Complex Systems Informatics and Modeling Quarterly (CSIMQ)
eISSN: 2255-9922
Published online by RTU Press, https://csimq-journals.rtu.lv
Article 205, Issue 37, December 2023/January 2024, Pages 69–86
https://doi.org/10.7250/csimq.2023-37.04

Integrating Models of Observing and Observed Activities Based on an Example of Empirical Research in Information Systems Discipline

Ilia Bider[1,2*]

[1] Department of Computer and Systems Sciences (DSV), Stockholm University, 164 55 Kista, Sweden
[2] ICS, University of Tartu, Estonia

ilia@dsv.su.se

Abstract. A situation where both observing and observed activities need to be taken into consideration is not uncommon in practice. In Viable System Model (VSM), System 3* is dedicated to making sudden inspections on how the work is done "on the floor". A typical case in research is an empirical study, where research activities are aimed at understanding the activities of the object under investigation. Though separate models of the observation activity and the observed activity are often presented, having an integrated model that connects both often falls under the radar. This article investigates how the latter model can be built and used in empirical research projects in the Information System (IS) discipline. Articles in the IS field presenting research projects that use data from practice, as a rule, describe the practice and research process, including which research methods have been used for obtaining and analyzing the data. Some articles present models of practice under investigation using appropriate modeling notations. Some articles present a research process in some graphical form. However, to the best of our knowledge, there is no established practice of presenting a model that interconnects practical and research activities. This article tries to fill the gap, and it presents some ideas on how to build a model that integrates observing and observed activities. Such a model can be used for planning a research project and to better understand the limitations of the approaches used or to be used in the project.

Keywords: Modeling, Research Process, FEM, Fractal Enterprise Model, Observer.

1 Introduction

A situation where an *observer* needs to observe some *business activities* to understand them and use the observations for some purpose is not uncommon. It is part of the business world, e.g., it is

* Corresponding author

Reference: I. Bider, "Integrating Models of Observing and Observed Activities Based on an Example of Empirical Research in Information Systems Discipline," Complex Systems Informatics and Modeling Quarterly, CSIMQ, no. 37, pp. 69–86, 2023. Available: https://doi.org/10.7250/csimq.2023-37.04

Additional information. Author's ORCID iD: I. Bider – https://orcid.org/0000-0002-3490-6092. PII S225599222300205X. Received: 24 April 2023. Accepted: 18 December 2023. Available online: 30 December 2023.

needed when management wants to understand how their business is really operating in order to take some measures if a problem has been detected. Viable System Model (VSM) [1] has a special subsystem – System 3* – that aims at conducting “surprised inspections” to provide upper management with information on the real state of affairs in the business. This information complements the reports provided to System 3 by the management of System 1 units*. Such observations can result in visual models that depict the essential characteristics of the observed activities, e.g., a BPMN model of a business process under investigation.

A similar situation exists in empirical research, where a research team investigates some system in order to understand it and generalize the findings or suggest a solution for a certain kind of problem. The current article focuses on this situation. Note that by *observation* here, we mean an investigative activity aimed at *understanding*, but *not changing* the object of investigation. This can include a pure observation with as little interaction with the object of investigation as possible, as well as interaction-insensitive investigation that includes, for instance, interviews with participants of business activities, surveys, facilitating workshops, etc.

Furthermore, we restrict our focus to the Information System (IS) discipline, which investigates the usage of IT technology in practice. In an empirical research project in IS, there are two human activities that interact with each other:

- An activity in practice, e.g., one or several interconnected processes in which the technological artifacts are/were/to be in use.
- Research project activities aimed at investigating the above.

Both types of activities, in principle, could be depicted in a model of some type. IS research has a rich set of modeling techniques to depict human activities, from a simple flowchart used for representing a business or IT process to more advanced techniques, such as UML class diagrams [2], IDEF0 [3], iStar [4], DEMO [5], BPMN [6], ArchiMate [7], etc.† These techniques are often used to depict activities in practice, thus providing conceptual, process, goal, or enterprise models to visualize, understand, and/or analyze what is happening in practice. Some works use a diagrammatic representation of the research process using one of these notations. Some can use both. However, to the best of our knowledge, there are no works that present a model, in which both activities (a) under investigation and (b) investigating are explicitly connected‡.

The first question this article is aimed to answer is:

Whether it is possible to have a model that explicitly connects these two human activities through the formal means of a modeling language, thus giving an overview of what has been investigated and what methods have been used for this end.

In this article, we restrict the question by adding an additional condition substituting the word *model* for a phrase *model in a known modeling language*. Without this condition answering the question may include designing a new modeling language for this particular purpose. The latter is outside the scope of this article, as we want to see whether this goal can be achieved by using an already existing modeling language.

In case of the positive answer to this question, the second question arises:

Whether such a model has any practical usefulness.

---

* For readers not acquainted with VSM, we present a short overview of this model in Appendix.

† The literature sources cited in this sentence refer to the basic works that have a description of a respective language. This article is not aimed at reviewing the usage of the languages, thus some of the references might be relatively old.

‡ The author has looked through many models that represent research, even non-formal ones, but have not found any traces of practical activities attached to the models. In addition, the author, being active in the domain of modeling, has never come across a paper or presentation that explicitly formulates the problem of building a model that connects the observer to the observed. It does not exclude that a model that (at least partially) covers both types of activities has not been published, it only means that the idea has not found its way to the mainstream. Even if a model of this kind exists somewhere, it does not totally negate the result presented in this article, as we use a special modeling technique for building the model, which is different from other modeling techniques.

A straightforward way to answer the first question, with an additional condition attached, is to take a suitable modeling technique and try to build such a model, which is what we aim to do in this article. More specifically, we will use a modeling technique called Fractal Enterprise Model (FEM) [8], [9], to design a generic pattern for presenting interconnected activities related to a research project in IS that uses empirical data from practice. We will try to make this pattern on an abstract level so that a specific model for a specific research can be considered as a specialization of this pattern. We will also try to make this pattern as rich as possible to cover various possibilities used in such a kind of research. This means that a specific model may not use all parts of the pattern, which will indicate directions for future research.

If we somehow succeed in building such a model, we can investigate its usefulness by applying a generic pattern to a specific research, and discussing in what ways this model could be useful.

The rest of the article is written according to the following plan. The next section, Section 2, presents a background for our research, such as methodology, knowledge used, and some details on FEM. In Section 3, we discuss a generic pattern for modeling practices and a generic pattern for modeling empirical research. In Section 4, we connect these two patterns together. In Section 5, we present an instantiation of the suggested pattern for a research presented in one of our published papers. In Section 6, we discuss the potential usefulness of the suggested pattern. Section 7 contains concluding remarks and plans for the future. An Appendix gives a short overview of VSM.

2 Research Background

2.1 Methodology and the Knowledge Base

The overall approach to research applied in this article is the Design Science (DS) paradigm [10], [11], [12], which focuses on looking for generic solutions for problems both known and unknown. The result of a DS research project is a solution for a problem in the terminology of [12], or an artifact in the terminology of [10]; alternatively, the result can be in the form of "negative knowledge" stating that a certain approach is not appropriate for solving problems of certain kinds [12].

Though the majority of DS projects start with defining the problem and then trying to find a solution for it, this is not the only strategy that is acceptable for DS. For instance, when the artifact/solution does not solve the original problem, it does not mean that it should be thrown away. Instead, a new problem can be discovered for which the artifact is a solution. A new, more interesting, problem can be found even if the artifact does solve the original problem, see the discussion on the topic in [13]. Therefore, it is quite acceptable for a DS project to reverse the usual order by creating an artifact that seems to be interesting first, and then trying to find what problem(s) it can solve, which constitutes finding a solution to an unknown problem. This path has been accepted for this article; it is predominately devoted to building an artifact, and it only partially discusses possible areas for its usage.

