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A Framework

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Evaluation Risks in Design Science Research: A Framework

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Abstract

Many things can go wrong in Design Science Research (DSR). But if you can foresee potential problems then you can prevent or prepare for them; you can manage risks. In this paper we present a framework for identifying, assessing, prioritizing, and treating potential risks inherent to DSR. The framework developed identifies six potential risk areas and includes a scale designed to simplify quantification and prioritization of risks as well as measures to mitigate risks in DSR. Finally the paper applies the framework to an ongoing DSR case study.

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1. Introduction to Risk Management for DSR

Like most activities in life, conducting research has risks. As a relatively new area of research, Design Science Research (DSR) in the IS field is particularly prone to risk, because there is not yet much experience from in IS DSR which to learn. We have developed a framework for DSR researchers to improve their ability to manage risk in DSR.

A *risk* is a potential problem that would be detrimental to a DSR project's success should it materialize. This may lead to a design with wrong or inadequate operation, rework, implementation difficulty, delay or uncertainty (Boehm 1991) *Risk Management* is identification and response to potential problems with sufficient lead time to avoid a crisis. Thus Risk Management is proactive.

Systematic Risk Management generally involves four main activities. The first is identifying risk**:** An organized, thorough approach to seek out the real risks associated with the DSR project. The second is analyzing risk: This includes examination of identified risks to determine the probabilities of undesired events and the consequences associated with those events. The third is risk treatment: Deciding how to handle or minimize the identified risks. Finally, the fourth is monitoring risks: Tracking the status of and changes in risk (e.g. potential, occurred, and omitted).

2. Risk Identification in DSR

There are two main ways to identify risks. One is to gather a number of key stakeholders and brainstorm "What could go wrong in this DSR?". The second is to take a checklist of things that could go wrong or have gone wrong in other projects (i.e. potential risks) and ask one by one "Could this go wrong in this DSR project?". To do so, we make use of the process framework for DSR developed by Hevner et al (2004) and identify six areas of potential risk (A-F) herein.

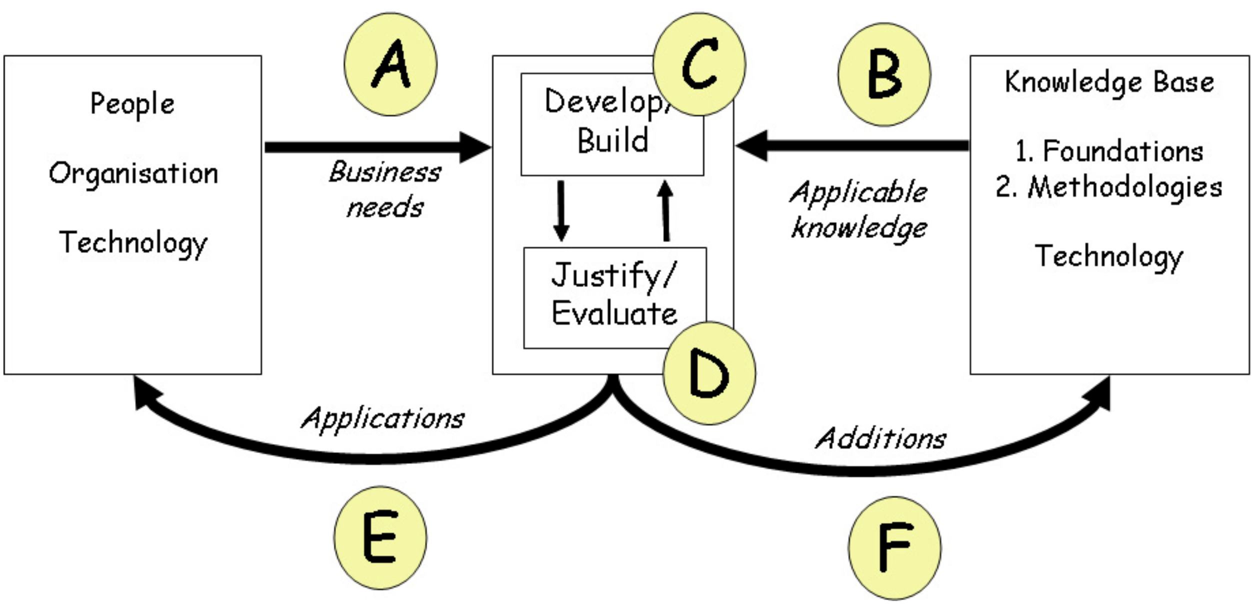

Figure 1. Process framework for Design Science Research (Hevner, et al. 2004)

