Towards Developing a Framework for Conducting Management Studies Using Design Research Methodology

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Abstract
Following trends are not limited to the fashion and beauty industry. Many researchers in papers, master’s degree thesis, and PhD dissertations prefer to solve domain questions or problems with research methodologies previously used by others in the field, mainly, case study research in operations management and technology management studies. This paper is about to stress on adding design research methodology (DRM) as a very useful and practical methodology in management studies that can meet the main aim and concern facing researchers in management studies: produce and develop practical domain knowledge which meets the rigor and relevance functions of the research. This study unlocks all the aspects of DRM and represents a methodological perspective, and sheds light on the reasoning behind why and how DRM should be used more as a methodology in management studies in general, and operations and technology management specifically.

Keywords
Research methodology, Design science research, Design research methodology

Introduction

“From the design perspective, organizations are at the same time artifacts, created under the influence of design-oriented human actions, and natural systems, developing under the influence of interactions and the self-organization and self-control of their stakeholders. In this respect, an organization can be compared with a garden, as artifact created through the designs and hard work of the gardener and as natural system developing under the influence of the sun, rain, soil, conditions, etc. (Van Aken, 2004).”

Higher education students and some specialized research domains face a limitation in picking the right research strategy. Broadening the portfolio of research methods and the adequate catheterization and implementation of these procedures have become common concerns in fields such as management (Dresch et al., 2015a). Let’s start the discussion with this question: what is academic research? What is the goal of conducting research? And what exactly is a good research paper? The nature of research is to create valid results/answers to the research goals/questions which are aligned with the scientific background of the research subject and research methodology’s steps and have two general orientations: practice- orientation and theory- orientation. Here, the question is despite having different theory- oriented research methods, why certain research domains are dominated by one or two research methods? In the previous research done by (Ebneyamini & Sadeghi Moghadam, 2018) case study is the dominant strategy in the management of technology (Technovation more than 68 papers, R&D Management more than 189 papers, Research Policy more than 162 papers). Using the same search strategy for design research methodology (DRM) results only in seven papers (one in Technovation journal, one in Research Policy, and five in R&D Management) thus, based on conducting a comprehensive literature review and researcher’s recommendations this...
research strategy needs to receive more attention (Dresch et al., 2015; Offermann et al., 2009; Romme, 2003; Van Aken & Romme, 2009). DRM can be used both for practice-oriented and theory-oriented research goals and supports both qualitative and quantitative studies. Using DRM leads to more relevant and interesting research questions, aiming at understanding, as well as solution design (Van Aken & Romme, 2009). The main goal of this research strategy is to produce results that can solve a class of problems in a specific domain of study (Dresch et al., 2015). By considering the research environment and reviewing the related knowledge base, DRM can give us the most appropriate and practical solution/result that the researcher needs. On the one hand, what DRM does is broader than action research because it can solve not only firm-level problems but also a class of problems in a specific domain. On the other hand, what case study does is study the phenomena in its environment and map the results based on the researcher’s observations and experience (Ebneyamini & Sadeghi Moghadam, 2018) but, besides studying the environment of the problem, DRM reviews the existing knowledge base related to the subject of the study, leading to theory-building/extension. A good study in management has to bridge the theory to practice or vice versa. Evidence-based management (EBM) is becoming increasingly popular in organization and management studies (Van Aken and Romme, 2009), DRM can contribute to these concerns. As for operations and technology management, based on Venable (2006), design science is an inventive or creative, problem-solving activity, one in which new technologies are the primary products thus, design paradigm and DRM (research strategy) seems to best fit the studies in this domain as well as case study research which is the dominant methodology. Adding Romme (2003) quote to highlight my reasoning in writing this article:

“Organization studies need design science to produce knowledge and conduct studies.”

**Background**

Considering design science as a research paradigm and DRM as a research methodology is heavily based on the researcher’s efforts to add a new strategy to the existing research method portfolio. In this section, as an important part of the background of this study, I want to introduce some of the main researchers and their important contributions to different aspects of design science research. Design science as a new approach in research first, introduced by Simon (1996) in his seminal “the sciences of artificial”. He defined the main differences between natural science and design science and highlighted the design science coverage in areas such as engineering and management besides medicine in his further studies (Simon, 1996). Other researchers in this field who contributed to the design science as a standalone research paradigm and structure a clear methodological perspective for researchers in different fields are as follows:

The epic effort of John R. Van Aken to distinguish and bring back attention to three categories of scientific disciplines: formal sciences, explanatory science, and design science is fascinating as it helps researchers establish a certain place for considering design science as a specific discipline and scientific paradigm. This gives the researcher a possible option to choose DRM as a research strategy if the research goal supports the design paradigm.