Creating a model that connects the observing activities to the activities of the observed system intuitively seems like an interesting problem. A particular case of observation is when a researcher engaged in empirical research in the IS discipline investigates practical activities that use IT/software applications. Creating a model for this particular case and investigating its usefulness is taken as a starting point for understanding how to connect observing and observed activities in general. Creating such a model requires a knowledge base that consists of two parts. The first part is knowledge of methodological aspects of conducting empirical research in IS discipline. The second part is knowledge of practical activities in which IT applications are used.

The methodological aspects of how to conduct empirical research in general, and in the IS discipline in particular, are discussed in numerous papers and books, such as [14]. Some of these works also include models of research processes in some graphical notation. Some of these models look like workflow diagrams, others are less strict and only show the choices that researchers can make when conducting their research [15].

Though the literature on the methodology of research is vast, it is not used as the primary knowledge base in this article. The work on building an integrated model is completed based on personal experience, both in practice and in research. The former was obtained by being a co-founder and a principal consultant of a small IT consulting firm IbisSoft [16] for more than 20 years. The latter was obtained from conducting research activities before, during, and after the time spent in practice. The practical experience includes decision-making related to all activities in a small company, as well as, programming, bug fixing, supporting the users, leading IT development projects, consulting, business analysis, including business process analysis. The research experience, besides conducting author's own research, includes the usual academic activities, such as functioning as a reviewer, organizing scientific events, teaching, and supervising projects of BS, MS, and PhD students.

Methodologically, using personal experience as a knowledge base is the basis of reflective theory building [17], to which our work can be related. Using personal experience as a knowledge base does not exclude the part of knowledge being obtained by reading scientific books and papers. However, this knowledge was amalgamated in the course of one's own activities, thus it is not easy to refer to specific books or papers at each moment.

2.2 Type of Model – What Needs to be Presented

As was already discussed in Section 1, the aim of this article is to develop a generic model pattern of connection between practical and research activities that shows how a model for a specific research project can be built. The generic pattern will describe connections on an abstract level so that a model built for a particular project can be considered as a specialization of the pattern. During the specialization, some parts of the generic pattern can be removed, and some extended to a certain point.

As the pattern is generic, it cannot in detail describe the processes, both in practice and in research. The difference in processes in practice is too great to have details in a generic pattern. Even for research, a model cannot take into consideration all possible details of the research process. Research is a creative activity, thus it is not always possible to describe it as a workflow, even when using a rich set of symbols, like the one that exists in, for instance, BPMN [6].

Based on the above consideration, we need to avoid using a time-related ordering of activities in our models, but rather connect different activities based on the input/output relations between them, as well as represent things that are important for connecting the practice with the research. These things include the objects of investigation, such as stakeholders, IT systems, manuals used in practice, as well as various methods of obtaining and analyzing data. Note also, that we need to represent both objects that have a physical representation, such as manuals, or IT systems, and tacit objects, such as knowledge and skills that the active participants of practical and research activities possess.

In this research, we use Fractal Enterprise Model (FEM) [8], [9], as a modeling technique. In Figures 1 and 2 we present simplified FEMs of practice and research activities that need to be connected. As the FEM technique is not widely used, we start by introducing it in the next section. Only after that, we do give some justification as to why FEM is suitable to the task at hand. Note that readers who are familiar with FEM can proceed to Section 2.4, skipping Section 2.3

2.3 Fractal Enterprise Model – Main Concepts

FEM was developed as a modeling language and notation for representing operational activities of an organization. Therefore, it belongs to the class of enterprise modeling languages. The basic version of FEM has two main concepts – *process* and *asset* – and two types of relations between them – *used in* and *managed by*.

A process, depicted as an oval in the notation, represents a repetitive behavior (see Figure 3). A process can be marked as a primary process – a behavior that produces some value for external stakeholders and for which the organization gets paid in one way or another. Such a process is visually represented with a double-line border (see Figure 3). An asset, depicted as a rectangle, represents a set of things that are engaged in the behavior and play a certain role in it, thus ensuring that the behavior continues to be repetitive (see Figure 3). An asset can be marked as tacit – something that resides in the heads of people related to the given process. Such an asset is visually represented as having a dashed border (see Figure 3). A process or an asset has a label attached to it that explains the kind of behavior that the process represents, or the kind of elements the asset has. The labels are not standardized, they are set by the modeler. Visually, the label is placed inside the shape that represents a process or asset.

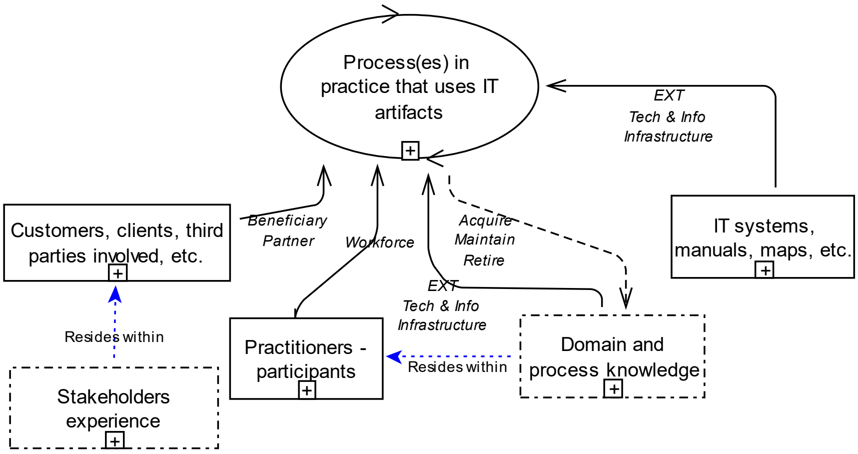

Figure 1. A simplified pattern of business activities in practice that uses IT applications

