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Title	Practice-related research methods as part of scientific information systems research
Author(s)	Halonen, Raija
Publication Date	2009
Publication Information	Halonen R. (2009) "Practice-related research methods as part of scientific information systems research." "Indian Journal of Science and Technology" Vol.2 No 5
Publisher	Indian Journal of Science and Technology
Link to publisher's version	http://www.indjst.org/current/may09raija.pdf
Item record	http://hdl.handle.net/10379/280

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Practice-related research methods as part of scientific information systems research

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Abstract: This article discusses the importance of research methods in scientific information systems research. To limit the approach, the emphasis is laid on practice-driven research methods. While the nature of 'research' is dependent on research approach, this article focuses on qualitative research. In addition, the focus is not on research methods but their role in scientific research. Prior literature also reveals that qualitative research and quantitative research are not exclusive; instead, often the approaches are complementary. This article introduces three examples how research methods were used and how they influenced the output.

Keywords: Research methods, case study, action research, collaborative practice, design science

Introduction

This article highlights issues that are essential for scientific information systems research. One important criterion for a scientific study is that it cumulates the existing scientific knowledge. Existing scientific knowledge is found with a literature review that is carried out with concern and with a meticulous procedure. Kitchenham (2004) describes three main phases of a systematic review, namely planning the review, conducting the review and reporting the review. "Planning the review" consists of identification of the need for a review and development of a review protocol. "Conducting the review" includes five stages such as identification of research; selection of primary studies; study quality assessment; data extraction and monitoring; and data synthesis. Finally, "reporting the review" is a single task.

Besides a systematic scientific literature review, scientific research necessitates the use of adequate research methods. In this article, we discuss practice-oriented qualitative research methods and we represent case study, action research, design science and collaborative practice research as examples of research methods that are closely linked with practice and live environment. In qualitative analysis there are no easily applied theory-based rules that would validate deductions based on empirical data (Lee, 1989). Furthermore, in qualitative research, the researcher can be an "outside researcher" or an "involved researcher". Walsham (1995; 2006) clarifies the difference by defining that an involved researcher is involved in action in the field or provides significant feedback to field participants. Walsham (2006) continues that all researchers are biased with their own background, knowledge and prejudices to see things in certain ways.

From the prior literature we read that each research strategy has advantages and disadvantages and no strategy is more appropriate than all others for all

research purposes (Benbasat *et al.*, 1987). In this article we commit in scientific research, however, in so doing we note the numerous models of science from which to choose (Lee, 1989). While qualitative and quantitative research methods are often introduced as two fundamentally separate paradigms, Brannen (2005) proposes that the divide between qualitative and quantitative research should be forgotten. Currently, quantitative researchers have seen qualitative researchers as too context specific and therefore they face problems in generalisation. To the same extent, qualitative researchers evaluate quantitative researchers simplistic, decontextualised and failing to catch the meanings that actors conceive (Brannen, 2005).

However, Lee (1989) found no differences between quantitative and qualitative approaches when assessing analytical rigour. Furthermore, Brannen (2005) remarks that by adopting several research methods the researcher may benefit from a palette of qualitative methods instead of only one specific qualitative method, or, consequently, a palette of quantitative methods or a palette of mixed methods consisting of both qualitative and quantitative research methods. Adding to that, Bryman (2007) emphasises the need of conversation between the quantitative and qualitative findings in the study. In other words, the idea of using qualitative and quantitative research methods would be a construction of a negotiated account of what they mean together in the study.

Research methods are chosen according to the adopted concept of science that is, respectively, dependent on the researcher's individual preferences (Lee, 1989). Qualitative research methods are used in research when for example quantitative multivariate research methods appear complex, when these multivariate research methods cannot be used due to distribution restrictions, when the sample size does not support quantitative research methods or when the results carried out by complex quantitative methods are too difficult to understand or interpret (Benbasat *et al.*, 1987). The research approach itself does not dictate the value of the research as Baskerville and Myers (2002) welcome positivist, interpretive and critical research articles as long as research itself is of high quality.

While the information systems area is characterised by ongoing technological change and innovation, IS researchers are often found behind practitioners proposing changes or evaluating methods for developing new systems (Benbasat *et al.*, 1987). In other words, the innovations are made by practitioners instead of researchers who provide their wisdom for the novel ideas.



