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Abstract:

Conceptual frameworks (CFs) are essential to communicate about research. They enable the target audience to focus on something (inside the frame) and ignore other things (outside the frame). Prior studies have discussed how to build CFs, yet these are mainly focused on their specific research domain and conflate the construction of a CF with research design. Therefore, it can be difficult to view CFs as part of an independent phenomenon—the process of creating a CF to accomplish a definite purpose in research. This problem is particularly relevant in information systems, where CFs are important research contributions. This study adopts a design perspective on the construction of CFs and positions CF design as an independent phenomenon. Peircean Semiotics is used as a foundation for CF design, which allows strict separation between the CF and all aspects of research. Based on Peircean Semiotics, a scheme for CF design is proposed. The scheme is illustrated in a case. This study contributes to a better understanding of the construction of CFs.

Keywords: Conceptual Frameworks, Conceptual Framework Design, Peircean Semiotics.

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1 Introduction

The Merriam-Webster dictionary assigns two different meanings to the word 'framework': 1) "a basic conceptional structure (as of ideas)" and 2) "a skeletal, openwork, or structural frame." The former type is usually called 'conceptual framework' (CF) (Maxwell, 2012; Miles & Huberman, 1994; Ravitch & Riggan, 2016). This helps distinguish conceptual from material frameworks. CFs play important roles in research. They help communicate about research (Ravitch & Riggan, 2016). They enable the target audience to focus on something (inside the research frame) and downplay/ignore other things (outside the research frame). Underlining again the definition from the Merriam-Webster dictionary, communicating research using CFs avoids complicated constructs and stringent structures, rules, or constraints, instead relying on intuitive items connected with other intuitive items (Connelly, 2014).

From a broad perspective, considering research in general, several studies have already discussed how to build CFs with great guidance (Maxwell, 2012; Miles & Huberman, 1994; Ravitch & Riggan, 2016). However, we identify some limitations and opportunities:

Prior studies conflate the construction of a CF with the research design (Antunes et al., 2021; Lindgreen et al., 2021; Van der Waldt, 2020). This makes it difficult to analyze CF construction as an independent phenomenon, which is necessarily linked to the underlying research but is also distinct in how it stands for certain aspects of the research. This is relevant for novice researchers, as separation of concerns facilitates method understanding and justification, but also for seasoned researchers interested in broader issues such as disciplined inquiry, research communication efficacy, and, of course, mentoring novice researchers (Antonenko, 2015).

Most discussions about CFs concern the research upstream, considering, for example, problematization and conceptualization (Maxwell, 2012; Miles & Huberman, 1994; Ravitch & Riggan, 2016). Nonetheless, practitioners often seek to employ CFs in the research downstream, for example, to communicate research contributions (e.g., Benz et al., 2024; Khuntia et al., 2024; Pinto et al., 2023) and characterize new constructs (e.g., Wieringa, 2014). Therefore, there is a need to consider a wider range of goals when examining the construction of CFs. Further, no prior studies have researched CFs from a design perspective, where the CF construction process is analyzed as an artifact-oriented problem-solving strategy supported by critical thinking and a solid knowledge foundation (Hevner et al., 2004).

Specifically targeting the IS domain, we find one additional challenge: The complexity of the IS domain has implications for CF design. The IS domain is characterized by a richness of boundaries (with other domains), challenges, viewpoints, concepts, and methods of inquiry (Sidorova et al., 2008). This richness of boundaries includes, for example, informational, technological, social, and sociotechnical dimensions (Alter, 2015; Chatterjee et al., 2020). Researchers must find ways to position the objects and contexts of research within such a complicated landscape while targeting a diverse audience. CFs offer an open, flexible mechanism that supports the researcher in that effort. However, each CF ends up being unique, requiring significant effort from the target audience to understand the design. Thus, a discussion on how to design CFs in the IS domain is paramount to reduce the effort from both sides.

Addressing all these challenges requires us to view CF construction as an independent phenomenon concerned with designing conceptual structures that meet a wide range of goals in the IS domain. The understanding of CF design is the unique proposition of this research.

Our notion of design is pragmatic and constructive, not normative (Gregor & Hevner, 2013; Iivari, 2007). We seek to identify useful processes at the conceptual level; they are intended to enhance practice. This is accomplished with support from Peircean Semiotics (Parker, 1994). By setting the perceptual dynamics of how a CF operates as a sign, Peircean Semiotics provides a foundation that allows us to analyze and derive guidelines for CF design.

The study is organized according to the following design-oriented research questions (Thuan et al., 2019):

RQ1: What existing applicable knowledge can guide CF design? This question is essential to ground the CF design rigorously on a solid theoretical foundation (Hevner et al., 2004). It is also important to justify the adoption of Peircean Semiotics.

RQ2: Which components define CF design? The answer to this question is the basis for characterizing CF design as an independent phenomenon.

RQ3: How can the CF design be realized? This question guides the central contribution of this study, a set of guidelines for CF design.

The paper is organized as follows. First, we provide background information on prior views over the construction of CFs, discuss their limitations, and propose a design perspective on the problem based on Peircean Semiotics (answering RQ1). We then discuss the abstract components of CF design (answering RQ2). This is followed by elaborating guidelines on realizing CF design (answering RQ3). The guidelines are synthesized in a scheme. We then illustrate the use of the guidelines with a case study. Finally, we provide some discussion points and concluding remarks about this study.

2 Background

2.1 Prior Research on CFs

Ravitch and Riggan (2016) overviewed several conceptualizations of CFs and noted that the concept is associated with "multiple, idiosyncratic meanings" (Ravitch & Riggan, 2016, p. 29). For example, CFs can be viewed as:

- Taking a supportive role in the process of theorizing, where they help position a study in relation to existing theoretical perspectives;
- Helping to identify gaps in prior research and advance new constructs (e.g., Hassan et al., 2019; Lee et al., 2004; Maxwell, 2012);
- Taking an integrative role in research design, linking the various components of research together while building an argument about why the research matters and how it is appropriate and rigorous (e.g., Ravitch & Riggan, 2016);
- Supporting the organization of specific research objects in a study, such as framing the research problem and research questions, relating the study to existing knowledge, outlining the literature review, structuring the data collection and analysis, and defining a working hypothesis (e.g., Miles et al., 2014; Nickerson et al., 2013; Schwarz et al., 2007).

These conceptualizations relate to what we designate the research upstream, where researchers communicate about the higher elements driving a study. In more practical terms, it also indicates that CFs based on these conceptualizations often appear early in a paper (Hjalmarsson et al., 2015; e.g., Zhang et al., 2010).

In line with the upstream positioning, most studies addressing the construction of CFs mix the process of building a CF with the research process, conflating arguments about the nature and purpose of a CF with the substance of the research. For instance, many studies on CFs focus on the unique qualities of qualitative research (e.g., Miles et al., 2014; Ravitch & Riggan, 2016). Other studies focus on medical research (Bordage, 2009), design science research (Antunes et al., 2021; Wieringa, 2014), and education research (Antonenko, 2015). This situation creates dependencies and hampers clarity and structure.

The diverse nature of IS research has also led researchers to bring CFs downstream. In the research downstream, they become part of the theoretical and practical contributions of a study; they may even become the core contribution of a study (e.g., Andaloussi et al., 2020; Molla et al., 2012; Nasery et al., 2023). In more practical terms, this indicates that CFs can also appear later in a paper. However, the lack of guidance can make it difficult to bring CFs downstream. Recommendations and patterns supporting the construction of CFs are often based on exemplary cases taken from the researchers' specific domains and study contexts (e.g., Miles et al., 2014; Ravitch & Riggan, 2016). This makes it challenging to translate knowledge to other study contexts.

The IS field is recognized to be very diverse in several dimensions, including the nature and role of theory in IS research, research approaches and methods, types of contributions, forms of communication, and considerations about usefulness and everyday practice (Bernroider et al., 2013; Gregor, 2006; Hevner & Chatterjee, 2010; Sidorova et al., 2008; Zobel, 2004). When borrowing CF construction approaches from other domains and contexts, researchers must scan and integrate various sources using multiple lenses and apply different contextualizations and extrapolations. Further, it may not capture the unique paradigms, research foci, and specific purposes of IS research. Examples include supporting the digital

world, tackling major societal challenges, and solving practice-related problems (Wieringa, 2014). Finally, the upstream-downstream continuum of IS research brings additional options regarding how CFs can be used, which further complicates the matter of constructing a CF.

2.2 Prior Research on CFs in the IS Domain

In the IS domain, few studies have discussed frameworks, including CFs. Weber (2012) proposed a framework for developing theory using ontological constructs, which guides what elements should be included in a CF. In a similar vein, Cushing (1990) presented an early overview that is mainly focused on IS research frameworks. These authors also identified a set of unique CF elements used in the IS domain. Elements such as users, developers, systems (including technology and information), organizational environments, and their interactions are unique to IS and help differentiate the IS domain from other domains. Lee et al. (2004) and Hassan et al. (2019) provide similar contributions, albeit with a focus on IS theoretical frameworks.

Antunes et al. (2021) studied the use of CFs in a specific IS field: design science research (DSR). The authors note the distinctive facet of DSR, which involves designing a wide range of socio-technical artifacts with different levels of abstraction. The authors systematically reviewed the use of CFs in DSR and proposed a typology: 1) CFs that position the research in relation to the knowledge base (which align with the notion of theoretical framework); 2) CFs that position the designed artifacts in relation to design practice (which align with the notion of research framework); and 3) CFs that describe the design of an artifact (which seem unique to DSR). The authors also suggested that a DSR study can be organized by interlinking the different types of CF, starting with a CF that positions the study in relation to prior knowledge, followed by a CF that explains the requirements, properties, and components of a designed artifact, and finishing with a CF that explains the artifact design, use and evaluation.

The above studies highlight that CFs are relevant in the IS domain. However, they do not say much about CF construction. There is a lack of guidance on how to align the creator's intentions with others' perceptions. This involves discussing what elements should go into a CF, how they should be put together, what is represented, and other aspects of communication, including visualization.

2.3 The Boundaries of this Study

Research about CFs can be difficult to delimit because it touches on a variety of important matters, such as scientific understanding (Kuorikoski & Ylikoski, 2015), logical thinking (Connelly, 2014), representation (Green, 2014), research methods and processes (Ravitch & Riggan, 2016), research policy (Geels, 2010), pedagogy (Antonenko, 2015), and research communication (Rocco & Plakhotnik, 2009). Therefore, it is important to precisely delimit the boundaries of this study.

