Journal of Operations Management xxx (2016) 1–8

Contents lists available at ScienceDirect

Journal of Operations Management

journal homepage: www.elsevier.com/locate/jom

Conducting and publishing design science research
Inaugural essay of the design science department of the Journal of Operations Management

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ARTICLE INFO

Article history:
Available online xxx

Accepted by: Mikko Ketokivi

ABSTRACT

The new Design Science department at the Journal of Operations Management invites submissions using a design science research strategy for operations management (OM) issues. The objective of this strategy is to develop knowledge that can be used in a direct and specific way to design and implement actions, processes or systems aimed at achieving desired outcomes. This knowledge is developed by engaging with real-life OM problems or opportunities. Manuscripts submitted to this department will be evaluated on pragmatic validity and practical relevance. Because design science research (DSR) differs in some important aspects from other OM research strategies, this essay examines in some depth its challenges and possible solutions.

1. Introduction

The operations management (OM) community is widely regarded as a problem-solving discipline, seeking to create knowledge by interacting with the real world (McCutcheon and Meredith, 1993; Lewis, 1998). OM scholars have consistently echoed this sentiment and urged researchers to develop valid and relevant knowledge that can directly or indirectly support managers' problem-solving efforts (Tang, 2015; Boyer and Swink, 2008). Van Mieghem (2013) calls for OM research to increase its relevancy dimensions and urges scholars to move away from the quintessential "ivory tower" syndrome.

1.1. DSR as a research strategy for OM

The new Design Science department at the *Journal of Operations Management* intends to contribute to this objective by publishing original, high-quality and practice-based OM articles using a design science research (DSR) strategy. Inspired by Herbert Simon (1996), DSR is conceptualized as a research strategy, aimed at knowledge that can be used in an instrumental[1] way to design and implement actions, processes or systems to achieve desired outcomes in practice. DSR is driven by field problems or opportunities; instrumental knowledge is developed by deep engagement with these real-life OM problems or opportunities.

DSR's core research products are well-tested, well-understood and well-documented innovative generic designs, dealing with authentic field problems or opportunities. DSR posits that such generic designs have significant practical relevance. In the OM context, they can take a variety of forms, from a highly responsive scheduling system to account for strong demand variations to an approach to manage power conflicts in a supply chain or a model for patient-centered hospital care delivery.

The assessment criteria for Design Science department submissions will be discussed in detail later in this essay. Key criteria, however, cover questions of validity and relevance: (1) How strong is the evidence that the design will produce the desired results (i.e. pragmatic validity)?; and (2) In what way does the design make a valuable contribution to addressing a significant field problem or

[1] The concept of instrumental knowledge use draws on Pelz (1978): it is use of knowledge in a specific and direct way for action or design. This is in contrast to conceptual use, the use of knowledge for general enlightenment on the subject in question.

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http://dx.doi.org/10.1016/j.jom.2016.06.004
0272-6963/

exploiting a promising opportunity (i.e. practical relevance)?

DSR can be unfamiliar territory for social science researchers, less so those with a background in practice. For them, DSR presents a natural approach: analyze the problem, design a solution and develop it further in cycles of testing and redesign. DSR, moreover, is widely used in other academic disciplines. As defined above, it is the main research strategy in engineering and medicine and is gaining ground in areas such as information systems (see e.g. Hevner et al., 2004).

1.2. DSR can be regarded as an engineering approach to OM

DSR in operations management can be regarded as a conscientious transfer of the strategy used in engineering research, taking into account the fundamental differences between designing and building a material artifact and designing and realizing a socio-technical system.

Generally OM-systems are socio-technical systems, having both technical and social components. Those with minimal social components (e.g. a fully automated assembly line) largely can be treated as technical systems with a smooth engineering-OM DSR transfer. Other OM systems such as professional services, however, may be almost entirely social systems. The engineering-OM transfer here involves specific and important issues, including establishing the pragmatic validity of designs, generalizing the design, and examining the (social) mechanisms producing system performance. Most OM systems lie between these two, thus a key OM research issue for DSR is dealing with the social components. A key objective of this essay is discussing ways to do so.

