Research Questions Guiding Selection of an Appropriate Research Method

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Abstract Research objects and research outcomes are proposed to act as a guide to select a proper research method. We, however, recommend that the research question as the essential factor of the research process should guide selection. Based on this idea we here develop taxonomy of research approaches with six categories. Taxonomy is then compared with three other classifications of research methods by using the comprehensiveness, parsimony and usefulness criteria.

I. INTRODUCTION

In natural and social sciences the main question has been: What or which kind is the world? Concerning an artifact and its construction process we ask: Why and how do we build an artifact, e.g. an information system (IS)? The objects under study and the questions are different, and the research methods and criteria used in evaluation of both types of studies might be different, too or are they?

In order to study the IS development methodology Galliers and Land [1] recommended to use such research methods as the field experiment, case study, survey, simulation, sub-jective/argumentative, descriptive/interpretive and action research. Nunamaker et al. [2] described and defended the use of systems development as a (research) methodology in IS research. Although we understand that on one hand the research methodology itself can be as a research object and on the other hand some information like the IS requirements are elicited during the IS development process, those two roles of the IS development methodology creates confusion. The dilemma also demonstrates the wideness of IS research domain. Hence we have many good reasons to more thoroughly study characteristics of research methods and try to structure them in the new and more natural way.

In this paper we first classify research objects and research questions. In fact, we develop and propose taxonomy to categorize information systems research. Our taxonomy reconciles the dilemma above. Vogel and Wetherbe [3] who presented one of the first taxonomies motivated their creation by writing: "Taxonomies help to focus research, clarify representation in the literature, define standards and spot trends or gaps in the research". Thus, the taxonomy can in many ways support an IS researcher in his research efforts.

We define a *research approach* as a set of research methods that can be applied to the similar research objects and research questions. The reason for taking a research approach instead of a research method as a unit of analysis is the limitations of human information processing [4]. We have tens of different research methods, for example, Miles and Huberman [5] refer to Tesch's [6] collection with 27 qualitative research methods, but the mental capacity of the human short term memory is restricted, 5 ± 2 observational units (von Wright [4]). Hence we restrict our taxonomy development on research approaches, and give lists of research methods belonging to a certain approach.

To test effectiveness of our taxonomy we apply Vogel and Wetherbe's [3] criteria of comprehensiveness, parsimony and usefulness. Bunge's [7, p. 75] argumentation for a good classification support the criteria above. To relate our taxonomy with other taxonomies we shall show differences between our taxonomy and the three other ones ([1], [2] and March and Smith [8]). Our aim is to argue how and why our taxonomy might better than the other taxonomies to assist an IS researcher in making an appropriate choice.

II. TAXONOMY OF RESEARCH OBJECTS AND RESEARCH METHODS

In the development of our taxonomy the top-down principle is applied, i.e. all the research approaches is first divided into two classes, one or both are then divided again into two sub-classes etc. (Fig. 1). At the beginning we differentiate other methods from mathematical methods, because they concern formal languages, algebraic units etc., in other words, symbol systems without having any direct reference to objects in reality. From the rest of methods concerning reality we then use research questions in differentiation. Two classes are based on whether the research question refers to what is a (part of) reality or does it stress on utility of an artifact (something made by human beings). From the former we differentiate conceptual-analytical approaches, i.e. methods for theoretical development, from empirical research approaches. When the past and present are empirically studied, we differentiate the theory-testing or theory-creating methods depending on whether there is a theory, model or framework guiding the study or is a researcher developing a new theory grounded on the gathered raw data. Regarding artifacts we propose a differentiation between to build and to evaluate them.

To give a more concrete view on our classes we enumerate their research methods. There are, however, a few research methods, e.g. case study, having many variants that belong to more than one approach. We therefore later consider different variants of the case study in more detail.

In *mathematical* studies a certain theorem, lemma or assertion is proved to be true in a particular context of fundamental mathematical pre-suppositions. The research question could then be as follows: Can we prove this theorem to be true?

