A Method For Consortial Research

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Content

Preliminary remark	iv
Abstract.....	v
1 Relevance as a challenge: The roles of researchers and practitioners	1
1.1 Current situation in information systems research.....	1
1.2 The challenge of grounding in practice	1
1.3 Information systems research as one link in a value chain.....	3
1.4 Requirements and expectations on information systems research.....	4
2 A Method for Consortial Research.....	5
2.1 Method requirements	5
2.2 Method design.....	7
2.3 Method components.....	8
2.3.1 Domain	8
2.3.2 Meta Model	9
2.3.3 Results	9
2.3.4 Phases and activities.....	12
2.3.5 Techniques	17
2.3.6 Roles.....	17
3 Assessment of the Method.....	18
3.1 Assessment of the method's applicability by means of case studies	18
3.1.1 Case studies	18
3.1.2 Other examples.....	20

3.2	Assessment of the method's applicability by means of criteria of public funding programs	21
3.3	Assessment from a methodical perspective	23
3.4	Discrimination against commercial consulting and software development	24
4	Summary and outlook.....	25
5	References	27

Preliminary remark

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Abstract

Design oriented research in information systems faces two major challenges: the effort to capture practitioners' knowledge on one hand (relevance) and the evidence to fulfill scientific requirements (rigor). In practice, businesses employ at least a centuple of the resources which are available in research for the design and implementation of innovative solutions based on information technology. For the researcher, it is almost impossible just to oversee the state of practice, in addition to the scientific body of knowledge. Since based on a single case, the engagement of an individual company in a collaborative research environment, e.g. in action research, is not appropriate to develop an artifact. This paper takes up these challenges and proposes a research method that extends the state of the art in action and design science research by introducing consortia of research partner companies.

Keywords: Design science research, Action research, Consortial research, Method, Rigor, Relevance

1 Relevance as a challenge: The roles of researchers and practitioners

1.1 Current situation in information systems research

The competitiveness of highly developed economies is founded on innovative products and well-performing organizations that are able to leverage the potential of information and communication technology (ICT). In this respect, the questions with regard to information systems research are: How can information systems research contribute to the positive development of economies? How can information systems research produce scientific findings that in turn yield substantial benefit in terms of improved solutions for business?

The intensive discussion about the relevance and potential of research methods is an indication that information systems researchers have identified a need for action [March/Smith 1995, Vessey et al. 2002, Rosemann/Vessey 2008] and have been vehemently seeking for methods capable of providing scientific knowledge for a significant part of the economy [Hevner et al. 2004, Bucher/Winter 2008]. This paper aims to contribute to the discussion by a research method based on the concept of design science research [Hevner et al. 2004], extending action research [Davison et al. 2004] by involving consortia of partner companies instead of individual companies.

According to the design science research process of [Peppers et al. 2006] the authors first define the problem and the objectives of the solution, then present the design of a Consortial Research method (the artifact), demonstrate and evaluate the method by cases and discuss finally the diffusion (communication).

1.2 The challenge of grounding in practice

Information systems research is currently facing fundamental challenges. First of all, research performance is increasingly measured in bibliographic terms, i.e. the number of publications in relevant scientific journals. One important criterion for a paper to be accepted by the scientific community is the usage of broadly accepted research methods. While methods for *descriptive* scientific work (i.e. identifying and verifying phenomena) have long been recognized, methods for *prescriptive* scientific work (i.e. designing artifacts) are still struggling to be accepted, just as engineering disciplines today are still trying to maintain their position in the realm of natural sciences. Unfortunately, papers are quite often being

reviewed primarily with regard to the method presented as opposed to the benefit yielded by the results.

Secondly, innovation in ICT largely takes place in business settings and environments, i.e. in companies using ICT systems and applications, in consulting companies, in software companies, and, increasingly, in companies providing electronic services. In order to be able to accomplish innovation, all these companies are using resources that are much larger than the resources available in scientific institutions, e.g. universities. For example, a company like SAP employs more than 15,000 people in research and development [SAP 2009a]. According to EUROSTAT, 368,263 people dealt with developing ICT solutions (NACE Code 72) in Germany in 2003. German universities employ about 200 professors working in the field of information research systems plus about 1,800 scientific staff (according to the member list of the *Wissenschaftliche Kommission Wirtschaftsinformatik* of the *Verband der Hochschullehrer für Betriebswirtschaft*). If we look at these figures, it becomes clear that the number of people developing ICT solutions in business environments is more than one hundred times larger than the number of personnel doing so in scientific institutions. Moreover, developers in business environments usually are specialized in certain technologies and application areas, whereas university researchers have to cover a number of different areas, as they are supposed to teach their students in different subjects.

Thirdly, a huge knowledge base regarding usage of ICT has been established within the last half century through efforts initiated both on the industry side and on the science side. This knowledge base must be taken into consideration by information systems researchers. It comprises knowledge on organizational solutions (e.g. shared-service centers), applications (e.g. ERP systems), methods (e.g. to implement standard business software), tools (e.g. service repositories), models (e.g. technology acceptance models), and theories (e.g. contingency theory). Besides, the knowledge generated and utilized in a multitude of application areas (such as in the market for products for telecommunications and entertainment) has virtually exploded. For the researcher, this means several months to understand the state of the art in practice, a time investment which is not granted by the typical academic career paths.

