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ORIGINAL ARTICLE

The need for systems development capability in design science research: enabling researcher-systems developer collaboration

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Abstract Information systems as an artefact-oriented discipline require a strong interaction between researchers, developers and users regarding design of, development of, and the study of the use of digital artefacts in social settings. During recent years, performing research in a design science research spirit has gained increasing interest. In larger scale design research endeavours, access to systems development capabilities becomes necessary. Such a unit, InnovationLab, was established in 2006 in a university setting in Sweden. In this paper we are investigating the 5 years' experience of running this InnovationLab. Our findings point to an innovation lab being valuable for research in general and especially for design science research. However, in order to balance the business of an innovation lab, it will be necessary to provide services for other stakeholders (such as administrative units, teachers, and students) as a means for developing systems development capability aimed at supporting researchers.

Keywords Innovation · InnovationLab · Design science research

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1 Introduction

Even though researchers within ICT have primarily focused on generating theories from studying artefacts in use, there are several successful examples of researchers creating artefacts in an academic environment. Two prominent examples in contemporary IT artefact development are the search engine Google and the enterprise modelling approach, Architecture of Integrated Information Systems (ARIS), (Scheer 2000). Moreover, the decreasing time gap between research findings and market capitalisation has led to more intense collaboration between academia and corporations, e.g. through the emergence of science parks and innovation clusters. However, this collaborative trend in innovative systems development also requires coordination and reconciliation of different stakeholders and their respective agendas.

In the identity discourse of the information systems discipline, some distinct characteristics among different contemporary claims can be identified, such as striving to *do* things in *collaboration*, in the process of *designing* and *evaluating* IT-based *artefacts* (Lindgren et al. 2004). The design science research (DSR) paradigm (Hevner et al. 2004; March and Smith 1995) has lately had a large impact on the IS field, and qualitative action research-oriented ways of thinking receive increasing attention in the field of information systems research (Mathiassen 2002). Within DSR, a particular focus is put upon knowing through the design, construction, and evaluation of artefacts in close interaction with the environment (Purao 2002). We acknowledge the user orientation that is advocated in Design Science Research. However, in this paper, the primary focus is on how an organisational unit can be established for delivering design science research as a service. By exploring the usage of such IT-based artefacts in authentic settings, researchers would potentially expose previously unforeseen patterns of behaviour and indicate the utility of the designed artefact.

The result of such exploration is dependent on the ability of the researchers and other participating stakeholders to implement and continuously refine IT-artefacts. In larger research endeavours, we argue, it will thus be necessary to assign someone other than the design researcher(s) to address these tasks. Consequently, to successfully develop generalisable knowledge from such projects it will be necessary to establish close collaboration practices and sufficient infrastructure between the design researcher(s) and the system developers involved, as well as other stakeholders (Hjalmarsson et al. 2010).

On the other hand, as a design researcher, in order to be able to carefully study the evolvement of innovative digital solutions (Hevner et al. 2004), there is also a need for a more controlled setting for such tasks. Many times such processes need to be performed in laboratory-like environments, while still meeting the demands of stakeholder involvement and mimicking a similar use situation as in reality. The main challenge for these types of innovative projects is to create a working model for a team of people, ranging from concept builders to high-tech specialists, integrators and evaluators (McKenney et al. 1995).

One potential environment for such design science research artefact development is within academia. One way of meeting the challenges of enabling close

collaboration between design science researchers and systems developers would be to establish a systems development unit for supporting this type of research. Such a unit, called InnovationLab,[1] was established at a Swedish university in 2006. In this paper, we will elaborate on the experiences and insights gained from establishing such a unit. The main focus of this paper is to investigate why and how an innovation lab could support the core business of academia by being a part of academia. By 'supporting core business' we especially mean supporting research, but also administrative tasks, as well as being a support for preparing students for the future. The problem space addressed by an innovation lab is a novel phenomenon where little research exists. The research question being explored in this paper is: *what are the necessary characteristics for an innovation lab to efficiently support multi-stakeholder DSR?* This introductory section is followed by a description of the founding idea of InnovationLab. Next, we present relevant theory for the study, followed by a discussion of the research approach. After presenting our findings we show the conclusions drawn in this study.

2 The idea of innovationlab in academia

InnovationLab combines research, business entrepreneurship, process development, systems development and management into one laboratory, serving system development needs within industrial and academic computing collaborative endeavours. InnovationLab is a tailored "living lab" for the general ICT sector and is an extension of the traditional "living labs" concept. Living Labs represent a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts (Eriksson et al. 2005). In addition to the tailored living lab concept, InnovationLab also transfers research results into software applications for validating purposes, into a pilot-stage for multi-user testing, into a prototype or demonstrator, or into full production, depending on the situation and the requirements. Therefore InnovationLab is able to support researchers, students and industry in various fields and sectors and is thus not limited to a few specific research disciplines within the ICT sector.

The main purpose of InnovationLab is to provide researchers and research groups with the environment, tools and know-how to produce artefacts in support of their research. The purpose is also to assist its clients in the process of inventing new and useful ideas, products, services, processes, etc., in collaboration with students, researchers and industry, and apply them in practice.

InnovationLab today consists of eight employees. The head of the unit has a background in the industry and from the academy, while the co-workers mainly have a background in software development. The main competences of the employees are programming skills, project management and research methods. The employees are also knowledgeable in technical infrastructures and architecture.

[1] We are using the term "InnovationLab" when we are specifically referring to the lab we have studied, and we are using the term "innovation lab" as a general term.

Recently, three PhD students have been employed to further reduce the gap between research, design and development. As doctorates, these employees are pursuing their PhD using InnovationLab projects as their PhD projects.

