What is a Contribution to IS Design Science Knowledge?

Research-in-Progress

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Abstract

In order to promote more rigor in Design Science Research (DSR), Gregor and Hevner have proposed guidelines for conducting and evaluating DSR in the Information Systems (IS) discipline. Their work has been influential and widely used to advance the field. However, the way they characterize IS-DSR knowledge contributions excludes what we believe are genuine contributions and includes works that in our lights are not contributing to IS-DSR knowledge. To overcome this problem, we borrow from the contemporary philosophy of science to develop a framework for identifying the types of IS-DSR knowledge. We posit that contributions to DSR are in the form of theories or technological designs, and each type could be either inter-field or field. We demonstrate the strength of the proposed framework in better identifying contributions and clarifying the boundaries of IS-DSR. Our experience led us to believe that the proposed view is applicable to the whole IS discipline.

Keywords: Design Science Research, philosophy of science, artifact, theory, technological design
Introduction

Information Systems (IS) is a cross-disciplinary field that has been positioned as the confluence of people, organizations, and technology (Hevner et al. 2004). Design Science Research (DSR), as a paradigm within the Information Systems discipline, has had a more dire situation comparing to the whole IS discipline. Paulo Goes, editor-in-chief of MISQ, in the Editor's Comments essay of the March 2014 issue, emphasized that the IS field needs more Design Science Research as it is a solution building paradigm, that ties all other IS paradigms together (Goes 2014). However, IS DSR has failed to gain much publication traction recently, as it is evidenced by the fact that “the total number of design science publications in MISQ since 2006 accounts for less than 5 percent of the total publications in the journal” (Goes 2014, p. iv).

Over the past decade, three seminal papers by Hevner et al. (2004), Gregor and Jones (2007), and Gregor and Hevner (2013) have proposed frameworks to think about the nature of Design Science Research (DSR) in Information Systems. Hevner et al. (2004) identified DSR as a problem-solving paradigm that generates a solution in the form of an artifact. They also provided guidelines to describe the process of research in Design Science. Gregor and Jones (2007) posited that design scientists need to develop theories of design and action, in order to rise to the level of scientists. In their latest paper, Gregor and Hevner (2013) provided a framework that combined their previous insights regarding research, contributions, and knowledge in Design Science.

Following their lead, the present paper proposes a refinement to a central aspect of their work; namely, that of characterizing the kind of knowledge that IS DSR produces as a distinct scientific field. According to Gregor and Hevner (2013), Design Science Research contributions come in three main types: well-developed design theories, nascent theories, and situated implementations of artifacts. IS DSR's contribution to knowledge is determined based on maturity of the solution, as well as the application domain. Publishable contributions are “inventions” (low maturity of both solution and application domain), “improvements” (low maturity of solution, but high maturity of application domain), and “exaptations” (high maturity of solution, but low maturity of application domain). According to their view, when the solution and application domain are both mature, the DSR output will be a “routine design”, and it would not be a novel contribution to the knowledge base.

The Gregor and Hevner framework has been considered as a reference framework for evaluating IS DSR in the community, as it is evidenced in the Editor's Comments essay in the March 2014 issue of MISQ (Goes 2014). Moreover, an analysis on knowledge contributions in IS DSR done by Dwivedi et al. (2014) also adopted the Gregor and Hevner (2013) framework to present the outcome. Their interesting finding about the status quo of the field – although beyond the scope of the current paper – demonstrates the influence of Gregor and Hevner (2013) on the way IS DSR is conducted and evaluated.

We acknowledge the merits of (Gregor and Hevner 2013) on the foundations of IS DSR; however, their view is faced with certain indeterminacy in identifying contributions to IS DSR knowledge. This paper, therefore, only focuses (or expands) on the contributions to IS DSR knowledge part of their work. More specifically, we posit that their framework would admit contributions that are not seemingly within the field of IS DSR, or it would exclude contributions that would otherwise be within the IS DSR domain.

