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Action Research is Similar to Design Science

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Abstract. In management information systems (MIS) action research is long considered as promising but low-level research approach. It has an utmost relevance because action researchers are working with practitioners to solve the important practical problem. Design science outlined some years ago is just winning a wider audience. Action research was traditionally classified into qualitative research methods. But it seems to be the "wrong" home of action research. We shall show that after comparison of the seven aspects: concrete results of the study, knowledge produced, activities, the intent and the nature of a study, the division of labor in a study and generation, use and test of knowledge, the concordance between the characteristics of action research on the one hand and of design science on the other hand is very good. Hence, action research and design science should next be considered as similar research approaches, and this is a turning point in the history of both action research and design science.

Key words: action research, design science, research method, qualitative method

1. Introduction

Ives et al. (1980) in their seminal paper presented a comprehensive framework for research in management information systems (MIS). The necessity for a more comprehensive research framework was derived from a review of past research frameworks. The new framework was validated by mapping 331 MIS doctoral dissertations into its research categories. The dissertations were also classified by research methodology employed. The authors "classified the research strategies employed using Van Horn's (1973) taxonomy of MIS research methods – case studies, field studies, field tests, and laboratory studies. Another method, action research, has been suggested as an MIS research approach by Keen (1974) and Gibson (1975). Action research includes the researcher as an active participant rather than a passive observer. … Only one dissertation employed action research as part of a case study strategy". Action research was not then popular nor supported by the professors guiding dissertations in the information systems (IS).

Orlikowski and Baroudi (1991) examined more than five years of published information systems literature – from between January 1983 and

May 1988 – in four major information systems outlets. These sources were *Communications of the ACM, Proceedings of the International Conference on Information Systems, Management Science*, and *MIS Quarterly*. They studied the frequency of the various research designs. The three primary designs which emerged from this analysis were case studies (13.5%), laboratory experiments (27.1%) and surveys (49.1%). These three designs accounted for almost 90% of the studies. Surveys, however, were clearly the dominant research method in this sample. Only one action research study was found in their sample. The chief editors, the editorial boards nor referees did not supported action research studies, or researchers in IS themselves avoided the use of action research as their research method.

Very recently the leading journal, MIS Quarterly, published the special issue on action research edited by Baskerville and Myers (2004). This special issue demonstrates that action research has become more popular and accepted as a research method in IS. The senior editors of this special issue stated three requirements for the acceptance of articles. "First, the authors must demonstrate a contribution or potential contribution to practice (the action). Second, the authors must demonstrate a clear contribution to research (the theory). Third, the authors must identify in the methods section of the manuscript the criteria by which to judge the research and show explicitly how the research in their manuscript meets those criteria".

In one article accepted into that special issue, the authors (Lindgren et al., 2004) claimed: "Design is central to information systems discipline (Markus et al., 2002; Hevner et al., 2004), and the action research method, with its iterative hypothesis development and testing, is particularly appropriate for the development of system design principles (Walls et al., 1992)". The citation refers to design science on which some important papers (March and Smith, 1995; Hevner et al., 2004; Van Aken, 2004) were recently published. Lindgren et al., (2004) did not elaborate their claim that action research and design science might be close each other. In this paper, our purpose is to analyze *can action research and design science be considered as similar research approaches*?

We shall proceed in our analysis in such a way that we first present some main characteristics of both action research and design science. Thereafter, we consider how well those two sets of characteristics fit with each other, that is, we try to answer to our research question. Finally, we try to evaluate, what our result implicates, in the one hand, on action research, and in the other hand, on design science.

2. Some Characteristics of Action Research

In this section, we try to collect such typical characteristics which describe the nature of action research in general and action research in information systems in particular. Rapoport (1970) identified four streams of action research development: 1. *The Tavistock* stream of experience brought together psychologists and social anthropologists with psychiatrists of a psychoanalytic orientation. 2. *The Operational Research* stream of work was of a multi-disciplinary mix emphasizing mathematics, engineering and the physical sciences rather than the psycho-biological sciences. 3. *The Group Dynamics* stream emerged from the work of Kurt Lewin and his followers. They have generated a number of studies with emphases on leadership, power, group dynamics, stress and identity. 4. *The Applied Anthropology* stream was another development with an action research emphasis. Rapoport also defined *action research* as the method which aims to contribute both to the practical concerns of people in an immediate problematic situation and to goals of social science by joint collaboration within mutually acceptable ethical framework. I pick up one of the fundamental features of action research (AR) from the definition above:

AR-1 (version 1): Action research contributes to the practical concerns of people in an immediate problematic situation.