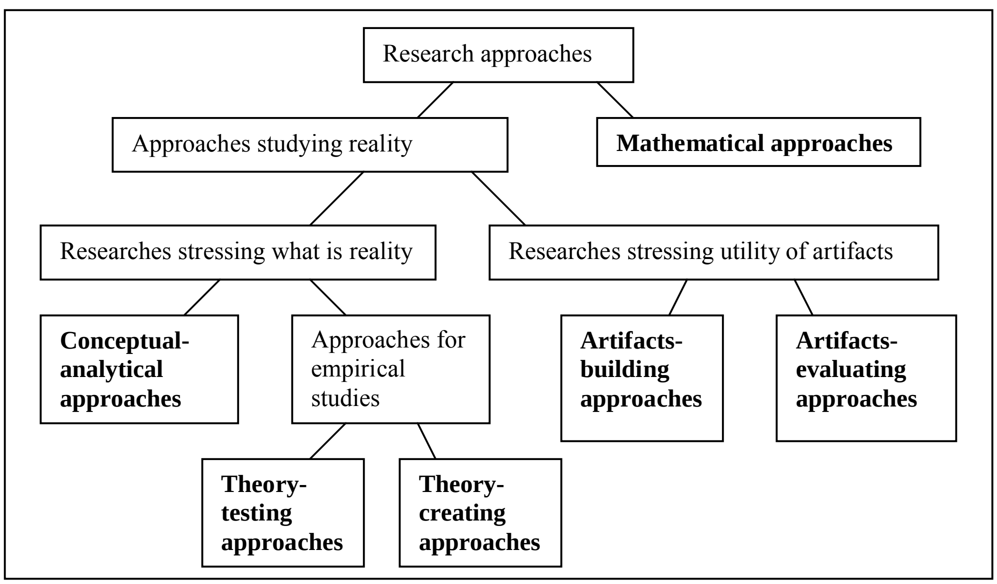

Fig. 1. Jarvinen's taxonomy of research methods

As an example of mathematical approaches we recommend a reader to look at how Aulin [10, 104] proved Ashby's [9] Law of Requisite Variety. Derivation of the Law of Requisite Variety does not require advanced mathematical methods. This law is an entropy law. If A is a variable of any kind, the entropy H(A) is a measure of its variety. It shows how much the various appearances of A differ from each other. For a quantifiable variable, entropy is just another measure of variance. But entropy can be used, as a measure of variety, for qualitative variables as well. The Law of Requisite Variety says that the variety of regulator plus the regulatory effects of outer arrangements must be greater than the variety of disturbance and the variety of the regulator's uncertainty. – To our mind, although the Law of Requisite Variety is applicable to very many different problems, it does not concern any specific domain in reality, and hence it belongs to the objects of mathematical approaches.

In *conceptual-analytical* studies normally two different approaches are identified. First, we can start from the assumptions, premises and axioms and derive the theory, model or framework. A researcher could ask: Which kind of theory concerning a certain part of reality could be derived, if certain assumptions and premises are valid? Second, the basic assumptions behind constructs in previous empirical studies are first analyzed; theories, models and frameworks used in those studies are identified, and logical reasoning to integrate them is thereafter applied. A researcher could then ask: Is there any common theory, which describes and explains those phenomena?

The example of the conceptual-analytical approaches concerns organizational mechanisms for enhancing user innovation in information technology (IT). The research question posed by Nambisan et al. [11] asks: "How can an organization encourage and nurture IT innovation among users? IT innovation initiation is viewed as a process of knowledge creation. Nambisan et al. offered a two-dimensional taxonomy derived from organizational learning theory. The two dimensions are: (1) the type of knowledge and (2) the type of knowledge creation activity. An organization desiring to exploit a new technology needs to acquire three different types of knowledge [12]: Type 1 is knowledge about an IT without reference to any application context. Type 2 is knowledge about the application of an IT in the general business/industry (external) context. Type 3 is knowledge about the application of an IT in an organization's own (internal) context. Nambisan et al. identified two types of knowledge creation activity based on Huber's [13] classification of knowledge acquisition and knowledge conversion. By combining two typologies Nambisan et al. formulated their taxonomy of five classes:

Class 1: Acquisition of type 1 knowledge
Class 2: Acquisition of type 2 knowledge,
Class 3: Acquisition of type 3 knowledge,
Class 4: Conversion of type 1 knowledge into type 2 knowledge, and
Class 5: Conversion of type 1 or type 2 knowledge into type 3 knowledge.

