# A Framework for Classifying Design Research Methods

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**Abstract.** Design Science Research (DSR) methods are much debated by the IS community with regard to outcome and research process. This debate creates ambiguity for the novice researchers in terms of selecting appropriate DSR methods. To address this ambiguity, this essay proposes a framework for classifying the DSR methods by providing conceptual clarity about DSR outcome and DSR research process. The proposed framework creates a taxonomy differentiating between outcomes as *a priori* formulated or *emergent* through contextual interaction, likewise, viewing the research process as *deductive* or *abductive*. The taxonomy provides guidance to the researchers before embarking any DSR projects. The essay contributes to the on-going discussion on utilization of the DSR methods in DSR projects.

**Keywords:** Design Science Research, Framework, Methods.

## 1 Introduction

While the IS design community agrees that IS design research methods are meant for developing scientific knowledge about artificial artifacts or processes but at the same time providing organizations with relevant practical solutions [1-5], the literature seems preoccupied with prescribing different intervention styles [6]. One type of intervention in design research typically proceeds along á priori defined software engineering approach comprising a set of activities to solve a known problem [3]. Other types of design research deals with a mixture of technical and organizational properties that dynamically and iteratively "emerge from design, use, and on-going refinement in context" [5] (p.38). Despite the difference in epistemology of these two views of design research both, however, seek to articulate generic design principles by generating prescriptive design knowledge [7].

While such instrumental goal is unquestionable, scholars have recognized the difficulty with methods in use. For example, proponents of design science research refer to the problem of differentiating between design research methods advocating that, "methodologies presents the researcher with choices for the structure of the research process and the presentation of the resulting solution" [8] (p.72). As design research involves the unfolding of changing ideas over time it is crucial for the researcher to be reflexive about his role and perspective when launching the study [9]. However, the

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question is how researchers go about turning implicit design research assumptions – unavailable to their conscious awareness – into explicit stance recognizing potential consequences of selecting a certain design research method. In line with the argument, this essay deals with how to distinguish between design research methods. We draw from seminal work in Design Science (DS) [3], Action Design Research (ADR) [5], Action Research (AR) [10], Dialogical Action Research (DAR) [11], and Engaged Scholarship [9] to identify and describe relevant dimensions that guide researchers to appropriate adoption of design research methods. Based on these seminal papers, we derived a framework that is described in the subsequent section.

## 2 Classification Framework

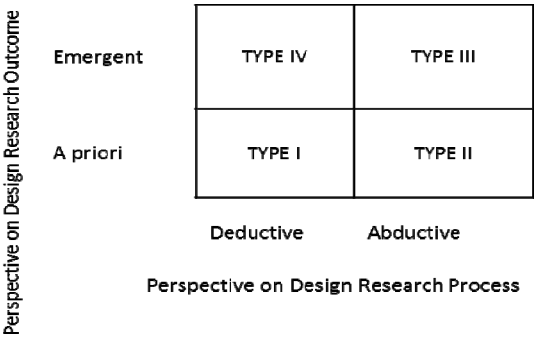


**Fig. 1.** A Framework to Classify DSR Methods

Two-dimensional typology diagrams are used in IS research to describe characteristics of a phenomenon. In particular, it is a representation of the assumptions about the nature of the phenomenon under study, see, e.g. [12, 13]. Given our review of the design research literature it is possible to adopt a similar characterization and viewing design research outcome from the two positions: à priori and emergent. Likewise, the design research process can be characterized as: deductive and abductive (figure 1), which are two common ways of reasoning about scientific knowledge discovery in IS DSR [14].