We focus on the cross-disciplinary nature of IS DSR, and borrow concepts from philosophy of science that have been used to describe scientific disciplines in terms of relations between “fields” of research – “inter-field” – or within the same field – intra-field, or simply “field.” We see IS design science as comprising at least two main elements: theories and technological designs. We contend that each of these elements could be either inter-field (bridging between IS DSR and another field) or field (supplementing existing IS DSR knowledge). We discuss each element and their types, and provide examples to demonstrate how the

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1 As mentioned earlier, DSR is a problem-solving paradigm. However, we consider IS DSR a field, and we attempt to classify the types of knowledge that are generated within this field.

2 The concept of a “field” was used to characterize theories that bridged two different domains, i.e., “interfield theories” (Darden and Maull 1977). How to describe the structure of science beyond identifying it with certain theories became a central problem in post-Kuhnian philosophy of science. In particular, the integration of different fields in scientific disciplines (Bechtel 1986).
Gregor and Hevner framework leaves out instances of work that in our framework are genuine contributions to IS DSR knowledge, and vice versa.

It is important to note (and we will show below) that we don’t suffer from “natural science envy,” in any of its forms, such as “physics envy” (e.g., Clarke and Primo 2012). Our claim is that concepts developed in the philosophy of other sciences are helpful in the analysis of Design Science.

In the next section, we discuss some background work done on positioning the field of Design Science Research in the discipline of Information Systems. Following that, we discuss our motivations and point of departure from the existing frameworks. Next, we present a framework that borrows from contemporary philosophy of science. We present some examples to demonstrate the advantages of our view in identifying IS DSR knowledge. In the final section, we evaluate and conclude our work, and suggest possibilities for future work.

**Background**

Hevner et al. (2004) described Design Science, a field within the IS discipline, as a problem solving paradigm that involves developing “technology-based solutions to important and relevant business problems” (Hevner et al. 2004, p. 83). The solution is a viable artifact in the form of constructs, models, methods, or instantiations. As guidelines for conducting the research process, they propose that design scientists should use rigorous methods in artifact construction and evaluation.

Gregor and Jones (2007) took a slightly different approach, and asserted that in order to rise to the level of science (as opposed to craft), design scientists need to develop design theories. They described the anatomy (or components) of a design theory. Six of the integral components of a design theory are its purpose and scope, constructs, principles of form and function (i.e., architecture), artifact mutability (i.e., degree of change encompassed by the theory), testable propositions (a la Popper 1980), and the underlying justificatory knowledge that provides explanation for the design.

Hevner et al. (2004) and Gregor and Jones (2007) adopt what we would like to call a foundational stance in IS DSR research. A foundational stance is a perspective or attitude on the nature of a given discipline articulated by one or a group of its practitioners. Indeed, the foundational stances that Hevner et al and Gregor and Jones adopt have been distinctively at play in other sciences as well. Scientists may adopt a “realist” stance, and demand that theories are true and explanatory of the world; or they may adopt a “pragmatic” stance, and demand theories that have a good fit with the data, whatever kind of data a given discipline has. In this sense then, Gregor and Jones (2007) approach is akin to a “realist” stance (aiming at true theories of the world in the format of theories of design and action), while Hevner et al. (2004) took a “pragmatic” stance (developing empirically adequate theories of the world by building technology-based solutions for business problems). We emphasize that these stances are not opposite; their coexistence is beneficial to research as they can complement each other.

In 2013, Gregor and Hevner reconciled their two stances and stated that design science contribution could be in the form of theories, as well as artifact construction. Building on Purao’s (2002) work, they proposed a classification for design science contribution types.

At the lowest level of abstraction, we have instantiations or situated implementations of an artifact. This type is considered less mature knowledge, and specific to a particular application domain. Usually when a new solution is developed for a new problem domain, the contribution will be in the form of a working or situated implementation of the concepts. For example, the paper by Agrawal, Imielinski and Swami (1993) titled “Mining Association Rules between Sets of Items in Large Databases” – which proposed a data mining algorithm as an aid to human decision making – is the “full conceptualization of mining databases for association rules as well as an efficient method for discovering them” (Gregor and Hevner 2013, p.346). This is a situated or working implementation of a new algorithm; however, this work can also be presented in a more abstract way (or as a nascent design theory) since it includes a logically consistent set of statements, with clearly defined constructs, as well as abstract algorithms.