We did not use the deductive strategy to derive the theory from the assumptions, premises and axioms because of the scarcity of space, but we applied the inductive strategy by integrating the two known structures.

In the *theory-testing* studies such methods as laboratory experiment, survey, field study, field experiment etc. are used. In the study where the theory-testing method is used the theory, model or framework is either taken from the literature, or developed or refined for that study. The research question could then be read: Do observations confirm or falsify that theory?

As an example of the theory-testing approaches we continue to use the study performed by Nambisan et al [11]. They used the taxonomy with five classes for organizational mechanisms. An extensive review of the IS literature resulted in a preliminary set of 19 mechanisms. This set was presented to practicing IS managers in six organizations. After excluding some mechanisms the managers were requested to allocate each mechanism into one of the five classes in a Delphi study. Seven out of the 14 mechanisms were unambiguously classified in the first round and five additional mechanisms in the second round. Two mechanisms classified in the third round were eliminated from subsequent analysis concerning antecedents of those five classes. Nambisan et al then described the mechanisms in different five classes. – Our example is not the most typical one, e.g. not any controlled experiment nor survey. We again refer to the scarcity of space, and we want to emphasize that if there is no theory ready for testing, it must be derived as Nambisan et al did and we demonstrated above.

To the *theory-creating* approach we include the "normal" case study ([14], [15]), ethnographic method, grounded theory [16], phenomenography, contextualism [17], discourse analysis, longitudinal study, phenomenological study, hermeneutics etc. A researcher could then ask: Which kind of construct or model could describe and explain the observations gathered? Which theory could explain "why acts, events, structure and thoughts occur" ([18], 378)?

Swanson and Ramiller's study [19] is an example of theory creating approaches. The authors analyzed the manuscripts submitted to the journal Information Systems Research during its start-up years, 1987 through 1992. Swanson and Ramiller tried to give a rich accounting of core concepts, broader patterns and underlying themes in the manuscripts. To characterize the individual categories they provided descriptions of each manuscript and listed the key words, concepts and associations that appeared in research questions. They also examined the relationships among the categories, as suggested by research questions that point toward other categories than those to which they have assigned. Finally they considered how clustering in the relationships suggests higher-order themes. – The study performed by Swanson and Ramiller can be called as a second-order study, because they did not study a 'concrete' reality but other studies concerning a part of reality itself. Their method is, however, similar as many other theory-creating methods, e.g. the grounded theory [16].

In *building* a new artifact utility aspects are striven and a particular (IS) development model is applied. The research question could be: Is it possible to build a certain artifact? In *evaluation* of the artifact, e.g. an information system, some criteria are used and some measurements performed. A researcher could ask: How effective is this artifact? *Action research* contains the following phases: diagnosing, action planning, action taking, evaluating and specifying learning, in the cyclical process [20]. Hence, action research contains both building and evaluation in the same process. A researcher is then working with a client and the latter could ask: Could you help me and could we together solve this problematic situation?

To consider the *building* process we take a negative example and describe difficulties in implementation. Orlikowski [21] explored the introduction of groupware into an organization to understand the changes in the work practices and social interaction facilitated by the technology. The Chief Information Officer of a large international consulting firm carefully chose a new groupware package (Lotus Notes) for helping the firm to manage its expertise and transform its practice. Results suggested that people's mental models and organization's structure and culture significantly influenced how groupware was implemented and used. Specifically, in the absence of mental models that stressed its collaborative nature, groupware was interpreted in terms of familiar personal, stand-alone technologies such as spreadsheets. Further, the culture and structure of the firm provided few incentives or norms for cooperating or sharing expertise, e.g. the consultants' incentive structure was based on having 'billable time' from clients for each of their activities. The firm's managers failed to modify this incentive structure. The consultants had no way to bill the significant amount of time (15-30 hours) for learning to use the new software or time that they would spend writing case reports that might help another consultant. – The artifact in our example consists of both the groupware package and its intended users. Our example does not demonstrate the construction steps taken in the artifact building process, but it pays attention those steps, e.g. the necessary training, did not be performed at all

To familiarize *evaluation* we take Sweeney's et al [22] framework for evaluating user-computer interaction. A framework classifies usability evaluations in terms of three dimensions; the strategy to evaluation, the type of evaluation and the time of evaluation in the context of the product life cycle. The strategies described are user-based, theory-based and expert-based. The strategy to evaluation reflects the source of the data, which forms the basis of the evaluation. The types of evaluation are diagnostic, summative and metrication. These reflect the purpose of the evaluation and therefore the nature of the data and likely use of the results. The time of testing reflects the temporal location in the product life cycle at which the evaluation is conducted. This dictates the representation of the product, which is available for evaluation. - We did not select any real evaluation case because of the scarcity of space. Instead of that we tried to give a more detailed view of usability evaluation.