Originally, the idea was that InnovationLab should support research groups in the construction of innovative artefacts, but also be able to manage research projects independently. Further, through its strong relation to the industry, InnovationLab would support researchers in putting their research into practice. Over the years, this aim has broadened. In addition to these research-supporting activities, InnovationLab is currently also supporting teachers and the administrative unit within the university with systems development services. Finally, InnovationLab supports students with access to empirical data from its projects. As in many new organisations, the assignment from the board of the university was somewhat ambiguous in its initial formulation. However, these rather vague formulations were considered a strength, since they provided a flexibility that initially was necessary. Through this paper we make a stronger stance towards the role that an innovation lab could have in an academic setting.

During the 6 years that have passed since its establishment, InnovationLab has engaged with many clients and other groups. Primarily such stakeholders have been researchers, administrators and students. Moreover, there has also been cooperation with teachers, policy makers, business developers, systems developers, companies and system designers. From a research perspective, the basic idea of starting InnovationLab was to gain access to professional technical support to enable the implementation of research ideas. Another founding idea, compared to a traditional IT-firm, is that InnovationLab should possess more organisational knowledge about the academy and design-related research methods. Examples of support that researchers may ask for are: development of a demonstrator for a research result, development of an architectural design, or development of a fully operational IT-system.

3 Innovation and design

One of the core concepts in this study is *innovation*. An innovation is not necessarily a physical object. An innovation can be a new thought, a new service or a new way to proceed. The key word is "new" and the concept 'innovation' means renewal. According to the European Union (2004), there are three different types of innovation: process, product and organisation. Process innovation means that a product or service could be produced with fewer resources. Product innovation concerns improvements of an existing product or the development of a new product. Organisational innovation refers to new forms of organisations. Schumpeter (1934) defined innovation as: ''The introduction of new goods […], new methods of production […], the opening of new markets […], the conquest of new sources of supply […] and the carrying out of a new organization of any industry.'' We perceive the establishment of InnovationLab as an organisational innovation, since it constitutes a completely new type of unit which creates value (OECD 1996) for researchers and other parties.

A second important concept is *design,* since the main task, according to the original ideas, is to design innovative artefacts. In recent years, framing systems development as design has aroused great interest within the community of information systems research. Although different streams of such research exist (Carlsson 2007), the by far most cited design research approach is DSR (Hevner et al. 2004; March and Smith 1995). In DSR, knowledge about, and understanding of a problem domain and its corresponding artefact-based solutions are achieved through a scientifically grounded implementation and evaluation of artefacts (Hevner et al. 2004). Hence, in DSR, the *researcher-as-designer* is stressed. At the core of DSR thus lies the creation of artefacts solving so far unsolved problems. In DSR, the formulation and discovery of a problem typically precedes the construction of artefacts (Vaishnavi and Kuechler 2007), but it has been argued that the opposite also holds true (Nunamaker et al. 1991). Hence, it might be argued that the research problem and the artefact typically co-evolve over time. According to Purao (2002), this co-evolving process requires a sufficient infrastructure to effectively deal with these changes. InnovationLab, analysed in this study, is a good example of such a necessary infrastructure—as part of a multi-stakeholder DSR setting—especially when it comes to more large-scale DSR endeavours. InnovationLab has been involved in several IT projects aimed at designing and implementing different types of IT artefacts. Most artefacts are, as defined by Hevner et al. (2004), of the type *instance*, but also *constructs, methods* and *models* have been generated. An example of a research project within InnovationLab is the "e-Me"-project in which a research team, together with InnovationLab, were designing an electronic assistant (Albinsson et al. 2006). The aim of the artefact was to take care of "boring" things for users, like sorting out administrative issues, organising offers from vendors, organising schedules and more.

While the above holds true for any type of design activity, a demarcation criterion between design in general and DSR is that scientific rigour is applied in at least three ways: (1) the design should be theory-informed (kernel theories); (2) the researchers must be able to retrospectively exhibit the process in which they arrived at the final artefact; and (3) the utility of the artefact must be verified through a variety of scientific methods—ranging from simulations to case studies to field studies (Hevner et al. 2004). In DSR, the artefact may thus be viewed as a working hypothesis about the artefact and its environment, which is tested during the evaluation phase (Liedtka 2004). The resulting knowledge from this type of research could be the artefact itself, some design foundations or methodologies (Hevner et al. 2004).

Kuechler and Vaishnavi (2008) argue that DSR stems from an engineering perspective, where DSR researchers are primary designers and experts in the pioneering technology they create and test (typically within a controlled environment). However, as DSR is becoming more frequently used as a means in theory-informed intervention (Sein et al. 2011; Lindgren et al. 2004; Markus et al. 2002), the research must consequently recognise the social as well as the technical dimensions, during design and evaluation. With this broadened research focus, researchers in DSR projects may not be able to develop technical artefacts solely themselves, but rather will participate in a researcher-developer collaboration. Yet,

the DSR literature has to date paid insufficient attention to how to deal effectively with such collaboration settings (Hjalmarsson et al. 2010). Furthermore, a significant portion of contemporary research is collaborative and includes not only researchers but also actors from industry, non-profit organisations and public authorities. DSR is not an exception to this. Often different types of prototypes, demonstrators and toolkits are needed to demonstrate the research ideas (Paradiso 2004) in these collaborative settings.

As mentioned above, InnovationLab can be seen as an infrastructure supporting DSR. We argue that this type of organisation meets the requirements for conducting DSR in the type of collaborative multi-stakeholder environment described above. Our argument is based on the fact that the formulation of the problem co-evolves in close relation with the solution as a result of the interaction with the different stakeholders. Further, when DSR addresses research questions encompassing both technical and social aspects of artefacts, there is typically a need for systems development capability.