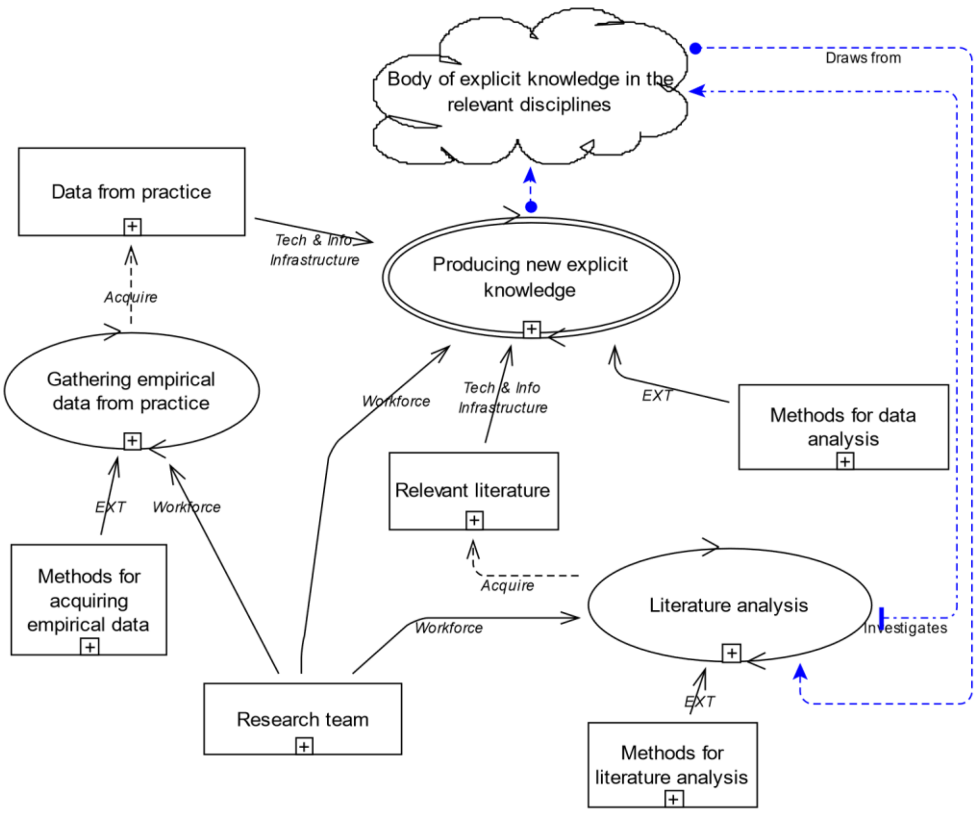

Figure 2. A simplified pattern of empirical research in IS

A *used in* relation between a process and an asset means that the asset plays a certain role in the process. The relation is visually represented by an arrow with a solid line that goes from the asset to the process (see Figure 3). A *managed by* relation between an asset and a process means that the process changes the asset, i.e., adds or removes elements or changes their properties (see Figure 3). The relation is visually represented by an arrow with a dashed line that goes from the process to the asset. To identify which role the asset plays in the process, or how the process changes the asset, a label is added to the relation. The set of labels is standardized, more exactly there are 8 labels that can be added to a *used in* relation and three labels that can be added to a *managed by* relation. These labels will be discussed in more detail in Section 3.

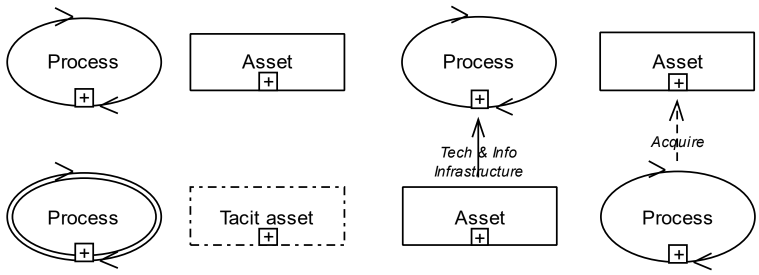

Figure 3. Basic concepts and relations in FEM

A straightforward way of building a FEM is to start from a primary process, find all assets engaged in it, find processes that manage these assets, and repeat the search for assets for the management processes. Thus, building the model can be viewed as alternatively applying two types of archetypes (or patterns), a *process-assets* archetype and an *asset-processes* archetype; see the visual way of representing archetypes in [9]. In the end, we will get a recursively built graph that represents the operational activities of the organization in question. The idea of recursion is represented by the term *fractal* in the modeling technique name; more information on this is available in [8] and [9].

Assets and processes can be presented on different levels of granularity. A connection between different levels, if needed, can be expressed with the help of decomposition. As an asset is a set of things, its decomposition means splitting the set into subsets. For the process, which represents behavior, we use decomposition for two different relations between processes (a) specialization – elements of the decomposition represent concrete versions of generic behavior*; (b) part of – elements of decomposition represent parts of the decomposed behavior.

Visually, decomposition is presented by placing elements of the decomposition inside the border of the decomposed element. In this case, the shape of the decomposed element changes to a rectangle with rounded corners; the border also changes from a solid line to a dashed or dotted line. The dashed border is used for decomposing assets or decomposing processes – behavior – using a *specialization* decomposition. The dotted border is used for decomposing a process using a *part of* decomposition. Details of the visual representation of decomposition are presented in Figure 4.

The two main concepts – process and asset – are used to describe the internal operations of an organization. To be able to represent the context in which the organization operates, an advanced version of FEM is used. It includes two new concepts and three new relations for connecting the concepts. The two new concepts are:

- External pool, which is represented by a cloud shape, see Figure 5. An external pool represents a set of things, active and passive, from which an organization can acquire some elements, or to which it can add some elements. The label inside the external pool describes its content.
- External actor, which is represented by a rectangle with rounded corners. An external actor is an agent, like a company or person, acting outside the boundary of the organization in question.

* Usually, specialization is not represented in a way similar to decomposition. In FEM, only processes can be specialized, as all other elements represent sets. We found it convenient to present specialization of processes in a way similar to decomposition of elements that represent sets, as behind each process element is a set of its completed and future runs/instances.

The label inside the external actor describes its nature. If the shape represents a set of external actors the box has a double line, see Figure 5.

Note that both an external pool and external actor represent sets, and thus they can be decomposed. Decomposition is represented in the same way as the decomposition of assets in Figure 4.

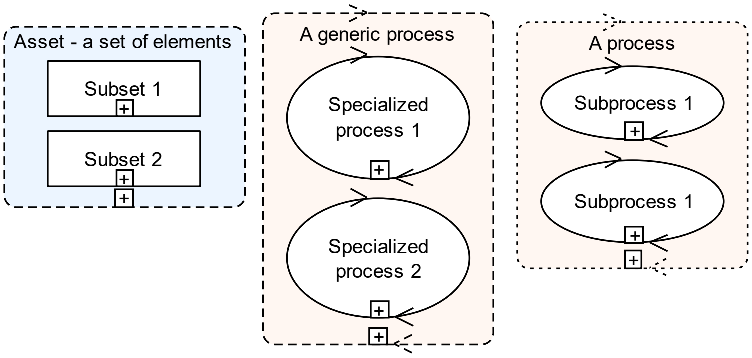

Figure 4. Decomposition of assets and processes

To connect these new concepts to other elements in a model, a new relation *Drawing/Adding* has been introduced, see Figure 5. It can be used to connect a process to a pool, external actor to a pool, or connect two pools. The visual representation is an arrow with a dashed blue line and a rounded tail. If the arrow is pointing to a pool, the arrow tail shows who is adding elements to the pool. In the opposite direction, it shows who is drawing elements from the pool to convert them to own assets. This kind of relationship can also connect two pools to show that there is a movement of elements from one pool to another. The labels on these relations are not standardized, a modeler can set any label to explain what it represents.

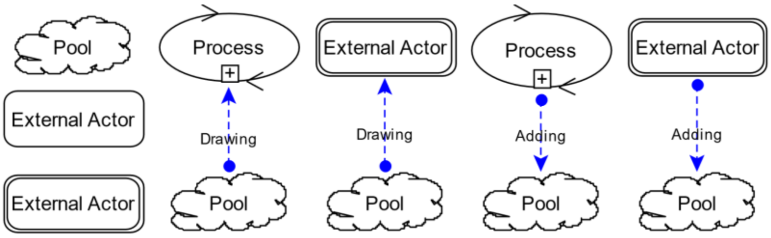

Figure 5. Pools and external actors and the *drawing/adding* relations

Besides the *Drawing/Adding* relation, the advanced version of FEM introduces two other relations: *Inspects/Monitors* and *Association*, see Figure 6. The first relation connects a process with any other elements of the model, i.e., a process, asset, pool, or external actor. The process in this case exhibits an observing behavior, i.e., gathering information from the observed with no or minimum intervention with it. Visually, this relation is represented by an arrow with a dash-dotted blue line; it also has a small rectangular tail. The tail points to the observing process, the arrow points to what it observes. A label in the form of free text can be added to specify the nature of the relation.