“The relevance problem of academic management research can be mitigated if one would create space for management theory research, based on the paradigm of the design science s next to more traditional organization theory research, based on the paradigm of explanatory sciences (Van Aken & Romme, 2009)”

George Romme and Van Aken’s significant effort on adding design science to the repertoire of organization and management studies in a shared paper, encourage researchers in the management field to consider and use DRM as a research strategy. Using DRM in organization and management research solves the relevance problem in management studies as well.

“The actor perspective and solution-oriented of design science research (DSR) can mitigate the relevance problem of organization and management studies by producing knowledge that is geared toward designing solutions for the field (Van Aken and Romme, 2009).”

The unique effort of Venable (2006) stresses on the theory building and theorizing aspect of DRM which is a significant goal of many research papers and thesis and discussed this goal of DSR in detail.

“DSR must not leave theory and theorizing to the natural and social (empirical) sciences (Venable, 2006).”

Last but not least, my main inspiration in writing this article and the savior of my PhD thesis, “design science research” book written by Aline Dresch, Daniel Pachero Lacerda, and Jose Antonio Valle Antunes. Their significant contribution to design science and introducing 12 steps required in applying DRM deserves the appreciation of researchers having designing goals in mind.

“This book structures how a rigorous research is done within a design science, particularly in those that are identified with broader field of management, where this approach is not yet widely accepted (Dresch et al., 2015a).”

All these great efforts and many more that I haven’t mentioned based on the goal of this paper lead us to a very useful yet not widely known research strategy Design Science Research (DRM). I still find room in introducing and discussing this methodology more especially, in operations and
technology management. Witnessing top knot journals ignoring papers that fell on the qualitative side, ignore the use of DRM, and still, value quantitative side makes me wonder why? Maybe it’s up to us to value the qualitative methods to contribute more to theory building as Venable (2006) accurately points out that theories are practical because they allow knowledge to be accumulated systematically and this accumulated knowledge enlightens professional practice. Thus, nothing is more practical than a good theory (Lewin, 1945). In this paper, aligned with the framework I recommended for conducting case study research before, besides introducing DRM and its functions, I tried to introduce a practical framework for DRM which makes it easier for researchers to use this methodology more informed, tractable, and effortlessly.

The Purpose of Design Research Methodology

The purpose of research using DRM is to achieve a satisfactory outcome for the context in which the problem is found (Dresch et al., 2015). DRM is a prescriptive method thus, by designing (prescribing) an artifact in the form of a solution, model, and construct… the researcher overcomes the problem/goal of the study which leads to solving a class of problems as well. It is important to have in mind that design science is an inventive or creative problem-solving activity, one in which new technologies are primary products (Venable, 2006). The actor perspective and solution-orientation of design science research can lead to more relevant research output and this output lead to more relevant and interesting research questions, aiming at understanding as well as solution design (Van Aken & Romme, 2009).

When to Use Design Research Methodology

According to Van Aken (2004), some studies have other objectives rather than explore, describe or explain, they prescribe solutions and methods to solve a problem or even design a new artifact. As mentioned before, DRM is a prescriptive research methodology, aiming to develop/design artifacts to solve a class of problems other than a specific one in a certain knowledge domain. Thus, DSR helps researchers to add a “solution-based” methodology to their method portfolio. Plus, According to Venable (2006), theory and theorizing are a part of design science research, and theorizing and theory building occur before, during, throughout, and at the end and as a result of design science research. Additionally, Van Aken (2009) discusses one of the most important issues/problems in management research which is the relevance problem. He correctly refers to the prescription-driven research⁵, based on the paradigm of the design science to mitigate the relevance problem as well as other functions of using DRM as a research method.

Why Using Design Research Methodology

As Dresch and his colleagues (2015b) mention, to decide on the suitable research method for each investigation, the researcher should consider some aspects, such as its contribution to addressing the research problem, legitimacy in the scientific community; and systematic procedures to be followed in conducting research. In management studies, design science research extends the body of knowledge on organizations as artifacts (Van Aken & Romme, 2009). To borrow Gregor and Hevner’s (2013) DSR knowledge contribution framework here, this methodology leads to four types of knowledge creation: routine design, exaptation, improvement, and invention. Meaning that despite the ignorance qualitative methods receive, they make a significant contribution to the theory and knowledge creation.