AR-2 (version 1): Action research contributes to goals of social science.

Susman and Evered (1978) described the cyclical process of action research (Figure 1).

Susman and Evered consider all five phases (1. diagnosing, 2. action planning, 3. action taking, 4. evaluating and 5. specifying learning) to be necessary for a comprehensive definition of action research. However, action research projects may differ in the number of phases which is carried out in collaboration between action researcher and the client system. The cyclical form with 5 phases is performed as many times as needed for achieving a solution to the problem. Baskeville and Wood-Harper (1998)

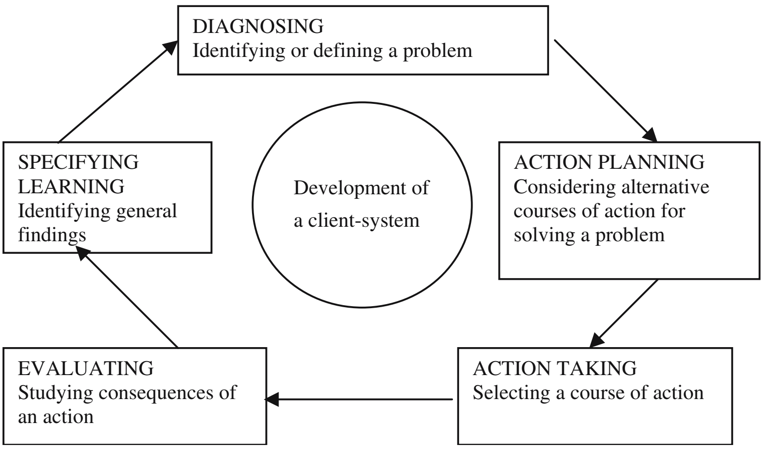

Figure 1. The cyclical process of action research (Susman and Evered, 1978).

call this approach to action research as a canonical one. From the phases of the canonical action research and the verbal description I find that

AR-3: Action research means both action taking and evaluating.
AR-4: Action research is carried out in collaboration between action researcher and the client system.

Susman and Evered (1978) characterized action research with six properties: 1. it is future oriented, 2. it is collaborative, 3. it implies system development, 4. it generates theory grounded in action, 5. it is agnostic and 6. it is situational. According to Susman and Evered those six properties provide a corrective to the deficiencies of positivist science. Susman and Evered explicate the first property (action research is future oriented) as follows: "In dealing with the practical concern of people, action research is oriented toward creating a more desirable future for them." From the latter I conclude that

AR-1 (version 2): Action research emphasizes the utility aspect of the future system from the people's point of view.

Oquist (1978) analyzed the kind of knowledge action research produces and its relation to different schools of philosophy of science. Action research is the production of knowledge to guide practice, with the modification of a given reality occurring as part of the research process itself. Within action research, knowledge is produced and reality modified simultaneously, each occurring due to the other. Oquist presented the reasons why action research do not belong to Empiricism, Logical Positivism nor Structuralism, but it seems to belong to Pragmatism and Dialectical Materialism. From above I shall slight clarify AR-2 as follows:

AR-2 (version 2): Action research produces knowledge to guide practice in modification.

From Oquist (1978) and Susman and Evered (1978) I pick up

AR-5: Action research modifies a given reality or develops a new system.

Baskeville and Wood-Harper (1998) described and analyzed the different models, structures and goals in various forms of action research. The boundaries of the IS action research paradigm defined in their paper parallel the published characteristics of action research in the social science literature. However, this literature is dominated by the canonical form of action research (cf. Figure 1), and tend to emphasize action research characteristics based on goals and objectives rather than characteristics based on the process. Baskerville and Wood-Harper's boundaries differ in the following ways, following Hult and Lennung's (1980) six major characteristics of action research:

1. Action research aims at an increased understanding of an immediate social situation. This goal is very similar to their (Baskerville and Wood-Harper's) view, although they emphasize the complex and multivariate nature of the social setting in the IS domain.
2. Action research simultaneously assists in practical problem solving and expands scientific knowledge. They extend this goal into two important process characteristics: first, there are highly interpretive assumptions being made about scientific observation; second, the researcher intervenes in the problem setting.
3. Action research is performed collaboratively and enhances the competencies of the respective actors. They focus on the narrower process of participatory observation implied by the collaborative goal. Enhanced competencies (an inevitable result of collaboration) are relative to the previous competencies of the researchers and subjects, and the degree to which this is a goal and its balance between the actors will depend upon the setting. The competencies goal may help to determine the form of action research: seen as a primary goal in some settings (e.g., canonical or clinical forms); seen as a by-product in other forms (e.g., process consultation and prototyping).
4. Action research is primarily applicable for the understanding of change processes in social systems. This characteristics is adopted explicitly in defining the IS action research boundaries.
5. Action research uses data feedback in a cyclical process. They did not adopt this characteristic. The empirical nature of action research data is implied by participatory observation. The cyclical process, while characteristic of some action research forms, cannot be justified as a critical defining characteristic of all action-based research. It is feasible that the outcome of the first (and only) iteration will be satisfactory. Some action-based research forms may assume this first outcome will usually be satisfactory.
6. Action research is undertaken within a mutually acceptable ethical framework. They did not adopt this characteristic. They agree completely with this platitude, and strongly feel that all research should adopt a mutually acceptable ethical framework regarding human subjects. Accordingly, they note that this characteristic does not distinguish action research from any other form of acceptable social research.

From item 2 above I found that

AR-6: The researcher intervenes in the problem setting.

Gummeson (2000, p. 208), the famous author of the text in management research, describes the management action scientist: "On the basis of their paradigms and pre-understanding and given access to empirical real-world data through their role as change agent, management action scientists develop an understanding of the specific decision, implementation, and change process in the cases with which they are involved. They generate a specific (local) theory which is then tested and modified through action". On the basis of the description above we can conclude that

AR-7: Knowledge is generated, used, tested and modified in the course of the action research project.

From the special number of action research (Baskerville and Myers, 2004) we picked three managerially oriented articles to be read in our seminar for PhD students (Järvinen, 2004b). Iversen et al., (2004) is study is not the typical action research (Järvinen 2004a, Section 5.3) but more close to the field test (Järvinen 2004a, Section 3.2) of the frameworks and methodologies the researchers developed based on their literature survey. Mårtensson and Lee (2004) introduced a new approach, dialogical approach, to action research. Two examples are excellent descriptions how reflective dialogue helped both the managing director and the researcher to proceed, that is, to realize changes in their businesses, in praxis and theoria. They "characterize the thinking of Ph.D.-trained social scientists as scientific, whether they subscribe to positivist, interpretive, or critical research approaches". The list of the three research approaches only concerns both the natural and social sciences, but not design sciences. Natural sciences and social sciences try to understand reality. Action researchers' intent is to plan and to take action in order to change a part of reality. Lindgren et al., (2004) was the only one of the three articles I can appreciate because they found that action research is close to design science.

Finally, I would like to make a note, that the wording in AR-3 (Action research is carried out in collaboration between action researcher and the client system) is a good choice, because it also covers cases (e.g. Coghlan, 2001; Lallé, 2003) where the researcher him- or herself belongs the client system, that is, she/he improves his/her own work by performing action research. I shall later compare those seven fundamental properties of action research with the characteristics of design science which will next be derived from the literature.

3. Some Characteristics of Design Science

In his analysis of research methods Iivari (1991) referred to "Burrell and Morgan (1979) who distinguished two extremes in the case of methodology: nomothetic methods and idiographic ones. Taking into account the special character of IS and computer science as applied sciences, Iivari identified on more category of constructive methods (conceptual development and technical development). Conceptual development as a category of constructive research methods refers to the development of various models and frameworks which do not describe any existing reality but rather help to create a new one, and which do not necessarily have any 'physical' realization. Technical development produces as its outputs 'physical' artefacts, the adjective 'physical' being interpreted here broadly to include executable software (e.g. CASE environments)". To our mind, conceptual development produces the description of the desired state of the new information system, and technical development produces the realization of that new system, or more precisely its technical subsystem. From above I derive the first version of the following characteristic:

> DS-1 (version1): Technical development produces as its outputs 'physical' artefacts.