A. Business Needs (Problem Analysis and Choice)

DSR is oriented toward problem solving (Simon 1996, Walls et al. 1992, March and Smith 1995, Hevner et al. 2004) to meet business needs. Developing one's understanding and formulating a definition of the problem to be solved are important. Here we found eight risk areas:

- A-1 Selection of a problem that lacks significance
- A-2 Difficulty getting information about the problem
- A-3 Different and even conflicting stakeholder interests
- A-4 Poor understanding of the problem to be solved
- A-5 Solving the wrong problem
- A-6 Poor/vague definition/statement of problem to be solved
- A-7 Inappropriate choice or definition of a problem according to a solution at hand
- A-8 Inappropriate formulation of the problem

B. Applicable Knowledge (Retrieved from the Body of Recorded Human Knowledge)

- B-1 Ignorance or lack of knowledge of existing research relevant to the problem understanding
- B-2 Ignorance or lack of knowledge of existing design science research into solution technologies for solving the problem

C. Develop/Build (Develop Theory/Knowledge and Build an Instantiation)

- C-1 Development of a conjectural (uninstantiated) solution which cannot be instantiated (built or made real)
- C-2 Development of a hypothetical (untried) solution which is ineffective in solving the problem
- C-3 Development of a hypothetical (untried) solution which is inefficient in solving the problem
- C-4 Development of a hypothetical (untried) solution which is inefficacious in solving the problem
- C-5 Development of a hypothetical (untried) solution which cannot be taught to or understood by those who are intended to use it
- C-6 Development of a hypothetical (untried) solution which is difficult or impossible to get adopted by those who are intended to use it
- C-7 Development of a hypothetical (untried) solution which causes new problems that make the outcomes of the solution more trouble than the original problem

D. Justify/Evaluate (Justify Theory/Knowledge and Evaluate an Instantiation)

The above risks of untried solutions may be reduced through justification (or possibly falsification) of an IS Design Theory (ISDT, Walls et al. 1992) and the evaluation of instantiations of the solution. However, evaluation itself carries risks of making errors, resulting in possible type I (false positive) or type II (false negative) errors (Baskerville et al. 2007).

E. Applications (of Knowledge to Business and Organisational Problem Situations)

Once a new solution has been published and promoted to the public, especially if it doesn't work well or at all, but also even if it actually can work effectively, there are a number of other risks:

- E-1 Implementation in practice of a solution does not work effectively, efficiently, and/or efficaciously

E-2 Misunderstanding the appropriate context for and limitations of the solution
E-3 Misunderstanding how to make use of (implement) the solution
E-4 Inappropriate handling of adoption, diffusion, and organisational change

F. Additions (to the Knowledge Base of Recorded Human Knowledge)

The risks in this area are primarily to the researcher, but also to others engaged in the publication process and even other researchers and eventually the public at large. Risks include:
F-1 Inability to publish or present research results
F-2 Publication of low significance research
F-3 Publication of incorrect research

3. Risk Assessment, treatment and monitoring

For each of the risks identified, the next task is to decide how serious a risk we are talking about. Thus we evaluate the *probability* of occurrence as well as the *consequences* if the risk should occur. This is done for each risk. For consequences a scale from "0" Ignorant, over "3" Important" to "5" Critical can be used. For probability "0" can mean highly unlikely, "3" is likely, and "5" is highly likely. The importance or priority of risks can be calculated by multiplying the consequence score by the probability score. Those risks with higher scores would then have higher priority and need to be managed more carefully.