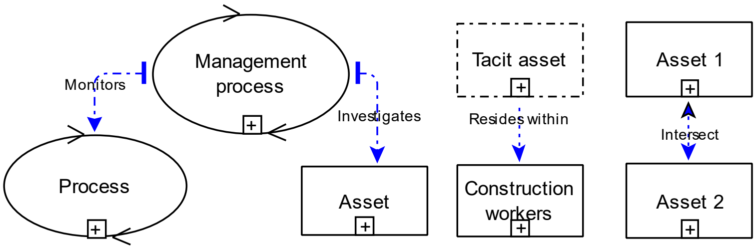

Figure 6. Relations inspects/monitors – to the left, and *association* – to the right

The relation *association* does not have any definite meaning; it is used whenever there is a need to express something that is not possible to express with other relations. Visually, it is represented by an arrow with a blue dotted line. This relation can be symmetrical – an arrowhead on both ends or asymmetrical – an arrowhead only on one end. The meaning of the relation is explained using a free text label.

With this, we finish our short introduction to FEM; some additional explanations will be given in Section 3. The readers interested to know more about FEM are referred to [8], [9], and [18]. The last source has the latest version of the meta-model for FEM.

2.4 Justification of Using FEM

At this phase, we are not looking for the best technique for building an integrated model. Any suitable technique would do for the first trial. If it fails, we can try another modeling technique. There are some rational arguments that make using FEM worth trying. In particular, it satisfies the needs discussed in Section 2.2:

- FEM can represent interconnection between various activities without imposing a time-related order between them.
- FEM allows to build models on different levels of granularity.
- FEM has special means of presenting research methods – an EXT (EXT = Execution Template) type of assets – assets that control the process (see the next section).
- FEM has special means for representing observation and investigation of processes and things in the form of the *Inspects/Monitors* relation. This is an essential part of the empirical investigation.
- FEM can represent tacit assets that are essential for both practice and research.

If we consider the modeling techniques listed in Section 1, only ArchiMate [7] looks promising for the task at hand. BPMN [6] relies too much on the time-related ordering of activities, which is not possible to use in a generic approach. iStar [4] is focused on goals, which is not what we want to have in a model. DEMO [5] is focused on transactions, and we do not want to introduce them in the model. UML class diagrams are too general, which will increase the size of the model, thus making it to be difficult to use. Using IDEF0 [3] is appropriate for expressing practice and research separately, but it is not clear how to connect them together.

The arguments presented above have convinced the author that FEM is worth trying for the task at hand. We have tried using FEM to build a model that connects the observer with the observed system for our specific case. The result of this trial is presented in the following sections.

3 Generic Patterns

When discussing generic patterns, we refer to Figure 1 and Figure 2 in Section 2.3.

3.1 A Generic Pattern for Practice

The practice in the generic pattern in Figure 1 is presented by one process – *Process(s) in practice*. However, when applying the pattern to specific research, this part could be expanded to include several processes. Besides the process, the pattern in Figure 1 includes assets related to it. Assets are grouped, so there are not many of them in the generic pattern. Again, when the pattern is used to represent specific research, there could be a need to represent assets using a finer granularity.

There are three groups of assets in Figure 1. They play the following roles: *Workforce*, *Stakeholders* (*Beneficiaries* and/or *Partners*), and *EXT* bundled with *Tech & info infrastructure*. The grouping is based on the method that can be used for investigating these assets, which will be shown later, in Section 4.

There are also two tacit assets; one is related to *Workforce*, and the other to *Beneficiary/Partner* stakeholders. These tacit assets are an important source of information about practice; they are often used by researchers, and there are special methods that allow explicating the tacit knowledge assets, e.g., interviews, surveys, and facilitating workshops.

3.2 A Generic Pattern for Empirical Research

As stated in Section 1, our goal is to connect the activities of an observer to the activities of the observed system in general and to do it for a particular case of empirical research in the IS discipline. Therefore, our focus is on the part of the research process that is related to obtaining empirical data from practices where IT systems are employed. Nevertheless, we consider it important to place these activities in the wider context of the whole research project. Therefore, in this section, we present a generic model of the research project, of which gathering empirical data is a part. This model reflects the author's understanding of the research process, which may or may not correspond to how other researchers understand it. The model discussed in this section does not go into details of the activities performed, it presents the main stakeholders of the process, and methods and tools used in various phases of the process.

A simplified generic pattern of research is presented in Figure 2. It presents empirical research in IS discipline as three activities – processes – interconnected with each other. The primary process of *Producing new explicit knowledge* is at the root of the model. The process results are extending the pool of explicit knowledge in the field. The two other processes play the supporting role providing the primary process with assets used in the latter. The process *Analysis of the literature* adds elements (thus the *Acquire* label on the *managed by* relation) to the asset *Relevant literature*. The process of *Gathering empirical data from practice* fills the asset *Data from practice,* which is also used in the primary process.

The most important asset of the type *used in* in all three processes is the *Research team* which plays the role of *Workforce* (represented by the correspondent label) in them. Each process has its own methods that are used as EXT assets. For *Gathering empirical data*, it is *Methods for acquiring empirical data*, for *Literature analysis*, it is *Methods for literature analysis*, and for the primary process, it is *Methods for data analysis*. Note also, that the process of *Literature analysis* draws from the pool *Body of explicit knowledge in the relevant disciplines*, as well as investigates it with the goal to decide what to draw.

A more sophisticated pattern for research is presented in Figure 7. It has some additions to the pattern presented in Figure 2. In particular, it adds beneficiaries to the primary process. There can be two types of beneficiaries, namely the *Research community* and *Practitioners*; they are represented as assets connected to the primary process by *used in* relation with the label *Beneficiary*.

Besides adding elements to the asset *Relevant literature*, the process *Analysis of the literature* may also add elements to the assets *Data from literature* and *Relevant theories*. *Data from literature* complements *Data from practice*. The asset *Relevant theories* plays the role of controlling element (EXT) for both the primary process and the process *Gathering empirical data from practice*, guiding the way data are gathered and analyzed. It functions in the same way as the component *Orient* of the Boyd's OODA (Observe, Orient, Decide, Act) loop [19], guiding the actions of the *Observe* component. In addition, the asset *Relevant theories* may play the role of information source in the primary process, e.g., for presenting alternative theories; this is represented by an additional label on the corresponding *used in* relation.

Besides acting as an active agent in the activities, the *Research team* asset possesses the tacit knowledge that guides how the activities are completed. This tacit knowledge is represented as a tacit asset – *Experience of conducting research* – that is connected by an *Association* relation labeled *Resides within* with the asset *Research team*. This tacit asset serves as an EXT in all three processes presented in Figure 7. This is quite an important asset without which neither of the other EXTs would work. Thus, it is important to have it in the generic pattern.

4 Expanding the Process of Gathering Data

In this section, we expand the process of gathering data in which research and practical activities intervene. This is done by decomposing the process of *Gathering empirical data from practice* and assets associated with it in the model of Figure 8. To connect this model to the model in Figures 1 and 7, we use the *ghost* feature of the *FEM toolkit* that was used to draw the models [9]. The ghost feature allows to present the same element in several places, in the same model, or in a different one. The feature allows the splitting of a complex model into parts by creating a package of interconnected models. A second, etc. occurrence of the same element has a thick arrow in the right upper corner of the shape that represents the element. A new occurrence of the same element can also be presented in a decomposed way, which is used in Figure 8 for some elements that were picked from Figures 1 and 7.