### 2.1 Type I Deductive – Á Priori

The type I design research methods, typically DS methods, represent a perspective that is firmly rooted in the positivistic research orientation, and thus contain informing elements suggesting ways to maintain control over design parameters [3]. Deductive-á priori oriented researchers assume the social world to be composed of stable empirical IT artefacts. In particular, they assume that an instance of an IT artefact is a proof of concept, and that the involvement of clients may, but not necessarily, have a positive effect on the outcome. Typical activities of type I methods are (a) classification and systematization of the instantiation, and (b) formalization. The purpose with

classification is to create a class model that explains how the pre-defined problem should be solved. Systematization activities include specification of conditions controlling the events of the artefact and the variables that affect the artefact in use. Formalization is an approach for developing a conceptual scheme drawing on the consensus of the research team that further lead way into implementation activities. The researcher is also in control over evaluation of the artefact, which is conducted with experimental methods.

### 2.2 Type II Abductive – Á Priori

In this position the researcher adhere to the proof of concept idea through á priori designable artefacts. However, complexity of controlling changing contextual circumstances infers uncertainty about the nature of the problem. Although research methods, such as AR adhere to the regulative principles of positivism, they embody descriptions for analysing subjective opinions of the social world in which the IT artefact is situated [10, 11]. Using a type II method means that the researcher is reasoning about the real world problem to develop the richest possible descriptions so as to excel in design activities. Type II methods are used for both improvement actions and construction interventions, but has as [4] notes been used in studies of technology adoption rather that building technology. In cases where IT design has been in focus, evaluation of the IT artefact would, in contrast to type I methods, separate empirical tests from evaluation and learning.

### 2.3 Type III Abductive – Emergent

Access to clients is significant feature of type III design research methods. Research methods in this orientation oppose regulative steps and espouse creativity. With access to clients and hence their context researchers can draw from a broad spectrum of requirements to elaborate upon. Underlying type III methods rest the core notion that technology and organization interact during design in so far that design outcome is a result of emergent perspective on design, use, and refinement in context. Using Type III methods means formulating conjectures - that can be shaped into sharp propositions - rather than explicating hypothesis. ADR is a typical design research method representing the view of continuous stakeholder participation in the research project. Different stakeholders examine the propositions iteratively together with researchers to define and redefine options for the design.

### 2.4 Type IV Deductive – Emergent

Type IV research methods may seem unrealistic because of the mutual exclusive nature of the deductive – emergent position. However, design research are emerging where the researcher have control only over the meta-artefact and the research problem. An instance is released to audiences with control over empirical test and evaluation & learning. IT design under the flag of open innovation strongly emphasized in the so called Living Lab and ‘crowd sourcing’ research projects enable the emergence

of concepts leading to innovative solutions involving users as co-creators [15]. As researchers consign test of the artefact to a community of which they have no control, the transferring of design data back and forth between researchers and the community is the critical passage point [16]. In essence, this will limit evaluation task, as pre-stated design hypothesis cannot be tested because of the dominance of summative evaluation before formal approaches.

## 3 Implications of the Proposed Framework

### 3.1 Implication for Problem Definition

While selecting DSR method, first and foremost criteria are to define the research problem. Defining or formulating the problem itself can be well structured or ill-structured where problem definition can emerge in interaction with the context [12]. As per the suggested framework, in Type I DSR method, problem is defined by researcher focusing on the existing 'gap of knowledge'. The gap can be understood through literature review, or understanding the practitioner's background. Likewise, in Type II, problem is defined by researcher together with practitioner in-situ. Empirical research such as case study can be conducted to understand and formulate the research problem. In Type III, the problem is defined in conjunction with contextual conditions like in type II, but in this type the problem itself can emerge with the progression of the research. The process goes through various discursive phases to check the relevance of the defined problem. In terms of Type IV DSR methods, the problem is defined like in Type I, however, the problem can emerge in a manner independent of primary researcher that can thus be one peculiar characteristic compare to Type I.