A fourth challenge results from the three previously mentioned challenges. With the situation being as outlined above, businesses do not address universities when seeking for innovative

solutions but increasingly ask industry experts for help. Like the CEO of a large Swiss bank said: ‚When we face a problem, we look for the best consultants worldwide. University research is government’s business.’ This statement supports the results of a survey among US human resources managers assessing university research as largely irrelevant and ineffective [Wilkerson 1999]. For researchers themselves it remains quite difficult to get access to research topics that offer a high potential [Benbasat/Zmud 1999].

1.3 Information systems research as one link in a value chain

For the advancement of businesses in the context of Business Engineering [Österle 1996], a complex value chain has evolved, ranging from developers and providers of software products to consulting companies to companies using ICT. Information systems research as a scientific discipline must redefine its role in this value chain. Examples of value creation by university research regarding information systems research are:

- Case studies: The market is inundated with success stories disseminated by ICT providers and consulting companies. Yet what both students and professionals really need are case studies, which identify critical factors of innovative solutions and provide objective assessment of the effects brought about by them. To be able to do so, researchers need to have a clear understanding of the solution and the business context it is embedded in. Moreover, they must be able to identify critical contingency factors and effects and to appropriately assess the views and opinions of the people surveyed.
- Models and theories: Business may be offered support for concrete decision-making through exploration of new areas of application of ICT (such as commercially used web services), through provision frameworks for structuring certain phenomena (such as hierarchies in business networks), through identification of interrelations between ICT strategies and commercial success, and through theories explaining phenomena. Descriptive research is impeded by the necessity to understand business realities to such an extent that researchers are able to recognize generalizable phenomena and control all critical variables.
- Reference models: By reference models we denote reusable conceptual models [vom Brocke 2007]. Examples are metrics for service levels being used as templates by

professionals for the development of concrete solutions (in our example: to measure the service level if a bank has outsourced its payment traffic to a service provider). Reference models mostly result from a generalization of real solutions by reference modeling. In any case, their benefit can only be assessed by looking at their applicability and effectiveness in real business scenarios.

- **Methods:** Methods applied in information systems research are instruction patterns allowing researchers to systematically design information systems [Brinkkemper 1996]. Methods presuppose a deeper understanding of the specific area they are to be applied in.

1.4 Requirements and expectations on information systems research

Information systems research is always about modeling business reality, either by describing reality in case studies, by analyzing single phenomena, by applying reference models for certain design areas, or by applying methods for business engineering. For empirical research and for design science research, the following core questions can be derived:

- How can information systems research connect theory and practical application in such a way that research results can be produced that offer substantial benefit for a defined area of application?
- How can information systems research capture business realities and the state of the art in such a way that the effort required to accomplish research objectives can be managed and the accomplishment of objectives can be verified?

From these two questions, the following requirements can be derived:

- **Understanding of area of application (business knowledge):** Each ICT application used in an enterprise must comply with the enterprise's business model. Knowledge with regard to this requirement is often referred to with terms like industry specific knowledge, process know-how, or business logic. Quite often, such knowledge has evolved from many years of business experience, and, equally often, it is poorly documented.
- **Problem identification and assessment of potential:** The business problem to be tackled determines the research question and the research objectives. The problem's

symptoms (e.g. insufficient profitability of certain products, or high manual effort when data is exchanged with customers) need to be identified, and their causes and effects need to be analyzed. Being able to differentiate between critical and non-critical variables affecting a business problem requires a particularly deep understanding of the area of application.

- **Knowing about successful and non-successful solutions:** Knowledge from information systems research (and from business management) primarily provides frameworks to structure and deal with a certain problem. In certain cases, such knowledge may provide approaches to innovative solutions (e.g. ontologies in Web 3.0). However, the biggest part of the knowledge is transferred into the solutions themselves which were developed. Standard business software, such as SAP ERP, Adobe LifeCycle Designer, or Apple Store (with over 25,000 applications for the iPhone only) represents knowledge that has been cast in software. Therefore, modesty is recommended to a certain extent when assessing the quality of academic knowledge, as ignorance regarding the technological state of the art on the part of university researchers may easily lead to research results falling short of current developments in business.
- **Prove of scientific quality:** Scientific quality of research results demands that artifacts are based on a meaningful model of reality, that existing academic knowledge and business knowledge have been evaluated, and that both the artifacts' applicability and the benefit they offer are verified in the specific area of application.

Thus, whether information systems research can be rated effective and successful largely depends on whether researchers are able to appropriately capture business reality (with basic research being the only exception here, as far as no reality check is assumed). So the central requirement on information systems research is to find ways of integrating business reality and academic knowledge into the design of its artifacts at an acceptable effort.

2 A Method for Consortial Research

2.1 Method requirements

Design science research aims to achieve rigor and relevance of design oriented research in information systems [Hevner et al. 2004, Winter 2008]. Based on that, elaborations of the

research process have been proposed [Peffer et al. 2006]. And participatory forms of research such as action research have been advanced by the need for a client-researcher agreement [Baskerville/Wood-Harper 1996] and by the definition principles of canonical action research [Davison et al. 2004]. These contributions as well as related work helped a lot to clarify on the types of research results (artifacts) and to structure the research process and connect it with the practitioners' domain. However, all of these contributions fall short in regard to a certain aspect: They do not tell the researcher how to attain the practical knowledge; they even do not discuss the volume and the relevance of practical knowledge and its exploitation in scientific research.