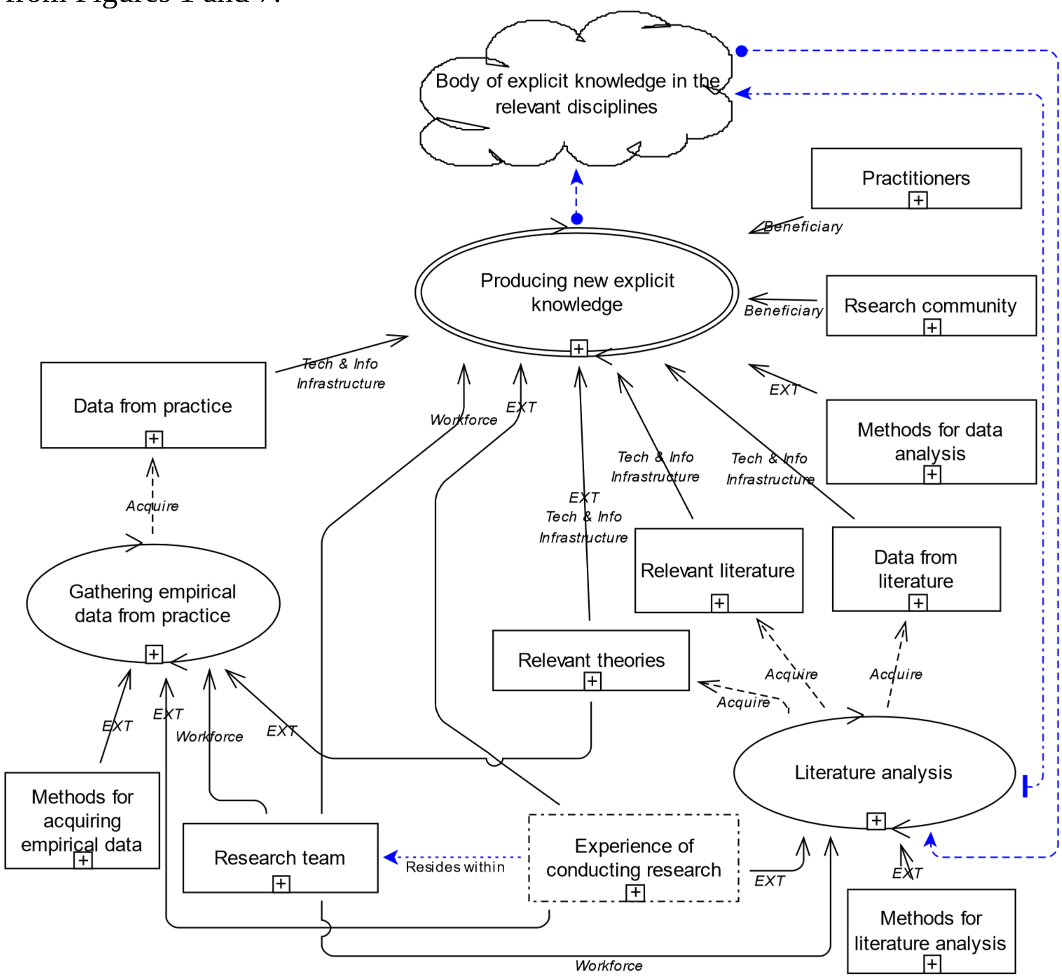

Figure 7. An extended pattern of empirical research

Besides decomposing the process of *Gathering empirical data from practice* and associated assets from Figure 7, the model in Figure 8 introduces the activities and associated assets related to the practice, thus incorporating the model of Figure 1. The elements from practice are highlighted by using the blue color for borders*.

The workforce asset from Figure 1 – *Practitioners* – is decomposed into two subsets – *Practicing researchers* – and *Other practitioners*. The first one appears also in the decomposition of the asset *Research team.* Though this asset is empty for most research projects, we have introduced it in the generic pattern due to its existence allows the use of a special process for getting data from practice, i.e., *Reflecting on own experience* [17].

* The colored borders are thicker than noncolored. In a print without colors these elements are highlighted by having a thicker border than other elements.

The process of *Gathering empirical data from practice* from Figure 7 has been decomposed into four processes in Figure 8. The decomposition is done based on what each of them investigates and what kind of data it provides. The asset *Data from practice* is also decomposed based on the process decomposition. The connections between the decomposed elements are as follows:

- The process of *Reflecting on own experience* investigates the tacit asset *Domain and process knowledge* using *Practicing researchers* as *Workforce*, and producing the informational asset *Reflections from practice* which is part of the decomposed asset *Data from practice*.
- The process *Observing the process in practice* observes the process(es) in practice using some kind of *Ethnographic methods* and produces the informational asset *Observations from practice*.
- The process of *Investigating assets, their size and quality* investigates assets engaged in practice and produces the informational asset *Data on assets*.
- The process of *Getting information from stakeholders* investigates tacit assets that reside in the heads of the stakeholders, using these stakeholders as a *Partner* and applying appropriate methods, such as interviews, surveys, and facilitating workshops.

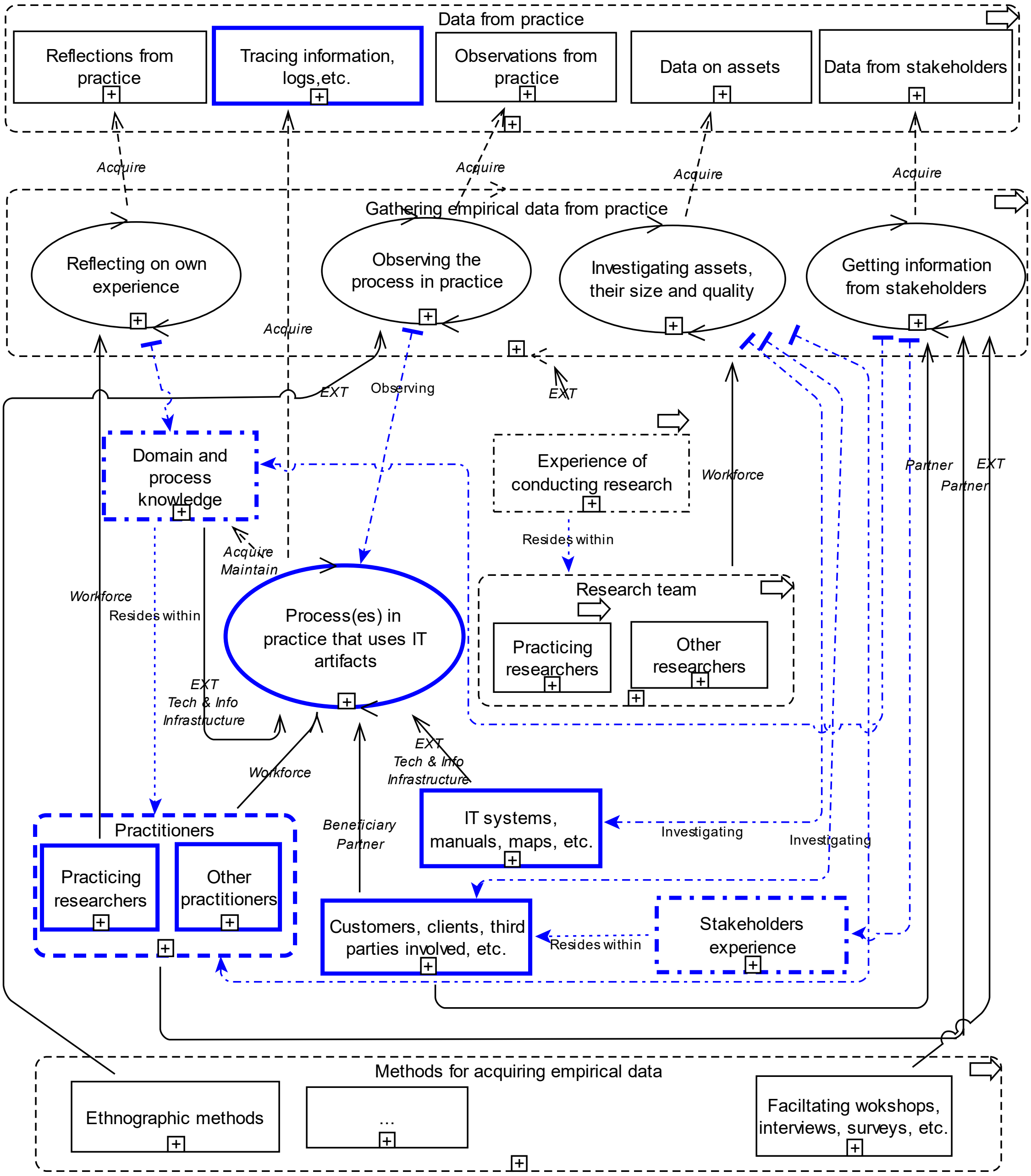

Figure 8. Expanding the process of gathering data

Note that for all the above activities, the asset *Research team* serves as *Workforce* using *Experience of conducting research* to guide their actions. Also, not all possible methods of obtaining empirical data are presented in the model in Figure 8. The assumption is that they will be specified when a generic pattern is applied to concrete research.