Nunamaker et al. (1991) described and defended the use of systems development as a methodology in IS research. They proposed a framework to explain the nature of systems development as a research methodology in IS research. Use of this methodology in the engineering field in general was compared with its use specifically in computer science and computer engineering. An integrated program for conducting IS research that incorporates theory building, systems development, experimentation and observation was proposed.

Nunamaker et al. (1991) claimed that "It is clear that some research domains are sufficiently broad that they embrace a wide range of methodologies. This is particularly true in engineering and systems where the concept at issues is likely to be viewed for its application value rather than for its intrinsic value. This suggests that a concept with wide-ranging applicability will go through a research life cycle of the form: concept – development – impact. Much IS research demonstrates such a life cycle. ... The advancement of IS research and practice often comes from new systems concepts. For instance, the use of information systems to support competitive advantages, electronic meetings, executive information systems, concurrent engineering etc., had its origin in MIS researchers' and practitioners' imagination. This creativity represents research at the 'basic' or 'concept' level and provides the raw material out of which many large, pragmatic investigations are formed. Concepts alone do not ensure a system's survival. Systems must be developed in order to test and measure the underlying concepts. ... Perhaps the major motivation in computing and computer application research is, 'what can be automated and how can it be done efficiently and effectively?' This is consistent with the concept – development – impact model. It suggests that "theories" are needed to identify what broad classes of things can be automated, 'instantiations' are needed to provide a continuing test bed for the theories, and that 'evaluations' of particular instances (systems) are needed to quantify success or failure of a system in both technical and social terms. Systems development provides the exploration and synthesis of available technologies that produces the artefact (system) that is central to this process. The artefact that results from systems development functions as a bridge between the technological research, which we have referred to as the 'concept' stage, and the social research, which we have referred to as the 'impact' stage." Nunamaker et al. (1991) support characteristic DS-1 (version1), in addition they present two new characteristics:

> DS-2 (version 1): The advancement of IS research and practice often comes from new systems concepts.
> DS-3 (version 1): After the development a particular instance of the new system its 'evaluation' is needed to quantify success or failure of a system in both technical and social terms.

We bypass the proposal made by Walls et al., (1992), because it is not in line with March and Smith (1995) who refer to Simon (1981) and bring design science into discussion. "Where as natural sciences and social sciences try to understand reality, design science attempts to create things that serve human purposes. It is technology-oriented. Its products are assessed against criteria of value or utility – does it work? Is it improvement? Building an artefact demonstrates feasibility. We build constructs, models, methods and instantiations." They gave a more concrete objective for research in the build activity: "It should be judged based on value or utility to a community of users". According to our wording we should ask: Did we achieve our desired state in the building or construction? The differentiations made by March and Smith support and slightly modify characteristic DS-1 and present the fourth one:

> DS-1 (version 2): Design science produces technical artefacts.
> DS-4 (version 1): Design science's products are assessed against criteria of value or utility.

According to March and Smith (1995) building and evaluating IT artefacts have design science intent. To their mind, "evaluate refers to the development of criteria and assessment of artefact performance against those criteria. We (March and Smith) try determine if we have made any progress. The basic question is, how well does it work? Evaluation requires the development of metrics and the measurement of artefacts according to those metrics. Metrics define what we are trying to accomplish. They are used to assess the performance of an artefact". March and Smith (1995) wrote also that, if the artefact (i.e. construct, model, method or instantiation) is really novel, "actual performance evaluation is not required at this stage". March and Smith crystallize characteristic DS-3 as follows:

DS-3 (version 2): Building and evaluation are the two main activities of design science.

According to March and Smith (1995) design science products are of four types, constructs, models, methods, and instantiations. We use their definitions. Constructs or concepts form the vocabulary of a domain. A model is a set of propositions or statements expressing relationships among constructs. A method is a set of steps (an algorithm or guideline) used to perform a task. An instantiation is the realization of an artefact in its environment. The first three types supplement characteristic DS-2.