4 Research approach

In order to answer the research question, we have applied a qualitative approach. That is, we are primarily interested in explaining how an innovation lab can support academia. According to Kvale (1989) and Silverman (1970), a qualitative approach is preferable when the researcher is interested in a deeper understanding of a phenomenon. A possible bias in this paper is that one of the authors is the same person who took the initiative of forming InnovationLab. These multiple roles could reduce the credibility of this study. In order to eliminate biased perceptions, all the authors have separately interpreted the empirical data. The fact that one of the authors also took the initiative of forming InnovationLab has also been an asset. That is, we have had good access to data.

Our approach embraces two phases. The aim of the first phase was to understand the current situation (as-is-state) and the aim of the second phase was to suggest goals for a future situation (to-be-state). In the first phase, we have tried to understand the primary working tasks performed by InnovationLab today, and the stakeholders' perceptions of the current situation. Data have been collected from major assigners/clients of InnovationLab: managers, researchers, teachers, and representatives of the internal administrative unit. In this paper, we refer to these groups of clients as *voices*. Altogether 32 interviews have been conducted (see Table 1). All the interviews were recorded and transcribed. We have used semi-structured questions (Patton 1990) and the interviews can be characterised as being of a conversational character. Interview data from the four voices are presented in the section "Findings".

Data have been collected and analysed according to SWOT-analysis (e.g. Kotler 2006). That is, we have collected and categorised data according to strengths, weaknesses, opportunities and threats from all the voices mentioned above. The argument for choosing SWOT-analysis is that we wanted to illuminate the current state from different aspects of the current situation. We wanted to understand

Table 1 Distribution of interviews

Voice	Number of interviews	Roles
Managers	10	Head of University, Dean of Department of Computer Science and Business, University CFO, Vice Principal, three Directors of Study, Dean of Education and Research Support, Director of the University Library, University Administrative Manager, Director of Centre of Entrepreneurship, and the Director of InnovationLab
Researchers	14	Five full professors, three associate professors, three employees with a doctoral degree and three PhD candidates
Teachers	4	Four senior lecturers
Representatives of administrative unit	4	Two system owners and two persons who are responsible for system resources

strengths, weaknesses and opportunities, as well as threats, in order to support a broad understanding. We have used a text-based analysis and categorised our findings according these four categories.

In the second phase, we suggested goals for a future situation. First, we collected goals from each voice separately. These goals have been related to each other in terms of means and ends by using the goal diagram technique (Goldkuhl and Röstlinger 2005). Second, we used the SWOT-analysis and the goal diagrams to visualise the different opinions that exist among the different voices. These models could then serve as the basis for a discussion to reach a consensus about future goals.

In order to discuss different opinions and to reach a consensus, we have used a focus group. A focus group can be seen as a form of qualitative research (Denzin and Lincoln 1994). The group of people who are interacting are asked about their perceptions, opinions, beliefs and attitudes towards a particular topic. Focus groups are often used in order to obtain feedback about the studied phenomenon. The moderator of a focus group usually follows a discussion plan that has the questions, prompts, tasks, and exercises for the group (Greenbaum 1993). The participants are free to talk with other group members. The focus group for this paper consisted of representatives of all the voices mentioned above. Participants have been selected according to their knowledge about, and interest in, InnovationLab.

The aims of using a focus group were: (1) to spread knowledge about different opinions; (2) to refine and improve the analysis from the first phase; and (3) to suggest future goals. In the focus group meeting the output from the SWOT-analysis was presented, discussed and refined. This output served as a basis for suggesting goals. In using the two phases described above, our aim has been to "move" from "how it is" (as-is-state) to "how it should be" (to-be-state).

5 Findings

The findings in the first phase consist of results from a SWOT-analysis representing the four different voices (stakeholders). The voices represent a repertoire of

strengths, weaknesses, opportunities and threats. In order to present a reviewable description of the findings, we have limited it to an extract consisting of the most frequent opinions. The findings from the second phase consist of a comparison of the voices, a suggestion for future goals and the voices' perceptions in relation to DSR.

5.1 The voices of the managers

One of the foremost opinions brought forward by the managers was that hosting InnovationLab brings a certain status to the university. Managers also agreed that InnovationLab attracts talented national and international researchers, just as InnovationLab attracts students to the university. Another interesting point of a university hosting InnovationLab is that InnovationLab creates revenue by both developing and selling products, and by attracting students. Furthermore, the managers think InnovationLab increases the possibility for research projects to get funding. One of the managers claimed that InnovationLab should take advantage of the fact that it belongs to a university because it "…gets an established trademark of a university for free, which it should exploit when selling their services".

Many of the managers did not perceive any weaknesses in hosting InnovationLab at the university. One weakness mentioned was that "there is scepticism about InnovationLab within the university, mostly from the IT Department, which may perceive the new InnovationLab as a competitor". The managers believed that the presence of InnovationLab is already positive for the university, but that InnovationLab could bring additional value to the university through more intense training of students, and even more support being given to researchers. One recurrent threat mentioned is that InnovationLab may become too institutionalised and thereby become positioned too "far away" from the researchers, and consequently lose its attraction. Another threat is that no guaranteed long-term financing has been established (see Table 2).

The goals uttered by the managers are displayed in Fig. 1. As shown, the managers have a broad view of the goals of InnovationLab. The managers' perspective is an economical perspective and it seems that the managers primarily view InnovationLab as a business idea that can generate an income. The managers also view the future of InnovationLab from a larger point of view; they include both a researcher and a student perspective.