Types of Design Research Methodology

Case study has two types: single case study and multiple case study (Ebneyamini & Sadeghi Moghadam, 2018). In the case of DRM, as the main objective is to develop artifacts that enable satisfactory solutions to practical problems (Dresch et al., 2015b) thus, we may divide them into two types: qualitative design research and quantitative design research⁶. In addition, design science research has the following characteristics: research questions are driven by field problems, there is an emphasis on solution-oriented knowledge, linking interventions or systems to outcomes, as the key to solving field problems, and the justification of research products is largely based on pragmatic validity (Van Aken & Romme, 2009).

Paradigm

Van Aken (2005) believes that the nature of this type of research is pragmatic and solution-oriented. As mentioned before, the paradigm of DRM is design science (Van Aken, 2004) or the science of design (Simon, 1996). DSR is a method based on the design science paradigm, a science that deals with the design of new systems or the solution of real and relevant problems (Dresch et al., 2015b).

Rigor and Relevance Issues

I couldn’t agree more with my fellow researchers in this field that what matters in management studies is the “rigor and relevance” function of the research (Dresch et al., 2015a; Van Aken, 2004, 2005; Van Aken & Romme, 2009) rather than “validity and reliability” issues which are more common. What validity is, can be found in the rigor of the study. When a researcher chooses the research method based on the goal of the study if the requirements and steps are followed carefully by the researcher why an invalid result has to occur? As is mentioned in Dresch et al., (2015a), validity can be
characterized as a set of procedures that are used to ensure that the research conclusions can safely asserted. The relevance issue also is hidden in the introduction section of the study meaning that if the research goal is defined well, the question of the study is based on the goal and the subject is a brief statement of the goal and question, the reviewer can decide on whether the subject is relevant to the domain enough or not. According to Van Aken and Romme (2009), the author perspective and solution-orientation of DSR can lead to more relevant research output. Parameters to assess the rigor of using DRM has 5 phases (Dresch et al., 2015a: 1) research problem must be relevant; 2) research products (artifact) must present solutions for real problems, the solutions developed must be satisfactory for the problem under study and the solutions must be presented as a design or prescription; 3) evaluation of the artifact: the artifact must be evaluated using adequate technique and tools; 4) generalization of solutions: the solutions must be generalized to a class of problems; 5) rigor in conducting the method: all the steps of the method (12 steps) must be performed and the researcher’s activities must be documented in the research protocol.

Methodological Issues
As this paper aims at developing a comprehensive framework for students and researchers to use when facing research with design epistemology, in this section previous methodologies or frameworks are discussed to highlight the reason why the author represents a more practical and comprehensive one for management studies particularly, technology and operations management. According to Van Aken & Romme (2009), design knowledge is built up through the reflective cycle: choosing a case, planning and implementing interventions (based on the problem-solving cycle), reflecting on the results, and developing design knowledge to be tested and refined in subsequent cases. In 2009, Blessing and Chakrabarti claimed that for the first time, the DRM methodology and associated methods and guidelines in its entirety in their book “DRM, a design research methodology”. They divided the research into four main stages: Research Clarification (RC), Descriptive Study I (DS-I), Prescriptive Study (PS), Descriptive Study II (DS-II) which, in my opinion, is a very accurate analysis of how research has to be structured when conducting research with DRM. They aimed to help engineering and industrial design research to become more relevant, effective, and efficient (Blessing & Chakrabarti, 2009). Offermann et al. (2009) tried to present a framework for researchers in the information system field to use DRM more easily and accurately. Reviewing the research done in IS studies they presented four stages: analysis, projection, synthesis, and communication. Later in a very comprehensive and accurate way, Dresch and his colleagues (2015) presented 12 stages for management students and researchers to follow while using DRM. This is based on reviewing more than 10 research processes used by previous researchers.

The above stages/frameworks can be combined and presented in a more practical yet comprehensive framework that a researcher/student can use as a checklist also, and make sure the research is on the right track. The aim of presenting a new framework, in line with my previous framework for CSR, is knowing that DRM is like other research methods, nothing so special to limit its use and function. Having creativity in picking the appropriate research method is the key to getting the best results in our research. There is no reason for students to worry about using this methodology. Using different research methods/normalizing DRM helps qualitative research papers to gain more space in top journals and have a chance to be as popular as CSR or other traditional methods. This goal is presented in the framework section.