The study is targeted at two actors central to research communication, the CF creators and users. We also concentrate on two goals linked to these actors: the creators seek to organize and communicate their research, and the users seek to interpret that research. This particular selection of targets and goals steers the present study toward the understanding of CFs as external artifacts that mediate the relationship between creators and users.

The study is centered on constructive design knowledge (Goldkuhl, 2012). We focus on the process, not the output of design. This selection steers the study away from elaborations about the output of design, e.g., in the form of arrangements and categorizations.

2.4 IS Design Perspective on CF Construction

We adopt an IS design perspective to examine the construction of CFs, following the "pragmatic design camp" followed by many IS researchers (Gregor & Hevner, 2013). Pragmatism, as a philosophical paradigm, emphasizes knowledge that can be useful in action (Goldkuhl, 2012). The pragmatic design camp puts particular emphasis on the value of new and interesting designs.

From a design perspective, the researcher plays the designer's role when creating a CF. The researcher may have different intentions and focus on various aspects of research when creating a CF, including the research upstream and/or downstream, but the notion of design abstracts them. Building a CF becomes a design endeavor: the process of generating an artifact through a set of design activities. The design

activities are focused on the reflective practice of creating an artifact that is fit for purpose rather than centered on the specifics of the realm where the design is done (Johansson-Sköldberg et al., 2013).

Once the specifics of the study are decided, for example, regarding problematization, theorization, research design, evaluation, and results, the researcher equates the need and opportunity of using a CF for support and/or communication. The CF can address either the whole of the research or specific research components. In some areas, such as DSR, it has already been established that various CFs can be used to structure and communicate about the research (Antunes et al., 2021).

Additionally, in areas emphasizing exploratory research and generative research practices, including creativity, abductive thinking, and analogizing, CFs can be used as a form of research contribution (Hassan et al., 2019). This often happens in computer science and IS, which are characterized by a constant flux of scattered (not necessarily incremental) ideas, exploratory approaches, and discoveries, where the development of core theories and models can be premature, and CFs can play a more open and flexible role in communicating and consolidating the research outcomes (Cushing, 1990; Hassan, 2014; Hassan et al., 2019). This is not to say that CFs in exploratory and generative domains should function as substitutes for theories and models; it is a recognition that they can and often do function as theory or model substitutes as researchers work out puzzles, solve problems, encounter anomalies, and overcome "crises" (Hassan, 2014).

Given the design perspective, we view CF design as a research phenomenon per se in the IS domain. This is because the IS domain pays attention to developing a wide range of design outputs, including "construct artifacts," with which we can characterize a phenomenon (Hevner et al., 2004; March & Smith, 1995). CFs are a type of construct artifact, as they are theoretical entities specifically built to characterize research phenomena. Their meaning and value lie in their capacity to enable dialogue and understanding of the specific research phenomena (De Sordi, 2021).

As a research phenomenon in the IS domain, CF design will have its specific research foci. We raise attention to two elements of design. One element is the design process. In IS, focusing solely on the design output yields an incomplete understanding of design (Baskerville et al., 2018). Exemplary or referential design processes contribute to repeated and improved practice and benefit the users' relationship with design outputs[1] (Goldkuhl & Sjöström, 2018). Applying this idea to this study's context, having a repeatable design process for constructing CFs helps researchers communicate with others. It establishes a relationship founded on repeated design practices rather than formalizing design outputs.

The other element concerns applicable knowledge. In IS, design is not done in a vacuum; it is guided by applicable knowledge (Hevner et al., 2004). Theories and methods from different domains can be used as a foundation for CF design. This notion of applicable knowledge is essential to this study's context because it provides appropriate (rigorous) justifications for delineating the CF design process.

2.5 Peircean Semiotics as a Theoretical Foundation for CF Design

This study selects Peircean Semiotics (Parker, 1994) as applicable knowledge for CF design for two reasons. First, Peircean Semiotics is well known for providing a basis for interpreting "content" through signs (Goharipour & Gibson, 2023). Peirce's conception of the sign has been much discussed in IS (Beynon-Davies, 2018; Grover & Lyytinen, 2015; Mingers & Willcocks, 2017). As adopted in this study, it offers an effective mechanism for interpreting CFs by identifying their constituent signs and their meaning. Second, we note that design and Peircean Semiotics share a common philosophical foundation: pragmatism. Design is considered to be pragmatic in nature due to its emphasis on action and practical utility (Hevner, 2007). Peircean Semiotics takes a pragmatic stance over the relationship between thoughts and actions mediated by signs (Beynon-Davies, 2018). Hence, Peircean Semiotics helps explain CF design from a pragmatic standpoint, which is concerned with the relationship between the creator's thoughts and actions while designing a CF.

Peircean Semiotics affirms that interpreting 'content' is an ongoing process involving a triadic relationship between three entities (Parker, 1994): object, sign (often designated by Pierce as representamen), and effect (also designated interpretant) (Figure 1). An object is something of interest. The sign is a physical

[1] This viewpoint over repeated design practices is particular to some domains. In more creative domains, such as architecture, repeated design practices can be seen as lacking creativity or conducing to fixation (Boland et al., 2008; Purcell & Gero, 1996). Repeated design practices are expected in domains such as computer science and IS. For instance, requirements elicitation is anticipated as part of sound systems design.

entity that represents (or signifies) aspects of the object and communicates them to someone. The effect occurs in someone's mind by interpreting the sign/object relation ("Peirce's Theory of Signs", 2022). In other words, the sign can be seen as a mediator that conveys aspects of the object to someone.

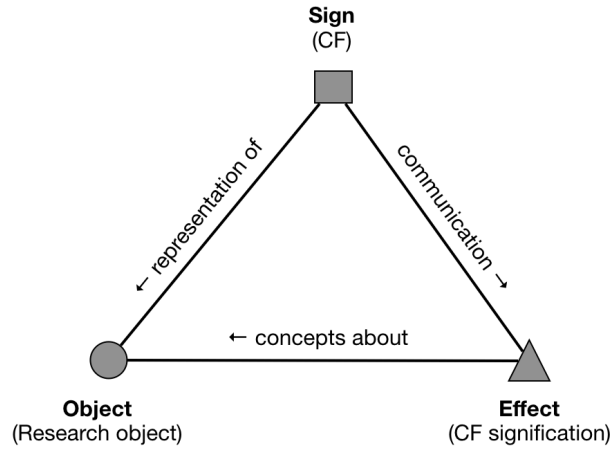

Figure 1. The Role of CFs, Based on Peircean Semiotics

In this study, Peircean Semiotics relates several critical concepts involved in CF design (Figure 1): Research object, CF, and effect in researchers' minds.

Research object: The object in the world is a research object. Any research object can be considered, such as a theory, model, method, process, system architecture, set of requirements, etc. A collection of research objects can also be considered a research object.

CF: The CF is a sign. It supports the communication of the research object through representation. Peirce characterized three types of signs (icons, indexes, and symbols) with different relationships to objects (Mingers & Willcocks, 2014). This study focuses on symbolic relationships, as they are particularly relevant in IS. They play an essential role in the representation and communication of meaning related to IS (Irvine, 2022; Mingers & Willcocks, 2014). Examples include the communication of system qualities, patterns, and rules (Parker, 1994).

Furthermore, we also emphasize visual forms of symbolic representation since, as noted by Simon (1996), the IS domain is characterized by a strong relationship between design, thinking, and visual imagery. This is not to say that other types of symbolic representation (e.g., logical and mathematical) are irrelevant. It reflects a pragmatic assumption that visual forms of representation are an essential aspect of social practice in the IS domain (Mingers & Willcocks, 2017).

Effect: The effect occurs in the user's mind when building a signification of the CF. It is the outcome of several interpretation steps (Brödner, 2019; Mingers & Willcocks, 2017). The first step concerns immediate engagement with the CF through observation, where direct information is construed from the CF (e.g., items, lines, arrows, and boxes). The subsequent steps are more conscious: first, journeying, decoding, relating, and combining information elements; then, building and internalizing concepts about the research object.

This conceptualization of the role of a CF is essential for the current study. It allows us to view the CF as an independent phenomenon mediating the relationship between the research object and people's minds. Functioning as a mediator, the purpose of CFs is twofold: 1) to represent the research object and 2) to generate an effect. It also allows us to separate the CF design from the research process; while the former is wholly interested in the effect, the latter concerns exclusively the object. For example, in most of our research projects, given a particular research process, we create several CFs to explore what and how to communicate with the users, considering both the research upstream and downstream. Decisions on which CFs to use in a paper depend more on communication than the research itself. This underlines the independent nature of CFs, yet the selected CFs still link to the research, supporting reflection and argumentation.

Besides supporting representation and communication, the sign also supports the connection between creators and users. This allows us to discuss the purpose of the CF creator as twofold: 1) to select and represent certain aspects of the research object and 2) through the CF, to influence or shape how users engage with the CF to build, assess, and internalize concepts about the research object. These relationships will be further analyzed later.

This theoretical foundation is adopted to answer RQ1. We conceive that CF design can be rigorously grounded in Peircean Semiotics, as it allows us to clarify the purpose of the CF, and the roles of the actors involved. Most importantly, this is accomplished with a clear separation between the CF design and the research process. We do not argue that this theoretical foundation is the single best one for CF design. We only suggest that it is a "good enough" (satisficing) approach. Satisficing approaches are common in design research (Simon, 1996). This happens because, in design research, approaches usually pose themselves as difficult, or even impossible, to maximize. There are multiple forms of reasoning, goals to achieve, and potential courses of action. For that reason, a variety of applicable knowledge could be selected. The chosen one is an "experiment" justified in terms of how "appropriate" it is to support CF design (Hevner et al., 2004).

2.6 Process Theory as an Explanatory Device for CF Design

Process theory provides a conceptual basis for explaining phenomena by considering events and state transitions (Burton-Jones et al., 2015; Niederman, 2021). This is not the only possible way of looking at the design phenomenon. However, it aligns with Peircean Semiotics, which emphasizes the underlying actions involved in understanding a sign (Brödner, 2019), and it also aligns with the understanding that designing something involves actions and state transitions (Gregor & Hevner, 2013). Therefore, we adopt process theory as the primary device for conveying knowledge about CF design. This theoretical foundation shapes our answers to RQ 1, 2, and 3. In particular, we look into the states and events involved in the CF design process.