One possible may lie in collaborative research, integrating theoretical knowledge from university researchers and practical knowledge from people working in business environments. Consortial Research, however, is not just another name for collaboration of science and business, but refers to projects in which a number of partner companies together with university researchers commonly work on a certain research topic under the following conditions:

- University researchers and business experts commonly define research objectives, assess progress of work, and evaluate project results.
- Partner companies participate in research projects with their own experts and grant university researchers access to their knowledge resources.
- The results of the research are artifacts that offer substantial benefit for the companies participating.
- The companies participating test the artifacts developed in their business settings.
- The companies participating finance the research project at least partially.
- The research results are made accessible to the public.

The duration of a Consortial Research project varies from two to eight years and typically involves three to five researchers. Thus, a Consortial Research project can be considered as a research program that is split up into several research projects, with the method's principles applying both to the overall program and the subordinated projects.

2.2 Method design

Figure 2-1 gives an overview of the method proposed, showing the *Domain*, the four *Phases* (*Analysis*, *Design*, *Evaluation*, *Diffusion*), important *Results* (document symbols) of the Phases, and some exemplary *Techniques* (hexagon symbols).

The cycle symbols indicate that the results of each phase are discussed with representatives of each participating company and – if deemed necessary - revised. If there are different views within a company, this is done for several company representatives.

Consortial Research is an extension of Design Science Research (DSR) [Hevner et al. 2004, Niehaves 2007]. It also adopts principles from Action Research [Davison et al. 2004] and hereby refines approaches for the process of design oriented research. As opposed to mere design methods, a research method yields new scientific insights [Lange 2005, Wilde/Hess 2006], and it provides researchers with a comprehensive instruction pattern for the research process [Peffers et al. 2006]. The proposed method consists of the following components:

- The *Domain* specifies the area in which the method is to be applied and is supposed to yield new insights.
- The *Meta Model* describes the method's objects (constructs) and the interrelations between them.
- *Phases* subdivide the research process into several stages, which are repeatedly run through partially or wholly in a given order.
- *Results* are products of the phases. Types of *Results* are case studies, explanatory models, methods, prototypes, and others.
- *Techniques* are applied to produce *Results*. *Techniques* used are, for example, reference modeling method engineering, or focus group interviews.
- *Roles* specify responsibilities of the researchers participating.

By integrating the *Domain*, we have extended the concept of Method Engineering [Olle 1991, Heym 1993, Gutzwiller 1994, Brinkkemper 1996] by another aspect, namely the area in which the method is to be applied and is supposed to yield new insights.

2.3 Method components

2.3.1 Domain

The specific domain of information systems research is the use of ICT in industry and society [Heinrich et al. 2007]. In their Information Systems Research Framework, Hevner et al. distinguish between *Environment* and *Knowledge Base* [Hevner et al. 2004], with *Environment* referring to business reality, from which requirements on science are derived, and *Knowledge Base* referring to the scientific knowledge in information systems research, i.e. explicit knowledge that has been published.

If the assumption is correct that the amount of business knowledge in information systems research is tremendously larger than the amount of scientific knowledge, researchers must take into account business knowledge at least as much as they do with scientific knowledge. While it is true that business knowledge usually is not generated following scientific methods and that it is usually not well-documented (which is why the document symbols have dashed lines in Figure 2-1), business knowledge is still valuable as it offers opportunities to verify its

applicability, can often be assessed by looking at a large number of cases in which it is applied (e.g. LinkedIn, Salesforce.com), and is subject to permanent evaluation on highly competitive markets.

So, as two blocks of the domain of information systems research we specify business knowledge on the one side and scientific knowledge on the other side. As business knowledge more often than not is available as implicit knowledge only, the researcher must acquire it from practitioners.

Socio-technical systems, such as private companies, public organizations, or private households, are viewed by information systems research on different levels, which are business models (strategy, business areas, revenue models etc.), processes and organizational structures (people, tasks and ICT support, responsibilities etc.), information systems (e.g. enterprise resource planning, social networks etc.), and ICT (devices and software).

2.3.2 Meta Model

The meta model describes the method's objects and the interrelations between them. A meta model is always a special form of a representation of constructs; it is a data model in the form of a UML description of objects and interrelations that is complemented by additional, verbal explanations of the terms used (like a glossary, and often based on the Wiki principle).

The meta model describes objects such as artifacts, model, software, evaluation results, milestones, or roles, and the most important interrelations between these objects. While the domain specifies the method's area of application, the meta model specifies the design objects. For lack of space we do not give a detailed representation of the meta model here.

2.3.3 Results

Results of research yield new scientific knowledge and insights. While the Consortial Research method primarily yields artifacts in terms of Design Science Research, it also produces – to some extent – descriptive results. In addition, the method produces formal results, such as a project plan for structuring the research process.

Constructs are components of theories. They represent the vocabulary for scientists, but also for practitioners [March/Smith 1995]. Examples of constructs are terms like application, authorization, or business process. For each research project, the Consortial Research method

requires the development of a meta model to specify the design area. It represents generalized constructs from different scientific approaches, different software and consulting companies (models and methods), and different companies using ICT systems and applications (instantiations), with constructs not only having different names but also – at least partially – different semantics. Thus, the meta model builds the basis for a common understanding of a research area among consortium partners.