We would like to return to the case study, because Cunningham [23] shows that there are at least 9 different case study types (TABLE 1).

TABLE 1.
DIFFERENT TYPES OF CASE STUDIES (PARTIAL DESCRIPTION) [23]

	Intensive cases	Comparative cases	Action research
Purpose	To develop theory from intensive exploration	To develop concepts based on case comparisons	To develop concepts which help facilitate the process of change
Assumption	Creativity through comparison with existing theories	Comparison of cases leads to more useful theory	Theory emerges in the process of changing
Examples	Dalton	Eisenhardt	Trist
Situation	Usually evolves out of a researcher's intensive experience with culture or organization	Usually concepts are developed from one case compared with another case	Developing theory to assist practices and future social science
Types	Narratives; Tabulation; Explanatory; Interpretative	Case comparisons; Case survey; Interpretative comparisons	Diagnostic A. R. Experimental A. R.

From the table above we can make some remarks. The columns in the table support and confirm our taxonomy, because the intensive case study types belong to the theory-creating approaches, the comparative cases to theory-testing approaches, and action research case studies contain both building and evaluation sub-processes in the same research process as demonstrated above. Traditionally the case study research method has been classified into the theory-creating research approach. Due to the fact there are also other case study types belonging to different research approach categories, the case study cannot be classified into one class only.

To consider the comprehensiveness of our taxonomy we argue that in each differentiation of a certain class we evidently provided the exhaustive set of sub-classes. The only exception to the rule is a division between questions “ (1) what is a (part of) reality or (2) does it stress on utility of an artifact”. We cannot create the third type question, which were important from either the practical, theoretical or both points of view. Our taxonomy has six classes of research approaches and hence it is rather parsimonious. The usefulness of our taxonomy will be demonstrated below when we compare it with three other taxonomies.

III. OUR TAXONOMY AND THREE OTHER TAXONOMIES

Next we analyze three highly-ranked taxonomies presented by Galliers and Land [1], Nunamaker et al. [2] and March and Smith [8]. Our purpose is to compare our taxonomy with those three ones. We then apply Vogel and Wetherbe’s [3] criteria of comprehensiveness, parsimony and usefulness.

Galliers and Land

Galliers and Land [1] classified the IS research methods according to modes and research objects (Table 2). They explain that ”the simulation, or game / role-playing category, has been placed on the boundary of the traditional and newer approaches. This is to indicate that these kinds of approaches range from the positivistic (simulation) to the subjective (role playing).”

The Galliers and Land's taxonomy is based on the classifications previously proposed by Galliers [24] and Vogel and Wetherbe [3]. Galliers and Land claim that their taxonomy above "differs from these earlier efforts, however, in that it does not suffer from the problem of overlapping categories by ensuring the *object* on which the research effort is focused and the *mode* by which the research is carried out are differentiated". The purpose of their taxonomy is same as ours.

Here we also apply Vogel and Wetherbe's criteria (compre-hensiveness, parsimony and usefulness) to the Galliers and Land's taxonomy. The comprehensiveness analysis can be focused on both the objects and modes above. Concerning comprehensiveness of the object classes, we cannot find data, information, and knowledge bases as research objects. By relating the comprehensiveness consideration to the mode classes we cannot find mathematical approaches (with no reference to reality). By 'Theorem proof' Galliers and Land seem to mean studying and mathematically modeling regularly behaving technology, not theorem proving in formal languages, algebra, number theory etc., which we classified into the mathematical approaches. The mathemat-ical modeling of the current or old technology belongs to the conceptual-analytical approaches, the mathematical modeling of technology for designing the new artifact to the artifacts-building approaches in our classification. The set of ten modes proposed by Galliers and Land is *not comprehensive*.