DS-2 (version 2): Design science produces design knowledge (concepts, constructs, models and methods)

March and Smith (1995) wrote that "research in the build activity should be judged based on value or utility to a community of users". They differentiate two cases concerning whether the construct, model, method, or instantiation already exists or is it totally lacking. For the latter case "building the first of virtually any set of constructs, model, method, or instantiation is deemed to be research, provided the artefact has utility for an important task. The research contribution lies on the novelty of the artefact and in the persuasiveness of the claims that it is effective. Actual performance evaluation is not required at this stage". For the former case, the construct, model, method, or instantiation in a certain form already exits, March and Smith (1995) gave the recommendation: "The significance of research that builds subsequent constructs, models, methods, and instantiations addressing the same task is judged based on 'significant improvement', e.g. more comprehensive, better performance". To apply the comparison idea a researcher could ask: Is the new construct, model, method or instantiation in some sense better than the old one? Phrase 'in some sense' means a certain assessment criterion used in comparison.

March and Smith (1995) considered all types of artefacts: constructs, models, methods and instantiations and proposed some metrics for them. We think that they strove to give as universal metrics as possible. We shall follow the order: constructs, models, methods, and instantiations, and present the proposals of March and Smith and then comment the proposals. According to March and Smith "evaluation of constructs tends to involve completeness, simplicity, elegance, understandability, and ease of use". March and Smith did not give any rationale for their list.

Models are according to March and Smith "evaluated in terms of their fidelity with real world phenomena, completeness, level of detail, robustness, and internal consistency". The first criterion, the fidelity of the model with real world phenomenon, can be checked *ex post*, but at the beginning of the implementation process (*ex ante*) the model of the target state describes a desire not yet realized. The next two criteria, completeness and level of detail, can be related to the reality by following Smith (1985) who wrote that "every model deals with its subject matter at some particular level of abstraction, paying attention to certain details, throwing away others, grouping together similar aspects into common categories, and so fort. ... Models have to ignore things exactly because they view the world at a level of abstraction. And it is good that they do: otherwise they would drown in the infinite richness of the embedding world". Hence, we cannot demand completeness of the model in relation to reality. The robustness criterion was not defined. One interpretation can be similar as Bunge did in consideration of classification. "By classification we can divide elements into classes or groups. One of the principles of correct classification (Bunge 1967a, p. 75) is that the characters or properties chosen for performing the grouping should stuck to throughout the work", that is, the grouping principle(s) is robust. The internal consistency criterion is, to our mind, a natural requirement from research point of view.

Evaluation of methods according to March and Smith concerns "operationality (the ability to perform the intended task or the ability of humans to effectively use the method if it is algorithmic), efficiency, generality and ease of use".

Evaluation of instantiations according to March and Smith concerns "the efficiency and effectiveness of the artefact and its impacts on the environment and its users".

Hevner et al. (2004) market and "inform the community of IS researchers and practitioners of how to conduct, evaluate, and present design science research. They do so by describing the boundaries of design-science within the IS discipline via a conceptual framework for understanding information systems research and by developing a set of guidelines for conducting and evaluating good design-science research". Their definition of IT artefacts "is narrower in the sense that they do not include people or elements of organizations in their definition nor do they explicitly include the process by which such artefacts evolve over time. They conceive of IT artefacts not as independent of people or organisational and social contexts in which they are used but as interdependent and co-equal with them in meeting business needs". This article does not give much new compared with March and Smith (1995), because Prof Salvatore March is one of the authors in the both articles.

Referring to Simon (1981) Van Aken (2004) describes that "the mission of a design science is to develop knowledge for the design and realization of, that is, to solve construction problems, or to be used in the improvement of the performance of existing entities, that is, to solve improvement problems", in other words, to implement some innovation. Van Aken enlarges characteristic DS-1 as follows:

> DS-1 (version 3): Design science solves construction problems (producing new innovations) and improvement problems (improving the performance of existing entities).

Van Aken does not consider an instantiation as the outcome of the design-science study, but its ultimate mission is to develop design knowledge, that is, knowledge that a professional can use in designing solutions to problems. "It is important to teach a civil engineer subjects like physics and mechanics, but in designing a bridge he or she needs the design knowledge developed by his or her discipline, like for instance the properties of different types of bridges. In the same way a medical doctor should have a working knowledge of physics and biology, but for medical problem solving he or she predominantly uses the results of the clinical research of his/her own discipline". Van Aken clearly supports characteristic DS-2 (Design science produces design knowledge).