5.2 The voices of the researchers

Given the difficulties experienced connected to using the private sector for support in developing artefacts for research purposes, the interviewed researchers believed that the greatest strength of InnovationLab is that it is possible for them to turn somewhere for technical support and development capability. According to the researchers, a substantial weakness is that not all employees in InnovationLab have a solid research education. Just as in industry, InnovationLab often works under time pressure, which is why researchers believed that sometimes there is not enough time for employees to reflect upon their work and thus contribute to science.

Table 2 The voices of the managers

Strengths	Promotes the university
	The employees have an excellent knowledge about information systems development
	Attracts skilled researchers and students
	Makes it easier to get funded
Weaknesses	The employees at InnovationLab do not have sufficient time for doing research
	The dialogue between research leaders and the manager of InnovationLab about how to conduct innovative research projects could be improved
	There is some scepticism about InnovationLab within the organisation
Opportunities	Generate income through research funding
	Coordinate IT-related issues in the university
	Act as the official developer of new systems while the IT-department should work on the maintenance of existing systems
	Apply for own research funding
Threats	Research projects have weak funding for overhead costs
	The lab cannot entirely support research. Relations with other departments must be preserved, since there is a high variation in funding for research
	InnovationLab can be too institutionalised and by this reduce its innovation ability
	There is no long-termed financing

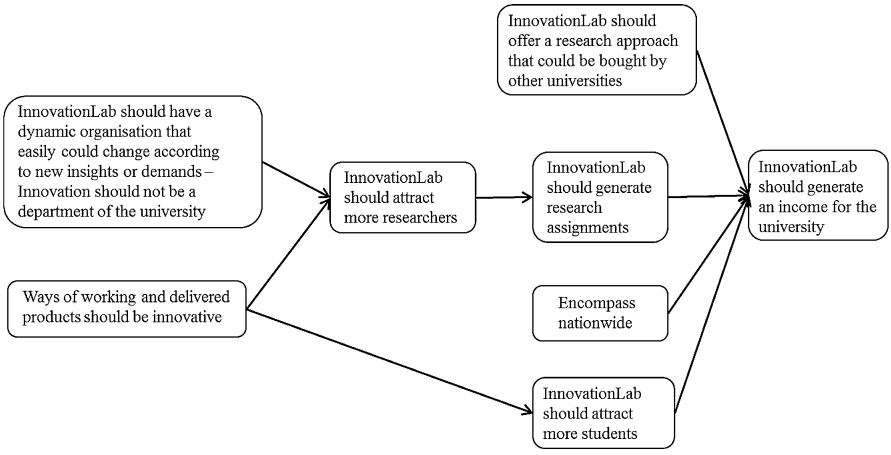

Fig. 1 Goals uttered by managers

Furthermore, some researchers perceived it as a weakness that InnovationLab charges for services. Another identified weakness/opportunity is that researchers would prefer that the staff in InnovationLab had a research education that would support the collaboration. One researcher stated "InnovationLab needs to have full support from the management of the university to be able to exist".

The researchers believed that many opportunities exist to further improve InnovationLab as an infrastructure supporting research, especially for design science research fundamentally requiring the realisation of artefacts.

Several researchers suggested that the InnovationLab in fact is a better supplier of research artefacts than profit-making companies. One researcher illustrated this by stating "Research projects are hazardous for profit-making companies, since they have to estimate the time and resources needed. Sometimes they also suffer from high requirement specifications. Thus, the companies have to compensate for the risk and consequently increase the price for their service. This means that we cannot realise the artefact—it will cost too much." InnovationLab is also offering an open environment where researchers and employees can come together to test new ideas. There was a great concern that InnovationLab may not be available when the researchers actually need it. The fear is that InnovationLab will be occupied with assignments from the administrative departments and thus have to prioritise tasks in a way that does not favour the research (see Table 3).

The goals uttered by the researchers are displayed in Fig. 2. As shown, the researchers suggest goals from a strict research process view. The researchers want InnovationLab to be an infrastructure that supports research projects in the development of artefacts. The researchers want to work closely together with the staff and thus they want the staff to be knowledgeable about research work. Moreover, the researchers also want InnovationLab to be proactive and suggest interesting new ideas for research projects.

5.3 The voices of the teachers

The teachers believed that the foremost benefit of InnovationLab is that it provides easy access to real empirical projects, for both students and teachers. Such projects can be both internal business development projects for the university, as well as research projects involving external parties. Furthermore, teachers believed that InnovationLab provides an opportunity for them, as InnovationLab generates many

Table 3 The voices of the researchers

Strengths	Can accept assignments at short notice
	Willing to accept "high-risk-projects"
Weaknesses	The role is unclear. Is the role to act as a supplier to research projects, or can the lab manage its own research projects?
	Not all the employees are educated researchers
	There is not sufficient time allocated for doing research
	The goals of InnovationLab are not clear
	InnovationLab charges for its services
Opportunities	The employees should be knowledgeable concerning the latest technology
	Solutions to problems should be of an innovative character
	Working procedures should be planned and conducted as research
	InnovationLab should be an open environment, free to use for employees who want to test or try out new "things"
	InnovationLab should market its services
Threats	InnovationLab will be occupied by internal administrative assignments
	There is a high variation in research funding over time