We codify those states and events into a scheme for CF design. The scheme highlights changes over time, as the creator progresses through different states. Event and state changes are fully dependent on the creator's play with different forces. The scheme is not normative and cannot be reduced to setting a standard way for CF design. Instead, it is a template that identifies a set of forces in play through positioning and progress (Niederman, 2021).

3 Understanding CF Design

Based on Peircean Semiotics and using process theory, we now provide a general conceptualization of CF design.

3.1 Cycles of Design and Use

Viewing CFs as design artifacts, we start this section by looking at the design cycle. The design cycle is accomplished by the creator (researcher), who creates a CF with communication objectives in mind. Using the Peircean object-sign-effect relationship, this can be denoted as a sequence of three stages:

CF design cycle = select(meaning) → build(representation) → mediate(effect)

In other words, the creator selects meaning and builds a representation with the intent to generate a certain effect. Figure 2 presents the three stages of the design cycle.

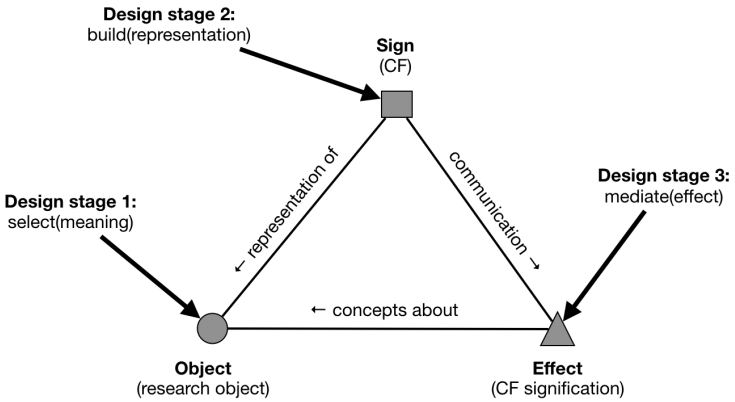

Figure 2. Cycle of CF Design

We note that it seems impossible to discuss the CF design without discussing its use. After all, design is not only a way of imbuing an artifact with purpose and meaning or materializing a solution; it is also a way of instilling values and experiences (McKay et al., 2012). Therefore, we now move on to the use cycle. Using the three entities of Peircean semiotics, the use cycle has three stages (Figure 3):

CF use cycle = produce(effect) → engage(representation) → reference(meaning)

In other words, the user produces an effect (in the mind) by engaging with a representation that references a certain meaning. The user notion is broad, referring to the research community, the practice community, and any other audience that could benefit from the CF. Ultimately, we may even consider that the CF creator becomes a user after building the CF.

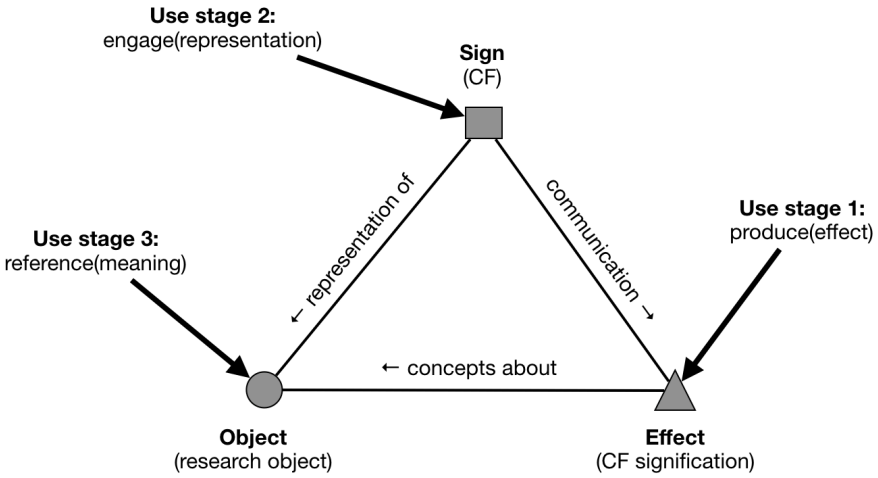

Figure 3. Cycle of CF Use

Figures 2 and 3 position the CF design and use cycles and corresponding stages in relation to the Peircean triadic relationship. The purpose is to highlight that even though the identified cycles and stages are distinct, they are also inherently connected. The creator of a CF needs to establish a connection between meaning, representation, and effect so that users can reconnect.

3.2 Design Stages and Concomitant Goals

Design is a problem-solving and constructive activity (Hevner et al., 2004). It requires transferring knowledge from the problem domain, where purpose and desirable properties are defined, to the solution domain, where a meaningful artifact having the desired properties is synthesized (Baskerville et al., 2015). The select(meaning) stage concerns this transfer of knowledge, where the creator tackles the definition of purpose and desirable properties by selecting and identifying features of the research object, which will shape the CF.

The build(representation) stage focuses on building an artifact representing the research object. The process has been conceptualized using the following expression (Giere, 2004):

> **S uses X to represent W for P, where**
>
> **S=scientist(s); X=representational artifact; W=an aspect of the world; P=purpose(s).**

Translating this expression to our context:

> **build(representation) = [creator] uses [CF] to represent [research object] for [produce an effect in user's minds]**

This conceptualization assigns two essential and complementary goals to the build(representation) stage (Knuuttila, 2011). One goal underlines representation: the CF is designed to represent the research object. The other goal emphasizes purpose: the CF is also designed to produce an effect.

These goals underline the need for the creator to balance representation and purpose. On the one hand, the creator must define appropriate correspondences to the research object. Success depends on faithfulness to the target, coherence, and internal structure. This understanding of success (or quality) is central to representation theory, as elaborated in the IS field (Recker et al., 2019). Weber (2020) emphasizes this fundamental idea, noting that the usefulness of a representation depends on its faithfulness to the target.

On the other hand, the creator must assign a purpose to the CF. This may require pragmatic changes in the representation, such as idealization, simplification, and approximation, which inevitably restrict faithfulness (Knuuttila, 2011). By considering purpose, the discussion about the build(representation) stage shifts from faithfulness towards purposefulness.

Finally, the mediate(effect) stage concerns the boundary between the design and use cycles. Even though individual users control the use cycle, the creator participates. Otherwise, the produced effects may deviate from the creator's intentions. This is not a matter of purposefulness. It is a matter of embedding the interpretation of the CF in the social world of the user (Mingers & Willcocks, 2017). It extends beyond the immediate interpretation of the CF towards a more expansive interpretation, where social aspects are considered, e.g., concerning traditions, metaphors, and patterns.

This understanding of CF design provides an answer to RQ2. CF design involves a set of stages and goals. The CF design is also related to CF use, given that the former is intended to influence the latter.

4 Guidelines for CF Design

Combining Peircean Semiotics with prior knowledge of CFs and IS design leads to a preliminary conceptualization of CF design. Given the original viewpoint adopted, this outcome can already be helpful for CF design. However, in this section, we consider going a step further. We elaborate on a set of guidelines for CF design. This new development is organized into three parts: empirical insights on CF design, questions/actions driving the CF design, and consolidation of guidelines into a scheme.

4.1 Empirical Insights

Design cannot only be situated at the abstract and theoretical levels, but it also concerns the empirical level (Goldkuhl & Lind, 2010). For that reason, we bring empirical considerations into the discussion. An iterative approach was adopted to accomplish this. First, a preliminary/tentative scheme with guidelines was developed. Second, a workshop with researchers was organized to gather empirical insights on the construction of CFs. Finally, both the guidelines and scheme were revised, consolidating the theoretical and empirical aspects of the problem.

The workshop included sessions dedicated to constructing CFs and interviews with the participants. Different sessions were organized according to the types of participants, considering experienced researchers, lecturers, and Ph.D. students. Each session included 3-6 participants. The sessions were initiated with a discussion on CF design and presentation of the preliminary scheme. After this initial discussion, each group was invited to select an ongoing research study and design a CF with support from the provided scheme. The participants were encouraged to reflect on CF design and the proposed scheme.

Subsequently, we conducted qualitative interviews to collect the participants' feedback. Adopting interviews is appropriate as it enables the participants to reflect on their experiences with the scheme (Myers & Newman, 2007). Further, qualitative interviews enrich our empirical understanding of the interplay between creating a CF and using the scheme. Five researchers and Ph.D. candidates voluntarily participated in the interviews. All participants had prior experience with constructing CFs. The interviews lasted about 40-60 minutes and were conducted two weeks after the workshop.

Together, the design sessions and interviews provided empirical data. In these, rather than collecting general feedback and opinions, we adopted a more focused approach centered on the cognitive experiences of the participants. Cognitive experience is an enabling condition for design expertise (Klein et al., 2017). We adopted three indicators developed by Termeer and Dewulf (2019) to evaluate progress in tackling complex problems (such as building a CF). This approach values 'small wins,' i.e., attaining satisfaction by embracing complexity, making small steps forward, and valuing concrete outcomes in small time scales. These characteristics align with the scenario at hand, where researchers face the complex task of building a satisfactory CF for a research task that some will know well, even while others may not.

The three selected indicators are *energy and enthusiasm*, *learning by doing*, and *logic of attraction*. Energy and enthusiasm refer to the cognitive drive to move forward (in this case, building a CF) and the intention to make a difference (in this case, communicating properly about research). Learning by doing refers to the idea that each step in trying to solve a problem (in this case, building a CF with support from the provided scheme), whether successful or not, fosters a better understanding of the task at hand. Finally, the logic of attraction means that visible results of small wins (in this case, building a CF) increase the chances of using the same mechanisms in the future (in this case, adopting the proposed scheme in future research endeavors).

We analyzed the data using structural coding (Miles et al., 2014). We coded data using the three indicators identified above. Furthermore, we also enabled new codes to emerge from the data (open coding). Data analysis was done iteratively, considering the structural codes and emerging codes. The codes were then arranged into main themes. The empirical insights gained from this process are summarized below.