Our classification has only six classes and it seems to contain every research approach. This means that the Galliers and Land's taxonomy is *less parsimonious* than ours. By looking at the columns 'Field experiment', 'Case study' and 'Simulation and Game / role playing' in Galliers and Land's Table 2 above, we find the same markings in those three columns, and we are now asking which mode to select. Their classification of the modes does *not* seem to be very *useful* in finding one appropriate research mode.

TABLE 2.

MODES FOR TRADITIONAL EMPIRICAL APPROACHES (OBSERVATIONS) MODES FOR NEWER APPROACHES (INTERPRETATIONS)

Object	Theorem proof	Laboratory experiment	Field experi-ment	Case study	Survey	Fore-casting	Simulation and Game / role playing	Subjective/ Argumen-tative	Descriptive/ interpretive	Action Research
Society	No	No	Possibly	Possibly	Yes	Yes	Possibly	Yes	Yes	Possibly
Organization group	No	Possibly (small groups)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual	No	Yes	Yes	Yes	Possibly	Possibly	Yes	Yes	Yes	Possibly
Technology	Yes	Yes	Yes	Yes	Possibly	Yes	Yes	Yes	Possibly	No
Methodology	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

Galliers and Land think that an IS development methodology is an object of research whereas in our classification the building and evaluating such methodologies belong to the artifacts-building and -evaluation approaches. Nunamaker et al. [2] consider it as a research methodology.

Nunamaker et al.

In their paper Nunamaker et al. [2] tried to show that an analysis of the objectives of IS research clearly demonstrates the legitimacy and necessity of systems development as a research methodology. They cited the following research classifications: 1. Basic and applied research, 2. Scientific and engineering research, 3. Evaluative and developmental research, 4. Research and development, and 5. Formulative and verificational research. The goal of formulative research (also called exploratory research) is to identify problems for more precise investigation, to develop hypotheses, as well as to gain insights and to increase familiarity with the problem area. They asserted that the idea of system development as a research methodology fits comfortably into the category of applied science and belongs to the engineering, develop-mental, and formulative types of research.

According to them systems development provides the exploration and synthesis of available technologies that produces the artifact (system) that is central to this process. The artifact that results from systems development functions as a bridge between the technological research, which they referred to as the 'concept' stage, and the social research, which they referred to as the 'impact' stage. The central nature of systems development in the research life cycle is depicted in Fig. 2. This shows an integrated strategy to IS research, which Nunamaker et al. believe to be necessary, if IS research is to keep pace with technological innovation and organizational acceptance. The multi-methodological approach to IS research that Nunamaker et al. propose consists of four research strategies: Theory Building, Experimentation, Observation, and Systems Development. They believe that a systems development methodology is both pivotal and general, and "it may well be the case that systems development represents a 'super-methodology' and actually contains a hierarchy of identifiable 'sub-methodologies'". We therefore analyze the 'super-methodology' and its relations to 'sub-methodologies'.

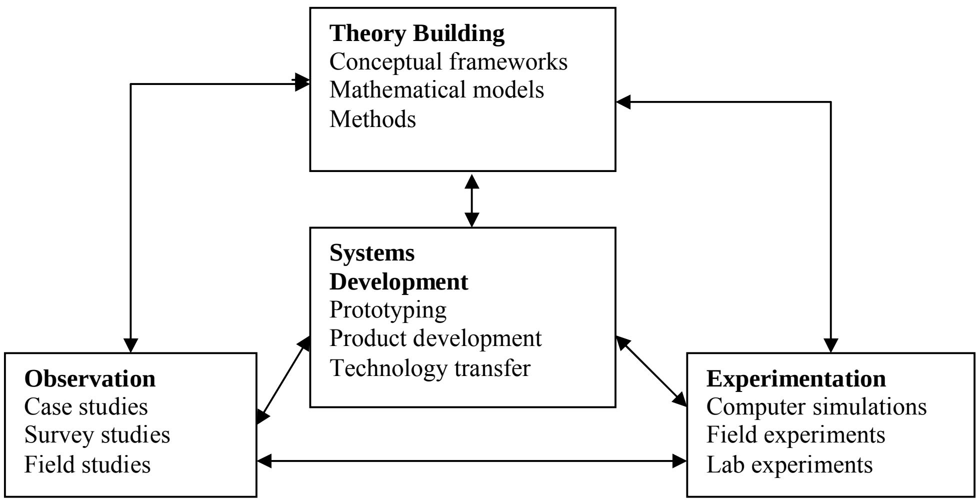

Fig. 2. A multi-methodological approach to IS research (Nunamaker et al. [2], the layout modified by us)

