Investigating the influence of situational factors on Participative Enterprise Modelling - making a case for a qualitative research approach

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Abstract

Participative Enterprise Modelling (PEM) has been used in Information Systems Development and Business Development for some time now. Research has shown that the full and positive effects of PEM methods heavily depends on the ability of its users to manage situational factors, which characterise, influence and constrain development situations where it is used. Therefore, a shift must be made in method development, from the invention of new methods to the development of guidelines for the practical use of current methods in various situations. Such a shift calls for research into the complex relationships between situational factors in development processes. This paper discusses the challenges of investigating the impact of situational factors on PEM and outlines an approach to be used as part of ongoing research.

1. Introduction

Enterprise Modelling (EM) or Business Modelling is an activity where an integrated model of an enterprise (private company, government department, academic institution or other organisation) is negotiated and created. The model consists of a number of different "sub-models", each describing the enterprise from a particular perspective, and often using a combination of graphical representation and text. Perspectives vary, depending on the method, and examples are objectives, processes, actors, data/information, etc. Enterprise Models (EMs) can be used for different purposes and in various contexts such as Business Process Reengineering, workflow planning, strategy planning, enterprise integration and Information Systems Development [1][2]. Their main contribution is to provide support for management of enterprise knowledge in development situations, where the result depends on a thorough understanding of the enterprise at hand. Since they can be used in Business Development *as well as* in Information Systems Development they also provide an opportunity to integrate the two areas [3].

In the process of creating EMs there are two main roles to be played: modelling expert and domain expert. One and the same person can of course play both roles, but normally they are different people. The basic assumption behind the term participation in this paper is that more than one person and more than one opinion are involved in the modelling process. Another basic assumption is that the degree of participation of domain experts in the modelling process is high. It is a collaborative process where domain and modelling experts create the model together. Modelling experts play the role of group facilitator. Validation is normally integrated in the modelling process. However, if other people than the ones present in modelling sessions need to be consulted, it may also be carried out through group sessions, interviews or by mail, fax or www.

Participative EM has been used for a number of years and in a large number of projects [4][5][6][7]. Experience has shown that the utility of EM methods is highly dependent on a number of situational factors. However, current methods give little guidance in this respect. A goal to improve maturity in method use and to increase the use of methods in practice motivates research into the influences of situational factors in Participative EM (PEM).

The aim of this paper is to discuss the challenge of research in PEM and outline a research approach for meeting this challenge. The content is as follows. Section 2 defines the concept of PEM. In section 3 we discuss situational factors in connection with PEM. The challenge of investigating situational factors is described in section 5. In section 6 we discuss the contributions of quantitative and qualitative research methods and present a general outline of a qualitative research. The expected results and some concluding remarks are included in section 7..

2. Situational factors in Participative Enterprise Modelling

We believe that research in the area of PEM requires a reasonably good understanding of its practice, promises and limitations. In order to improve our own understanding of PEM, we have therefore conducted empirical studies, using PEM in different development situations [9][5]. We view our empirical work so far as a base-line for future research, and this section of the paper reports on some important experiences, which has directed our plans for such future research.

PEM is often used in some larger development context such as Information Systems Development or Business Development (Fig. 1). Both types of development focus on systems, the Information system and the enterprise as a social system. Both development situations are inherently *social* settings [10]. Success relies on functioning collaboration between many different types of stakeholders. They may all have their own ideas as to the characteristics of the problem at hand. They may also have their own objectives regarding the product of the development process. There is a variety of available EM methods [11][12][13][14][3]. They all have three important components: 1) an underlying philosophy, 2) a meta-model, which describes model components as well as constructs, and 3) a defined process for populating,documenting, validating and managing models. From our empirical work [5] we conclude that the successful application of PEM is far from simple. The meta-model itself with its component types, relationship types and notation is actually the least critical factor.

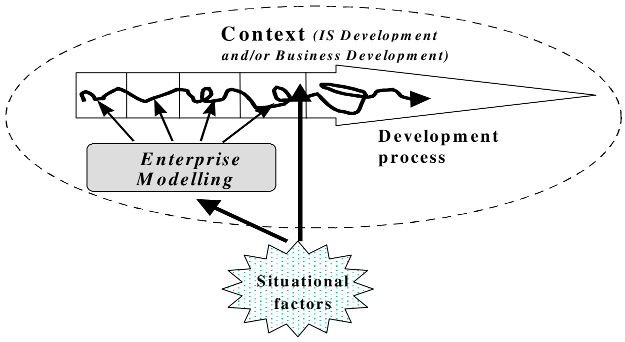

Fig. 1. Enterprise Modelling and situational factors

According to Goldkuhl [15], methods are intended to transfer problem solving knowledge between people. The knowledge encapsulated in methods, however, must be considered as descriptions of "ideal" situations, which is why methods often must be adapted to fit a specific situation. Competent method users are therefore characterised by their ability to adapt the use of a method [15]. In support of this view, our research shows that the full and positive effect of PEM methods is heavily dependent on the ability of its users to deal with a large number of situational factors. To deal with situational factors means to be aware of and to understand their impact well enough to:

- determine which is the appropriate choice of method for the situation at hand,
- determine how to use the chosen modelling method and
- anticipate/manage possible problems occuring in the modelling process.