Regarding energy and enthusiasm, feedback indicated that having a scheme allowed the participants to "visualize what was going on in their mind," "have a way to go forward," and consider what "would attract the audience." The participants were encouraged to develop CFs that "serve as a foundation to discuss the results of my [their] study." Most participants felt energized when they organized the CF design according to the suggested stages. One participant highlighted their enthusiasm for settling on a CF: "You feel happy. That is an achievement. It is self-efficacy, you know, something like 'I reached it!'". Given that, we suggest that the proposed stages are not only a logical inference from Peircean Semiotics but also a practical-empirical insight from the workshop.

Considering learning by doing, the participants noted two interesting learning points. First, they realized that they could use more than one CF in a study, organizing their thinking using various CFs. This means that they could apply the cycle of CF design (Figure 2) multiple times. One participant noted: "It enlightens me. When studying it, I understand that CFs can have more than one role. I used to think that a CF serves only one role." Second, while the participants agreed on the purposes of each stage, they faced challenges with their operationalization. For instance, one team took "many, maybe 7-10 times" before completing the select(meaning) stage. Addressing this problem, we revised the scheme to improve understanding. In particular, we added a precise sequence of stages to the revised scheme to help organize thinking and attached sets of questions to stages to clarify their purposes.

Considering the logic of attraction, feedback indicated that the abstract scheme changed how the participants viewed CFs. Most participants were only familiar with using CFs upstream, for example, in theorizing or reviewing the literature. However, in the workshops, they realized they could use CFs downstream. They also appreciated they could use more than one CF in the same study. One participant noted, "[t]he scheme opened my eyes. I know these elements, but I didn't have the idea that we could organize them like this." They also indicated other advantages, like "constructing CFs in a more systematic way" and a reminder to check what may be missing: "to know what kind of structure they need to have."

A summary of the major empirical insights from the workshop is provided in Table 1 (See also Appendix A). These insights drove several improvements to the final scheme, which is discussed next.

Table 1. Major Empirical Insights from the Workshop

Having a scheme	Positive impact on practice
Scheme's cycle organization	Helps organize thinking around several CFs
Scheme's linear process	Assists in understanding
Scheme's abstract outlook	Suggests a variety of uses, including upstream and downstream Assists communication

4.2 Questions/Actions Driving the Design

We now develop a more detailed account of the CF design process. This is accomplished by identifying actions at each stage (Figure 4). Actions are based on answering a set of questions.

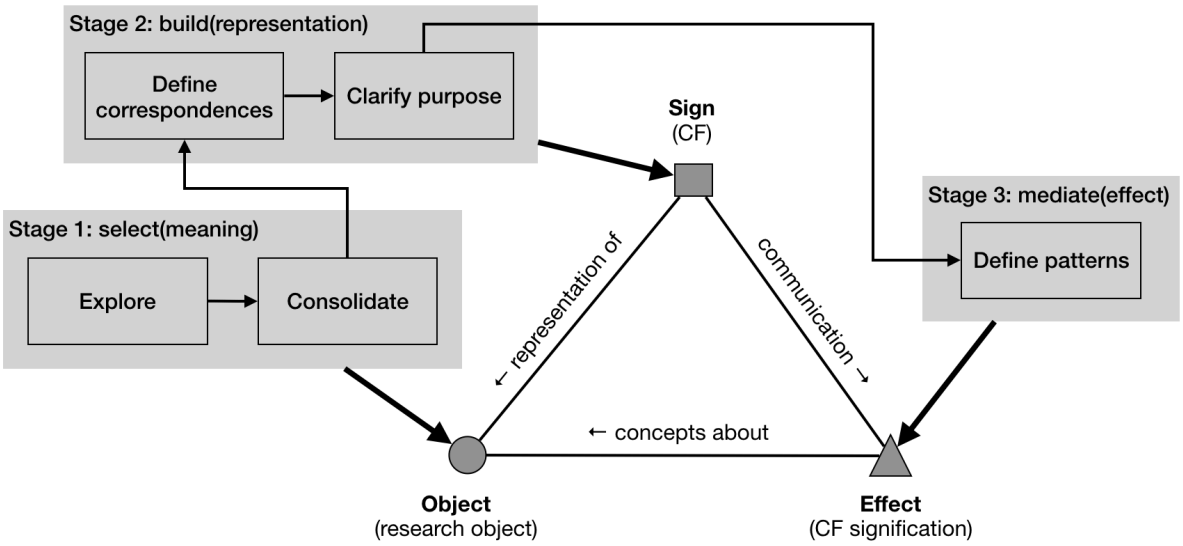

Figure 4. Actions in CF Design

4.2.1 Stage 1: Select(Meaning)

This stage comprises two complementary actions: explore and consolidate. These actions are common in knowledge construction situations, where researchers scope their research as a narrative arc (Shepherd & Suddaby, 2017).

The explore action concerns the researcher's level, where the creator extracts, selects, and transfers meaning about the research object. This requires asking questions like (Gregor, 2006):

- Which elements relate to the research object (e.g., concepts and relationships)?
- Which elements can describe, explain, or predict the research object (e.g., constructs, relationships, and causal explanations)?
- Which elements can prescribe the research object (e.g., strategies, methods, procedures, and techniques)?

The consolidation action leads the creator to focus on the research and practice environments with the purpose of bringing attention and recognition. This may require establishing relevant links to existing meaning and considering matters of coherence and relevance. It involves asking questions like (Ravitch & Riggan, 2016):

- Which elements are new, and which ones are pre-existing?
- How are the new elements outgrowing pre-existing ones?
- How will users assess the coherence and relevance of these elements?

Miles et al. (2014) discuss a qualitative research process where the CF evolves through several stages, from exploratory to confirmatory, as the study progresses. This is a macro-process, different from CF design. CF design is focused on selecting and extracting meaning from the research object. The macro-process discussed by Miles et al. (2014) is centered on producing new knowledge. That macro-process, which is iterative, involves either refining or building multiple CFs and, therefore, requires various CF designs or redesigns.

Example[2]. Beaulieu et al. (2015) developed a CF offering a "broad" perspective on crowdfunding, using a typology and classification approach. Considering Beaulieu et al. (2015) regarding the select(meaning) stage, the research object is the state-of-the-art of crowdfunding. The CF views (explores) crowdfunding from different stakeholder perspectives, considering founder, backer, and website providers. Crowdfunding is viewed (explored) as a sequence of activities: ex-ante, during the crowdfunding campaign, and ex-post activities. The CF is grounded (consolidated) on prior literature supporting the stakeholder perspectives. Thus, we can reframe the example's Select(meaning) as:

> **Select(meaning) = explore(stakeholder perspective, process) → consolidate(prior literature on stakeholder perspectives)**

4.2.2 Stage 2: Build(Representation)

The representational success of a CF requires the combination of two properties: one that establishes the CF as a representational vehicle, which gives knowledge about what is represented, and another that manipulates the CF for a specific purpose or point of view (Knuuttila, 2011). We translate these two properties into actions.

The first action defines correspondences between the CF and the research object. This is accomplished by identifying various elements, such as features, components, relationships, and categories. The following questions can be asked:

- Which parts or features of the research object should be represented?
- Which elements are necessary to represent the selected parts or features of the research object?
- Are these elements faithful to the research object?

The second action is to clarify the purpose of the CF. The shift from the first to the second action highlights that the CF needs to balance faithfulness and purpose.

This may require applying simplifications, generalizations, and filters to the representation. It involves asking questions like:

- What should be the primary focus of attention?
- Are all these elements necessary?
- Which tradeoffs may be required to clarify the purpose?

Example. Venable et al. (2016) propose a CF for evaluation in design science research. Evaluation is, therefore, the research object. Evaluation involves a variety of perspectives and dimensions, e.g., formative versus summative and ex-ante versus ex-post. However, the authors suggest two dimensions are appropriate for adopting an evaluation strategy: the functional purpose of the evaluation and the paradigm of the evaluation study. The CF focuses attention on four types of evaluation: quick and simple, purely technical, technical risk and efficacy, and human risk and effectiveness. Thus, the example's build(representation) can be expressed this way:

[2] More examples for this and subsequent stages are provided in Appendix B.

Build(representation) = define correspondences(functional purpose, paradigm) → clarify purpose(types of evaluation)

4.2.3 Stage 3: Mediate(Effect)

This final stage concerns the CF's effect on the users at a psychological level (Tversky, 2014). Unlike the previous stages, where the creator can exert significant control over meaning and representation, there is much less control over the psychological effect. It is largely produced by the users and ultimately depends on the individual. Users engage with the CF through their own lenses and contexts. Nevertheless, from a design perspective, the creator can still mediate (influence or shape) how users engage with the CF, considering, in particular, the habits of the research and practice communities.

We consider one action at this stage, where the creator defines visual patterns. Manipulation of visual patterns is required for mediation. The user detects the visual patterns the creator defines, forming an interpretation (Williams & Colling, 2018). Defining appropriate visual patterns is essential to designing a CF, even when text prevails over visuals.

Visual patterns are defined through the organization of symbols and text (Tversky, 2014). A repertoire of symbols can be used, such as boxes, arrows, bullet points, and other forms (Langley & Ravasi, 2019). Basic visual patterns include grouping concepts through proximity and similarity, arranging concepts through hierarchical structures, raising attention to certain concepts through center-periphery arrangements, and ordering elements through direction (Tversky, 2014). More complex visual patterns include timelines, processes, tables, matrixes, and node-link schemas (Heer et al., 2010).

Existing modeling notations could be used to build visual patterns. However, they could be detrimental to interpretation, especially if the targeted community is unfamiliar with the notation or if it is rigid and has too many rules. Defining visual patterns involves asking questions like:

- Can the adopted symbols be easily understood by users?
- Which visual patterns best mediate access to the research object?
- Could users interpret the CF in unexpected and/or undesired ways?

Example. Greenaway et al. (2015) proposed a CF explaining how organizations respond to customer information privacy challenges. The research object concerns the firm's response to demands for privacy, including legal, ethical, and managerial. Two dimensions of response are considered: control and justice. Different types of privacy responses are identified: ignorers, minimizers, balancers, and differentiators. The CF is presented using well-recognized visual patterns: the two dimensions identify four quadrants, and the types of privacy responses are positioned in those quadrants to facilitate comparison, which is the intended effect. The mediate(effect) stage can be expressed this way:

mediate(effect) = define visual patterns(dimensions, quadrants, types)

4.3 CF Design Scheme

So far, we have discussed several conceptual structures for CF design. Based on Peircean Semiotics, we related CFs with research objects and their effects on users. We identified and related the cycles of CF design and use and corresponding stages. Focusing on the design stage, we outlined specific actions and questions for the creator to consider. What answers the creator determines are most essential and what form they take will likely guide the CF design. Our final step is consolidating all these elements into a scheme (Figure 5).