The rest of the article is organised as follows. Case study research is described first and its characteristics are explained. Then, action research is described beginning from its introduction in 1940's. After that, design science is explained with the framework introduced by Hevner *et al.* (2004). Finally, collaborative practice research is reported leaning mainly on the research of Mathiassen (2002). Next, the research methods are opened briefly in three examples. The article ends with conclusions.

Case study

Case study research approach is often a good choice when theory and understanding are not well developed. That is the situation for example if the phenomenon of interest is dynamic and not yet mature or settled. Darke *et al.* (1998) list areas such as business strategy with use of the Internet or when terminology and definitions are not clear or widely accepted.

Generally, in case studies the case can be a person, society, organisation, incident, series of incidents, process, physical unit or an occasion. The case must be delineated from its surroundings and the grounds for that must be explained (Yin, 2003.) Benbasat *et al.* (1987) define case research strategy as qualitative research and offer suggestions about how to conduct and evaluate case study research. Benbasat *et al.* (1987, 371) introduce 11 characteristics that define case studies:

- 1) Phenomenon is examined in a natural setting, 2) Data are collected by multiple means 3) One or few entities are examined, 4) The complexity of the unit is studied intensively, 5) Case studies are most suitable for the exploration, classification and hypothesis development stages of the knowledge building process, 6) No experimental controls or manipulation are involved, 7) The investigator may not specify the set of independent and dependent variables in advance, 8) The results derived depend heavily on the integrative powers of the researcher, 9) Changes in site selection and data collection methods could take place as the researcher develops new hypotheses, 10) Case research is useful in the study of "why" and "how" questions, and 11) The focus is on contemporary events.

Similarly, Eisenhardt (1989) defines case study as a research strategy which focuses on understanding the dynamics present within single settings. According to Eisenhardt, case studies combine data collection methods such as archives, interviews, questionnaires and observations. One significant piece of empirical material may evolve from diaries, as Schultze (2000) describes how confessional writing produces information for scientific research. Eisenhardt (1989) also believes that case study research has important strengths like novelty, testability and empirical validity which arise from the close linkage with empirical evidence. Lee (1989) adds that laboratory controls, statistical controls, mathematical propositions and replicable observations act as tools instead of objects in any scientific methodology.

However, case study research is not only interpretive but there is also a positivistic approach. With positivistic approach, data analysis focuses on discovering regularities or patterns in the empirical data and the data analysis is based on detailed data case study descriptions (Darde *et al.* 1998).

Almost 20 years later, Eisenhardt and Graebner (2007) discussed theory building from case studies. Eisenhardt and Graebner note that case studies emphasise the rich context in which the phenomena occur. The authors add that theory building from case studies is an increasingly popular and relevant research strategy that forms the basis of an excessive large number of significant studies. Eisenhardt and Graebner continue that research that grounds on rich qualitative data predicts challenges that, however, can be managed with appropriate tools. The tools include careful justification of theory building, theoretical sampling of cases, interviews that limit informant bias, rich presentation of evidence in tables and appendices, and clear statement of theoretical arguments.

Klein and Myers (1999) highlight the importance to evaluate case studies and they introduce seven principles for conducting and evaluating interpretative case studies: 1) the fundamental principle of the hermeneutic circle, 2) the principle of contextualization, 3) the principle of interaction between the researchers and the subjects 4) the principle of abstraction and generalization 5) the principle of dialogical reasoning 6) the principle of multiple interpretations, and 7) the principle of suspicion.

However, Klein and Myers also clarify the use of their principles and warn that researchers should not follow all of these seven principles if they do not find them pertinent to their research. The idea behind the principles is to offer an approach that enables more rigour to conduct and report the results of case studies. This is possible if the researchers carefully consider how and which of the principles apply in their particular research settings.

Contrary to unofficially agreed research practice, generalisability need not have a quantitative or statistical dimension (Lee & Baskerville, 2003). Lee and Baskerville introduce a framework of four types of generalisability, namely generalising from data to description (involving generalising data to a measurement, observation or other description); generalising from description to theory (involving generalising measurement, observation or other description to a theory); generalising from theory to description (involving generalising a theory, confirmed in one setting, to descriptions of other settings); and finally, generalising from concepts to theory (involving generalising a variable, construct or other concept to a theory).