5 An Example

In this section, we demonstrate the usage of the modeling patterns from the previous sections for the purpose of presenting a completed research project. To this end, we have chosen a project where the author has been an active participant. The project concerned applying a socio-technical approach to a sales process in an international company and finding ways for its improvement. The results were published in [20]. The project has been chosen due to the author having full knowledge of it, part of which might have been missed if we had taken a random published paper.

An application of the generic pattern from the previous section to the chosen research is presented in Figures 9 and 10. We have skipped building a model of the type of Figure 1, introducing the practical part directly in the model of Figure 10. The model in Figure 9 repeats the generic pattern from Figure 7, but the labels inside many of the elements have been changed to specify more exact methods and theories used in the research project.

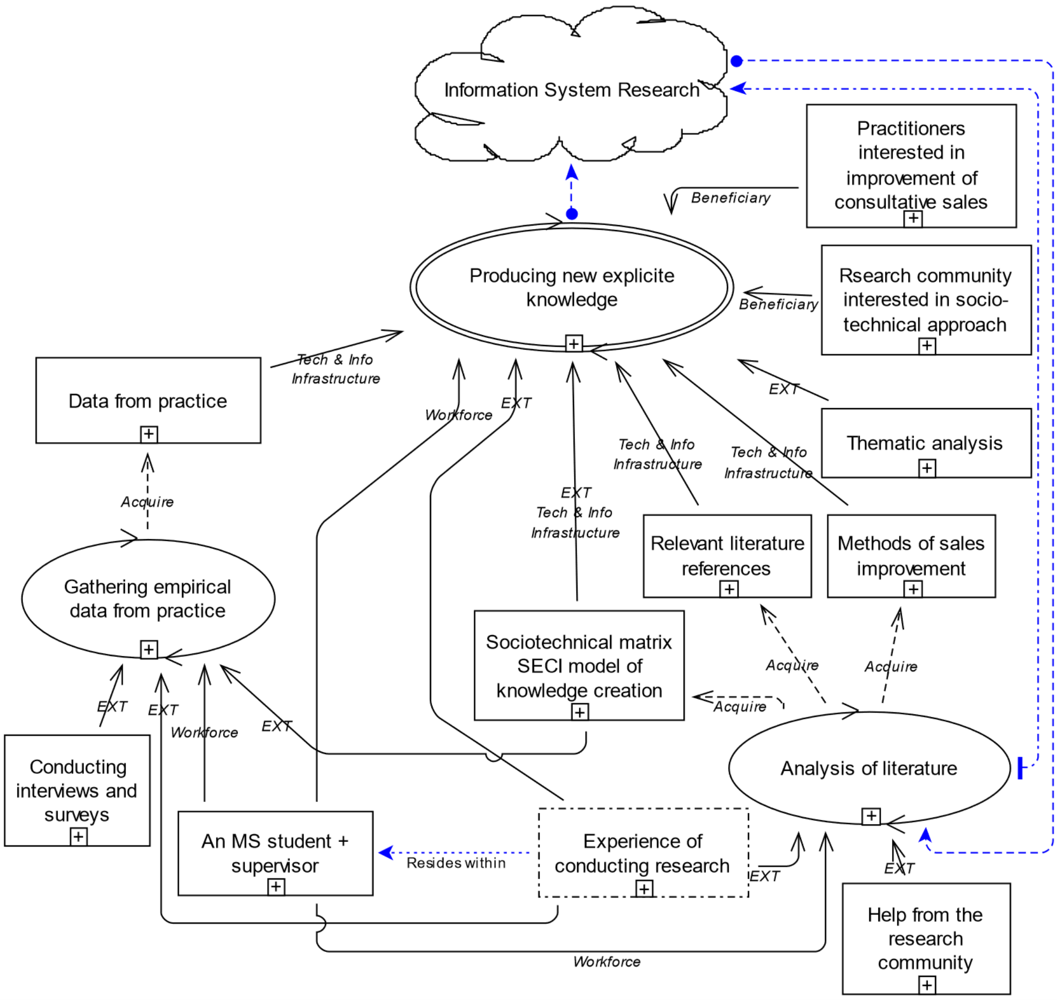

Figure 9. A specialization of the model in Figure 7 for the research project from [20]

The model in Figure 10, related to gathering data, is also more concrete, and it looks quite reduced in comparison with the generic pattern in Figure 8. It shows that only a few methods from the possible alternatives have been used in the project*. For instance, we did not have any sales practitioners in our research team; thus, no reflection on our own experience. Also, we have not used any observations of the process itself, we have not investigated customers or partners, and we have not used logs from the IT systems. All elements that were not investigated are highlighted using a yellow background color† in Figure 10.

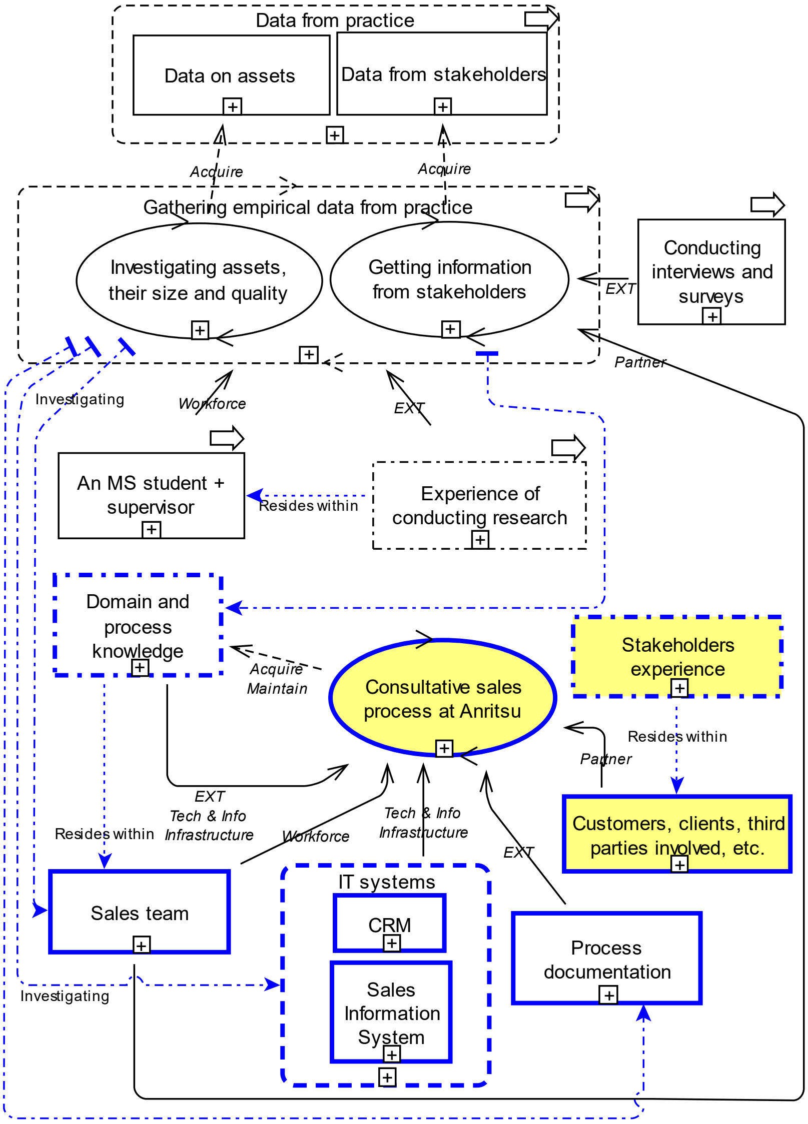

Figure 10. A specialization of the model in Figure 8 for the research project from [20]