Theories are supposed to analyze, explain, and predict (describe) reality [March/Smith 1995, Gregor 2006]. Typical results of theories are classification schemes, frameworks or taxonomies, explanations of phenomena, or predictions of events based on certain factors. One example may be Zarnekow et al. stating that 80 percent of an IT application's cost result from its operation, while only 20 percent result from its development [Zarnekow et al. 2004]. Description typically is an issue in empirical research, in which theories are derived from a large number of observations. By contrast, Consortial Research formulates rudimentary theories by viewing only a small number of cases (the companies participating in the project) and deriving from them problems, contingency factors, the design area, solutions etc. So, the theories developed by Consortia Research are theories referring to the state of the art in specific areas of application in business environments in which the artifacts to be developed are supposed to be used. The central assumption is: If statements about business reality are made by a small number of experts, who have long-standing business experience and who have thoroughly analyzed the topic under investigation, one gets a better and more precise impression of reality than by doing surveys involving a large number of people with limited knowledge or limited interest in the results. Developing theories is a mandatory intermediate step on the way to prescription [Chmielewicz 1974]. Consortial Research usually does not come up with statistically proven theories in terms of behaviorism, but produces descriptions of reality that can be used as a basis for constructing artifacts.

Models in terms of Design Science Research [March/Smith 1995] represent a set of statements on the interrelations between constructs. Types of models frequently occurring in Design Science Research are, amongst others:

- **Reference models:** Reference models are always purpose oriented, as they are used as templates for designing models, i.e. their significance is determined by the way they are applied when it comes to designing artifacts [vom Brocke 2007]. Reference

models can have various forms and characteristics, ranging from frameworks specifying terms to sets of generic statements to techniques used in design processes [Fettke/Loos 2004]. Examples of reference models are ARIS (Architecture of Integrated Information Systems) [Scheer 1992], SCOR (Supply Chain Operations Reference) [SCC 2008], or the reference model for networks of financial service providers [Alt et al. 2009].

- **Solution cluster analyses:** Solution cluster analyses represent pre-stages of reference models. Examples would be categorizations of software packages (e.g. for solvency checks), of electronic services (e.g. for e-banking), and of methods for business engineering (e.g. to design websites). Without sufficient analysis of existing solutions research risks to reinvent things that are already available, thereby falling short of the state of the art already accomplished in the industry.
- **Maturity models:** Maturity models specify steps and stages to achieve an ideal design of business processes. An example would be the maturity model for corporate data quality management, which allows to assess the degree of maturity when it comes to establishing companywide master data quality management by applying a set of criteria in six different design areas [Hüner et al. 2009].
- **Business models:** Business models are formalized descriptions of companies' operations. Business models specify organizational units, transformation processes, transfer flows, contingency factors, and supporting tools [Scheer et al. 2003].

Instantiations are implementations of artifacts in specific domains [March/Smith 1995]. The development of fully operational IT business applications (e.g. for order processing) usually is no subject of university research, as this would clearly exceed existing resources and is involved with a lot of routine work rather than innovative power. In business environments, however, instantiations of artifacts reflect the state of the art in both industry and science, and they yield new knowledge with regard to applying artifacts and developing them further. Therefore, description of instantiations is another fundamental requirement for progress in science.

Case studies [Yin 2002] (e.g. about service level agreements or a service portal) represent a rudimentary form of description. However, as they represent important intermediate results

they are of particularly high relevance in Consortial Research. While the accentuation of a particular case as best practice would be desirable, this usually does not happen as researchers have no access to all solutions and the selection criteria would have to be specified on a company specific level.

Formal results are the results needed to be able to ensure highly structured project management (which is required by Consortial Research). Typical formal results are research sketches, consortium agreements, and research plans. The research sketch outlines the Consortial Research project planned and contains important specifications, such as a formulation of the problem to be tackled by the project, the scientific state of the art, the gap identified in previous research, the design area, the target groups, the objectives of the research, and the project's milestones. The research sketch thereby describes the area of research as perceived by the researchers prior to the start of the actual project. The consortium agreement, being an extended form of a client-researcher agreement [Baskerville/Wood-Harper 1996], specifies the collaboration among the consortium partners, their rights (to use the project's results) and duties (to commit themselves to the project and contribute to the project's success), the duration of the project, and the project's management by a steering committee. The consortium agreement also specifies what the scientific partners are supposed to do in the project and how they are reimbursed for their work [Miller/Salkind 2002]. Models for reimbursement may include financial payment or payment in kind. The research plan concretizes the research sketch by specifying intermediate results and final results expected. Results encompass activities during all phases, i.e. they go beyond the design of artifacts, encompassing activities with regard to the evaluation of artifacts or activities with regard to the diffusion of results by the consortium partners and in the scientific community. The evaluation of artifacts is something Consortial Research attaches great importance to. In the evaluation plan the companies participating in the project specify which of the artifacts to be developed they want to implement in a pilot application, with artifacts then be available for iterative development in terms of Action Research.

2.3.4 Phases and activities

Action Research and Design Science Research have come up with several suggestions to subdivide the research process into phases. Peffers et al. have analyzed seven schemes from which they developed a consolidated approach [Peffers et al. 2006] on which our Consortial

Research method is based on. It is important to note here that all these process models do not postulate a strict sequence to be maintained in the research process but rather suggest a general direction of progress that allows feedback of information and offers many points to re-enter into the process.

The first phase, *Analysis*, is an aggregation of two activities proposed by Peffers et al., namely ‘Problem Identification and Motivation’ and ‘Objective of a Solution’ [Peffers et al. 2006]. Taking into account the experiences described in the next section, this phase can take between three and twenty-four months. The phase starts with a first, vague idea on a research topic and ends with the completion of a research and financing plan signed by all consortium members (including the researchers).