Walsham (1995) states that with a rich description of a case, the researcher can generalise to concepts, to a theory, to specific implications or to rich insight. Indeed, Walsham describes generalising from empirical statements by reflecting the observations made in a case



study, to theoretical statements such as concepts, theory, specific implications and rich insight. According to Schultze (2000), diaries are good tools to get a rich description of the case and to record reflections when the circumstances are still on hand.

A successful case study research in information systems requires research areas that are relevant both to industry and practitioners. In addition, the case study researcher is assumed to have ability to take advantage of unexpected events, ability to react initiatively and persistently in the research environment and to follow pragmatism in the dynamic research settings (Darde *et al.*, 1998).

Action research

In action research, the emphasis is more on what practitioners do than on what they say they do (Avison *et al.*, 1999). Further, the researcher is fully involved in the actions, trying consciously and explicitly to change issue in the way that they feel best (Walsham, 2006). Action research as a concept was first introduced by Lewin (1946) when he reported his research on workers' intergroup relations. Lewin wanted to know workers' way of thinking, their line of action and the major obstacles that the workers encountered. Lewin found that the biggest obstacle to the workers' work seemed to be their own lack of clarity about what they ought to do. Lewin continued that if people cannot judge whether an action taken has led forward or backwards, there is nothing to prevent them from making the wrong conclusion and encouraging the wrong work habits.

Moreover, Lewin (1946) argues that realistic fact-finding and evaluation is a prerequisite for any learning. Lewin called his research "a type of action-research, a comparative research on the conditions and effects of various forms of social action, and research leading to social action". Lewin formulated that there are four functions in an action research cycle: 1) evaluating the action, 2) giving a chance to learn, 3) serving as a basis for correctly planning the next step, and 4) serving as a basis for modifying the overall plan.

However, the roots of the action research method are already several hundred years old. The background is laid out in the thoughts of Charles Peirce when he introduced his concept of the fixation of belief (Peirce, 2000). Peirce uses the words of Roger Bacon who, in the middle of the thirteenth century, had realised that only experience is needed when one wants to teach something. Peirce explains this further, describing the importance of reasoning and its object as being "to find out, from the consideration of what we already know, something else which we do not know". Reasoning leads us to determine one inference instead of another and to act according to some habit of mind. He calls this action a guiding principle of inference. This guiding principle is supposed to lead us to correct conclusions from true premises. Peirce continues by

describing the differences between doubt and belief and states that there is a practical difference. According to him, our beliefs guide our desires and shape our actions. Doubt, on the other hand, leads us to efforts to get rid of it and to proceed to the state of belief.

In this sense, both doubt and belief have a positive influence on individuals. Both of them make people act and think, and individual's behaviour changes according to that. However, people generally reason correctly, by nature (Peirce, 2000).

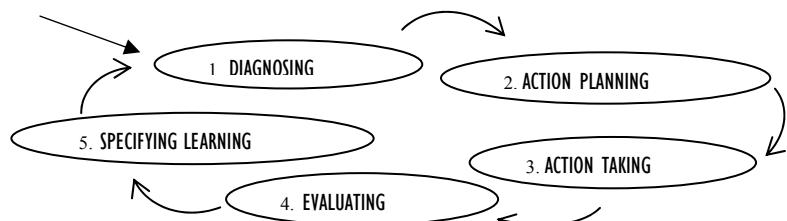
Action research was later developed by the central elements defined by Rapoport (1970):

- a) The need to get collaboration from members of an organisation to help them solve their own problems,
- b) The operational research stream of mathematics, engineering and physical sciences concentrating on logistical problems of various kinds,
- c) The group dynamics stream researching leadership, power, group dynamics, stress and identity, and
- d) The applied anthropology stream studying psychological warfare, intelligence and administration of occupied territories.

Rapoport (1970) reformulated the definition of action research as follows: "Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework." Susman and Evered (1978) emphasised the cyclical nature of action research. They rather see action research as a cyclical process with five steps (diagnosing, action planning, action taking, evaluating and specifying learning) instead of the four functions described by Lewin (1946).