They outlined Systems Development as the research process in the following way: 1. Construct a conceptual framework, 2. Develop a system architecture, 3. Analyze and design the system, 4. Build the (prototype) system, and 5. Observe and evaluate the system. Stages 2, 3 and 4 clearly belong to the Systems Development itself. Stage 1 is related to Theory Building sub-methodology in Fig. 2. Nunamaker et al. explain that the conceptual framework leads to theory building with different types of efforts: (a) Declare the "truth" ('go to statement considered harmful' [25]), (b) Formulate a concept (e.g. a framework for software productivity), (c) Construct a method (information hiding and hierarchical decomposition in software engineering [26]), and (d) Develop a theory (software science [27]). In the parentheses we presented examples of theory building efforts written by Nunamaker et al. Those examples demonstrate that Stage 1 (Construct a conceptual framework) in Systems Development uses Theory Building sub-methodology from the utility point of view, i.e. for supporting artifact-building process.

Nunamaker et al. (1991) described tasks in Stage 5 (Observe and evaluate the system) as follows: 5.1 Observe the use of the system by case studies and field studies, 5.2 Evaluate the system by laboratory experiments or field experiments, 5.3 Develop new theories/models based on observation and experimentation of the system's usage, and 5.4 Consolidate experiences learned. Task 5.1 refers to sub-methodology Observation, and in it the use aspect of the system is emphasized, Task 5.2 refers to sub-methodology Experimentation, where evaluation of the system is emphasized. Both tasks 5.1 and 5.2 would belong to the artifact-evaluation approach in our taxonomy (Fig. 1). Task 5.3 emphasizes the system's usage, and may produce new theories/models for building and evaluation of the system. The experiences learned (5.4) also relate to both building and evaluation of the new system.

We conclude that in Stages 1 and 5 the similar methods and arrangements are mentioned as in the traditional theory building, experimentation and observation approaches. However, *the essential difference appears in research questions*. Systems development emphasizes the *utility* aspect of the artifact (system), whereas the traditional theory building, experimentation and observation approaches are normally used for answering such questions as: What is a part of reality, why and how do some processes and events take place? In the thinking of Nunamaker et al. [2] systems development dominates and the traditional research approaches are subordinated. They do not therefore seem to recognize that difference in research questions.

Because of the purpose of Fig. 2, the dominating role of systems development, differs from our purpose (Fig. 1), consideration of comprehensiveness, parsimony and usefulness of the classification of Nunamaker et al. in Fig. 2 does not have any sense. If we make a thought experiment, ignore relations in Fig. 2 and only look at four sets of methodologies (theory building, experimentation, observation and systems development), we can imagine the following contents of methodologies: (i) The theory building might contain both mathematical and conceptual-analytical approaches. (ii) The experimentation and observation contain both theory-testing and theory-creating approaches. (iii) The systems development contains both the artifact-building and artifact-evaluation approaches. Two main differences compared with our classification in Fig. 1 were in category (i) and (ii). Especially in category (ii) Nunamaker et al. are emphasizing naturalness of research settings in the observation approaches compared with the experimentation approaches, hence they use different dividing factor than we. Hence the *parsimony* of the classification of Nunamaker et al. provides *less comprehensive* and *less useful* classification than ours.

March and Smith

March and Smith [8] presented that there are two kinds of scientific interest in IT, descriptive and prescriptive. Descriptive research aims at understanding the nature of IT. It is a knowledge-producing activity corresponding to natural and social sciences (later shortly natural sciences). Prescriptive research aims at improving IT performance. It is knowledge-using activity corresponding to design science (Simon [28]). March and Smith further argue that an appropriate framework for IT research lies in the interaction of design and natural sciences.