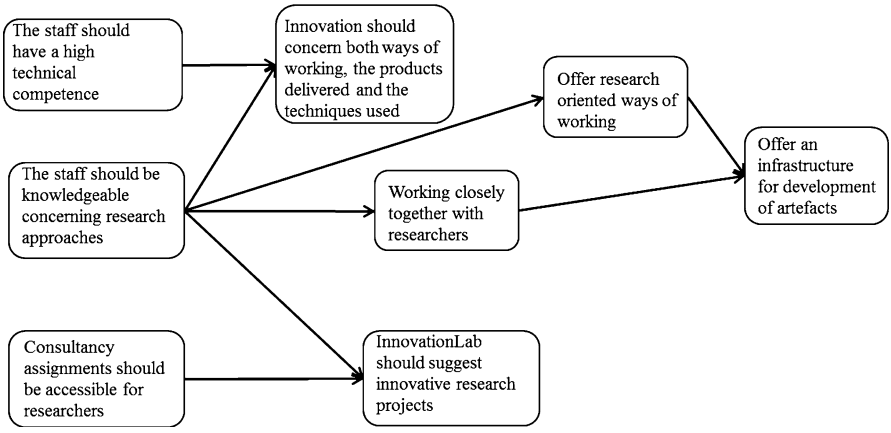

Fig. 2 Goals uttered by researchers

reports and essay topics for students. It is also a strength that the employees at InnovationLab have extensive technical skills. That is, they can act as co-educators in courses and teach modern programming techniques.

One voice of the teachers claimed that "InnovationLab does not see itself as part of the academy; it views the academy as a customer. InnovationLab should be more integrated into the academy concerning education, and it should provide good project data as examples to students". According to the teachers, the weakness with InnovationLab is that teachers, students and employees at the lab do not have a general model for cooperation. Today, there is a collaborative approach that is specific for each situation. Opportunities for the future are that InnovationLab works more closely with teachers in order to simplify and support information transfer to students. This transfer can consist of information concerning real empirical projects and methods, as well as technical knowledge. The primary threat identified is that there is a risk that InnovationLab fails to support this category because it spends more time fulfilling other stakeholders' interests (see Table 4).

The goals uttered by the teachers are displayed in Fig. 3. As shown, the teachers suggest goals from an educational perspective. The teachers want InnovationLab as a support for teaching. They want to use real industrial projects in order to exemplify theories; they want to use the staff at InnovationLab as experts in specific teaching areas; and they want InnovationLab to suggest ideas for thesis work.

5.4 The voices of the representatives of the administrative unit

The voices of the administrative unit had a positive experience of working with InnovationLab, both in terms of interpersonal skills as well as InnovationLab's capability to deliver results on time and with the right quality. According to the voices of the administrative unit this arises from the fact that InnovationLab has a great knowledge of the business of the university. One voice of the administrative unit claimed "There is no coordinator regarding existing and new IT-systems at our

Table 4 The voices of the teachers

Strengths	The external relations provide a link between education and the industry
	Easily accessible (located in the same building)
	The assignments conducted by InnovationLab can be part of Bachelor and Master topics
Weaknesses	Teachers and students don't know how to cooperate with InnovationLab
	InnovationLab is not sufficiently integrated into academic education
Opportunities	The relations to education should be tighter. Lessons learned from real life projects should be discussed in the classroom
	InnovationLab should be accessible for students who want to test, or try out, new "things"
	All on-going projects should be researchable for students
Threats	InnovationLab will be a unit entirely for serving researchers

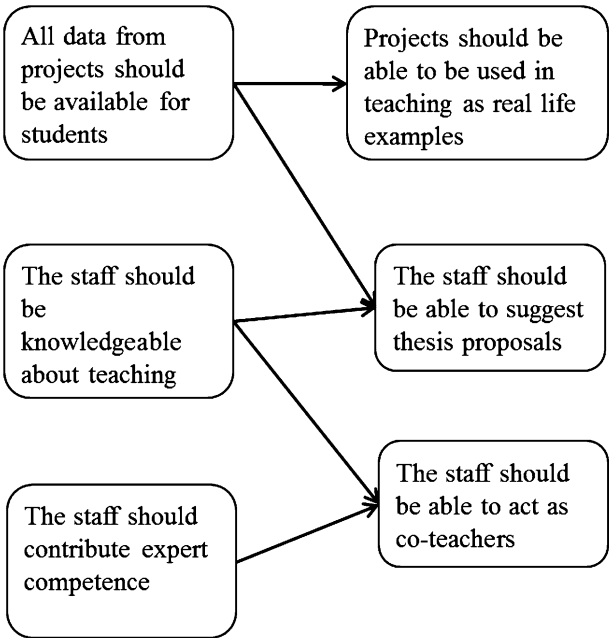

Fig. 3 Goals uttered by teachers

university. There's no one who knows the complete picture. InnovationLab could take on that role". One weakness that the administrative personnel acknowledged is that InnovationLab does not follow up projects in a way that companies in the private sector would do. They mean that InnovationLab is not trying to make additional sales by such means as proposing changes and being proactive. A potential threat would then be that the university chooses to shut down InnovationLab due to the belief that they might not see that great value which InnovationLab would contribute to the core business (see Table 5).

Table 5 The voices of the representatives of the administrative unit

Strengths	InnovationLab has knowledge about the university's organisation and procedures
	New knowledge generated from research is accessible
Weaknesses	InnovationLab is part of a bureaucratic organisation. Ineffective ways of decision-making
Opportunities	Become the natural choice for other departments who need IT-development support
	Establish a close relationship with the IT-department
	Provide business consulting through collaboration with researchers
Threats	The university is not willing to host InnovationLab

The goals uttered by the administrative unit are displayed in Fig. 4. As shown, the administrative unit suggests goals from an internal perspective. The administrative unit wants to have access to highly qualified technical staff who can develop information systems that support their needs and who are familiar with internal bureaucratic procedures. They also want InnovationLab to cooperate with the IT-department at the university.