Design knowledge concerns "three designs: an object-design, the design of the intervention or of the artefact; a realization-design, that is, the plan for the implementation of the intervention or for the actual building of the artefact; and a process-design, that is, the professional's own plan for the problem solving cycle, or, put differently, the method to be used to design the solution to the problem. This design knowledge is general, that is, valid for classes of cases. The problem of the professional, however, is always unique and specific. Therefore, general knowledge must be translated to the unique and specific case at hand".

"Within each of the three types of design knowledge, prescriptions are an important category. The logic of a prescription is 'if you want to achieve Y in situation Z, then perform action X'. There are algorithmic prescriptions, which operate like a recipe. However, many prescriptions in a design science are of a heuristic nature. They can rather be described as 'if you want to achieve Y in situation Z, then something like action X will help'. 'Something like action X' means that the prescription is to be used as a design exemplar. A design exemplar is a general prescription which has to be translated to the specific problem at hand; in solving that problem, one has to design a specific variant of that design exemplar." Van Aken (2004) enlarges characteristic DS-2 with prescriptions describing potential opportunities to help the transfer process from the initial problematic state toward to the desired state.

"In the design sciences the research object is a 'mutandum'; these sciences are not too much interested in what is, but more in what can be. The typical research product is the prescription discussed above or in terms of Bunge (1967b, p. 132) a technological rule: 'an instruction to perform a finite number of acts in a given order and with a given aim'. A technological rule is defined as a chunk of general knowledge, linking an intervention or artefact with a desired outcome or performance in a certain field of application. A major breakthrough occurred with the systematic testing of technological rules. The tested technological rule is one whose effectiveness has been systematically tested within the context of its intended use. The real breakthrough came when tested technological rules could be grounded on scientific knowledge (Bunge 1967b, p. 132), including law-like relationships from natural sciences. The typical research design to study and test technological rules is the multiple case: a series of problems of the same class is solved, each by applying the problem solving cycle. By borrowing concepts from software development one can say research on technological rules typically goes through a stage of α-testing, that is, testing and further development by the originator of the rule, to be followed by a stage of β-testing, that is, the testing of the rule by third parties." Van Aken (2004) both enlarges characteristic DS-2 with technological rules and demands that those technological rules must be grounded and tested.

Van Aken (2004) considers the building process either after or before the actual realization. As said earlier multiple case studies are valid for the extracting and the developing case study. The extracting multiple case-study "is a kind of best-practice research and is aimed at uncovering technological rules as already used in practice. A good example of such research is the classical study of Womack et al., (1990) of the automotive industry and especially of Japanese practices. This research has produced, among other things, a number of very powerful technological rules, like the Kanban-system and Just-in-Time delivery for driving a supply chain.

In the developing multiple case study the technological rules are developed and tested by researcher(s) in close collaboration with the people in the field and often in the context of application. Such research is initiated by the researcher(s) interested in developing technological rules for a certain type of issue. Each individual case is primarily oriented at solving the local problem in close collaboration with the local people. Following the reflective cycle, after each case the researcher develops knowledge that can be transferred to similar contexts on the basis of reflection and cross-case analysis. This development process can first go through a stage of α-testing, that is, analysis of effectiveness of a certain rule in the original context. But invaluable insight can be gained by subsequent 'β-testing', that is, translating the rule to other contexts, having third parties use it, assess its effectiveness and make final improvements. It is this β-testing, which can provide further insight into the indications and contra-indications for the rule and hence in its application domain". Both the successes and the unsuccessful applications should be included into the scientific knowledge base of design science. Van Aken (2004) also pays attention to the participants of the construction or improvement processes and hence creates the following characteristic:

DS-5: Design science research is initiated by the researcher(s) interested in developing technological rules for a certain type of issue. Each individual case is primarily oriented at solving the local problem in close collaboration with the local people.

Järvinen (2004a) has recently enlarged both Hevner et al.'s (2004) view (technical artefacts only are allowable) and Van Aken's (2004) (social innovations are allowable) view on design science with the third resource type, informational resources used in the development of a new innovation. Hence, the new innovation can be based on new properties of technical, social and/or informational resources or their combination. This resource-oriented perspective slightly enlarges the concept view of Nunamaker et al. (1991).