1.3. Essay structure

The remainder of this essay flows as follows. In Section 2, we discuss the differences between DSR and explanatory research in terms of research paradigms. In Section 3, we illustrate basic DSR ideas using two OM examples we also will discuss later: the first is predominantly composed of technical components (an assembly line manufacturing setting) and the second predominantly composed of social components (in a hospital health-care delivery setting). In Section 4, we detail DSR's core research product, the *generic design*, together with the *design proposition*, which gives information on where and how the generic design is to be used in practice. In Section 5, we discuss the impact of *human agency* on the design, realization and performance of OM systems and *experiential learning* as a strategy to deal with it. Establishing the *pragmatic validity* of generic designs is discussed in Section 6, the *generalization* issue in Section 7. In Section 8, we discuss *operational issues* when conducting DSR, followed by a look in Section 9 at the *'DSR-add-on'*, the use of a design science approach as an addition to a largely explanatory research project. We conclude the essay with a discussion on the required *documentation* of the design and how it has been tested along with the *criteria* on which Design Science department submissions will be assessed.

2. Research paradigms: DSR and explanatory research

2.1. Two paradigms compared

Most management sciences research, including OM research, is based on the paradigm of explanatory research, the iconic example of which is physics. When using this paradigm, the mission of research is to describe and explain the present (or past) from the perspective of a detached observer. Research according to this approach is a quest for understanding what is, the causal model being the iconic research product. This type of research tends to be a *'science of the average'* focusing on average relations between causes and outcomes and its outcomes are justified on the basis of descriptive and explanatory validity.

DSR, on the other hand, focuses on improving the present. The main stream research strategies of engineering and medicine are the iconic examples of the DSR strategy. DSR takes the perspective of involved actors seeking to improve matters – a doctor needing to deal with a certain medical disorder or an engineer designing a bridge (see van Aken, 2004 on the paradigms issue).

As said, the core research product of DSR is a generic design. The justification of a generic design is based on pragmatic validity, or whether its implementation produces desired outcomes. For instance, does a drug proposed for a disorder lead to the desired recovery, or does an OM system produce the desired performance in practice? Ultimately, DSR is a science of the average (e.g. by developing a certain *type* of bridge) *as well* as a science of the particular, giving knowledge on how to deal with specific contextual issues (such as in designing an instantiation of a bridge over a river with unstable shores). See Section 7 to explore this topic further.

While based on different research strategies, explanatory and DSR are not to be regarded as opposites, rather as complements. DSR projects, in fact, consist of two components, respectively descriptive/explanatory and design/testing. The first provides a solid foundation for the second by cultivating a deep understanding of the field problem for which the second component produces improvement-oriented knowledge.

2.2. The logic of justification in DSR

In explanatory research on the present (or past), justification is about truth, moving from question to answer using logical deduction: this is the research question, this is the research design, and its execution produced these answers. The explanatory validity of these answers is to be proven on the basis of the way outcomes have been obtained.

Logical deduction is possible, when dealing with what *is*, an attribute of explanatory research. Design-oriented research, however, makes a creative jump to what *can be*. A design, therefore, cannot logically be deduced from the problem it is to solve, nor from extant theory or from problem solution specifications.

The justification of a generic design concerns not truth but effectiveness. Justification in DSR goes from answer to question: this is our design (an answer to a design problem), this is how we have tested it in various contexts, and this is how the design solves the problem or satisfies given specifications. The validity of a generic design is, unlike an explanation, not justified on the basis of how it has been made but by proving that it "works."

2.3. Research strategies sharing characteristics with DSR

There are other well-known research strategies, used in OM-research, that share several characteristics with DSR for the social domain. One of them is Action Research (see e.g. Eden and Huxham, 1996; Reason and Bradbury, 2001; Nair et al., 2011; Netland et al., 2015). We must, however, note important differences, mainly that most action research projects aim for case-specific improvements. DSR, by contrast, seeks to develop generic knowledge to support organizational improvement actions.

Another strategy similar to DSR is evaluation research (see e.g. Powell, 2006). This stream is important for DSR because of its contributions to field testing approaches. However, evaluation research normally tests the effectiveness of a given system or process, while field testing in DSR also has a crucial function in optimizing and generalizing a design. For DSR the book *Realistic*

Please cite this article in press as: van Aken, J., et al., Conducting and publishing design science research, Journal of Operations Management (2016), http://dx.doi.org/10.1016/j.jom.2016.06.004