Our empirical work has resulted in a tentative framework of related situational factors [5] containing the following categories.

1. *Project factors* - influences caused by the conditions of an actual project - such as type of project (IS development, Business development), resource constraints, and management support
2. *Organisational factors* - influences caused by the actual type of organisation involved - such as organisational structure and organisational culture
3. *Problem factors* - influences caused by the actual type of problem involved - such as type of problem, agreement on problem definition and agreement on goal for solution
4. *Human factors* - influences caused by “human” constraints- such as method knowledge, domain knowledge, authority of participants, social skills, conflicts between individuals/groups and method acceptance.

3. The challenge of investigating situational factors in the use of Participative Enterprise Modelling (PEM)

We argue that a shift must be made in method development, from the invention of new EM concepts and methods to the development of more elaborate guidelines for the practical use of *current* EM methods. Our research objectives are therefore as follows:

1. From the point of view of practitioners, which situational factors influence the use of PEM and which of them are most important?
2. How do situational factors influence different types of development situations where Participative Enterprise Modelling can be used?
3. Which guidelines can be defined for managing situational factors in different development situations where Participative Enterprise Modelling can be used?

The area of situational factors in PEM is extremely complex.

In a specific situation, the number of situational factors to take into account is large.
We have identified 21 situational factors so far [5]. However, we realise that they need to be specialised into more concrete factors without too much inherent complexity. Otherwise it will be very difficult to find means of assessing them in a specific situation. One example of such a complex factor is type of project which has been specialised into IS development project and Business development project. This categorisation is too coarse grain, since there can be many different types of projects within each category, all with their own set of interrelated characteristics.

Situational factors cannot be addressed one by one. They influence each other.
One such cluster of factors is management support, available resources and authority of the people assigned to the project. They clearly influence each other.

The values of situational factors in a specific situation (e.g. method knowledge = high), influence which combination of factors to take into account and also influence which strategy to take.
One example is the degree of agreement among stakeholders regarding the nature of the problem and the goals for its solution. A high degree of mismatch between the views of different stakeholders means more negotiation and conflict resolution. This can be time-consuming, which impacts on available resources. We must therefore consider management support. If at the same time management support is low, the outlook is not very promising for the quality of the result. We need to define a strategy to improve the situation or abort the project.

The study of the use of methods is problematic, since it entails studying problem solving processes in the minds of method users. In the PEM literature [3][4][7][16] some situational factors are discussed. However, we have found no evidence of any *systematic* investigation. Keeping in mind the relatively immature state of research , we find that our study has to focus on systematising the knowledge of experienced PEM users. Goldkuhl [15] defines the following levels of a method:

1. Subjective level; the method knowledge of an individual method user
2. Inter-subjective level; the generalisable knowledge of several method users
3. Language level; expressed method description
4. Action level; actions in accordance with the method
5. Consequence level; materialised effects of actions in accordance with the method

Putting our work into this framework, we see that our research focuses on describing and analysing the subjective and inter-subjective levels, aiming to improve the language level. An improved language level helps the method user to make informed decisions on the action level, which in turn enhances the effect of using the method on the consequence level. Analysing and describing the subjective and inter-subjective levels above with regard to situational factors in PEM means dealing with subjective opinions about a complex social context, the EM process. We now ask ourselves: which is the appropriate way to investigate the area?

4. Quantitative and qualitative research methods - two possible approaches

A classification of research methods, which seems to be commonly accepted, distinguishes quantitative methods from qualitative. According to Myers [17] *quantitative* research methods (survey methods, laboratory experiments, formal and numerical methods) originate from the natural sciences and aim to study natural phenomena. *Qualitative* research methods, on the other hand, aim to investigate and understand social and cultural phenomena in the context where they exist. Furthermore, qualitative research tries to place studied phenomena in a holistic framework [18] and mean that social and cultural phenomena are best investigated by studying people's actions in and verbalised thoughts about the social and cultural context under study [17]. Examples of qualitative research methods are action research, case studies, ethnographic research and grounded theory (See further section 6).

