2 Research Paradigm

Researchers in Information Systems (IS) are interested in designing and building systems that solve problems, whereby 'design' means to put together the components of a system and establish relations (Churchman, 1971). Design Science Research (DSR) is a discipline in IS research based on the findings of Simon (1996), who defined design science as a search process in a closed solution space, and Walls, Widmeyer, and El Sawy (1992), who introduced the field of Information System Design Theory (ISDT).

DSR is technology-oriented and aims at creating new things that benefit human purposes, in contrast to natural science that tries to comprehend reality (March & Smith, 1995, p. 253). Hevner et al. (2004) further extended the design science research paradigm by suggesting guidelines for DSR. In total, seven guidelines were proposed to be followed in a design science research study. The guidelines were introduced to follow the goal of design science research:

> *"Design science research is a research paradigm in which a designer answers a relevant question to human problems via the creation of innovative artefacts, thereby contributing new knowledge to the body of scientific evidence. The designed artefacts are both useful and fundamental in understanding that problem." (Hevner & Chatterjee, 2010, p. 5)*

The goal of the paradigm is reflected in the proposed guidelines: (1) design as an artefact; (2) show the problem relevance; (3) demonstrate the design (artefact) evaluation; (4) make the research contribution clear; (5) follow rigorous research methods; (6) design as a search process; and (7) communicate research, e.g., in the form of research articles. The central purpose of this paradigm is to develop an innovative artefact. This approach can also be found in the German '*gestaltungsorientierte Wirtschaftsinformatik*' (see Österle, 2010). The innovative artefact has to prove that it is a contribution to existing knowledge and practice. The

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guideline design evaluation assures that the designed artefact creates new knowledge, which distinguishes DSR from mere design (Hevner & Chatterjee, 2010, p. 7).

Table 1: Seven design guidelines for DSR, following Hevner et al. (2004)

Guideline	Description
G1: Design as an Artefact	Design-science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.
G2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
G3: Design Evaluation	The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.
G4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.
G5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.
G6: Design as a Search Process	The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
G7: Communication of Research	Design-science research must be presented effectively to both technology-oriented and management-oriented audiences.

A consistent framework for research in Information Systems (IS) is needed in order to guarantee significant progress (Hevner et al., 2004, p. 89). The IS research framework (Hevner & Chatterjee, 2010) acknowledges this quest and extends the suggested guidelines from Hevner et al. (2004). On the one hand, the environment informs the design of the DSR artefact with existing problems concerning people, organizations, and technology. In this stance, the business need and relevance of the DSR artefact is founded, and at the end of the design science research, the designed artefact is returned to this application domain, where the artefact has to prove its utility. Hevner and Chatterjee (2010) call this the *relevance cycle*.

According to Nicolai and Seidl (2010), a relevant DSR artefact addresses instrumental, conceptual, and legitimate dimensions. Technological rules, forecasts, and schemes describe an instrumental relevance. Most dominant among these are rules that appear at the end of scientific papers in a form similar to, ‘if you want to achieve Y in situation Z, then perform action X’ (Nicolai & Seidl, 2010, p. 1267). Conceptual relevance sources from causal relationships, contingencies, and linguistic constructs. Most often, authors argue for conceptual relevance with causal relationships; then, they uncover unknown side-effects. Lastly, legitimative relevance is exerted, such as when scientific knowledge is returned in the form of education (‘credentialed’), or rhetorical devices, whereby scientific knowledge is embedded in rhetorical argument, and the argument subsequently attains more trustworthiness.

In DSR, an artefact is built to solve a specific problem and evaluated to measure its performance (March & Smith, 1995, p. 254). The artefact can either be a model, method, instantiation, or construct (March & Smith, 1995). In the middle of the IS research framework is the *design cycle*. This cycle describes the iterative building and evaluation of DSR artefacts. The DSR evaluation framework of Sonnenberg and Vom Brocke (2012) extends this cycle by introducing a step-wise evaluation approach to continuously refine the constructed artefact. In addition, it argues to return the developed prescriptive knowledge. With this, the artefact design becomes a truth-like value before the final version is built (Sonnenberg & Vom Brocke, 2012, p. 386). The design cycle, nonetheless, continuously assesses the quality of the artefact through evaluations. It is the essence of the research process, and it depends on the *relevance* and *rigor cycle*; artefacts that are relevant but not rigorously demonstrated and vice versa have no utility.