The data received from practice were obtained only from *workforce – Sales team –* via interviews and a survey, and from the investigation of available documentation and supporting IT systems. Not using other methods, naturally, raises the question of the reliability of the results. The reliability was, however, increased by using data from the literature that is depicted in Figure 9.

Note that the models in Figures 9 and 10 say nothing about the results achieved in the research project, they only show based on which kind of data the results were obtained.

* Our access to the information in the project was limited due to the time limitations and human resources available, which is not unusual for a small-scale project. Note that the possibility of removing some parts of the generic pattern or adding new elements to the model for a particular project was discussed in Section 2.2.

† In a print without colors, these elements have a grey background.

6 Potential Usefulness

In the previous section, we applied the generic patterns to the completed research project with published results. Based on this example, we can draw the following preliminary conclusions:

1. As far as the generic model in Figure 7 is concerned, the application of the pattern, in Figure 9, mainly consists of changing the labels in its element to more specific ones compared to Figure 7. For instance, the pool of knowledge was narrowed down to a specific discipline – IS; the beneficiaries are defined more precisely; other elements also got more specific labels.
2. As far as the model of obtaining empirical data in Figure 8 is concerned, the changes when moving to the model in Figure 10 are more substantial, as many parts of the generic pattern have not found their places in the model in Figure 10. In addition, the shapes with a yellow background explicitly show the elements that were not investigated in the project.

Creating an integrated model of completed research can make some sense if the reader feels uncertain about the results. Such a model may show that not all possible methods were used when obtaining data from practice. Not being able to build an integrated model may also indicate some problems. For instance, in a case study, the model of practice represents how things are done in a particular place. In a study where respondents are from different companies, it is not always possible to understand whether the respondents are engaged in the same kind of activities. If it is not possible to build a generic model that covers relevant practices, it points to possible inconsistencies in the research project.

From the discussion above, we can draw a conclusion that building an integrated model for completed research has a limited area of usage. It could be useful for critical analysis of the published research, in case one wants to use its conclusion in one's own scientific undertaking. We believe that a wider area of usage is in planning and completing the research. This especially concerns the part of the generic model presented in Figure 8. It makes sense to build a model of practice based on the generic pattern of Figure 1, and then make decisions on which elements of practice would be investigated, and which means, i.e. methods, should be used. Using such a model could help to avoid important parts of the relevant business activities missing from the investigation. In cases when the investigation concerns respondents from different organizations, building a model could help avoid mixing opinions from the respondents engaged in different business activities.

The general part of the model based on Figure 7 could also be useful in planning. In particular, to which discipline the work belongs, and who are the beneficiary. This may help decide which scientific channel to use when publishing the results, and the style of the publication. For instance, if practitioners are considered important beneficiaries, the style should be adjusted correspondingly. The above deliberation shows that a generic FEM model of research activities could be useful for research planning, as well, which goes beyond our goal of connecting observed and observation activities. To investigate this kind of model usage, the model should present details of other activities related to the research process, e.g., activities related to literature search or theory building. However, this goal is outside the scope of the article.

If the integrated model was used for planning the research, it could also be included in the publication, either in the background section or as an appendix. This could help convince the reader of the validity of the approach for getting empirical data, as the model provides a clear picture of the practice, what was investigated, and what was left out (yellow shapes).

7 Concluding Remarks and Plans for the Future

As has been stated in the introduction, this work is aimed to answer two questions (1*) whether it is possible to have a model that explicitly connects observer activities with the activities of the observed system using formal means of a modeling language,* and (2) *whether such a model has* *any practical usefulness*. To answer the questions, we have considered a particular case of a situation that happens in a research project in the IS discipline that obtains and uses empirical data. Gathering the empirical data in such a project represents a situation of an observer investigating an organizational system without the explicit intention of changing it.

The model built for the chosen field does explicitly connect the observer/investigator activities to the activities of the organizational system, and this model is a primary contribution of the article. It allows us to positively answer the first question, at least for the field we have investigated. The generic pattern presented can be applied to a specific research project and the result can potentially be used in planning the project, which constitutes a partial answer to the second question. Such a model could also be potentially useful for convincing the readers of a scientific publication of the soundness of the data obtained from practice. There could be other usages of the model, e.g., analysis of already completed and published work to understand whether one can trust the findings and use them as a basis of own work.

The core of the suggested way of connecting the observer to the observed is a generic pattern – a model on a high level of abstraction – that can be specialized for a particular research project. To present this pattern, as well as to make a specialization of it for a research project, we have used a specific modeling technique – Fractal Enterprise Model (FEM). The choice of FEM was based on it having means that are needed to connect observer and observed activities. The work shows that FEM is suitable for connecting these two kinds of activities, which does not exclude that some other modeling technique could do it better. Thus, there is a need to test other existing modeling techniques for this end. Another potential way of having a better technique is to develop a new technique taking into consideration the needs of connecting two different types of activities.

The arguments for the usefulness of the model for planning are theoretical and need to be tested in practice, which is harder than applying the generic pattern to an already completed work. For this, we need to use it in our own projects but to be more convincing, it should be used by somebody else. Hopefully, this publication can help in finding a test project.

Another direction in this research is to see whether a more general question of integrating the observer and the observed can provide help for practice, e.g., planning surprise inspections of System 3* of VSM.

Historical note. This work has its origins in the discussion in the session on "The Future of E.M.E.A" conducted during the "EEE CBI 2021" conference – https://cbi2021.events.unibz.it/program/#future-emea. The author suggested to use enterprise modeling to model activities in the domain of Enterprise Modeling, enterprise engineering, and Enterprise Architecture (EMEA). This led to the need for connecting the observer's activities, where the observer is a researcher or modeler, to what is happening in the observed organizational system – enterprise.

Acknowledgements. The author's work was partly supported by the Estonian Research Council (grant PRG1226). The author is grateful to the anonymous reviewers whose critical comments have helped to improve the article.

References

[1] P. Hoverstadt, "The Viable System Model," in *Systems Approaches to Managing Change: A Practical Guide*, Springer, pp. 87–133, 2010. Available: https://doi.org/10.1007/978-1-84882-809-4_3

[2] G. Booch, J. Rumbaugh, and J. Jacobson, *The Unified Modeling Language User Guide*. 2nd ed. Addison-Wesley Professional, 2005.