In their design science portal Vaishnavi and Kuechler (2004) describe the general methodology of design research in (Figure 2). They describe steps as follows: "In this model all design begins with Awareness of a problem. Design research is sometimes called "Improvement Research" and this designation emphasizes the problem-solving/performance-improving nature of activity. Suggestions for a problem solution are abductively drawn from existing knowledge/theory base for the problem area. An attempt at implementing an artefact according to the suggested solution is performed next. This stage is shown as Development in the diagram. Partially or fully successful implementations are then Evaluated (according to the functional specification implicit or explicit in the suggestion). Development, Evaluation and further Suggestion are frequently iteratively performed in the course of the research (design) effort. The basis of the iteration, the flow

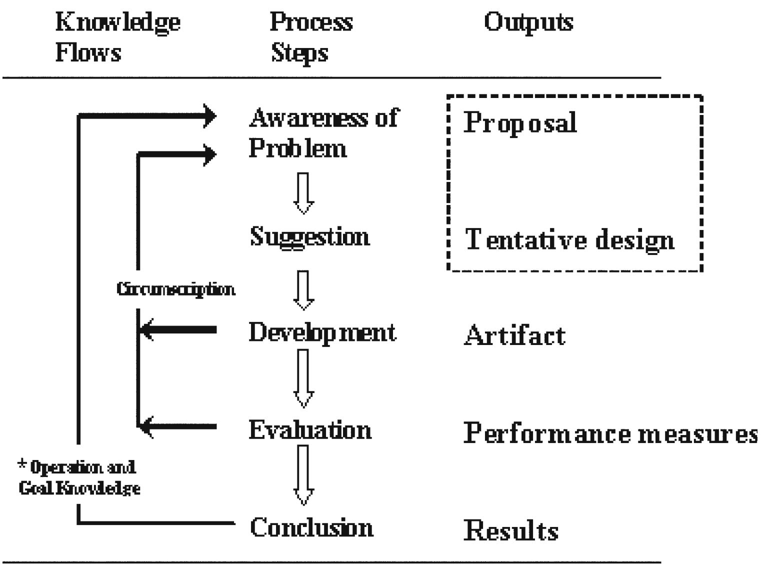

Figure 2. The general methodology of design research.

from partial completion of the cycle back to Awareness of the Problem, is indicated by the Circumscription arrow. Conclusion indicates termination of a specific design project."

Vaishnavi and Kuechler also refer to Owen (1997) who presents a general model for generating and accumulating knowledge that is helpful in understanding design disciplines and the design research process: "Knowledge is generated and accumulated through action. Doing something and judging the results is the general model … the process is shown as a cycle in which knowledge is used to create works, and works are evaluated to build knowledge." From the citation above we conclude

DS-6: Knowledge is generated, used and evaluated through the building action.

We are now at the end in describing the most important characteristics of design science or design research, and we are ready to compare them with the characteristics of action research.

4. Fit Between the Characteristics of Action Research and Design Science

To start we ask the reader to compare the cyclical process of action research (Figure 1) and the general methodology of design research (Figure 2). To my mind, there are many similarities, e.g. five steps with different names but almost identical contents. To compare two approaches in more detail we collect the characteristics derived above. The numbering in both sets of the characteristics took place in the chronological order. The numbers do not therefore exactly correspond each other. We shall in Table I follow the numbering of action research and try to find the corresponding characteristic of design science. The "latest" version is used. In the five pairs of the total 7 pairs (AR-1 & DS-4; AS-3 & DS-3; AR-5 & DS-1; AR-6 & DS-5; AR-7 & DS-6) the similarities are obvious, respectively. In the second pair (AR-2 & DS-2) the latter consists from many different types of design knowledge, e.g. concept, constructs, models, methods, prescriptions, technical rules etc. but all the types connected with design. Although in action research the knowledge produced were not explicated much, it concerns both the process and its result. In the fourth pair (AR-4 & DS-5) the collaboration is emphasized in both sides. In information systems the lack of co-operation between designers and the future users in the building process is in many studies found to cause failures.

To summarize, we have compared some important characteristics of both action research and design science, and the fit between dimensions seem to be very high. To this end, we claim that action research and design science should be considered as similar research approaches.