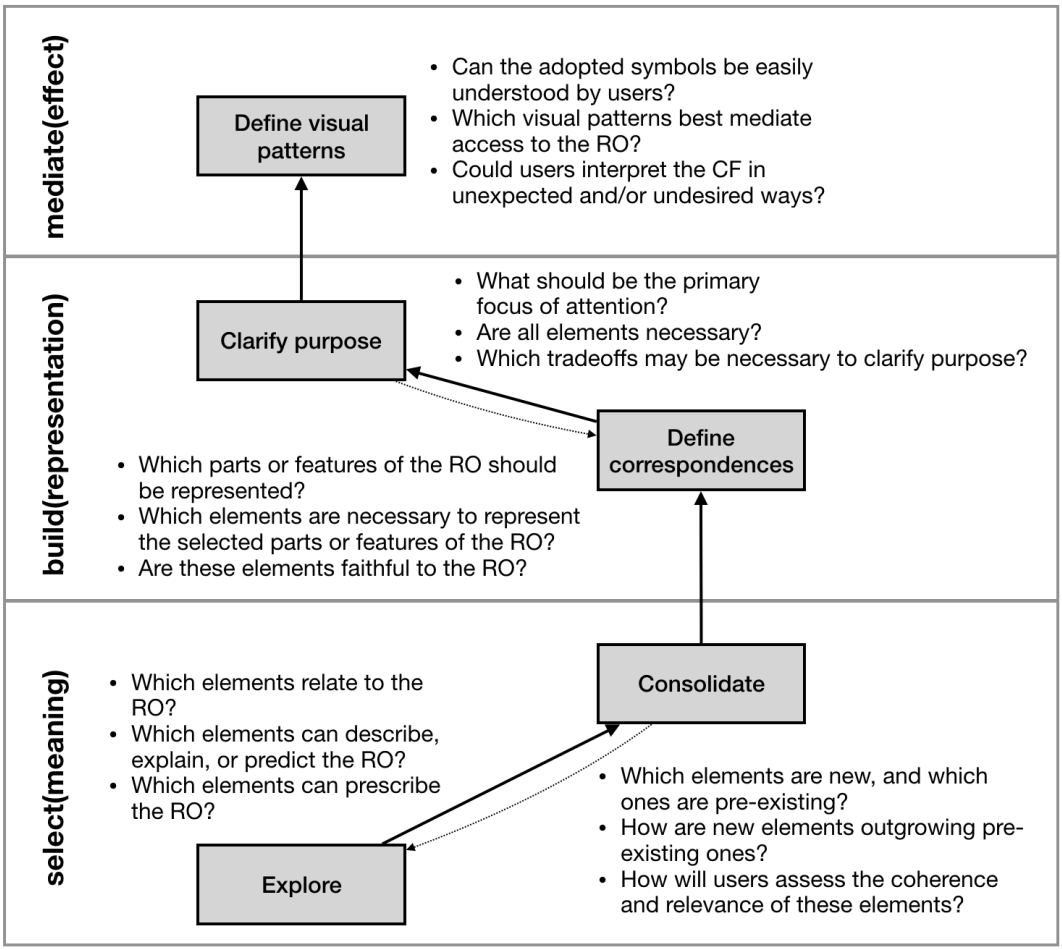

Figure 5. Scheme for CF Design

The scheme suggests a linear process, starting with exploration and ending with defining visual patterns. Empirical insights from the workshops indicated that a linear approach helps establish an overview of what is involved in CF design and then check for any missing aspects of the problem. Nevertheless, we recognize the iterative nature of creating a CF. The creator may iterate between the explore and consolidate actions when selecting meaning. And may also iterate between the define and clarify actions when building the representation.

The explicit identification of layers adds a macro-structure to CF design. It helps identify intermediate goals, each contributing to developing a solid conceptual structure for communicating meaning about the research object. The select(meaning) stage indicates that any CF needs to be firmly grounded on carefully selected elements about the research object. The build(representation) stage departs from this foundation to focus on another important goal: building a representation of the research object that balances faithfulness and purpose. Finally, the mediate(effect) addresses a less obvious but still relevant goal: to fine-tune the communication with the users.

This scheme provides an answer to RQ3. It configures a set of viewpoints and guidelines to operationalize the construction of a CF.

5 Illustrative Case

This study adopts a design perspective for the justification of our propositions. In design research, justification cannot be reduced to truth-like forms and empirical regularities (Sonnenberg & Vom Brocke, 2012). Other forms can be used, such as examples, exemplary cases, demonstrations,

assessment episodes, and design instantiations (Akoka et al., 2017; Peffers et al., 2012). This study uses two forms of justification. One has already been discussed in Section 4.1 and concerns the empirical insights from the workshop, understood as an assessment episode early in the design cycle. Another is the illustrative case here discussed.

The illustrative case is intended to show that the proposed CF design scheme is fit for purpose. The approach is appropriate because it shows how the scheme operates in a real context (Peffers et al., 2012). Further, it supports in-depth analysis, using a variety of events, descriptions, and explanations about the relationships between the scheme and the conditions surrounding its use (Yin, 2013).

The selected case considers a research project related to evidence-based management (EBM) (Antunes et al., 2023). EBM brings evidence-based practices to the management domain, such as conducting systematic literature reviews and using decision-support tools (Wainwright et al., 2018). An EBM CF is used to synthesize prior research on the topic (Antunes et al., 2023). In other words, the state-of-the-art in EBM is the research object.

5.1 Select(Meaning)

The origins of the EBM CF can be traced back to the artifact shown in Figure 6. This artifact is the product of the "explore" action. While the researchers explore evidence-based practices in various domains, such as medicine, nursing, and management, they start developing a mind map with topics of interest and references to the literature. By doing so, the researchers address the key question in this stage: which elements are related to the research objective? The action outcome reveals various interests, such as ontologies, evidence-based IS, rule-based systems, and decision support systems. As meaning is not consolidated and representation is still lacking, this artifact cannot yet be considered a CF.

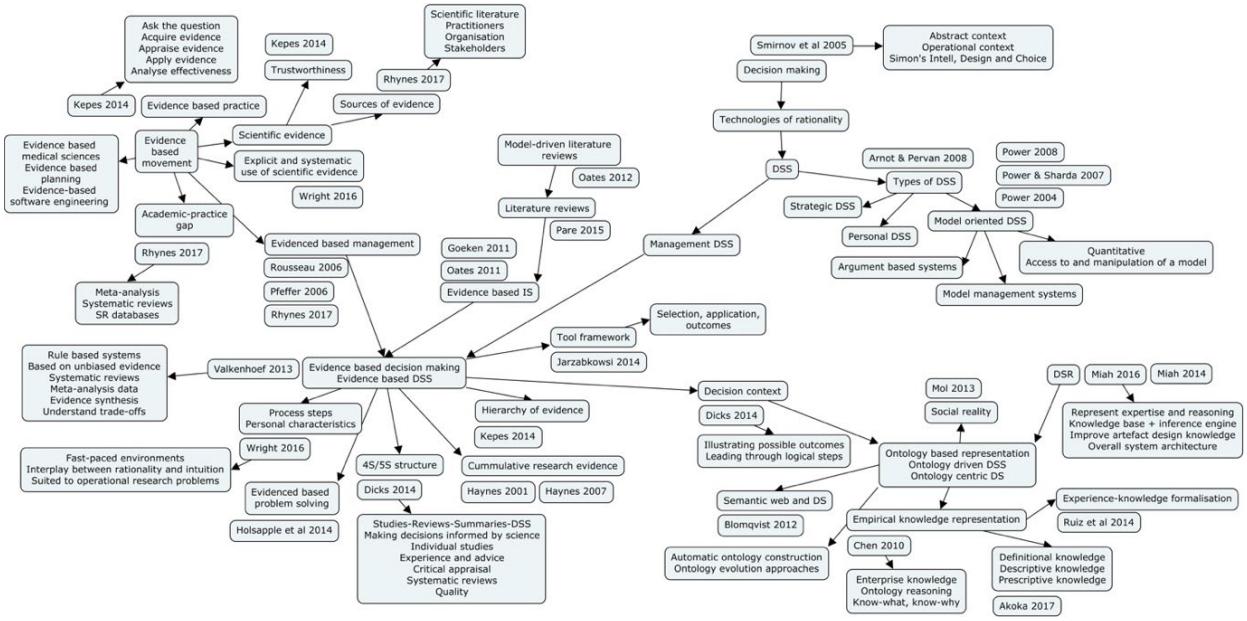

Figure 6. The Outcome of the "Explore" Action

The following action involves consolidation. The researchers decide which knowledge elements should be conveyed to the community and consider coherence matters. Addressing the three questions in this stage requires the researchers to select knowledge elements that are coherent and relevant. The outcome of this action is shown in Figure 7. Fewer concepts are used, and evidence-based management, decision-making, and decision context are given the center stage. Eventually, some users could already understand this artifact. However, it cannot yet stand for the research object, as representation is still missing.