5.5 Comparison of the voices and suggestions for future goals

The future goals are suggested from four different voices and consequently they represent a broad variety. Not surprisingly, the analysis reveals that each voice uttered strengths from their own perspective. It became clear that the managers applied a broader perspective on InnovationLab than the other voices (see Table 1). The managers perceive InnovationLab as: (1) a status symbol that promotes the university; (2) a strategic competitive advantage that will attract both researchers and students to the university; and (3) something that can generate an income. The researchers mainly perceive InnovationLab as a supporting infrastructure for the development of artefacts. That is, InnovationLab is seen as a means for achieving research goals. The voices of the teachers stress the importance of supporting education, such as the opportunity for using the competence of InnovationLab in the classroom and having access to real empirical projects. The voices from the administrative unit stress the importance of having access to developers with highly qualified technical skills, who are familiar with the bureaucratic procedures of the university. It is obvious the number of expressed goals is higher for the managers

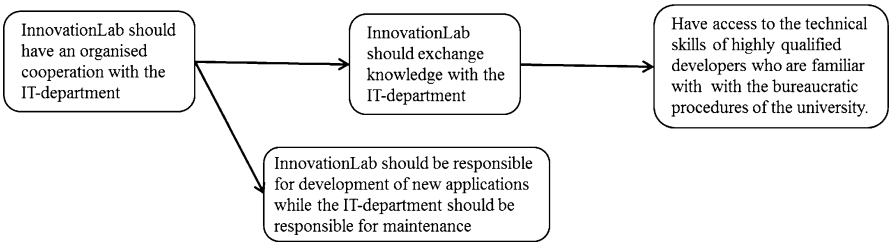

Fig. 4 Goals uttered by the administrative unit

Table 6 Comparison of goals

	Managers	Researchers	Teachers	Administrative unit
Economic/strategic goals	x	x	x	x
Supporting research	x	x		
Supporting education	x		x	
Internal infrastructure support		x	x	x

and researchers than for the teachers and the administrative unit. One explanation for this difference in quantity is probably that the managers and the researchers are able to see more possible benefits of how to utilise InnovationLab.

A closer comparison of the goals reveals that the voices mostly have uttered different goals, but there are also some similarities. All these goals can be summarised into four main categories: economic/strategic, supporting research, supporting education and internal infrastructure support. The aim of Table 6 is to present an overview of conflicting and non-conflicting viewpoints. The "x" represents a main category suggested by a voice.

Goals concerning 'economy/strategy' are suggested by all the voices. Minor similarities can be found among the voices but mostly the economic/strategic goals are different. The managers and the researchers express a similar opinion; they both recognise the importance of competitive advantages. Mainly the economic/strategic goals are different among the voices. One example is that the researchers stress the importance of the fact that InnovationLab can manage high-risk projects, while the administrative unit primarily views InnovationLab as a unit that can improve and manage a bureaucratic university organisation. Goals concerning 'supporting research' are also suggested by managers and researchers. However, these two voices bring up somewhat different goals. The managers stress the possibility of selling research support to other universities and the fact that InnovationLab will attract more research funding. The researchers mainly view InnovationLab as a means (infrastructure) for conducting research. Goals concerning 'supporting education' are suggested by managers and teachers. The managers are interested in attracting more students to the university since it generates more income. More students will also improve the application statistics, such as the student ratio or the student quota (the number of applicants in relation to the number of available places in a study programme). A good application ratio means increased status and ranking. The teachers do not view InnovationLab from an economic/strategic perspective. Instead, they suggest practical goals such as teaching support and an improved access to interesting empirical data that can be used in student projects. Researchers, teachers and the administrative unit view InnovationLab as an internal infrastructure support that could support higher goals, such as conducting research, improving education, or enhancing and simplifying internal IT-development and maintenance.

We consider these diversified goals both as a strength and as a weakness. The strength is that many important stakeholders at the university believe that their business can be improved by the services of InnovationLab. The weakness is that

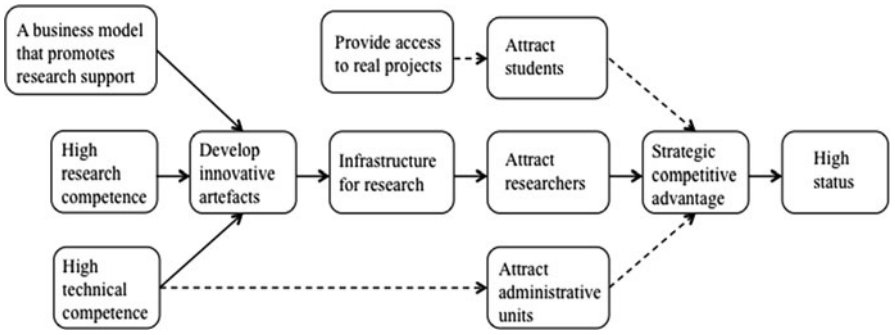

Fig. 5 The future goals and means of InnovationLab

InnovationLab may be inefficient, since there are too many tasks requiring quite different sets of skills. In order to reach a consensus about the future of InnovationLab we have to: (1) inform the stakeholders (voices) that different opinions exist; and (2) negotiate in order to make a collective decision about the future goals for InnovationLab. This task could be challenging, given the different motives, attitudes and opinions (Hollingshead et al. 1993). In this second phase of the study we used a focus group including representatives from all the four stakeholders. The main result from the focus group was to prioritise the research support and that all other business should merely become a means to develop excellence in this task. The focus group also contributed to a shared understanding of the primary aim of InnovationLab. As the SWOT-analysis and the goal diagrams revealed, the stakeholders have had different expectations of what InnovationLab could do for the university. Thus, the focus group managed to reconcile some of the tensions experienced among different stakeholders. A compilation of the goals, expressed by the focus group, is illustrated in Fig. 5.