On the other side is the knowledge base, which is applied in the *rigor cycle*. In a trustworthy scientific discussion, existing theories, frameworks, and other forms of knowledge are embedding the construction, thus ensuring the DSR artefacts' contribution to knowledge. Hence, artefacts must convince science and practice when returned.

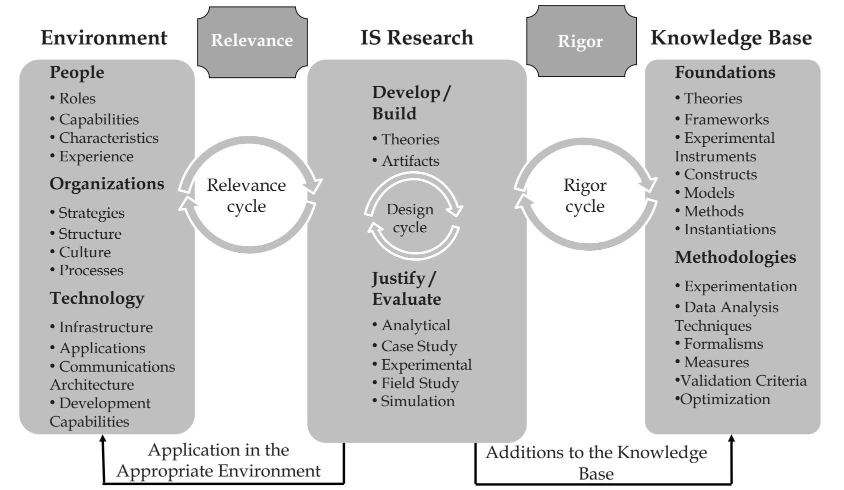

Figure 1: Information system research framework (cf. Hevner & Chatterjee, 2010)

In all, the framework combines relevance sourcing from business needs and rigor sourcing from applicable knowledge. In the centre of the framework are DSR artefacts that are iteratively built, evaluated, relevant, and rigorously demonstrated. Procedures coming from the knowledge base underpin the theoretical foundations (see, e.g., Gaß, Koppenhagen, Biegel, Maedche, & Müller, 2012).

In this dissertation, principles for the use of boundary objects will be iteratively constructed. To provide readers with guidance on what to expect from this research, the thesis follows the six steps of the methodology for DSR design: (1) problem identification (*part II*); (2) definition of the objectives (*part III*); (3) design & development (*part IV*); (4) demonstration (*part V*); (5) evaluation (*part V*); and (6) communication (Peffers et al., 2007). All six steps are executed in accordance with the IS research framework and the seven suggested guidelines from Hevner et al. (2004). This 'mental model', as it is described by Peffers et al. (2007, p. 52), is a small scale model of reality. It structures the situation at hand and depicts research as a process with an according output. Each step is individually introduced in the following parts of this dissertation. Communication of the results is on-going with research papers and this thesis.

The concept of boundary objects is well founded in literature (e.g., Kimble, Grenier, & Goglio-Primard, 2010). Scholarly work has also concentrated on further classifying boundary objects to strengthen their explanatory power (Nicolini, Mengis, & Swan, 2012). However, principles on the appropriate use based on the kind of boundary object are missing. Particularly, a 'recipe' for effective collaboration is missing in the field of virtual innovation communities, which lacks the most natural face-to-face collaboration. This dissertation aims to provide such principles, the intended DSR artefact (*new solution*), for an effective use of boundary objects on real-time collaboration platforms to achieve shared understanding in innovation communities. It thereby tackles the problem of knowledge boundaries (Carlile, 2004) and misunderstandings (Brown & Duguid, 2001) in virtual collaboration communities (*known problem*). In accordance with Gregor and Hevner (2013), the DSR artefact is an *improvement* in the knowledge contribution framework. The built artefact is based on a problem identification study (*part II*), which shows the sub-optimality of current collaboration in virtual (innovation) communities. Drawing on an extensive literature review (*part III*), the knowledge base is fully explored to design new principles (*part IV*) and solve the problem. Through the empirical study on the effectiveness of boundary objects (*part V*), a clear demonstration of the design is predicted to advance the current knowledge base.

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