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3 In distinguishing between foundational stances, we are inspired by the work of Arthur Fine and his “NOA”- “natural ontological attitude” (Fine 1996).
The most complete and mature IS DSR knowledge includes grand and mid-range theories. The existence, or necessity, of an all-encompassing theory (i.e., grand theory) is not clear in IS/IT design science (Gregor and Hevner 2013, p.339). However, most of the design science theories could be considered middle range theories or “theories that lie between the minor but necessary working hypotheses that evolve in abundance during day-to-day research and the all-inclusive systematic efforts to develop a unified theory that will explain all the observed uniformities of social behaviour, social organization, and social change” (Merton 1968, p39). Gregor and Hevner (2013) discuss data mining theory, as an example of middle range theory (and more mature knowledge), which is the evolution of Agrawal et al.’s work (1993). The data mining theory in Williams and Simoff (2006) collects better data mining algorithms that are tested and led to rule development, and also extended the methods to areas such as business intelligence and security.

Deciding whether a design science output is in fact a contribution to knowledge or it is merely a routine design has been a challenging task. Gregor and Hevner (2013) proposed the framework presented in Figure 1, in order to help design science researchers distinguish contributions to design science knowledge. They claim that inventions (new solutions for new problems, e.g., first data mining algorithm), improvements (better solutions for existing problems, e.g., improving data retrieval efficiency), and exaptations (using an existing solution in a new application domain, e.g., using data mining in meteorology) are contributions that are publishable.

Our Motivation and Point of Departure

We believe there is room for refinement in the framework proposed by Gregor and Hevner (2013). In this section we describe two factors that motivate the present proposal. First, we believe that there are knowledge contributions that should not be considered to be IS DSR contributions, yet they qualify as one according to Gregor and Hevner (2013). As an example, a design scientist could use data mining methods on weather records to predict heavy rainfall with great accuracy. This solution could be considered an “exaptation” (applying the existing solution of data mining to a new problem domain) and also an improvement at the same time (assuming that greater prediction accuracy is achieved). Since nothing much needs to be changed in the data mining methods, we can argue that this is a straightforward routine design as there is no contribution to design science. However, since this is an application to a new problem domain (i.e., weather forecast), the Gregor and Hevner (2013) framework will consider it as IS DSR. There is no doubt the data mining algorithms used in weather forecast are contributions to knowledge; the problem is to determine its proper domain. In this case, the insights gained from this research might be more suitable to the meteorology domain (or meteorology DSR), than IS DSR; unless meteorology domain represented an exemplar of a group of problems that can be addressed by the new data mining algorithm, which then the contribution would be related to the usage of algorithms and be within the domain of IS DSR. We agree with Gregor and Hevner (2013) that the specifics of the application domain and the relevant influences of existing solutions are important to be determined before the research is conducted. However, judging whether findings actually contribute to a particular application domain (e.g., meteorology) should be left to the researchers in that domain – as it is beyond our scope.

It is not uncommon that techniques developed in one field are imported into new domains; e.g., when the application of a development in pure mathematics leads to the development of a new field. In this case, the contribution to knowledge is in the new domain and not in the mathematical one, e.g., the application of the theory of matrices to model population growth with age structure by Paul Leslie in 1945 (Leslie 1945). Leslie’s work was a contribution to knowledge in mathematical ecology, and not in matrix theory. We also contend that by admitting contributions that are not really IS DSR-knowledge may make it more difficult to raise IS DSR to the level of a science, as Gregor and Jones (2007) propose.

Second, we believe that there are grey areas near the border of each quadrant in the 2x2 framework by (Gregor and Hevner 2013) in Figure 1. One design may entail applying an old solution to a different domain.