Framework
In line with my previous study on case study research, this paper aims at presenting a framework for conducting research using design research methodology. The framework (Table 1) acts as a checklist, step by step requirements for researchers to confidently see if their research fits DRM, then it helps with fulfilling the rest of the research based on the logic and requirements of DRM. The main considerations and steps necessary for using DRM are as follows:

1. Epistemological considerations:

As mentioned before, like other research methods, using DRM has to fit in the research goal and questions. In this step, the researcher has to justify the reason to use DRM based on the epistemology and paradigm of the study.

2. The purpose of using DRM:

In this step, the researcher defines the aim of using DRM: theory-oriented study or practice-oriented research.

3. Defining the artifact

“It is expected that the research in the field of management might not only explore, describe, and explain a given phenomenon but also study the design and creation of artifacts. These artifacts, in turn, may be described as: artificial objects that may be characterized in terms of goals, functions, constructs, models, method instantiations and adaptions that are normally discussed, particularly when being conceived, both in imperative and descriptive terms (Dresch et al., 2015).”

The above quote describes this step. In other words, when the researchers start researching with DRM, step 2 defines the general purpose of the study but, this step has to set the specific goal of the research whether, it is developing and creating an artifact (model, construct…) or theory-building/extensions.

4. How to design the artifact/theories (design phase)
Figure 1 illustrates the DRM in the best and most simple way in my opinion: in the designing phase, the researcher starts to design the artifact which was defined in the last stage. Imagine a luxury clothes designer. When she/he wants to start designing a piece, she has a big picture in her mind (artifact) how it’s going to be… but first, she needs to know if her design is original and new enough to have a competitive advantage and be sold so, she has to know the previous designs, searches for the best-sellers models/products of the brand, be aware of the competitors to see if her artifact (a physical one in this case) is not similar to them or can compete with their designs. Also, she has to be aware of her design to fit the season (environment), depending on the design and the clothes model… the researcher is the same when designing an artifact: first, he/she has to search the previous knowledge base to completely be aware of the existing knowledge then, based on the information gathered from the environment that the artifact is being designed for (an industry/organization/firm) as well. This comprehensive searching process builds a firm foundation that leads to the best design of the artifact.

5. Rigor and relevance issues

In using DRM as it is shown in Figure 1, there are multiple ways to support the rigor of the study (Hevner et al., 2004): observational, analytical, experimental, testing (physical artifact), descriptive. The goal of the study and the need for designing an artifact that has to be justified in the introduction of academic research supports the relevance factor of the study.

6. Getting feedback and report

This stage depends on the nature of the artifact like the evaluation stage (previous stage). If we develop a physical artifact that is designed for an organization/firm, it can be tested in the environment and receive feedback and modify. In the case of theory, the researcher can present the results to a focus group and get feedback then, prepare the paper for expert journals. In each case, what matters is that because since the foundations of design are based on gathering data from the research context (knowledge base and environment), the artifact has a rigorous base of validity.

Results

It seems like an unwritten law of “follow the leader” is dominating the research papers and books in specific fields. As an example, most of the research papers, master’s thesis, and PhD dissertations in technology and operations management used case study research (CSR) as a dominant research methodology as if there is no other method that can give us the expected rigor and relevance. Although CSR is a very well-known and practical research method, other research methods can be perfect for the researcher to use with both practice-oriented and theory-oriented goals. DRM is a useful, comprehensive yet unknown methodology that can lead us to the best results if applied correctly in the research with design goals.

Besides introducing design science as a paradigm and design science research (DSR) as research based on design science logic, this paper fully went through design science as a methodology and emphasized the methodological perspective of DSR. This study aims at helping researchers to know more about DSR and give them an extra option in attaining their research goals with a broader research method portfolio and presents a practical framework to use DRM which can lead to achieving the best results.

Discussion

Methodology-wise, this research and the framework are based on a meta-synthesis method. Searching for books/articles on design science research/design science/design science methodology using the web of science platform, with the methodological perspective/methodology as inclusion criteria. The emphasis of
the author is developing a practical framework in line with other research methodologies to stress on DRM as a research methodology like other methods, that’s why the framework is in line with the CSR framework previously presented. Researchers/students/teachers can consider DRM like other traditional ones, not being afraid of adding this methodology to the research methods portfolio and using it when it fits the research. As the framework is a result/sum of previous studies, the author refused to add a practical case on its usage. Framework/stages represented by Blessing and Chakrabarti (2009) is based on:

"It involved creation, evaluation, and improvement of various specific methods through our own research projects and those of our Masters and Ph.D. students, the analysis of a large number of research projects in design, and the feedback from those outside our research groups."

