twins* (e.g., see [22]), a specific, hypothetical goal could be to design *digital twins for collaborative use* (e.g., see [57]).

Step (3): Once the *solution objective* or multiple of them are formulated, one must identify a suitable knowledge base that scientifically supports the formulation of meta-requirements that need to be fulfilled. As the morphology is present and presets delimited design dimensions, it is purposeful to take these design dimensions as conceptual borders to elicit meta-requirements. Meta-requirements can stem from various knowledge bases, typically including, but not limited to, *literature reviews*, *theories*, *interviews*, or *case studies* [53]. These findings should substantiate the

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[2] *Equifinality* refers to a concept of *organizational design* and means the existance of multiple potential solution patterns for a design problem [54] In the following, we will refer to the singular of a solution pattern, though we acknolwedge that there can be more than one that fulfills the same purpose.

formulation of meta-requirements that address the targeted artifact on each design dimension.

Step (4): Once *meta-requirements* are formulated for each design dimension, it is about the designer to argumentatively select and justify the characteristics most suitable to fulfill them. Naturally, one could arrive at the conclusion that no characteristic is fitting, which would force the designer to formulate new ones and extend the taxonomy. The designer must choose at least one characteristic per design dimension, and their combination results in the solution pattern. Identifying and evaluating the right design configuration could be supported by expert feedback or experience from designers.

Step (5): The solution pattern would only prescribe the specific configuration of the target artifact. Yet, it does not give instructions on designing the artifact successfully, i.e., what must be done to realize the target artifact. For that purpose, one can formulate design principles that implicate, linguistically, what the designer should do in each design dimension. As per the entanglement and mirroring of constructs in both domains (see **Table 3**), we recommend an adjusted template that is consistent with the terminology of taxonomies. The design principle should precisely address how the **artifact** should be designed (i.e., which **characteristics** should be chosen) to achieve the goal defined in the outset. Next, the design principle should specify the **activity**, which should be derived from at least one meta-requirement, that is made possible by selecting the characteristic. Lastly, analog to [31] 's notion of *boundary conditions*, which delimit scenarios for application, the design principles, in the present case, are only ever applicable in the context in that they were built.

Table 4. Adapted template for design principles. Based on [31].

Template of [31]	Adapted Template
Provide the system with **[material property – in terms of form and function]** in order for users **[activity of user/group of users – in terms of action]**, given that **[boundary conditions – user group's characteristics or implementation settings]**.	Provide the **[artifact with a specific goal]** with **[at least one characteristic]** to enable **[activity derived from meta-requirement]**, given the design of **[dimension]** in **[boundary condition]**.

Step (6): Summarizing, in the enclosed design space generated and tailored to achieve a particular goal, one can follow the notion of *technological rule* formulation by [58]. Subsequently, one can see the instantiation of the final set of design principles in a chain of them as the last step to achieve the goal. Thus, one can easily imagine the final artifact as the sum of instantiated design principles:

$$\sum_{k=0}^{n} \text{IDPn} = DA$$

Where the desired artifact (DA) is the final product of a chain of instantiated design principles (IDPn) that ranges, as a finite set, from one design principle to, however, many are needed, i.e., *n*-many design principles.

4 Scenario-based Illustration

As per the relatively large-scale endeavor of our proposed framework, we construct a simple scenario that supports our reasoning [59]. For example, the case of [24] offers a taxonomy of data-driven services in manufacturing. The taxonomy is an excellent example of the deconstruction of a design artifact in generic design dimensions that can be configured freely.

Step (1): The taxonomy of [24] describes data-driven services in manufacturing. We will assume that the taxonomy is comprehensive and thus does not require manipulation of dimensions or characteristics. Their meta-characteristic reads as follows: "key characteristics of data-driven services within the manufacturing industry" [24 p. 5]. The meta-characteristic delimits the formulation of the solution onto the domain of data-driven services in manufacturing industries. Thus, the solution objective must reside in these conceptual borders.

Step (2): Suppose our goal was to formulate design principles for data-driven services that are determined to enhance quality in manufacturing. Subsequently, a possible *solution objective* could be:

Solution Objective: How to design data-driven services to enhance quality in manufacturing environments successfully?