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4 This hypothetical example considers the first time that data mining was used in meteorology to highlight our point. We acknowledge that using data mining for weather forecast is done on a daily basis in recent years and it would not be considered knowledge contribution to either domain.
application domain. Arguments might arise whether that work is an exaptation or a routine design. For example, using 3D environments for social interactions (Pandzic et al. 1995, Witmer and Singer 1998) was back in the 1990s a new solution and the methodology of such platform has been discussed. Proposing to use 3D environments in a psychological self-service environment could be considered an exaptation of 3D environments as an existing solution in the new domain of studying self-service psychology, or a routine design as the psychological self-service environment can be considered just a special case of social interactions that was discussed earlier.

![Figure 1. IS DSR Knowledge Contribution Framework](Taken from (Gregor and Hevner 2013, p. 345))

As another type of impediment caused by the grey area, we could think of a case that should be considered IS DSR contribution, but according to (Gregor and Hevner 2013) it is a routine design: Hellmuth and Stewart (2014) performed a case study by applying Enterprise Information Architecture (EIA) analysis to model a wicked problem\(^5\) in a school. It could be argued that both the solution (i.e., EIA) and the domain are in the mature quadrant of the contribution framework by Gregor and Hevner (2013). However, Hellmuth and Stewart found out that using EIA helps in better identification of misaligned entities within an organization. Moreover, they contend that EIA achieves more effective definition of requirements and goals, thus it could lead to higher rates of system success and adoption. This is an example of a routine design that may have not changed the solution (i.e., EIA approach) or the application domain (i.e., school), but led to new insights related to information use in the domain of business.

In short, the two factors arise from inclusion of contributions that are seemingly not within the field of IS DSR, or exclusion of what would otherwise be within the IS DSR domain by the Gregor and Hevner’s (2013) framework. Accordingly, our proposed view aims at providing more definite answers in these two kinds of scenarios.

**An Alternative View of Design Science in IS**

As stated above, we borrow from philosophy of science in developing our view. Despite undisputable differences between design science and sciences like biology or physics, they share the two elements we have highlighted: theories and technological design. These two elements became neatly differentiated for the first time in Hacking (1983). Science is now understood as a multidimensional activity, and those two elements have to be understood as two very basic ones. We thus believe that concepts developed in

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\(^5\) Wicked problems are characterized by unstable requirements, complex interaction within the problem domain, inherent flexibility to change, and critical dependence upon human cognition and social abilities (Hevner et al. 2004).
philosophical analyses of the natural sciences can be profitably applied to understanding IS DSR. We like to reiterate our position we stated in the introduction that it is not one of “natural science envy,” e.g., we are not claiming that design science ought to follow the model of physics (“physics envy”) or biology, or any other science for that matter. Our claim is that concepts developed in the analysis of other sciences can help us think about Design Science.

A central problem for the history and philosophy of science and for science studies more generally has been to characterize the structure of science in ways that go beyond identification with a single theory. The notions of a scientific “discipline” and a scientific “field” have been used to capture the fact that a particular science can have different theories with diverse domains, and with changing, possibly overlapping boundaries depending on their stage of development. Scholars opting for a discipline-oriented description of a specific science (Suarez 2009) have emphasized historical and sociological aspects, whereas those describing science in terms of “fields” of research have emphasized the relation between theories and different domains (Darden and Maull 1977). In this paper, we propose a field description of Design Science Research, with the aim of capturing its complex cross-disciplinary nature.

We propose to characterize a scientific field as a domain of research with certain more or less identifiable boundaries within a scientific discipline. A well-established field has clear boundaries, whereas, an emergent one, has fuzzy boundaries. IS DSR could be considered emergent fields with fuzzy boundaries since the discipline is young, and it is situated at the confluence of people, organization, and technology.