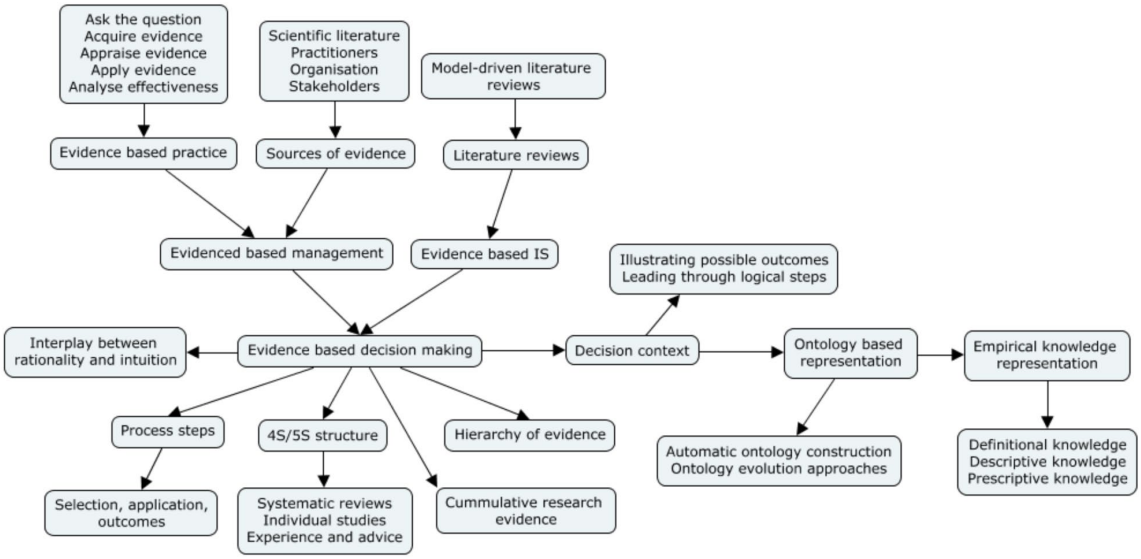

Figure 7. The Outcome of the "Consolidate" Action

5.2 Build(Representation)

The creators then move to the representation stage, starting with correspondence to the research object. This is where the CF starts to emerge. The outcome of this action is shown in Figure 8. EBM is characterized as two major activities, review and decide, connected by synthesized knowledge. Other elements are represented that clarify the nature and purpose of the review and decide activities, and the synthesized knowledge connecting element. For instance, the review activity takes as inputs a question, available evidence, and a set of practices. The review activity delivers as outputs synthesized knowledge and a repository of evidence. At a secondary level of detail, the represented elements are supported by elements taken from the literature.

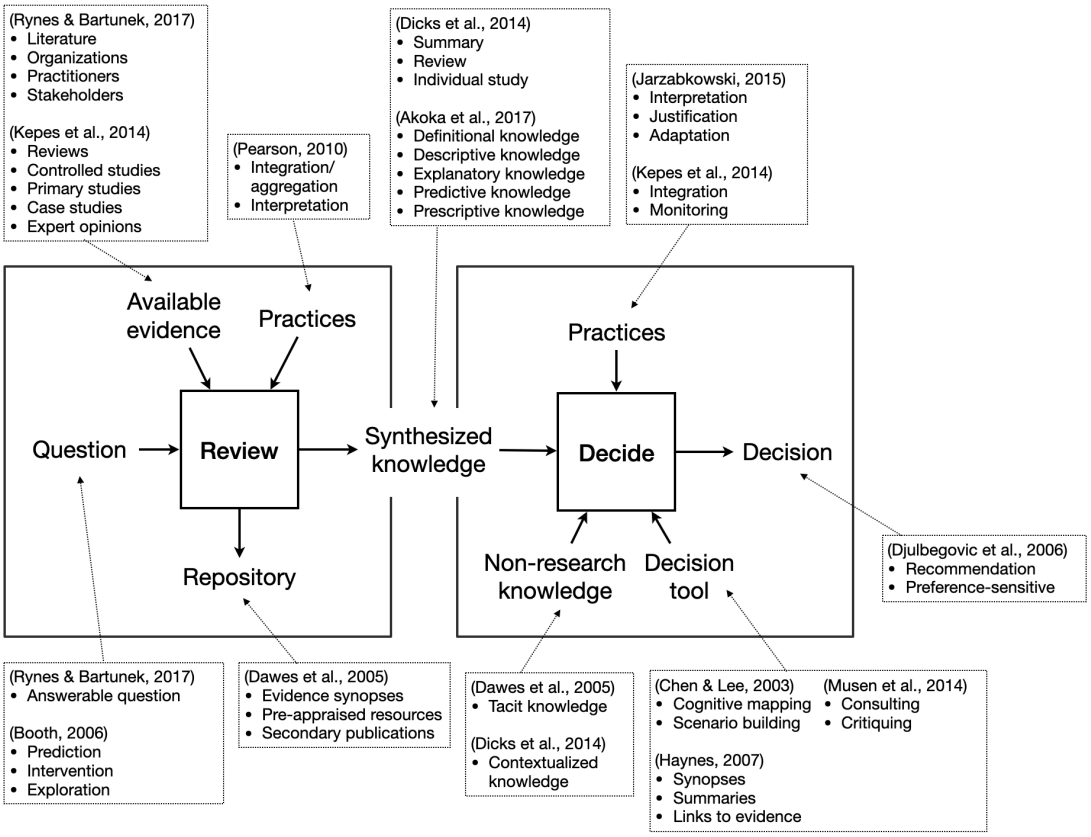

Figure 8. The Outcome of the "Define Correspondences" Action

The following action is to clarify the purpose of the CF. This may require applying simplifications, generalizations, and filters to the representation. Figure 9 shows the output of this action. Several elements deemed as secondary were removed, e.g., the decision tool, types of questions, and types of decisions. The supporting elements were also generalized, and references to the literature were removed. This increased the user's focus on the remaining elements. The synthesized knowledge was divided into two new elements (scenarios and domain knowledge) that clarify the nature of the connection between the review and the decision.

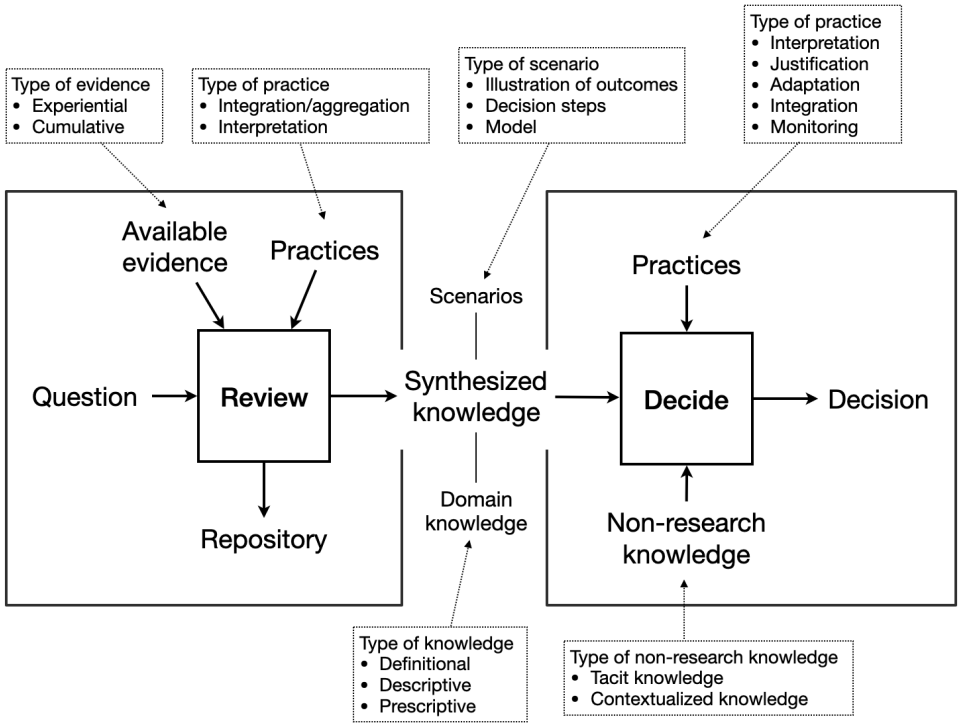

Figure 9. The Outcome of the "Clarify Purpose" Action

In this artifact, some visual patterns have already been defined. They reflect a process-oriented view, where EBM starts with a question and moves through review and decide activities until a decision is made. The use of boxes and arrows highlights this understanding. However, careful consideration of visual patterns has not yet been given.

5.3 Mediate(Effect)

The final action is to fine-tune communication through visual patterns. The outcome of this action is shown in Figure 10. The process pattern, already apparent in the previous artifact, is clarified through cosmetic choices like removing boundary boxes around the review and decision activities. The process pattern is also improved by splitting the decision activity into two (exploration and decision). Finally, secondary elements are eliminated to concentrate on the process activities. These changes help users better focus on the EBM process.

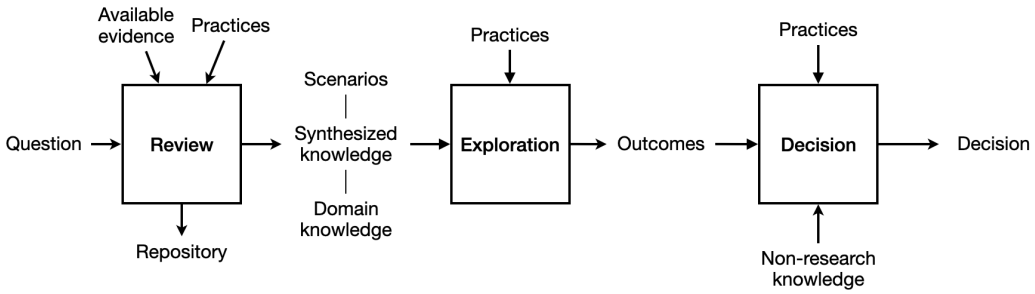

Figure 10. The Outcome of the "Define Visual Patterns" Action

Considering all steps together, we observe how the communicative discourse changes throughout the CF design process. The artifact steers away from being a collection of items, becoming more focused, selective, and purposeful. Not surprisingly, the final artifact preserves essential elements from the initial artifact (e.g., evidence can be experiential or cumulative). However, its structure changes as the creators explore the best way to use the CF to communicate.

6 Discussion

Consequent to the intricacy of the discussed matters, this study articulates several conceptual foundations to make a proposition on CF design. In Figure 11, we attempt to visually condense and consolidate the essential elements of the study.