### 3.2 Implication for Evaluation

The evaluative or reflective approaches can be applied to construct the outcome. The evaluative in this context refers to evaluation of the outcome as the final undertaking of the research, whereas, reflective refers to evaluation as an iterative process of the research. As per suggested framework, design research of Type I, can be referred as artificial evaluative approach [17]. It produces planned outcomes that can be anticipated by reference to any a priori design. In this case, a researcher does not care to test the artefact in various contexts and reflect in the social settings. They typically take a distanced and outside perspective to maintain impartiality and legitimacy, or very controlled field evaluation.

Type II research methods uses naturalistic evaluation where research is conducted to evaluate artefacts (constructs, methods, policies, programs, or models) pre-set by designer's for solving practical problems. This kind of research focuses mainly on describing, explaining, and obtaining evidence-based knowledge of the practical problems that supposed to be solved. In terms of the engaged scholarship model [9], these decisions include the purpose of the evaluation study (problem formulation), the criteria and models used to evaluate the program in question (research design), and how study findings will be analysed, interpreted and used (problem solving). Type II

suggests that engagement of stakeholders is important so that they have opportunities to influence and consent to those evaluation study decisions that may affect them. The outcome of these design research methods as a proof of concept can be useful in the field evaluation of conceptual artefact.

Design research methods of Type III use naturalistic [17] evaluation where criteria are adjustable. It produces outcome that may exhibit emergent features of numerous local actions (e.g. use, interpretation, negotiation and redesign), but these emergent features cannot be anticipated by reference to any a priori design. These kinds of research suggest that the researcher should engage with practitioner while making intervention in an organizational context. For example, action design research advocates that building of an artefact, intervention of the artefact, and evaluation of the artefact should be done as an iterative research process, but not as a final undertaking. The foundation of these methods is to learning through action and reflection in organizational settings. A researcher directly involves in context and utilizes their knowledge to formulate and solve the applied problems. However, this knowledge may not apply or may require substantial adaption to fit the ill-structured or context-specific nature of the client's problem. Furthermore, it is suggested that the only way to understand a social system is to change it through deliberate intervention and reflection through experiences. These kinds of methods may require intensive training, and consulting by the researcher with people in the client's setting.

Type IV, also uses naturalistic evaluation where the criteria is set by 'the users' on the fly. Evaluation of the artefact is done as an iterative research process but in a fuzzy environment (e.g. crowd sourcing and living lab). The foundation of these methods is to learning through action and reflection in natural-experimental settings. A researcher doesn't directly involve in context, rather users utilizes their knowledge to formulate and try to formulate the solutions to the emerging problems.

### 3.3 Implication for Theorizing

In this framework, design research of Type I and Type IV can apply deductive method that involves arriving at a 'result' based on applying a 'rule' or hypothesis to a case. These kinds of methods use variance model to make causal or conditional relationships among variables of units that are sampled, measured, and analysed. The outcome of this strategy will lead to meta-artefacts that can instantiated to context specific artefacts. Design science research method of Type II and Type III falls in the abductive (iterative cycle of deduction and induction) category, which is an inferential procedure in which we create a conjecture that, if it were correct, would contribute to the understanding of ill-structured problem of the world. Abduction entails creative insight that can combine the rigor and relevance to provide solution to the practical problems [14]. This strategy applies process model that seeks the answers to the questions like how things change and develop over time. The outcome of this strategy starts from instantiated artefacts that are gradually generalized to class of meta-artefacts. As suggested by [9], it requires longitudinal data because collecting primary data, building relationships with people in the field took long time.

## 4 Conclusions

Selection of an appropriate design science research method is vital before embarking any design research project; however, guidelines for selecting a DSR method need more attention. To address this need, the paper proposed a framework that characterizes the relationship between IS design research outcome: à priori and emergent, and IS design research process: deductive and abductive. Viewing through the two dimensional matric, the framework provides guidelines particularly to the beginners in the DSR research to make decision about which design research method to utilize in the DSR project. The research is still in progress; furthermore, more in-depth review of the seminal work as well as empirical research will be conducted to warrant the usefulness of the framework and development of key criteria for the selection of DSR method.

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