Combining the “field” descriptor and the two common elements we mentioned at the beginning of this section, a field has at least two main elements: theories and technological designs. Theories are developed to represent the structure of a system, and technological designs that are used to enable the “observation” of systems. Familiar examples of theories include: the general theory of relativity and the standard model of particle physics; examples of technological design include telescopes and particle accelerators. An example of an IS DSR theory could be the relational theory by Codd (1970) that describes the structure and operations needed to manage data by applying set theory. As a technological design, one could think of the inception of distributed databases; it applied the existing principles of database management systems (e.g., a relational database) over a set of separate databases that were distributed over a network – more examples from IS DSR knowledge contributions (theory as well as technological designs) are analyzed in more detail in the coming paragraphs.

Central to this distinction is that by enabling observation, technological design generates knowledge about the world that is not dependent on theory testing (Hacking 1983, Pickering 1995). Clearly, any technological design has a theory behind it (e.g., optics, in the case of the telescope), but the point is that technological designs enable researchers to “see” phenomena that are not predicted by theory. Hacking discusses three ways to investigate the hypothesis that the interior of the sun is rotating; optical observations of the oblateness of the sun, and measurements of the gravitational properties of the sun with satellites presuppose physical theories; but measuring gravitational effects of the mass of the sun on an apparatus in orbit around the sun (e.g., a gyroscope), is independent of theory (Hacking 1983). This supports Hevner et al.’s (2004) view of IS DSR as a problem-solving paradigm that involves developing technology-based solutions to important and relevant business problems (p.83) and evaluating the artifact “with respect to the utility provided in solving those problems” (p. 78). What counts as a new observation will (i) depend on background knowledge: a new observation relative to the kind of observations previously made; (ii) be new in the sense that at least one previous observation had been made. Observation, on the other hand is an umbrella term for “obtaining information (data) from a certain system” (Shapere 1982). Relating back to Hevner et al.’s (2004) point that IS DSR produces an IT-based solution to a business problem, we posit that the newly observed phenomenon enabled by a technological design, could in fact be a new utility that is afforded to a user or business stakeholder.

Having discussed the two main elements of a field, we propose that the contributions to IS DSR knowledge include the same two elements. Our classification scheme is presented in Table 1. As it can be seen, it agrees with commonly accepted views in IS Design Science community (Hevner et al. 2004, Gregor and Jones 2007, Gregor and Hevner 2013). Our scheme is simpler and we accommodate Gregor

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6 According to Herbert Simon, in his classic work *The Sciences of the Artificial* (1996), the science of designing an artifact that interfaces with the outer environment to provide a satisficing solution, is also used in other sciences such as physics and management science.
and Hevner’s (2013) three types of contribution into our two types: Theories and Technological Designs. Theories could be mapped to level 3 and 2 of Gregor and Hevner (i.e., nascent, mid-range, or grand theories) while the Technological Designs cover level 1, with some overlaps on level 2 (i.e., instantiation as well as methodologies for developing the technological design). We define technological design as the artifacts (i.e., “constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implemented and prototype systems)” Hevner et al. 2004) that enable new observations. A technological design that does not enable new observations is a routine design, and we agree with Gregor and Hevner (2013) that routine designs are not publishable. Enabling of observations is also broader than the concept of ‘providing utility in solving a business problem’. Our view is advantageous in evaluating innovations that are not necessarily solving a previously known problem, but are scientific contributions nevertheless. Gregor and Hevner (2013) acknowledged that innovations are hard to evaluate, and thus are not easily published. Our philosophical view of technological design, while covers the existing paradigm of providing utility, broadens the scope of our field.