To achieve the ultimate goal it was concluded that InnovationLab should simultaneously work with three strategic business areas: support for research, support for education and support for administrative systems development. The reason that InnovationLab cannot place all its eggs in one (research) basket is that research funding varies greatly over time. In Figs. 5, 6 the goals connected with solid lines represent what should be prioritised. This priority does not mean that InnovationLab should not serve the other voices. Other voices can be served if time and space can be allocated, or if that service is strategically motivated. We have used dashed lines to illustrate the goals for attracting students and the administrative unit.

Furthermore, other tasks not initially intended as related to research projects should also, as much as possible, be carried out as research. I.e. other development tasks might also be a basis for reflecting upon as research endeavours. That is, if for example InnovationLab is developing or maintaining an application for an administrative unit, it should be investigated whether this work could be aligned with an existing research interest. In this way, even more services performed by InnovationLab can be seen as a means for fulfilling research goals.

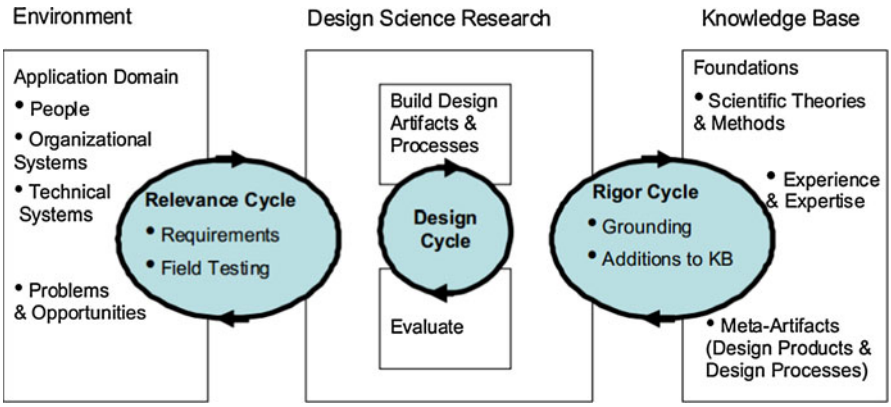

Fig. 6 Design science research cycles (Hevner (2007), p. 88)

5.6 The relation of the voices to design science research

To further explore the necessary characteristics to efficiently support multi-stakeholder DSR, we next view these voices through a lens of DSR activities and how InnovationLab can support them.

As framed by Hevner (2007), DSR can broadly be seen to encompass three major research cycles. First, DSR researchers need to ensure the relevance of the research through a *relevance cycle*. This includes both understanding and verifying the requirements of the business environment, as well as the criteria and field evaluation of a materialised hypothesis. Next, DSR includes a *rigor cycle* where researchers both draw upon existing theory to inform their design, and where the findings from the research project are fed back to the scientific body of knowledge. Finally, and at the core of DSR, researchers engage in a *design cycle* where they iterate between a mode of actively modifying the artefact (design) and investigating its actual utility (evaluation).

Starting with the relevance cycle, researchers stress the need for InnovationLab to *be acquainted with the latest technology*. Given the fast rate of information technology development and that rigorous research takes time, it is necessary to be at the technological forefront to remain relevant when the findings are published. Further, DSR research outputs should display significant novelty (March andStorey 2008). However, innovative artefacts come with high project risk. As pointed out by the researchers, because InnovationLab is *willing to accept high-risk projects*, it thereby becomes an attractive partner for researchers to work with.

Moving to the rigour cycle, we see how the scope of InnovationLab's engagement matters. The researchers pointed out the risk of InnovationLab's employees not being trained researchers. Typically the rationale in systems design decisions is based on elicited user requirements, previous developer experiences, software design heuristics etc. These sources of design rationale remain important as artefacts are developed for usage in authentic settings rather than controlled environments. However, being DSR, the rationale must also be firmly grounded in

theory and the design team must iterate between theoretical guidance, artefact development and the requirements in the environment (Hevner 2007). Thus, to be able to manage entire DSR projects, we see a need for InnovationLab to *employ fully trained researchers* (not only PhD students), as selecting and understanding appropriate kernel theories, designing the research process and writing academic papers is a highly specialised profession. However, if InnovationLab rather focuses its efforts in the design cycle, the requirements become somewhat altered. Rather than having to make overall research decisions, there instead arises a need to *entail boundary spanners* to act between theory and artefact realisation. We hold that such employees need both to have thorough systems development knowledge and understand how to apply existing, and support the generation of new, scientific knowledge. E.g. a PhD student may have sufficient understanding of academic theory to act as a researcher "proxy" in the development when applying kernel theories, as well as seeing that the testing being done also can be used as DSR evaluation.

Finally, and perhaps at the core of an innovation lab's DSR-supporting abilities, we move to the design cycle. We have previously mentioned the need for boundary spanners to enable DSR rigour. However, there are additional activities that are required to successfully conduct DSR research. The researchers expressed the view that the work being done should follow scientific principles. One such DSR-related principle is to retrospectively exhibit the search process used to arrive at the final artefact (Hevner et al. 2004). Consequently, when the artefact construction is conducted by actors other than researchers, it becomes of the utmost importance to *rigorously document and reflect on the design decisions made during development*. Even though the design should be informed by theory, these scientific principles cannot guide all developer design decisions at all times. Rather, developers typically make a range of micro-decisions during development which may add up to substantially affect the properties of the resulting artefact (Markus et al. 2002). To be able to display the design process, developers need to document these decisions made while iterating between the problem and the artefact, an activity which has surprisingly gone unnoticed in the current DSR literature. We thus identify a future research opportunity to explore these methodological issues further.