The *Analysis* phase is extremely important, since during this phase the needs of the consortium members, the objectives of the project, and the basic conditions of the project work are specified. The motivation to participate in a Consortial Research project may be totally different. Whereas one project partner is interested in a new technology (e.g. sensor or actuator technology), another partner is motivated by a scientific report (e.g. on the distribution and development of IT costs in companies), and a third partner wants to tackle a concrete business problem they are facing (e.g. outsourcing of services provided by banks).

In the *Analysis* phase, the researchers participating in the project repeatedly run the activities listed in Table 1 until all consortium members have signed the research sketch, the consortium agreement, and the research plan.

The results of the *Analysis* phase are gathered in many one-on-one interviews with decision-makers and experts from possible research institutions, before they are thoroughly discussed with all consortium partners in a least one workshop. Special aspects of the *Analysis* phase as part of the Consortial Research method are:

- Business knowledge: Consortium partners need to make sure that the project takes into consideration not just the scientific state of the art but also (or primarily) the state of the art in the industry. Such business knowledge is available as solutions (instantiations), standard business software and services (models), methods applied by companies using ICT or by consulting and software companies, and concepts such as concrete metrics (theories and constructs). Usually business experts have accumulated

such knowledge over many years. In Consortial Research, these experts pass on their business knowledge to the scientists participating in the project. Scientists thereby benefit from getting access to business knowledge in a highly efficient way, which is only possible in mixed teams.

- **Relevance check:** Each consortium partner needs to check if the benefit expected to result from the research justifies the expenses incurred in the project.
- **Iteration:** The research plan is repeatedly discussed with each consortium partner, until it is finally approved or rejected. A Consortial Research project comprises at least three partners each of them with two representatives. If the research plan is verified three times with each business representative, the number of iterations is eighteen.

Define research objectives	Develop research plan	Put together consortium	Revise proposal
Identify and formulate problems Identify and examine existing solutions (instantiations) Identify and examine existing models (in science and industry) Identify and examine existing methods (in science and industry) Identify and examine existing theories Identify and examine existing constructs (in science and industry) Identify and formulate gap in research	Define results of the research to be done Define measures for evaluation of results Define objectives for diffusion of results Derive activities Derive timetable	Search for possible partners Put up consortium agreement	Collect feedback Repeat single activities

Table 2-1: Activitie of Analysis phase

The second phase, **Design**, comprises design and development as specified by Peffers et al., using proven techniques for construction of artifacts [Peffers et al. 2006]. Examples would be a catalog containing metrics indicating the degree of maturity of a company's data management, a prototype for a web service, or a method for developing processes.

Figure 2-1 shows examples of techniques used in a rigorous design. Being artifacts of the categories 'model' and 'method', and 'constructs', these techniques are elements of a

scientific discipline's knowledge base. Special aspects of the *Design* phase as part of the Consortial Research method are:

- **Business knowledge:** Together with representatives from the consortium partners, the researcher designs and inspects artifacts incrementally, thereby ensuring that existing approaches are taken into consideration adequately. The artifacts' applicability is best ensured by intensive interaction of researchers and industry experts during construction.
- **Relevance check:** As artifacts are developed in a collaborative effort, artifacts that turn out to be inapplicable can quickly be rejected.
- **Iteration:** Artifacts are repeatedly revised, until they are finally approved by all partners.

The third phase, ***Evaluation***, is an aggregation of two other activities proposed by Peffers et al., namely 'Demonstration' and 'Evaluation' [Peffers et al. 2006]. In this phase, artifacts are tested to find out whether they live up to the research objectives specified before (i.e. they must be applicable and they must yield the expected benefit). Techniques used for evaluation are experiment, simulation, pilot implementation, or functional testing. In the best case (which occurs rather rarely) the delta of a new artifact against an initial state can be measured objectively at the companies participating (e.g. by means of logistics metrics). If artifacts cannot be tested, expert reviews are conducted.

Results of the *Evaluation* phase are documented in evaluation reports (document symbol in Figure 2-1). Consortial Research demands two components for minimum evaluation:

- **Review:** More sophisticated artifacts, like models or methods, are always discussed intensively in at least one workshop (which is designed as a modified form of a focus group interview) with all business representatives participating.
- **Pilot implementation:** Each artifact is tested in at least one company participating in the project.

More activities for evaluation may be conducted depending on the specific type of artifact.

The fourth phase, *Diffusion*, follows the idea of Peffers' et al. communication phase, during which research results are disseminated [Peffers et al. 2006]. March and Smith additionally demand explicit theory building in terms of an explanation as to why and how an artifact has worked as expected during the *Evaluation* phase [March/Smith 1995].

Regarding university research, dissemination of research results primarily means teaching of students and publishing the results in books or scientific journals. In Consortial Research, representatives from the industry additionally demand activities for transfer of research results to their companies. Whether a Consortial Research project is continued largely depends on the instantiation of artifacts in the companies participating.

In the environment of universities more and more organizations are being established that are specifically devoted to fostering the transfer of research results. Likewise, in the environment of Consortial Research projects a kind of 'scientific eco-system' frequently evolves, comprising company representatives, consultants, educational institutions, software developers, and university research, and providing fertile surroundings for further research activities.