The action research process (Fig. 1) begins with identifying or defining a problem (step 1) and continues

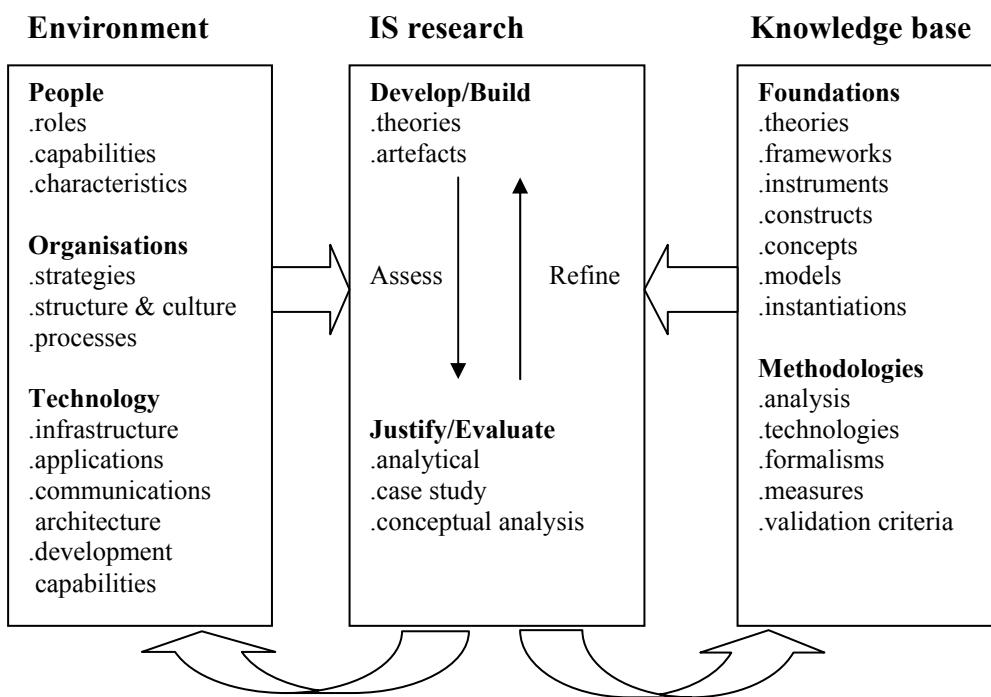
*Fig. 1. The cyclical process of action research
(Susman & Evered, 1978).*



with considering alternative courses of action in order to solve the observed problem (step 2). After that actions must be chosen and taken (step 3), followed by evaluating how the actions influenced the prevailing situation (step 4). The last step in the action research cycle is to specify learning and to generalise findings from that learning (step 5). After the last step of that cycle it is expected that another action research cycle will take place, beginning with diagnosing the prevailing situation.

The interaction between the information system development and the action researcher maintains and regulates some or all of these five steps or phases jointly. Susman and Evered (1978) propose that all these phases

Fig. 2. Information systems research framework (adapted from Hevner et al., 2004).



are necessary for a comprehensive definition of action research. However, they add that the number of phases may differ in action research projects, meaning that the researcher does not always collaborate with the information system project when performing these phases.

Action research is argued to be ideal for studying information systems in practice, it serves different interests and it offers good means to improve practice in general (Baskerville & Wood-Harper, 1998). While action research combines theory and practice, it combines also researchers and practitioners through change and reflection in an instantaneous problematic situation in a mutually acceptable ethical framework (Avison et al., 1999).

Design science

Design science aims to implement a solution to a real world problem and in design science it is significant that the output is both created and studied (March & Smith, 1995). Design science is described as focusing on creating and evaluating innovative information technology artefacts that enable organisations to address important information-related tasks (March & Smith, 1995; Hevner et al., 2004). Hevner et al. (2004) described design science as a framework of environment, IS research and knowledge base (Fig. 2). In their article about design science in information systems research, Hevner et al. (2004) have introduced seven guidelines that arise from the principle that knowledge and understanding of a design problem and its solution are acquired in the building and application of an artefact. These seven guidelines are:

- 1) Requirement of creating of an innovative, purposeful artefact,
- 2) Specified problem domain,
- 3) Careful evaluation of the artefact,
- 4) Novel solution
- 5) Rigorously defined, formally presented, coherent artefact,
- 6) Use of search process, and
- 7) Effective communication of research.

Hevner et al. (2004) remind that these guidelines are important but are not compulsory to be present at the same time. The authors also countenance researchers to be both proactive and reactive with respect to new technology, which is often overemphasised in the artefacts. Furthermore, they encourage the alignment of

design-science with real-world production experience.

Collaborative practice research

Mathiassen (2002) names his approach collaborative practice research and it combines action research, experiments, and practice studies. It is essential that the research method constantly meets dilemmas between practice-driven and research-driven goals and general and specific knowledge interests. Levina (2005) describes how collaboration in multiparty information system developments can be understood as a collective reflection-in-action cycle that changes and is changed by versatile organisational and professional stakeholders.