March and Smith compare their own framework with the old framework (Ives et al. [29]) characterizing specific research subjects and identifying sets of variables to be studied. They criticize the old framework with four reasons. First, it fails to provide direction for choosing important interactions to study; any and all interactions among identified variables are treated equally. Second, it fails to account for the large body of design science research being done in the field. Third, it fails to recognize that IT research is concerned with artificial phenomena operating for a purpose within an environment; the nature of the task to which the IT is applied is critical. Fourth, it fails to recognize the adaptive nature of artificial phenomena; the phenomena itself is subject to change, even over the duration of the research study.

Fig. 3 describes a new research framework based on four ideas by March and Smith [8]. First, columns are divided by natural science and design science. Second, March and Smith differentiate the aspects ‘theorize’ and ‘justify’ in the natural science, and third, the ‘build’ and ‘evaluate’ aspects in the design science. Fourth, 4 types of design science products (constructs, models, methods and instantiations) are recognized. – We can immediately inform that we partly applied three first ideas to our taxonomy (Fig. 1).

By comparing Fig. 3 with Fig. 1 we identify that the mathematical approaches are not included in Fig. 3.

		Research Activities			
		Design science		Natural science	
		Build	Evaluate	Theorize	Justify
Research Outputs	Constructs				
	Model				
	Method				
	Instantiation				

Fig. 3. A research framework (March and Smith [8])

March and Smith implicitly consider social sciences similar to natural sciences by assuming that natural laws can be derived in social sciences, too. But this is not the valid assumption in human behavior, because a human being can use her free will. Hence, sciences studying human beings as self-steering systems might need own theorizing and justifying columns in Fig. 3 (cf. Aulin [30]). We conclude that the framework in Fig. 3 is *not comprehensive*. After the proposed amendments it *no more is parsimonious either*.

At first sight the tabular form of Fig. 3 seems to be very useful. At the beginning of her study a researcher should only imagine her research activities and potential research outputs, and she could then deduce a correct research approach from Fig. 3. The tabular form was problematic for March and Smith, because they first wrote that “natural science uses but not produce methods”. Hence the entry with ‘coordinates’ (Method, Theorize) were empty. Later they wrote that “for algorithmic methods, theorizing can be formal and mathematical with logical proofs being used for justification or it can be behavioral, explaining why and how a method works in practice”. This would mean that the same entry were non-empty! - The citation above also demonstrates that March and Smith have difficulties to conceptually separate justifying and theorizing from each other.

Our evaluation above showed that the comprehensiveness, parsimony and *usefulness* aspects in the March and Smith’s framework *left a lot to be desired*. March and Smith drew examples primarily from the domain of data management. However, it is typical of this domain that it behaves regularly and hides some special characteristic (for example, self-steering) of human being. This fact and the promising tabular form might lead them to a bit narrow view.

IV. DISCUSSION

Our taxonomy was based on both research questions and research objects. Although Galliers and Land [1] also used research objects in classification, they did not succeed to give explicit instructions for a researcher. To our mind, Nunamaker et al. [2] overemphasize the role of systems development methodology as a research methodology and at the same moment subordinated other research approaches. They proposed that the traditional theory building, experimentation and observation approaches should be used to consider and measure the utility aspect of the artifact (system). Whereas those traditional approaches are normally used for answering such questions as: What is a part of reality, why and how do some processes and events take place? March and Smith [8] found many useful classification principles. The tabular form and ignoring special character-istics of some research objects, however, lead them to a little incomplete framework. We showed that these three competing frameworks are less comprehensive, parsimonious and useful than our taxonomy.

To our mind, a researcher first tries to formulate her research question. The other three frameworks emphasize research objects, activities and outcomes, which might become more concrete later in the research process than the research question. We believe that our taxonomy could better assist a researcher to find the best research approach. (We collected, classified and presented many research methods in our text-book (Järvinen [31]). It also contains a short chapter describing how some research methods are related to different schools of philosophy of science.)

This research domain is not yet exhaustively studied. We could, for example, study whether differentiation between experimentation and observation proposed by Nunamaker et al. [2] could be applied in other classes than the theory-testing one, too. Another idea to make our taxonomy more dense is to try to locate all the modes presented by Galliers and Land [1] into appropriate classes and future subclasses in our taxonomy. March and Smith's [8] article raised the following question into our mind: Are the models used in describing 'what is a (part of) reality' truly different from those models, which stress on utility of an artifact?

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