While the aim of any university research is to extend the scientific knowledge base by adding new findings gained in research projects (which is typically done by publishing the results in books or scientific journals), Consortial Research demands some more things:

- Implementation plan: How and to what extent research results are being diffused (i.e. how research results are actually used by the consortium partners) is part of the - project plan.
- Teaching materials for practitioners: As scientific publications usually are not suited to be used by practitioners, educational material, reference books, and manuals are important results of Consortial Research.
- Publication for practitioners: An important thing for universities to do is to make research results available to the industry over various media, thereby opening up opportunities for new research topics and potential research partners.

Consortial Research clearly demands that general research results gained in projects be made accessible to the public. Only company specific results, which may have an effect on companies' competitive position, may be classified as confidential.

2.3.5 Techniques

Consortial Research is open to a number of specific techniques. Examples were already given with regard to the design and the development of artifacts. Other techniques could be used to promote creativity, to conduct interviews, or to conduct case studies [Ethridge 1995, Cavana 2001, Lange 2005, Wilde/Hess 2006].

2.3.6 Roles

Consortial Research is ideal for large projects of long duration and for research programs demanding highly structured project management and well-defined roles. Participants from the industry must fill two roles:

- Member of the working group: Experts from the consortium partners work as members of the working group during all phases of the project. They provide practical knowledge, inspect artifacts, test artifacts in their companies, and participate in diffusing research results. If necessary, they are joined by experts from other functional areas.
- Member of the steering committee: The person who has signed the consortium agreement becomes a member of the steering committee hat. The steering committee decides on the project's overall strategy and monitors the project's progress.

For participants from universities, there are three roles to be filled:

- Professor: The professor has the overall scientific responsibility for the project. He or she is rooted in a certain scientific approach and is associated with certain special areas of his/her discipline. During the project, he or she identifies research topics together with his/her team, ensures scientific quality, and ensures that the method of Consortial Research as well as specific techniques are rigorously applied.
- Project manager: The project manager is an experienced researcher (post-doc), who should have some practical experience in the area to be tackled by the project. He or

she produces research results together with his / her scientific assistants, and he /she is responsible for the administrative management of the project.

- Research assistant: Research assistants produce research results under the direction of the project manager and the professor.

3 Assessment of the Method

The research question restated is: Can design oriented information systems research combine theory and practice to produce scientifically rigorous research results that are at the same time of great value to a defined application area in practice? Existing research methods exhibit a fundamental gap, namely in the perception of the knowledge from practitioners, of the application areas, of the problems and their potentials, of the knowledge inherent in existing solutions as well as of the adequacy of theoretical models for the application area.

The assessment of the method is carried out in a multi-perspective approach. Results of research projects using this method or similar approaches are used as indicators for its value. The method framework is evaluated against the criteria of good research postulated by research programs. Moreover, the method is discussed from an action research point of view.

3.1 Assessment of the method's applicability by means of case studies

3.1.1 Case studies

The Consortial Research method is used in the *Business Engineering* research program at the University of St. Gallen (BE HSG) [IWI-HSG 2009]. Since 1989 the program has been connecting private companies and public authorities with the scientific community. In Consortial projects, the research approach is implemented in the form of Competence Centers (CC), in which besides the Institute of Information Management of the University of St. Gallen (IWI-HSG) up to ten user companies work on a common topic. In total more than ten Competence Centers have been established in the last twenty years, dealing with various topics in the area of business engineering. Among the results produced were more than 60 doctoral theses and habilitation theses documenting the development of artifacts. Twelve theses developed architectures, 45 theses produced case studies, 29 theses drew up concepts, 23 theses developed methods, seven theses produced prototypes, and nine theses developed reference models. Research results were documented in 47 publications in scientific journals

of categories A and B (according to the *Wissenschaftliche Kommission Wirtschaftsinformatik* (WKWI) [WKWI 2008]. 74 publications appeared in conference transcripts of categories A and B and in journals of category C. In all Competence Centers the projects were and are financed by the user companies (55 million CHF since 1989).

The scientific outcome as well as the long-term relationships with the partner companies indicates that the results are well accepted in the scientific community and fulfill the expectations of the practice. The majority of partner companies participate in the research program for several years in a row.

A detailed discussion of the particular research method is part of most of the above mentioned scientific publications.

The *Fraunhofer-Gesellschaft zur Foerderung der angewandten Forschung e.V.* in Germany runs 56 institutes with a total of about 13'000 employees. The work of the institutes aims at bringing together research and industry, providing research infrastructures, promoting knowledge transfer, and collaborating with other research institutions [Fraunhofer-Gesellschaft 2003]. Many of the projects follow a procedure very similar to the proposed Consortial Research method. One example is the development of ETIM (Electro-Technical Information Model), in which the *Fraunhofer-Institut fuer Arbeitswirtschaft und Organisation (Fraunhofer IAO)* was involved. ETIM allows describing and classifying electrical articles. It aims at reducing costs for the exchange of product data between manufacturers and traders while at the same time increasing process quality. The information model was developed between 1999 and 2003 by Fraunhofer IAO together with ETIM Deutschland e.V., the *Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (ZVEI)* and the *Zentralverband der Deutschen Elektro- und Informationstechnischen Handwerke (ZVEH)* in a Consortial Research project. ETIM represents a clearing center (an electronic platform for product data) as well as structures and processes for a standardization organization for maintaining and improving the model [ETIM 2001]. The projects were primarily financed by private companies and lead to several implementations in the industry.