In the present case, as per the previously defined meta-characteristic, steering the objective of the data-driven services explicitly onto a specific value proposition domain seems reasonable and well within the previously pre-determined restrictions.

Step (3): Once the solution objective is formulated, the designer must endeavor to elicit meta-requirements that are tailored for each design dimension. As our illustration is a scenario, we will assume that a suitable knowledge base, e.g., the literature on quality management or qualitative interviews, will produce ample grounds for reasoning the selection of specific characteristics from the taxonomy. For example, if the findings would prescribe that ensuring quality through data-driven services requires the integration of data generated from the machine (i.e., data about the process), which can be supplemented through acquired data from other machines, these characteristics should be selected. Possible, hypothetical meta-requirements derived from the solution objective for the dimension **Data Sources** and **Pricing Model** could be formulated, as shown in **Table 5**.

Table 5. Hypothetical meta-requirements for the present scenario.

Dimension	Meta-Requirement (MR)
Data Source	**MR1:** Data-driven services should provide quality through monitoring machine data.
	MR 2: Data-driven services should leverage data from comparable machines.
Pricing Model	**MR 3:** Data-driven services should foster long-standing monetary relationships with customers instead of single payments.
	MR 4: Data-driven services should produce recurring income.

Step (4): Once all meta-requirements are formulated, one can match them with the characteristics that are most useful to achieve them. In the present case, the (abbreviated) solution pattern is supposedly the most fitting to achieve the overarching goal of generating data-driven services that enhance the quality of manufacturing processes.

Step (5): Lastly, based on the solution pattern, the designer must formulate design principles. Staying with the example of the design dimension *data sources*, a design principle that addresses MR1 and MR2 could be formulated as follows:

Provide the **Data-Driven Service for Quality Enhancement** with mechanisms to integrate **acquired data** to enable **benefiting from analysis of historical data from similar machines**, given the design of **Data Sources** in **Data-Driven Service Design in Manufacturing Industries**.

Provide the **Data-Driven Service for Quality Enhancement** with mechanisms to integrate a **Subscription-based Revenue Model** to build long-term relationships with customers generating recurring income and opportunities for selling additional services, given the design of the **Pricing Model** in **Data-Driven Service Design in Manufacturing Industries**.

The first design principle would address MR1 and MR2, as leveraging data produced by machines that are owned by the manufacturer should not pose any issues of data ownership and draws from the most prominent data source. The second design principle would address MR 3 and MR4.

Step (6): Naturally, the last step would be instantiating the chain of design principles, which would, hypothetically, then lead to the desired *Gestalt* of the artifact.

5 Contributions, Limitations, Outlook

Our work theorizes a way to bridge the gap between two popular IS artifacts that, respectively, have a high amount of value regarding either descriptive or prescriptive design knowledge contributions. We propose the interweaving of both artifacts, with the ultimate goal of mapping the entire spectrum of design knowledge regarding an artifact's design. For that purpose, a generic morphological description of an artifact's design structure is the essential requirement to spur the design and development of more specific artifacts of that same type that are tailored to fulfill particular goals. We argue that our work is a significant contribution to extend and further substantiate taxonomies in IS research and to use them as the basis for further study and comprehensive design knowledge contributions, rather than a finished result. As this implies that descriptive knowledge is transformed into prescriptive knowledge, we contribute to the highest goal of design science, which is the accumulation of prescriptive knowledge.

Our work is subject to limitations. First and foremost, we theorize on argumentation to transform descriptive knowledge to prescriptive knowledge, that we showcase using a hypothetical, illustrative scenario. Thus, both a limitation and a natural opportunity and obligation for further research is testing our framework in practice and studying how design principles for goal-oriented artifacts can be designed from generic, morphological descriptions.

Lastly, our work provides fertile soil for further research, as it, hopefully, spurs discussion on design knowledge transformation. As our framework is yet a product of theorizing, the next steps could include gathering empirical data, e.g., conducting interviews with researchers with experience and knowledge in taxonomy design and design principle development. Additionally, our conceptualization of descriptive and prescriptive design knowledge offers potential for subdividing that process into more distinct design stages.

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