Risk treatment falls into four major categories (Dorfman 1997, Jones and Ashenden 2005):

1. Avoidance – which means that you don't do something risky – thereby avoiding the risk.
2. Controlling – means that you do something to reduce or eliminate the risk
3. Self Insurance – a means of accepting the consequences of the risk by dedicating resources toward future risk occurrence
4. Transfer – could for example involve the purchasing of insurance thereby transferring the risk to someone else

Finally risk monitoring is about regular follow up and asking: Has anything changed in relation to risks. Fixed intervals between continued risk identification are recommended.

4. Evaluating Risks: A Case Study

SourceIT is a research project that received funding from the Ministry of Research, Technology and Innovation in December 2007. The total budget is the equivalent of 6 mio. US$ over 3 years. One University, one technology transfer organization, and three companies are participating in the project. The aim of SourceIT is to answer questions like:

- How can a company be innovative while at the same time optimizing sourcing?
- What are the pre-conditions for optimal sourcing in relation to innovative capability?

Sourcing is defined as both in- and out-sourcing, as well as decision about letting customer or client organisations develop part of the IT product. For example one of the participating companies develops an electronic patient journal system. One sourcing decision is how much of the system should be developed or adapted locally in the specific department at a hospital.

The SourceIT project is using a design science research approach to develop a method for sourcing decisions. The approach to be used is a so-called design nexus (Pries-Heje & Baskerville, 2008). It is foreseen that DSR needs to be combined with an action research approach thereby "covering a weakness in both research methods; namely that design science is extended with learning cycles characterising action research thereby ensuring better learning. And action research is extended with a formalised approach to how theory is made explicit; namely in the form of a design artefact" [translated from research application].

In January 2008 project participants from the SourceIT consortia (including and facilitated by one of the authors of this paper) carried out an evaluation using the six areas of potential risks in DSR as an inspiring starting point. A list of 14 risks was generated (see list below). For each risk, the risk area(s) (referring to Figure 1) and the specific potential risk(s) identified in Section 3 are given in parentheses after the risk:

1. It is impossible to define precisely the need for sourcing. (A-6)
2. The needs for sourcing are very different in the three participating companies. (A-3)
3. Managers have invested in existing sourcing decisions; will never admit problems. (A-2)
4. Hard to get access to organisations in India, to which two participants outsourced. (A-2)
5. Many diverse and conflicting problem descriptions in hospitals (A-3)
6. There is a vast (too much) literature and knowledge on sourcing. (B-1, B-2)
7. May be impossible to build design nexus due to lack of information. (B-1, B-2, and C-1)
8. May be impossible to build design nexus because the design problem is not wicked (C-1)
9. Evaluation criteria not obvious for choosing sourcing method. (A-2, A-3, and D-C)
10. Very difficult for all stakeholders to be involved in evaluation (D-1b, D-C, and D-I)
11. Will take considerable time before effects of using sourcing nexus can be seen (D-C, E-1)
12. Difficult to decide how to evaluate whether the sourcing problem is solved (D-C and E-1)
13. There is no guarantee that new knowledge will be obtained. (F-1)
14. The companies participating in SourceIT are not interested in publishing results. (F-1)

The research manager for SourceIT then used the scales from 0 to 5 to evaluate the consequences and probability for each of the risks in the list above. Then consequence and probability ratings were multiplied; the top five risks in the list above are shown below:

Risk #	Consequence	Probability	Treatment
14	4	3	Control: Make sure that contract for SourceIT gives researchers the right to publish – eventually anonymous
13	5	2	Self-insure: Use pilots and prototypes so it becomes clear very fast what the contribution could be
3	3	3	Control and transfer: Use many diverse problem identification techniques such as document study, observe sourcing-at-work, interview at many levels, etc.
11	2	4	Avoidance. Study effect only in projects that ends within second year of SourceIT project; leaving a full year to study long-term effects.
7	4	2	Control: Place considerable effort in literature study very early

The research manager of SourceIt believes this list of activities to avoid or control risks is extremely valuable. "It is highly likely that this will make the difference between success and failure in the project", he states. Whether that is going to be the case will be seen in the future.

5. Conclusion

The Risk Management Framework for DSR provides a means for understanding and explaining risks in design science research. As illustrated by the case above, the framework can be further used to illuminate risks and thereby lead to extremely valuable treatments that permit practitioners to avoid or control risks.

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