**Table 1: The Proposed Contribution Framework of IS DSR**

<table>
<thead>
<tr>
<th>Contribution Domain</th>
<th>Inter-field</th>
<th>Field</th>
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<tbody>
<tr>
<td>Theory</td>
<td>Predicts new items for the domain of one or both fields (Darden and Maull 1977, p.59)</td>
<td>Supplements existing domain knowledge</td>
</tr>
<tr>
<td>Technological Design</td>
<td>Enables observation of new phenomena within one or both fields</td>
<td>Enables observation of new phenomena within the field</td>
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Based on the proposed scheme, design scientists could develop theories; some of the theories may import knowledge from other fields and hence become inter-field theories, while some may be extensions of, or improvements on existing theories (i.e., intra-field theories). Inter-field theories are generated when “two fields share an interest in explaining different aspects of the same phenomenon” and they “provide answers to questions which arise in one field but cannot be answered within it alone” (Darden and Maull 1977, p.43). Inter-field theories “predict new items for the domains of one or both fields” (Darden and Maull 1977, p. 59). An example of an inter-field theory in IS DSR is the Bunge-Wand-Weber ontology (Wand and Weber 1990); information systems in general, and conceptual models in particular, are representations of the real world. In development of information systems, it is imperative to describe the real world and also concepts that are relevant within information systems. Borrowing from the field of ontologies – that are order and structure and reality in the broadest sense possible (Angeles 1981) – Wand and Weber (1990) developed a theoretical ontology to describe the reality, and its representation in conceptual models and information systems.

Field theories in design science are contained within the field. For example, Steven Alter’s Work System theory (2013), took the Work System methodology in systems analysis and design, and by evolving it, developed analytical framework and explanatory statements regarding the work system life cycle model. This theory – which supplements existing IS knowledge - could be considered a field theory in IS DSR.

Technological designs (corresponding with level 1 and 2 of Gregor and Hevner 2013) could also be considered contributions to knowledge, as long as they enable new “observations” on the application domain environment. For instance, designing an email system based on speech act theory for organizations (Flores and Graves 1988) could be considered an inter-field technological design of linguistics and business, as it leads to new observations of work coordination, and directionality of change by modelling technology-based communicative orders within the organization (Suchman 1993). As a field technological design, developing a more efficient graph traversal algorithm (e.g., the first proposal of breadth-first search) is considered a field technological design. The more efficient algorithm could in

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7 It should be noted that we are not trying to redefine the terms “artifact” or “theory” (as they were used by previous researchers such as Gregor and Hevner 2013). The purpose of the current paper is to propose a new approach for evaluation of IS DSR. The term “technological design” was used since it does not require association of purposeful artifacts to predefined business problems (a la Hevner et al. 2004).
principle, improve knowledge discovery within organizations and remove constraints that might have been associated with the older algorithms (e.g., depth-first search has different space and time complexity and by improving on it, capabilities of a Business Intelligence application in mining hierarchical data may increase; this could in turn impact IT managerial practices, which enables new observations).

In order to determine whether theories and technological designs are in fact contributing to the field of IS, we refer to the influential paper by Benbasat and Zmud (2003) in which they identified the core properties of the IS discipline. Adopting their approach, we propose that a theory or technological design is within the IS field, when its contributions are related to the conception, construction, and implementation of the IT artifact, and in a broader sense the capabilities and practices involved in designing, usage, and evolution of the IT artifact, as well as the IT artifact’s consequential impact on users (individuals or organizations). The aforementioned aspects are described as the IT artifact and its immediate nomological net (Figure 2).

Applying the Proposed Framework

Referring back to our motivation for developing the proposed framework, we questioned some of the contributions that qualified as IS DSR using (Gregor and Hevner 2013) and also discussed the grey areas that exist on Figure 1. Based on our framework, a data-mining algorithm that uses weather forecast records to predict rainfall with greater accuracy is indeed a technological design, but the observations it enables are not within the realms of IS DSR, as the rainfall phenomenon is not in the immediate nomological net of the IT artifact; therefore, should be published in Geography or related journals instead of IS journals. The same argument could be applied to the example of 3D environments for psychological self-service environments. Referring to the example of application of EIA to identify wicked problems – we consider it an IS DSR contribution as it enables better identification of misaligned entities and also captures goals and requirements more effectively (these are the new observations).