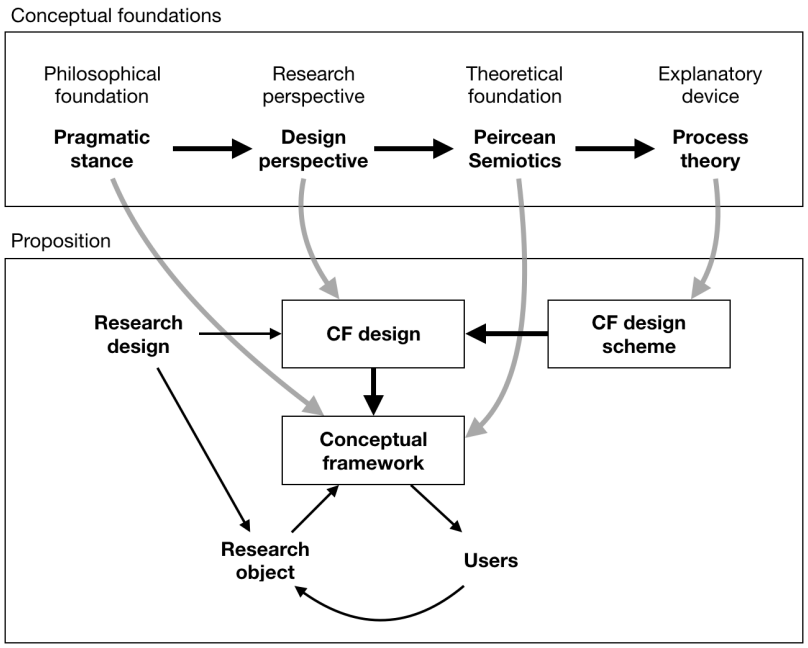

Figure 11. Summary of the Conceptual Foundations and Propositions of this Study

We highlight the logical, stepwise arrangement between the pragmatic philosophical stance, design research perspective, semiotic theoretical foundation, and the use of process theory as an explanatory device (Figure 11, top). These foundational constructs shape the three main elements in our proposition, considering the CF artifact, the CF design process, and the CF design scheme (Figure 11, grey rounded arrows).

We also underline the logical relationships between the three main elements in our proposition and other elements required to enunciate the proposition, considering the research design, research object, and CF users (Figure 11, bottom). All these elements help answer questions regarding how a CF can be constructed with separation, but also connection, with a research design.

This approach differs from previous approaches because:

- Clearly separates, while still connecting, the elements related to the constructions of a CF from the elements related to research design;
- Highlights the role of the CF as a mediator between research objects and users;
- Defines a design-oriented scheme for CF construction, focusing on the design process, which is delineated using a set of logical steps, associated actions, and guiding questions;
- Provides an approach for deconstructing the constructive elements of a CF while recognizing that different states and events may influence the design process.

Next, we bring some additional discussion points emerging from this proposition.

6.1 CF Design and Flexibility

A key characteristic we associate with the use of CFs is flexibility. CFs can be used in various research contexts and target very different research objects, especially in the IS domain. They can also target distinct phenomena (e.g., technical and social) and align with diverse research methodologies (e.g., qualitative and quantitative) (Recker, 2021). However, flexibility does not mean neglecting the adoption of

sound design guidelines in constructing a CF. The proposed guidelines are intended to accomplish this endeavor while not overlooking the importance of flexibility.

A significant contribution of this study is supporting flexibility through a separate but clearly defined connection between the CF design and the research design. All aspects of the research design are condensed into the research object. The research object may embody a variety of research contexts, methods, approaches, and items. They can be used upstream and downstream and can even encompass the whole of the research. The CF design specifically and methodically concerns how to select(meaning), build(representation), and mediate(effect) independently of the targeted research object. Discussing research object types is irrelevant to CF design, contributing to flexibility.

6.2 CF Design and Theory Building

In many research settings, the researcher seeks to simultaneously build a CF and build a theory (Shepherd & Suddaby, 2017). Such settings are challenging because different but related concerns will be entangled, making it more difficult to develop and validate the function of conception.

Peircean Semiotics contributes to disentangling the different concerns. The separation between object and sign provides a "method of reaching clearness of thought" (Peirce, 1878). On the one hand, theory building seeks to define a system of concepts and relationships that produces "belief." On the other hand, the relationship between the CF and the research object is focused on "the action of thinking" driven by "the irritation of doubt" and establishing "habits of action" (Peirce, 1878). As implied by Peircean Semiotics, the CF depends on the research object, but the research object does not depend on the CF.

It should also be noted that while the research object provides an understanding that persists over time, the CF provides "close attention," "clearness of apprehension," and a "road to logic" necessary for users to understand the research object. Therefore, both are necessary. This study contributes guidelines that direct the mind to the research object without contradiction with the power of thinking required to interpret the object (Peirce, 1868).

6.3 CF Design and Representation

Our proposition considers a set of stages where the build(representation) stage is crucial in establishing a triadic relationship between the CF, the research object, and the effect in people's minds. This relationship is characterized by two opposing forces, one that pushes towards faithfulness to the research object and another that pushes towards purpose. Understanding and articulating these two forces is at the core of an effective CF. Our proposition highlights some pragmatic questions that should be asked by the creator regarding such balance, emphasizing parsimony and clarification of purpose, which necessarily will lead to increasing attention towards some elements of the research object and neglecting others. The principles and rules defined in the CF design scheme may help creators and users better align their minds.

We emphasize that the actions and questions assigned to the build(representation) stage align with the Peircean Semiotics epistemology. However, other epistemological standpoints could be considered, for example, agential realism (Weber, 2020), which emphasizes dynamic relationships, and representation theory (Burton-Jones et al., 2017), which highlights the operational characteristics of systems. Future research could consider assigning different configurations to the build(representation) stage to reflect different epistemologies.

6.4 CF Design and Cognition

An interesting point for discussion concerns the cognitive orientation of CFs. On one extreme, a CF may adopt a textual form. Conversely, the CF may adopt a graphic form based on symbols, lines, and shapes punctuated by spotted text pieces. In between, a CF may combine textual and visual forms. A question arises: Do the guidelines developed in this study apply to the whole spectrum of possibilities? The select(meaning) stage seems impervious to this distinction, as it only concerns meaning. The build(representation) covers both forms, even though CFs operate best in graphical form, overviewing all aspects of what is represented and highlighting relationships (Miles et al., 2014). Naturally, the mediate(effect) emphasizes graphic form. The answer to the question above is that the current study promotes graphic form but is not confined to that form.

The focus on graphic form makes CFs stand out as independent, coherent, and dependable entities, containing all relevant meaning instead of playing a secondary role, supplementing textual statements, which ultimately contain the relevant meaning. A coherent design perspective on the construction of CFs, covering all stages discussed in this study, increases the independence, cohesiveness, and dependability of CFs. In summary, our proposition contributes to letting CFs stand out by themselves as visual artifacts.

6.5 Conceptual and Theoretical Frameworks

In the IS discipline, one concept that is close to the CF concept is the theoretical framework. We now discuss the distinctions between them. Ravitch and Riggan (2016) provide very specific definitions of conceptual and theoretical frameworks. According to the authors, a theoretical framework is focused on the pre-existing theories informing a study, while a CF covers all of the research, including research questions, research methodology, research context, and theoretical framework. Both definitions conflict with the more flexible understanding espoused by this study, where a CF can be used upstream (like a theoretical framework), downstream (not discussed by Ravitch and Riggan (2016)), and across the whole of the research.

Other researchers posit that theoretical frameworks articulate what the leaders in a field say about a phenomenon, while CFs express the beliefs espoused by the researcher (Mensah et al., 2020). This study aligns with the latter definition. We regard the theoretical framework as a particular type of research object which can be targeted by a CF.

Finally, in the current study, we view CFs from a design perspective. Thus, the relationship with the research object (theoretical or not) is exploratory and interpretative (Jabareen, 2009; Miles & Huberman, 1994). They are an attempt to explain/understand the research object in dialogue with the users. Thus, we align with Hassan (2019) regarding CF construction as a generative discursive practice in which the domain knowledge is communicated through visual patterns familiar in the domain.

6.6 Future Research

Future research is necessary to empirically evaluate the proposition developed in this study. Ethnographic studies of researchers using the CF design scheme ‘in the field’ could further bring additional insights into understanding CF design from a socio-technical perspective (Termeer & Dewulf, 2019). Research on the educational uses of the CF design scheme, particularly doctoral studies, would also contribute to evaluating utility.

7 Conclusions

This study addresses a current gap in IS research. Even though the use of CFs is almost ubiquitous (Khuntia et al., 2024), understanding the construction of CFs has been complicated by mixing the problem with another problem: how to conduct research. Since understanding how to conduct research is a highly complex problem, combining the two further complicates matters. It is not the aspect of understanding the nature and purpose of the CF that is complicated, it is more about what has to be done to effectively communicate with users. This matter is particularly relevant in exploratory research domains pursuing diverse research goals and adopting diverse approaches, where exemplars can be challenging to find and adapt. The construction of CFs in consolidated domains is less affected because the research community is well-acquainted with few pivotal exemplars. On the other hand, understanding how to construct a CF is more relevant in exploratory research domains. This is because the CF is not only a vehicle to communicate about a study, but it can also become a contribution in itself.

This study analyses the construction of CFs from a design perspective. The approach helps separate the process of constructing a CF from the research process, notwithstanding keeping some necessary links. The design perspective is unique in the sense that it leads the creator to focus on the design goals/qualities of the CF. We discuss three essential goals/qualities: meaning, representation, and effect. A set of actions and questions is defined that helps the CF design. The set of actions/questions helps make decisions regarding how a CF links to the research object, how it represents the research object, and how it mediates the interpretation of meaning by users.

Guidance from this study should be taken flexibly. There is no single best way to design a CF. Researchers can take different directions and emphasize specific design elements while discounting others. This is inherent to the notion of design. Design is something that is accomplished for unique

purposes, affected by exceptional circumstances and values. The guidance provided does not restrict design. Instead, it points out another essential aspect of design: the search for internal consistency in the construction process. This study's main contribution is identifying the elements of internal consistency in the construction of CFs.

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Appendix A: The Workshop and Interviews

A workshop, including three design sessions and a set of interviews, was conducted with researchers to gather empirical insights on the construction of CFs. The participants included IS researchers, lecturers, and Ph.D. candidates. Workshops are an appropriate way to introduce innovative design artifacts (Hevner & Gregor, 2022). In the workshop, a preliminary scheme for CF design was discussed. After this initial discussion, the participants were divided into groups and participated in separate CF design sessions. In each session, the group was invited to select a research study and construct a CF using the proposed scheme. They were then encouraged to reflect on the design process, considering, in particular, the support provided by the scheme. All groups completed the exercise, creating a CF for their chosen study. Then they presented the created CFs to all participants.

After the workshop, we conducted qualitative interviews with selected participants. Adopting interviews is appropriate as it enables the participants to reflect on their experiences with the preliminary scheme. Interviews are also adequate to evaluate innovative artifacts like the proposed scheme (Myers & Newman, 2007). Finally, qualitative interviews enrich our empirical understanding of the interplay between researchers and the scheme.