[3] NIST: Integration definition for function modeling (IDEF0), Draft Federal Information Processing Standards, Publication 183, 1993. Available: https://www.idef.com/idefo-function_modeling_method/

[4] F. Dalpiaz, X. Franch, and J. Horkoff, iStar 2.0 Language Guide. Available: https://arxiv.org/pdf/1605.07767

[5] J. L. G. Dietz, "Understanding and Modelling Business Processes with DEMO," in *Conceptual Modeling – ER'99. ER 1999. Lecture Notes in Computer Science*, Springer, vol. 1728, pp. 188–202, 1999. Available: https://doi.org/10.1007/3-540-47866-3_13

[6] M. Chinosi and A. Trombetta, "BPMN: An introduction to the standard," *Computer Standards & Interfaces*, vol. 34, no. 1, pp. 124–134, 2012. Available: https://doi.org/10.1016/j.csi.2011.06.002

[7] The open group: ArchiMate® 3.2 Specification. Available: https://publications.opengroup.org/standards/archimate/specifications/c226

[8] I. Bider, E. Perjons, M. Elias, and P. Johannesson, "A fractal enterprise model and its application for business development," *Software & Systems Modeling*, vol. 16, pp. 663–689, 2017. Available: https://doi.org/10.1007/s10270-016-0554-9

[9] I. Bider, E. Perjons, and V. Klyukina, "Tool Support for Fractal Enterprise Modeling," in *Domain-Specific Conceptual Modeling*, Springer, pp. 205–229, 2022. Available: https://doi.org/10.1007/978-3-030-93547-4_10

[10] A. Hevner, S. T. March, J. Park, and S. Ram, "Design Science in Information Systems Research," *MIS Quarterly*, vol. 28, no. 1, pp. 75–105, 2004. Available: https://doi.org/10.2307/25148625

[11] S. Gregor and A. Hevner, "Positioning and Presenting Design Science Research for Maximum Impact," *MIS Quarterly*, vol. 37, no. 2, pp. 339–335, 2013. Available: https://doi.org/10.25300/MISQ/2013/37.2.01

[12] I. Bider, P. Johannesson, and E. Perjons, "Design science research as movement between individual and generic situation-problem-solution spaces," in *Organizational Systems. An Interdisciplinary Discourse*, Springer, pp. 35–61, 2013. Available: https://doi.org/10.1007/978-3-642-33371-2_3

[13] I. Bider, E. Perjons, and P. Johannesson, "Just Finished a Cycle of a Design Science Research Project: What's Next?" *Complex Systems Informatics and Modeling Quarterly, CSIMQ*, no. 22, pp. 60–86, 2020. Available: https://doi.org/10.7250/csimq.2020-22.05

[14] M. Denscombe, *The Good Research Guide: For Small-scale Social Research Projects*. 6th ed. Open University Press, 2017.

[15] B. Oates, *Researching Information Systems and Computing*. Sage Publications, 2005.

[16] IbisSoft AB. Available: https://www.ibissoft.se/

[17] V. Mott, "Knowledge comes from practice: Reflective theory building in practice," in *Workplace learning: Debating five critical questions of theory and practice*, pp. 57–63, 1996. Available: https://doi.org/10.1002/ace.36719967209

[18] Fractalmodel.org: Fractal Enterprise Model. Available: https://www.fractalmodel.org/

[19] J. Boyd, "The Essence of Winning and Losing," *Unpublished lecture notes*, 1996.

[20] I. Bider and V. Klyukina, "Using a Socio-Technical Systems Approach for a Sales Process Improvement," in *2018 IEEE 22nd International Enterprise Distributed Object Computing Workshop (EDOCW)*, pp. 48–58, 2018. Available: https://doi.org/10.1109/EDOCW.2018.00019

[21] R. Espejo and A. Reyes, *Organizational Systems: Managing Complexity with the Viable System Model*. Springer, 2011. Available: https://doi.org/10.1007/978-3-642-19109-1

Appendix – Viable System Model

Viable system model (VSM) has been developed by Stafford Beer [1] and his colleagues and followers, see [15]. It represents an organization as a system functioning within its environment and consisting of two parts: *Operation* and *Management*. In its own turn, *Operation* is split into a number of semi-autonomous operational units, denoted as System 1, that have some communication mechanism to ensure their coordination. This communication mechanism is denoted as System 2. *Management*, in turn, is split into three parts, denoted as System 3, System 4, and System 5. Depending on the author, these systems may be dubbed differently (see Table A1) but they have more or less the same meaning, see the last column of Table A1.

Note that the components listed in Table A1 do not need to coincide with the organizational structure of a particular organization. Different components can be manned by the same people. This, for instance, happens in a small enterprise where the same group of people does the job on all levels. The components in this case are differentiated not through who is doing the job, but through the nature of the job done, e.g. policy development belongs to System 5, while completing a customer order belongs to System 1.

Table A1. Components of VSM

Identification	Naming	Function
System 1	Operations, Implementation, Delivery	Producing and delivering products and services for external customers, thus actively interacting with the environment.
System 2	Coordination	Coordinate work of operational units included in System 1.
System 3	Control, Delivery management, Cohesion [21],	Managing operational units (System 1) and establishing/maintaining coordination mechanisms (System 2). Making the semi-autonomous units function well as a whole (cohesion) in the current business environment.
System 3*	Monitoring, Audit, Inspections	The purpose of monitoring is twofold: firstly, to allow managers to have confidence that what they think is happening in the units they manage really is happening, and secondly to provide those they manage with the confidence that their managers do actually understand the issues they face. To be effective, monitoring has to be a sporadic, in-depth activity that bypasses unit management and engages with the reality of the unit's activities [1].
System 4	Intelligence [21], Future	Forward-looking adaptation to possible future changes in the environment through identifying trends and preparing for changes or affecting the environment in the desired direction (intelligence). System 4 is considered to include development, marketing, and research.
System 5	Identity (management), Policy [21] (management)	Solving conflicts between System 4 and System 3. Permitting System 4 to introduce changes despite the conservatism of System 3, and not allowing System 4 to change the identity of the whole system that exists via the functioning of Systems 3, 2, and 1. This is done through designing, maintaining, and imposing policies that stay in place even when changes designed by System 4 are implemented in Systems 3, 2, and 1.

The part of VSM relevant to this article is represented in Figure A1; the figure does not include System 4 and System 5. It shows that each operational unit works with its own part of the environment, though there can be intersection of these parts. System2 coordinates the System 1 units to resolve conflicts in the intersections, and in the usage of common resources, e.g. equipment. System 3 provides System 1 with resources and demands to achieve certain business goals. Units of System 1 provide reports on the achievements of these goals to System 3. System 3* investigates the work of System 1 units and provides System 3 with information that compliments the reports.

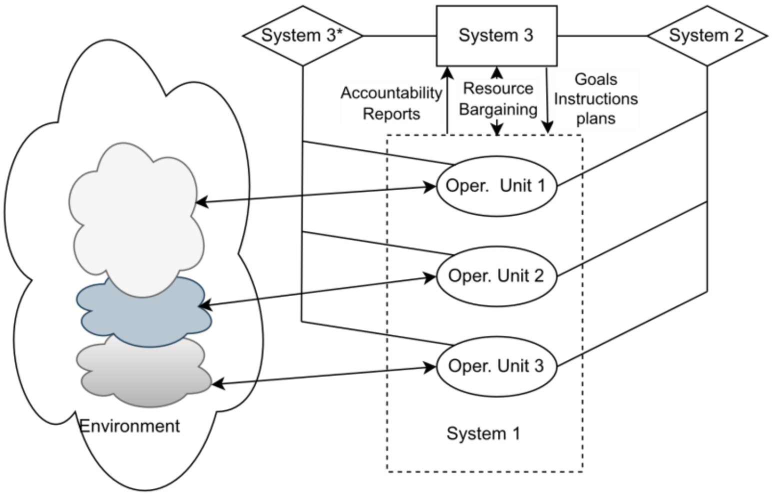

Figure A1. A simplified and reduced diagram of VSM