Mathiassen (2002) combined interpretative understandings of practice with normative propositions to support professional development. He notes how establishing properly functioning relations between research and practice is the main concern in collaborative practice research. Further, Mathiassen expresses lessons learnt as follows:

- a) Collaborative practice should be organised to support versatility,
- b) Understanding and supporting practices are basic knowledge interests in studying systems development,
- c) Collaborative practice studies combine action research, experiments and practice studies and
- d) Extensive documentation is needed to ensure sufficient rigour when organising research initiatives.

Mathiassen (2002) concludes that collaborative practice research offers good possibilities to find a useful balance between relevance and rigour in information systems research. However, the approach necessitates a devoted aim to involve both research work and organisational work.



Based on her research, Levina (2005) adds that to achieve effective collaboration, it makes sense to involve participants from lower status organisational positions early enough in the implementation projects. She also confirms the need to reflect more deeply on the nature of the relationship and associated modes of control in the collaboration.

Examples of using of the research methods

In this section we introduce three cases where the presented research methods were used. First, we introduce an information system implementation that was carried out in a small hospital to pilot part of an inter-organisational information system. After that, we describe a case study about designing and implementing a procedure to be used in access control. In that case, design science was followed. Finally, we look at a case that was carried out with collaborative practice research. In that project, an inter-organisational information system was produced.

Hospital case

In the hospital case, the researcher acted as a project manager and in that role she was able to influence the development process in many ways. She collected empirical in the means of qualitative research, that is, by observing, writing notes about encounters and meetings, collecting project memorandums, transcribing phone calls and collecting official documents related to the project.

In the hospital environment, the new information system was to replace a character-based information system that, among other things, was also suffering from maintenance problems due to its old-fashioned structure. However, the users who were mainly nurses and clinical secretaries were very satisfied with it as the system appeared quick and reliable. The new information system was totally different with its Window-based approach. An important change was the application that did not include the pre-defined work process but the users had to know what to do next. A significant feature in the new system was its ability to transfer the information across borderlines between hospitals and hospital districts that was needed due to the increased mobility of inhabitants in the country. The information system was not received with pleasure as it was delayed several years and as it required great changes in the work processes of the personnel in the hospital.

Besides tutoring the use of the new system, the project manager was also responsible for teaching the users in using Windows and during those circumstances she was able to reflect the attitude of the users and transfer the knowledge between the developers and the future users. The users were actively supported to tell their experiences to the project manager and to ask if they had anything in their minds. Despite the users strongly felt that their main task was to take care of their patients, they managed to get experiences of the new

information system that was later expanded in the whole hospital instead of only two clinics.

Following the principles of action research (Walsham, 2006), the researcher was deeply involved in the actions and she was able to reflect according to the settings at the time. In the project, the expertise possessed by the developers and the users differed significantly. The great gap between the knowledge bases necessitated that the project manager was able to react or change issues whenever they appeared.

Further, as the project aimed to pilot a new information system, it was essential to collect experiences, documents and suggestions for improvements in the project. The project produced valuable knowledge base for the organisation to be used when the information system was extended to be used in the whole hospital and later in other hospitals.

Factory case

The factory case, the aim of the project was to produce an information system that would - better than the existing procedure - support user access into the information systems. From the very beginning, the project was carried out rigorously, following the principles of Hevner *et al.* (2004) who introduced their framework (Fig. 2) for implementing information systems.

Fig.3 represents the main phases in the project that started with a literature view. The literature review was needed as it was significant to look for prior research on information systems supporting user access. The literature review also provided experience to be used when designing the questionnaire. Then, the current process was investigated by a semi-structured questionnaire. Further, users were asked to suggest

Fig.3. Factory case as a process.



improvements in the processes and to express their conception of the security in the user access. In addition, prior research influenced the implementation especially in the form of the chosen framework.

The seven guidelines of design science introduced by Hevner *et al.* (2004) were realised in the factory case as follows:

1. An innovative and purposeful artefact was needed due to the expanding problem of access rights in the company,
2. A specified problem domain was identified in the company, supported by prior research,
3. The artefact was evaluated carefully in the company by discussing of it in the company and by testing it. Due to the rigorous use of prior research, only one iteration was needed,
4. The solution was novel in its context as if was not realised until the responses on the questionnaire had exposed the requirements,
5. The artefact was rigorously defined



leaning on prior research on information security and access rights and on the responses to the questionnaire, 6. A search process was followed in the case as described in the implemented framework, and 7. Effective communication of research was realised due to becoming acquainted with prior research on access rights and information security.