Five researchers and Ph.D. candidates voluntarily participated in the interviews. All participants had prior experience with creating CFs. The interviews lasted about 40-60 minutes and were conducted two weeks after the workshop. Table A1 provides details about the participants.

Table A1. Interview Participants

Part.	Profile	Research experience	Gender	Nr. of CFs created prior to the interview
A	Researcher, PhD supervisor, journal reviewer	>3 years	Male	>5
B	Researcher	>4 years	Male	>2
C	PhD candidate, invited lecturer	>3 years	Female	2
D	Researcher	>5 years	Male	2
E	PhD candidate	>3 years	Female	1

Rather than collecting general opinions about the scheme, we adopted a more focused approach centered on the cognitive experience of the participants in the exercise (Klein et al., 2017). Individual cognitive experience is an enabling condition for expertise in CF design. We adopted a set of indicators developed by Termeer and Dewulf (2019) to assess the cognitive experience of the participants in the exercise: *energy and enthusiasm* using the scheme, *learning by doing* a CF through surprises and disappointments, and *logic of attraction* brought by successful construction of a CF. The interviews were organized in three main stages:

Stage 1. Introduction and background questions regarding the participant's prior experience with CFs:

1. How many CFs have you constructed before the exercise?
2. How did you come up with those CFs?

Stage 2. Recall the exercise, summarizing the function of the scheme in constructing a CF.

Stage 3. Questions related to the cognitive experience of the participants during the exercise:

3. Energy and enthusiasm: Did you feel energized when using the proposed scheme? Why? Would you suggest the proposed scheme to other colleagues? Why?
4. Learning by doing: Did you learn while using the proposed scheme? How?
5. Logic of attraction: Did you experience any small wins using the proposed scheme? Did you celebrate them?

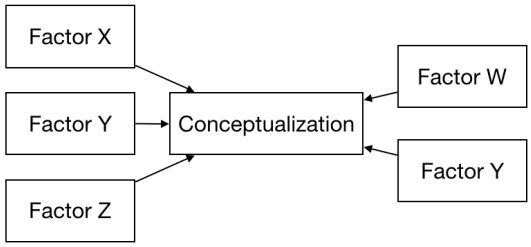
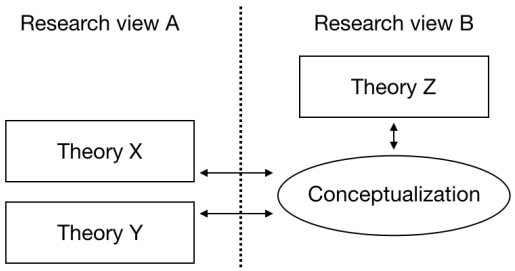
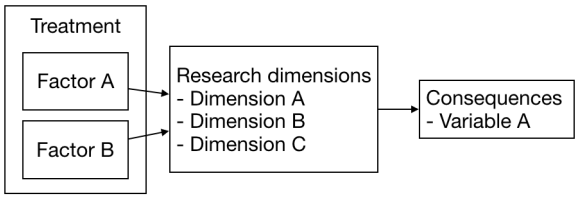
Appendix B: Examples

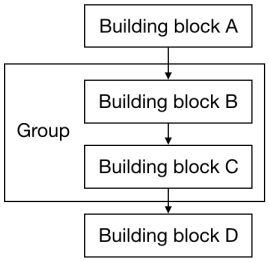
In this section, we apply the scheme proposed in this study to identify several CF design examples. These examples were taken from selected IS literature. The selection highlights the openness and diversity of uses and approaches in the IS literature. Therefore, the CFs were chosen because of their diverse natures and purposes.

As noted in the main body of the paper, this study promotes graphic form. Thus, all selected CFs focus on graphic forms. Even though some of the examples can be found in multiple studies, this collection is not suggestive of generalizability or completeness.

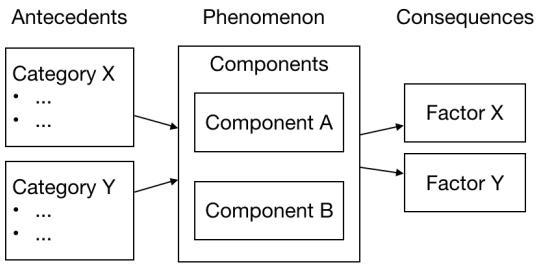
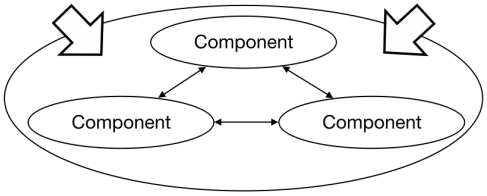
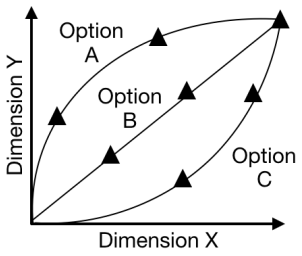
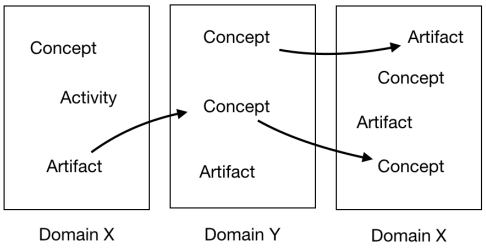
The examples are organized according to the three stages of CF construction discussed in this study, considering the selection of meaning, building a representation, and mediating the effect of the CF. For each example, we consider the actions suggested by our scheme. To better contextualize the examples, we also identify the targeted research objects, noting, however, that researchers may consider alternative research objects.

Select(Meaning)

Research object: Factors of a study. **Explore**: The CF identifies the main factors affecting a study. **Consolidate**: This kind of CF is usually presented at the beginning of a study, as it is intended to identify the key points shaping the study. **Based on**: (Tuunanen et al., 2010, p. 52).	
Research object: Theoretical foundation of a study. **Explore**: The CF explores the relationship between a proposed conceptualization and existing theoretical views and/or theories. **Consolidate**: The CF highlights the distinctions between new and pre-existing knowledge. **Based on**: (Baskerville et al., 2018, p. 363).	
Research object: The conceptual structure on which a study is founded. **Explore**: The CF synthesizes the study's research strategy. It seeks to investigate how a number of factors influence a set of research dimensions, which are evaluated using specific variables. **Consolidate**: The relationships between factors, dimensions, and variables are common in qualitative and quantitative research. It allows readers to assess which new propositions are claimed by the study and check the study's coherence. **Based on**: (Cheng et al., 2016, p. 983).	

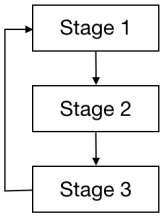
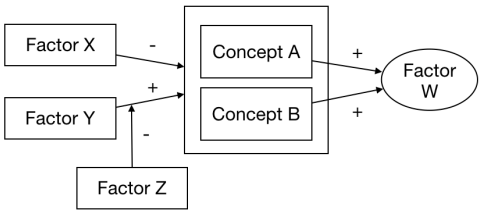
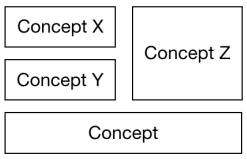
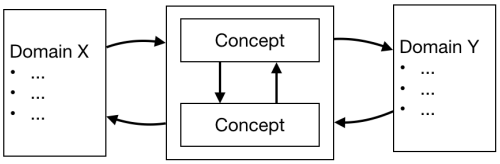
Research object: A method contributed by a study. **Explore**: The CF identifies and structures the essential building blocks of the proposed method. **Consolidate**: The CF relies on the logical organization of concepts to highlight the coherence of the proposed method. **Based on**: (Albani et al., 2016, p. 8).	

Build(Representation)

Research object: An IS phenomenon requiring understanding. **Define correspondences**: The CF raises attention to a set of components characterizing the phenomenon, plus the antecedent and consequent factors. **Clarify purpose**: This kind of CF can be used at the beginning or end of a study, either to set the stage or summarize the research results. **Based on**: (Benz et al., 2024, p. 131).	
Research object: A type of system. **Define correspondences**: The CF identifies the perimeter, inputs/outputs, main components, and interactions between system components. **Clarify purpose**: The main purpose of the CF is to develop a holistic and synergistic idea of the system, focusing on a parsimonious set of components and interactions, and showing they have permeable boundaries. **Based on**: (Chatterjee et al., 2017, p. 5720).	
Research object: A method guiding the design of a research strategy. **Define correspondences**: The CF raises attention to two dimensions guiding the design decisions. **Clarify purpose**: The CF only represents the features of the research object that help distinguish design options. **Based on**: (Venable et al., 2016, p. 80).	
Research object: A method for understanding and managing an IS. **Define correspondences**: The CF positions a set of systems elements (e.g., concepts, activities, and artifacts) within different domains and identifies the links across domains. **Clarify purpose**: The CF is intended to highlight the richness of links between elements belonging to different domains, showing how events flow across the	

whole IS. **Based on**: (Aftabi et al., 2025).	

Mediate(Effect)

Research object: Review of selected items (e.g., papers). **Define visual patterns**: The CF adopts a comparative-table pattern. The main purpose is to systematically emphasize the major differences between a set of items using a set of criteria. **Based on**: (Poniatowski et al., 2022, p. 263).	
Research object: Literature synthesis. **Define visual patterns**: The CF adopts a stage-gate pattern where a defined goal is accomplished by advancing through a set of stages where specific problems or subgoals are resolved. The progression may include backsteps. **Based on**: (Tim & Leidner, 2023, p. 1191).	
Research object: A research proposition on a phenomenon. **Define visual patterns**: The CF adopts an input-process-output pattern showing the input and output factors related to the phenomenon. **Based on**: (Seo, 2017, p. 695).	
Research object: A method for artifact design. **Define visual patterns**: The CF adopts a layered pattern. Each layer characterizes a set of features or operations required to design the artifact. The sets of features or operations are designed from the bottom up. **Based on**: (Hsieh & Yuan, 2010, p. 8).	
Research object: A conceptualization of design. **Define visual patterns**: The CF adopts a systems pattern, showing the main building blocks involved in design conceptualization. **Based on**: (Hevner et al., 2004, p. 80).	

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