Relationship between Theory and Technological Design

It is of paramount importance to discuss the relationship between theories and technological designs. Theories – as abstract entities that “aim to describe, explain, enhance understanding of, and in some cases, predict the future” (Gregor and Hevner 2013, p. 339) – can be the basis or kernel knowledge of a technological design. A technological design that enables new observations can lead to generation of theories. An example that Gregor and Hevner (2013) gave was Data Mining (Agrawal et al. 2013) that was a technological design, and over the course of time, its observations and implications led to the theory of data mining (Williams and Simoff 2006). The construction of the technological design and principles of replication could also be considered theories (Gregor and Hevner used the term “nascent theory”). In short, one could distinguish between a theory that is the basis of a design, and a theory associated with or reached from a technological design. However, both, according to our view, are scientific contributions worthy of publication in the best IS journals. We emphasize again that technological design are not merely built to support theories. As discussed earlier, a technological design that enables new observations in the domain of Information Systems is a IS DSR contribution. Moreover, the implications of observations...
generated by a technological design could lead to generation of IS DSR theories (e.g., data mining algorithm led to data mining theory).

Summary and Conclusion

We believe there is room for improvement in current views on Design Science Research. In order to address shortcomings, we propose that DSR contributions are in the form of theories and technological designs. Each of these types could be considered inter-field (i.e., having contributions to one or more fields) or field (i.e., supplementing existing knowledge and observations). Inter-field and field descriptors are related to the process of conducting IS DSR, and can be used by the community to place research contributions within an interpretive framework. Beyond that, we believe that the distinction leads to better evaluation criteria for exaptations (old solution to new domains). According to the definition of inter-field theories (Darden and Maull 1977), they “provide answers to questions which arise in one field but cannot be answered within it alone”. The inter-field description helps in evaluating exaptations by stating that the problem cannot be solved without the old solutions in this new domain (i.e., from the point of view of the new domain), rather than just applying old solutions to new domains (a la Gregor and Hevner’s exaptation). We contend that whether an IS DSR is inter-field or field, the contributions are within the domain IS DSR when they are related to the IT artifact and its immediate nomological net.

Although this paper focused on IS DSR, we believe that with more research work, this classification of knowledge in DSR should also be applicable to the whole IS discipline; since IS DSR is intertwined with other paradigms of the discipline, one could find design elements in behavioural studies of IS. For example, Qui and Benbasat (2009) studied the anthropomorphic aspects of an interface, by studying inclusion of an avatar (as a technological design) on an e-commerce website. They found that the human embodiment of the avatar increases perception of social presence in users (as shopping is considered a social experience). This study includes a field technological design (as the design of avatar was made possible by utilizing the knowledge within the IS field), and the observations garnered by this design, enforce users’ belief that computers are social actors (Qui and Benbasat 2009).

As another example of a behavioural IS study that can be evaluated with the proposed framework, one could consider Tan et al.’s (2013) work in which the dimensions of service quality in e-Government were studied. Using Customer Service Life Cycle (CSLC) from marketing domain, Tan et al. designed an interface that manifested different aspects of service functions (i.e., needing, acquisition, ownership, and delivery functions). Their findings showed that service content quality, as well as service delivery quality, are dimensions of online service quality. This inter-field theory (between marketing and IS), contributes to the IS domain, and enables observations regarding how service quality can affect users’ enjoyment of interacting with an interface, and consequently influence their usage intentions.

In summary, we believe that the two basic elements of sciences (i.e., theories and technological designs) that were used to develop the proposed framework on IS DSR could also be applied to understand and evaluate IS research in general.

Implications for a Philosophy of Design Science

Our work could be considered an inter-field meta-theory as it intersects work on the foundations of IS DSR with the philosophy of science. We hope our framework can help Design Science researchers and reviewers in identifying IS DSR contributions

In their development, sciences have gone through periods where doing science cannot be divorced from thinking about the nature of science, and what it says about the world. A notable example is the Bohr-Einstein debate in the development of quantum mechanics (Hooker 1972). Such periods stand out for their importance in the establishment of the given science. The adoption of what we have called foundational stances is characteristic, but not exclusive, of such periods, and the debates they prompt can result in stagnation or provide fuel for a field to move forward. Design science may be going through one of these periods, and it is one of the functions of a philosophy of design science to provide concepts which may be shared by design science practitioners, despite their different methodological persuasions, and thus ensure a common ground for fruitful discussion. We offer this work as a preliminary step in that direction.
References