The concrete output in our research project was an information system that was adaptable in other similar environments, as well. In addition, the used research approach added knowledge in the company in two respects as described in the framework (Fig. 3):

- 1) Environment: i) Roles, abilities and characteristics of the IT experts were described, ii) Strategies, structure & culture and processes of the company were analysed, and iii) Technology issues such as infrastructure, applications, communications architecture and development capabilities were described.
- 2) Knowledge base: i)The project increased knowledge about theory related to access rights, texts, standards, instructions and methods; and ii) methods to find out current state of processes, to make questionnaires, to find out documentations and reporting methods, and to find analysis methods.

Collaborative practice

In the case of collaborative practice, an inter-organisational information system was designed and implemented in a project of several stakeholders. The group of stakeholders consisted of two vendors, four user organisations, one consortium of several organisations including also the four user organisations and, finally, the project manager who did not belong to any of these stakeholders. In addition, the funding organisation participated every now and then giving a substantial comment about the project and its goings. So, one could conclude that the palette of stakeholders predicted a lot of challenges in the information system project.

As the project manager was an outsider, she did not know the substance area of the future information system. Furthermore, the procedures differed more or less between the participating organisations, and this situation necessitated a deep involvement from the organisations. Therefore, collaborative practice was needed. On the other hand, the project manager was the only individual who carried out research in the project. Despite that, the participants did not experience the situation negatively. Instead, they were ready to express their feelings and also commented both privately direct to the project manager and in the project meetings when the project manager could make notes about the feelings and attitudes in the meetings.

Thus, the empirical material included official project memorandums, open and closed feedback from the users, a private research diary kept by the project manager, notes written by the project manager and other participants, and transcribed phone calls. As the information system project took three years, the

researcher collected research material that consisted of hundreds of emails, almost 600 feedback notes from the users, tens of project memorandums and more than 350 diary notes, among others. To verify the quality of the diary, the writing met the criteria described by Schultze (2000): authenticity (the role and identity of the researcher was explained in the text); plausibility (the text was structured, following the timeline according to the empirical case) and criticality (the diary helped to understand the attitude of the researcher and was still questioning the objectivity of the data).

The project produced an inter-organisational information system that was piloted in the beginning in three organisations but was extended in two other organisations before the project was ended. The project was commenced without becoming acquainted with prior research, nor was any framework chosen to be followed. The project was conducted using a dynamic and reflective procedure and the project participants were supported to act whenever needed. However, only few meetings were arranged without the project manager even if the practitioners were encouraged to meet by their own.

The output of the project was evaluated successful and the information system was eagerly waited for by outside organisations, too. During the project, feedback was collected and wishes and experiences were recorded to be used for future development of the system. Thus, a knowledge base was created to be used in later phases.

Conclusion

The aim of the article was to introduce practice-related research methods in scientific information systems research. In so doing, the article emphasised the need to choose appropriate research methods. The chosen research methods are related with each other and there are scientists who see them overlapping or even as the same method. However, the discussion about the proposed similarity is out of the scope of this article.

While the aim of the article was to concentrate on practice-related research methods, the article briefly introduces three research projects where these research methods were applied. As seen in the descriptions, only in one case the research process followed rigorously the chosen framework. In the other two cases, namely the hospital case and the collaborative practice research, there was no ready-made framework in use. Despite the lack of prior framework in the two cases, the knowledge was evolved in the organisations. In the hospital case, the information system implementation acted as a pre-phase for a hospital-wide information system renewal. Likewise, in the collaborative research project, the project included only the first phase of the implementations. In other words, the project ensured the information system to be ready to be delivered nation-wide in other organisations.

The brief case descriptions show that the rigorous work process followed in the factory case produced outputs that were valuable for the case company also



outside of the information system. The organisation was able to gain knowledge about its environment and it was able to increase its knowledge base.

This article did not evaluate the use of the chosen research methods. As Lee (1989) noted, appropriate research methods are dependent on the researcher's individual preferences. This article emphasised that whatever research method is used, it should be used with rigour and the research method should be rationalised.

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