Offermann et al. (2009) reviewed research papers which used DSR in the information system field and presented a step by step process. Dresch et al., (2015a) reviewed nearly 126 research done in design science field (based on the references of the book). All these frameworks/stages overlap and have similarities but, the practical factor and serving DRM as a common method and, presenting a framework in line with other methodologies is done in current essay specifically, aiming at the ability of DRM in theory-building which is useful for higher-education studies.

Table 1. Framework (source: Author).

| Epistemological considerations | Purpose of the study | Definition of the artifact | Design phase | Rigor and relevance | Feedback and report |
|--------------------------------|----------------------|-----------------------------|--------------|---------------------|-------------------|
| -Traditional research methods can't meet the research goals (Dresch et al., 2015) | -Theory-oriented studies (Dresch et al., 2015; Venable, 2006) | -Model | 1- Identifying the artifact’s environment and gathering relevant data to meet the environmental requirements, and assist in designing the artifact | -Designing an artifact that best suits its environment and has the latest domain-knowledge relevancy in design that can meet/answer the research goals and questions | -Publications in journals, trade magazines, seminars, conferences |
| -Design science paradigm best fits the research goal and domain (Van Aken, 2004; Van Aken & Romme, 2009) | -Qualitative research (Dresch et al., 2015) | -Construct | 2- Comprehensive search through and gather the domain knowledge from the related knowledge base (Dresch et al., 2015; Hevner et al., 2004) | -The artifact has to solve a class of problems in its domain (Van Aken, 2004) | -Reaching out experts in the artifact’s environment to approve the artifact |
| -Practice-oriented study | -Theory | | | | -Application in the target environment get feedback and modify if needed (mainly physical artifacts) (Dresch et al., 2015) |
| -Quantitative research (Dresch et al., 2015) | -Physical artifact | | | | |
| -Developing solutions in management field which considers relevance and rigor of a study (Gregor and Hevner's, 2013; Romme, 2003; Van Aken, 2004) | -Function (New/Modified) | | | | |
| -Methods | | | | | |
| -Instantiations | | | | | |
| -Adaptions (Dresch et al., 2015) | | | | | |
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Notes
1. When using “domain” in this paper, the author refers to the research domain in which the research is done.
2. Authors went through three popular journals in the management of technology, based on their ranking using Scimago which are: Research Policy, R&D Management and, Technovation, to see if the case study is used as a dominant strategy in the field or not. They used Google scholars advanced search, searched in all of the words “case study research” anywhere in the article between 2005 and 2015. The results show a wide use of case study as a methodology in the management of technology and innovation field (Technovation more than 68 papers, R&D Management more than 189 papers, Research Policy more than 162 papers).
3. Google scholar advanced search, with the exact phrase (as using all the words especially “design” shows irrelevant results), return articles published in Technovation, Research policy, and R&D management, Return articles between 2000 and 2021 (broader timeline).
4. I prefer to use DRM (design research methodology) to use DSR (design science research), widely used by the researchers in this field, when discussing about a research using design science paradigm. The reason is stressing on the methodology which leads the research to the results not the research on its own. This is in line with the Blessing and Chakrabarti (2009) book with the title “DRM, a design science methodology”.
5. Prescription-driven research is solution-focused, rather the problem-focused and, as said, it takes the perspective of the player rather than the observer (role of the researcher) (Van Aken and Romme, 2009).
6. Besides the nature of the research goal/questions of the study (in some cases), data analysis method used in designing the artifact defines the type of the study.
7. Following the framework supports the rigor factor of the research.
8. Relating to the theory of knowledge, especially with regard to its methods, validity, and scope, and the distinction between justified belief and opinion.
9. Theories are practical because they allow knowledge to be accumulated in a systematic manner and this accumulated knowledge enlightens professional practice (Venable, 2006).
10. The artifact meets the main functions of an academic research which are: rigor and relevance (Dresch et al., 2015a).
11. The ultimate mission is to develop design knowledge that can be used in designing solutions to problems in the field in question (Van Aken, 2004).
12. DRM creates/develops mode2 knowledge production (Van Aken, 2004).
13. Prescription-driven research is solution focused, rather than problem-focused and, as said, it takes perspective of the player, rather than the observer (Van Aken, 2004).

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