6 Conclusions

In this paper we have investigated the role of an innovation lab in a university setting. We have explored 5 years experience of setting up and running such a unit. Our study revealed that there are different opinions uttered by different voices. Not surprisingly, these voices bring forward strengths from their own perspective. One message in this paper is that an innovation lab cannot equally serve all voices. If one makes a standpoint of the necessity for the field of information systems research to facilitate innovation in a DSR-spirit, an innovation lab should primarily be a support for research. Consequently, all other business should be seen as means for establishing a systems development capability aimed at research. We are not saying that the opinions of the other stakeholders are unimportant, but the foremost aim of

an innovation lab is to support research, and findings in research can then be transferred to education. Other administrative units should be able to engage an innovation lab only when it is not engaged in other research-driven projects. An important finding from this investigation, however, is that development projects for administrative purposes might also be a valuable source for research. This is, however, only possible when there are enough researchers involved and engaged in the business of an innovation lab. The message of this paper is not that the administrative unit's use of InnovationLab has undermined its research mission. Rather, the purpose is to present insights gained from different voices and emphasise the importance of a common understanding of the goals of an innovation lab.

Inspired by the new service era (as advocated in, for example, service oriented architectures), an idea of conceptualising design science research as a service has evolved as a way to conceptualise the kinds of services an innovation lab could offer. Being influenced by the world of SOA, four principles that guide services, namely abstraction, loose coupling, messaging, and composability (c.f. Rosemann 2010; Svahn et al. 2009), are used for conceptualising DSR as a service. By using these criteria, DSR as a service would mean the following (inspired by Rosemann 2010):

- In terms of abstraction, it means that the service can be described and consumed without any deeper insights into the way the service is delivered and executed. Based on the idea that an innovation lab provides parts of the process of realising (large-scale) DSR by its development capability, it also means that the design researcher might not need to be engaged in the particular development/realisation of the service. It rather becomes a question of how to interact (see 'messaging') to ensure the continual development of the construction of the artefact and thereby ensure that it is constructed as the intended working hypothesis.
- In terms of loose coupling, it means that the service should be as autonomous as possible. In this way it will facilitate wider re-use of the service and allow consumption of the service independently of other services. In order to identify different services necessary to realise a DSR endeavour, the DSR process needs to be broken down into its different parts. As has been discussed in this paper, the realisation of an artefact, as part of DSR endeavour, is possible to delimit as part of the DSR process and thereby it is possible to assign it to another organisational unit, such as, e.g. an innovation lab.
- In terms of messaging, it means that the service has to have well-defined interfaces that facilitate its interaction with its environment. This means that there needs to be established ways of interacting between the design researcher and the developer, in order to make the best out of the DSR endeavour. As reported in Hjalmarsson et al. (2010), it is however important that there is tight interaction between the researchers and the developer in order to ensure success from the DSR endeavour.
- In terms of composability, it means that a single service needs to be possible to be a component for the creation of offers that rely on multiple services. The

ability to offer multiple services both depends on the components, such as, e.g. if there are researchers as well as developers employed at InnovationLab, which would enable the production of reflections during the development, or whether InnovationLab also would take responsibility to perform field tests based on the developed artefact. At the core, however, lies the capability to develop artefacts based on newly produced, or existing (digital) components.

InnovationLab as a unit providing (parts of) DSR as a service would enable design science researchers to perform large DSR endeavours. Large-scale projects require a large extent of programming capabilities. We characterise thus an innovation lab primarily as an infrastructure for research. That is, an innovation lab constitutes a means that supports the researcher in fulfilling research goals, i.e. innovative artefacts (Hevner et al. 2004; March and Smith 1995). It is important to have a proficient research-supporting system development infrastructure, since the developers of the artefact may actively contribute to the research findings (c.f. Markus et al. 2002). Therefore the role of an innovation lab should not be reduced to being a mechanical infrastructure that unreflectingly acts upon predefined requirement specifications. The staff in an innovation lab should rather be seen as active partners in the process of problem formulation and artefact construction. In DSR, the "researcher-as-designer" is discussed, but equally important is to view the "designer-as-researcher". Since the artefact is evolving in close collaboration between the researcher and the developers (Purao 2002), developers at an innovation lab need research competence that both simplifies the communication with the researchers and increases the possibilities that projects meet the objectives from a research perspective, as well as collecting relevant data about the design process (which may become important when writing up the findings). Having these pieces in place, we believe that the ideas and hypotheses of the researchers may be effectively realised and tested (Liedtka 2004). In order to enable large-scale DSR endeavours, it becomes necessary to divide the workload between different competencies. In order to avoid cycles of design and reflection being undermined, there needs to be a close interaction between researcher and developer; information exchanges between the two parties need to be agreed, and procedures established for the development of a common understanding of what is to be achieved.

As DSR researchers, we strongly believe that an innovation lab would serve as a valuable and essential resource for running large-scale DSR endeavours where it become necessary to do things in collaboration in the task of designing and evaluating artefacts. One challenge for the future would be how to facilitate such collaboration when researchers and practitioners from other organisations are invited. In this way, an innovation lab would become a valuable asset in a neutral arena of open innovation (Chesbrough 2003).

In this paper, we have not focused on the researcher-user interaction, but we acknowledge the importance of involving the research-user interaction and thereby encouraging InnovationLab to establish user relationships in order to facilitate and improve actions in design science research. The conclusions are based on one case study. Despite this, we believe that the findings are possible to transfer to other organisations with similar conditions. According to Yin (2003), "case studies, like

experiments, are generalizable to theoretical positions and not to populations or universes. In this sense, the case study does not represent a sample, and in doing a case study, your goal will be to expand and generalize theories (analytical generalization) and not to enumerate frequencies (statistical generalization)". That is, the researcher should generalise beyond the theory's empirical base. We believe that our findings are valid for other universities, colleges or research institutes with similar conditions.

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