Table I. Similarities of the fundamental characteristics of action research and design science

Action research	Design science
AR-1: Action research emphasizes the utility aspect of the future system from the people's point of view.	DS-4: Design science's products are assessed against criteria of value or utility.
AR-2: Action research produces knowledge to guide practice in modification.	DS-2: Design science produces design knowledge (concepts, constructs, models and methods).
AR-3: Action research means both action taking and evaluating.	DS-3: Building and evaluation are the two main activities of design science.
AR-4: Action research is carried out in collaboration between action researcher and the client system.	DS-5: Design science research is initiated by the researcher(s) interested in developing technological rules for a certain type of issue. Each individual case is primarily oriented at solving the local problem in close collaboration with the local people.
AR-5: Action research modifies a given reality or develops a new system.	DS-1: Design science solves construction problems (producing new innovations) and improvement problems (improving the performance of existing entities).
AR-6: The researcher intervenes in the problem setting.	DS-5: Design science research is initiated by the researcher(s) interested in developing technological rules for a certain type of issue. Each individual case is primarily oriented at solving the local problem in close collaboration with the local people.
AR-7: Knowledge is generated, used, tested and modified in the course of the action research project.	DS-6: Knowledge is generated, used and evaluated through the building action.

5. Discussion

In this section we shall consider implications of our result, that is, action research and design science seem to be the similar research approaches, limitations of our study, practical recommendations and new research needed. First, we comment the earlier assumption that action research is a qualitative research method (Baskerville and Wood-Harper, 1998). One reason for this assumption could be the ignorance of design sciences. In fact, their paper supports the similarities of action research and design science, because they included the following design science approaches in IS:

information systems prototyping, soft systems methodology (Checkland, 1981), Multiview (Avison et al., 1998) and Ethics (Mumford, 1995), into their different forms of action research. The main reason to differentiate action research from the tradition of natural and social sciences concerns the research intent. Natural sciences and social sciences try to understand reality. Natural and social scientists develop sets of concepts, or specialized language, with which to characterize phenomena, describe the nature of reality with a certain theory. Action researchers' intent is to plan and to take action in order to change a part of reality.

To demonstrate the difference between natural and social sciences, and design science we take Weber's (2003) view on the theory development. He recommends that the researcher articulate the lawful state space and the lawful event space of a theory. In the improvement task which action researcher studies there is a problematic existing system which can be described with the lawful state and event spaces plus the bad value of the goal function. The natural and/or social scientist can study the lawful state and event spaces of the existing system. He or she is not interested in the value of goal function, that is, the utility of the system, but the action researcher is. The action researcher in co-operation with the practitioners plans the desired future system and the expected better value of the goal function. When the description of the problematic system is a tentative positive theory of the system, the description of the planned future system is a tentative normative theory, because the action researcher and practitioners want that the future system ought to be as described after the "action taking" phase. The transition from the problematic state to the desired state is a unique, hopefully irreversible or sustainable (Lindgren et al., 2004) and one-time change which must be planned and implemented by the action researcher and practitioners. After implementation the research methods in natural and social sciences can be applied to the new realized system, and again the result is a tentative positive theory of the new system which describes the structure and functioning of the new system, but not the goal function of the new system. The latter belongs to the domain of action research and design science. We hope that the delineation of the different interests between the natural and the social scientists on the one hand and the action and design researchers on the other hand will demonstrate how those sciences differ from action research and design science.

The change of the science position proposed, that is, action research is similar to design science, is the very important and far-reaching result as such, and may imply many changes in ways how to validate the action research study, what to include into the study report, etc. Much advice can be taken from design science. The new system, an instantiation as a result of action research, is now accepted as a scientific merit of the action researcher.

We know that in our analysis and comparison there are some deficiencies. To our mind, our seven characteristics are the most important factors, and they can be kept as a tentative list of dimensions to compare two research approaches. But in the future researchers can possibly find even more evidence and support to our result: action research and design science are similar.

When March and Smith (1995) and Hevner et al. (2004) emphasize the constructions and the significant improvements, Van Aken (2004) accepts the moderate improvements, even failures and the scientific knowledge about them. Note that Van Aken's view is analogical and similar as Davis and Parker's (1979) balanced view with explanatory studies, that is, both confirming and falsifying results are interesting, when March and Smith, and Hevner et al. only emphasize the success stories of new IT applications. Baskerville and Wood-Harper (1998) recommend that the results of the action research study "should help to explain why certain actions resolved the problem setting and why certain actions failed to resolve the problem setting". I agree with the other authors above that in addition to successes also failures should be reported, and this issue as such needs further study.

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