The third case study refers to the MIT Total Data Quality Management Program, which is a joint effort comprising members from the TDQM Program, the MIT Information Quality Program, the University of Berkeley, U.S. government agencies (e.g. the U.S. Navy), and

industry partners. The aim of the program is to produce and disseminate scientific results for corporate data quality management.

Table 3-1 contrasts the characteristics of Consortial Research with these three case studies.

Characteristic	BE HSG	Fraunhofer IAO (ETIM)	MIT TDQM
Common definition of research objectives and evaluation	Yes, by means of consortium agreement	Yes, by means of a contract	Yes
Collaboration of industry experts from user companies	Yes, in pilot projects and focus groups	Yes, in all DSR phases	Yes
Artifacts produce benefit for companies	Yes, by using the artifacts in regular business operations	Yes, ETIM is used in regular business operations	Yes
Testing of artifacts in companies	Yes, in pilot projects	Yes, ETIM is used in regular business operations	Yes
Project financing through private companies	Yes, to a large extent	Yes, to a large extent	Yes
Research results are made accessible to the public	Yes	Yes	Yes

Table 3-1: Assessment of the method's applicability by means of case studies

As can be seen, the basic applicability of the method can be confirmed for all three projects described in the case studies.

3.1.2 Other examples

Despite the fact they are not labeled as research, there are many design and development projects in the software and consulting industry which follow the similar principles as postulated by the Consortial Research method. Packaged software is a very specific type of knowledge (kind of reference model). Software vendors such as SAP make use of the knowledge of their corporate customers to develop new models, concepts, and solutions [Thomke/von Hippel 2002]. During each of the four phases specified for Consortial Research, SAP collaborates with partners, customers, and research institutions [SAP 2009b]. Instruments used by SAP are amongst others:

- SAP Developer Network (SDN), comprising more than 1 million members, for collaborative development, testing, and evaluation of concepts and software components.

- Industry Value Networks as a forum for collaboration of SAP with providers of software products and technologies, system integrators, and corporate customers.
- Support of user groups (e.g. America's SAP Users' Group) to channel user demands and take advantage of industry knowledge about both successful and failed concepts and solutions.
- SAP Ramp-Up Program to test constructs and models that are to be translated into applications.

This kind of collaboration between a provider of standard business software and its ecosystem shows the same characteristics that we specified for Consortial Research, namely collaboration of developers and users, testing of artifacts in user companies, project financing through user companies, and practical benefit of artifacts. Also, common definition of objectives and public access to results can be detected – at least to a certain extent – in this example. The results are not adding to the scientific body of knowledge in form of scientific publications, but are part of academic education at dozens of universities all over the world (in case of SAP, fostered by the so-called University Competence Centers).

3.2 Assessment of the method's applicability by means of criteria of public funding programs

Information systems research wants to contribute to the advancement and competitiveness of highly developed national economies. Public authorities have the same intention, so they put up public funding programs in order to promote 'good research'. Thus, the value of Consortial Research can be assessed also by looking at its capability to meet the criteria of such programs. The following programs/authorities have been analyzed:

- The *Industrielle Gemeinschaftsforschung (IGF)*, which is coordinated by the *Arbeitsgemeinschaft industrieller Forschungsvereinigungen (AiF)* in Germany, aims at compensating the disadvantageous situation of small and medium-sized enterprises when they want to do research. Funds are provided by the Federal Ministry of Economics and Technology [AiF 2005].
- The National Science Foundation (NSF) is an American federal agency that promotes the progress of science in many fields, among them computer science and social

sciences. A strategic plan documents the agency's mission, objectives, and main fields of activity [NSF 2006].

- The ICT Work Programme, as part of the Seventh Framework Programme of the European Commission (FP 7), specifies criteria for evaluating project proposals [EC 2007]. The European Commission explicitly enforces the collaboration of industrial and scientific research players and the direct exploitation of the results in an „innovation ecosystem“ [EC 2008].
- The OECD assumes a direct impact of the intensity and quality of collaboration between science and practice on the effectiveness and efficiency of innovation [OECD 2008].
- KTI is the innovation promotion agency of the Federal Office for Professional Education and Technology in Switzerland. Among other kinds of projects, the agency provides funding for so-called Discovery Projects, taking place at the interface between basic research and applied research [KTI 2008].

To identify relevant criteria, we analyzed how these four programs assess submitted project proposals. Table 3-2 lists the criteria and gives for each criterion an assessment as to what degree it is met by Consortial Research.

Criterion	Degree the criterion is met by Consortial Research
Degree of innovation	Neutral: Consortial Research itself has no direct effect on the degree of innovation. The degree of innovation largely depends on the research topic selected.
Scientific quality	High: Due to the high number of iterations (resulting from the number of business experts from user companies and the number of pilot projects) Consortial Research meets the demand for triangulation specified in qualitative research [Maxwell 1996, Yin 2002]. Furthermore, the risk that usage scenarios cannot be compared with each other is reduced in Consortial Research, as it is this very opportunity to compare oneself with others that motivates companies to participate in Consortial Research
Business potential	High: Companies participate in Consortial Research only if they are sure that the expected benefit outdoes the costs and efforts incurred in the project. In this respect, the <i>Analysis</i> phase in Consortial Research projects has an important filter function in a sense that only such research objectives are specified which are expected to yield a positive cost-benefit ratio.
Quality of project execution	High: Quality of project execution is ensured by coupling scientific results and formal results.
Transfer of knowledge to areas of teaching and education	Neutral: With regard to transferring knowledge to areas of teaching and education Consortial Research shows no significant difference when compared to other methods of doing research.

Use of research results	High: Pilot projects in Consortial Research follow the principles of Action Research. Interaction between researchers and business experts leads to a change in reality in user companies, i.e. to a change in processes, standard procedures, and guidelines [Baskerville/Wood-Harper 1996]. The members of the working group participate actively in the research process, first by specifying their requirements and expectations on artifacts, and then by evaluating these artifacts. By this integration of business experts, research results reach exactly those points in user companies where they can be used.
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Table 3-2: Assessment of the method's applicability by means of criteria of public funding programs

The results of this first rough analysis suggest that Consortial Research meets the criteria of public funding programs to a large extent. This assumption is supported by an increasing occurrence of 'Living Labs' (which show similar characteristics as Consortial Research) in research projects funded by the European Commission [Følstad 2008].

3.3 Assessment from a methodical perspective

The Consortial Research method is developed according to the framework of method engineering as the technique for the design phase. It follows primarily the principals of design science and action research, but also incorporates elements of behavioral research e.g. focus group interviews, expert interviews and experiments. In the following, the compliance of the Consortial Research method to the principles of action research is outlined [Davison et al. 2004] (see Table 3-3).

Researcher-Client Agreement (RCA)	This requirement is formalized by means of the consortium agreement.
Cyclical Process Model (CPM)	Multiple evaluations of artifacts are ensured by the number of user companies and the number of pilot projects.
Theory	Researchers in Consortial Research projects adopt the role of designers whose work is based on theory [Heinrich et al. 2007]. While results of behavioristic research constitute pre-stages for the construction of artifacts, evaluation of artifacts in business environments produces new knowledge.
Change through action	Because they have signed the consortium agreement and also because they finance the project, user companies are highly interested in transforming research results into concrete action. The basis to do so is provided by the pilot project plan.
Learning through reflection	Reflection on research results takes place both in pilot projects and in events comprising all members of the consortium, e.g. when results of single Action Research cycles are discussed and evaluated by focus groups.

Table 3-3: Assessment of the method's conceptualization of pilot projects against the principles of Action Research

In terms of behavioral research, five to ten partner companies certainly do not allow for rigorous generalization. The effort to increase the sample significantly and to control the effects of a large number of variables is not realistic. On the other hand, the engaged industry experts represent practical knowledge gathered from multiple different sources over years and cover more aspects (variables) than a questionnaire ever could. They share the knowledge in intensive bilateral project work with the team of researchers. And most important, the quality of the research results often directly linked to their individual annual performance assessment.

3.4 Discrimination against commercial consulting and software development

Application oriented information systems research has often been criticized as being just another form of consulting or contract based development of solutions and software, yet performed under the guise of science. According to that view, such research does not meet the criteria of ‘good’ research. Although the principle question whether research and consulting are disjunct is still open [Miller/Salkind 2002], research, Consortial Research in particular, differs from commercial consulting and software development with regard to the following aspects:

- **Innovation:** Consulting and software development projects have a certain degree of innovation, but primarily apply existing artifacts to new situations. Research on the other side lays the foundation for fundamental innovation. Consulting and software development aim to solve a specific problem for one company whereas research looks for generic artifacts.
- **Multilaterality:** The consortium of a Consortial Research project constitutes a network-like platform for developing results for all participating user companies and for the public. Also, multilaterality can be ascribed to Consortial Research because of the multitude of knowledge sources that can be made accessible during the *Analysis* phase.
- **Risk of failure:** Companies participating in a Consortial Research project are aware of the risk that – although Consortial Research is highly goal oriented – there can be no absolute certainty regarding the project’s results.

- Pre-competitive character: As research topics and objects dealt with in Consortial Research are characterized by early stages of maturity, they usually are of pre-competitive nature [Rogers 2003]. While Consortial Research mainly aims at developing artifacts like constructs, models, and methods, commercial providers of consulting services and software products predominantly render instantiations of artifacts.
- Diffusion of results: One elementary idea of Consortial Research is to make research results available to both the scientific community and the industry.

4 Summary and outlook

Design science and action research as well as behavioral information systems research leave one question open: How can the researcher acquire the domain knowledge correctly and within given time and resource constraints? The proposed Consortial Research method provides a framework for in-depth collaboration between companies and researchers in a common area of interest. The research does not fit to every research setting and question, but in the aforementioned cases. It guides the researcher in the development of artifacts to solve certain classes of practical problems using research techniques of design science, action and behavioristic research.

In doing so, the method for Consortial Research contributes to the objectives of information systems research in three ways:

- It helps extend the knowledge base by gaining new scientific knowledge on the one hand and by making accessible up-to-date and relevant industry knowledge on the other hand.
- It constitutes a platform for collaborative research, thereby increasing effectiveness and innovative power of scientific research as a whole.
- It provides relevant results, as only such research topics are addressed which are expected to offer substantial benefit for business, and because knowledge with regard to previously made mistakes and failures is taken into account.

The Consortial Research method is a contribution to the discussion of rigor and relevance. It is constructed along the guidelines of method engineering. An evaluation by multiple perspectives shows that the method is applicable and its application fulfills the requirements of scientific rigor as well as of practical utility. Future work should improve the research techniques and communicate the opportunities to potential research partners in practice. Information systems research has the opportunity to position itself in the business engineering value chain, i.e. in the further development of our economies by using its position: neutrality, long-term view and fundamental thinking.

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