Quantitative methods are sometimes argued to be "better" than qualitative methods, claiming to build on objective measurement, as opposed to qualitative methods, which build on inherently subjective data [19]. However, discussing which type of method is "better" than the other is not very constructive. Let us therefore take a more general view of long term research within a certain field (Fig 2.). The cycle of long-term research entails 1) discovery of hypotheses/theories and 2) justification/proof/validation of hypotheses/theories. The discovery phase is followed by justification and then new theories or elements of theories can be discovered, which need justification, etc.

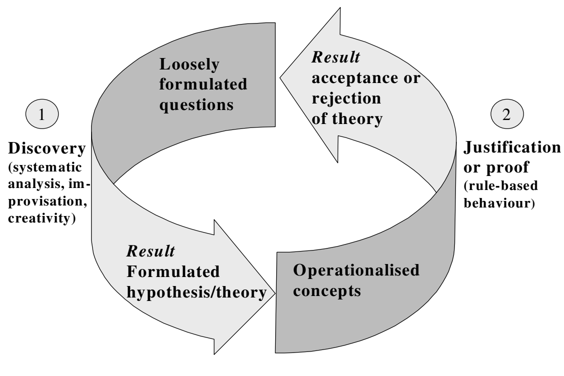

Fig.2. The cycle of research (adapted from [19] p21)

This means that discovery and justification clearly complement each other as different phases in long-term research. Both phases may be carried out using *qualitative* methods *or* using *quantitative* methods. In order to "discover" the researcher should have previous knowledge and maybe also experience in the area under study [19]. Without this knowledge and experience the researcher will not be able to state what is called "loosely formulated questions" at the beginning of the discovery process (Fig. 2). We find that our empirical studies have given us the knowledge that enables us to explore our research area, trying to discover theories/hypotheses for future operationalisation and justification. On the other hand our initial framework of situational factors could be seen as a tentative hypothesis, which needs justification, validation and further development. Either way, we need to make a choice whether to use a quantitative or qualitative approach.

Our field of study is clearly a complex social context and we need to rely on the verbalised knowledge and thinking of the people in that context as our main data source. It could be argued that in order to achieve valid results we need to isolate a small number of situational factors and find ways to objectively measuring their effects. However, the social context and complexity of PEM makes it almost impossible to set up controlled experiments and in that way validate research results. There *may* be some aspects of the area that could be investigated in this way, but at this stage we seriously question the effectiveness of such an approach. In fact, looking at the fairly immature state of research, we realise that it would be dangerous only to focus on what is objectively measurable, i.e. to study what *can* be studied instead of what is *important* to study. If we can not grasp the complexity of an issue, we tend to underestimate its problematic nature [21]. An overview of the area has to be made, in order to assess its complexity and to find motivation for further investigation into more specific and isolated issues.

The chosen approach needs to aid in fulfilling the following two aims:

1. Investigate people's experiences and thinking in a complex, social context.
2. Systematically create a holistic view of situational factors in PEM.

Taking these two aims and our previous discussion into consideration, we conclude that a qualitative approach is the most appropriate in our case.

5. A qualitative research approach for investigating situational factors in PEM

In this section we discuss the suitability of various qualitative research methods and introduce the method grounded theory, on which we plan to base our approach. We also outline our approach.

The most commonly known and discussed qualitative methods are action research, case studies, ethnographic research and grounded theory approaches [17]. Let us analyse their applicability to our research problem, taking into account the current status of our research and the aims stated above. Now, we have studied the important traits of the methods mentioned above. They are all methods for empirical studies, which investigate social and cultural phenomena in the context where they exist.

Keeping this commonality in mind, let us focus on the differences between the methods.

In action research, the researcher participates actively in the process that she/he is studying (e.g. as a facilitator in PEM) observing the issues of interest. Our previous empirical studies can be viewed as action research. We rule out action research as a possible option, since we at this point need to complement our own experiences and observations with those of other people in the field.

In case studies, ethnographic studies and grounded theory approaches the researcher observes without actively participating. Ethnographic studies are particularly focused on the softest social/cultural/anthropological issues and require the researcher to immerse in the life of people she/he studies for a long period of time. Depending on limited resources we rule out ethnographic studies as a possible option. Case studies and grounded theory projects, on the other hand, can be set up as shorter and more focused activities. Now, our aim is to create a holistic view of the research area. A case study is one specific instance of the use of PEM. In order to achieve our aim, we would need to generalise a large number of instances. Taking the limitations of available time into consideration, we rule out also this option. This leaves grounded theory as a possible approach. A more detailed evaluation of the suitability of grounded theory is made in section 6.2 below.

5.1 Basic assumptions of grounded theory

Grounded theory (GT) is "an inductive theory discovery method that allows the researcher to develop an theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" [17][22]. The essence of the hypothesis generating approach is problematisation of the relationship between data about phenomena in a certain context and hypotheses concerning the causes and effects of those phenomena (Fig. 3).

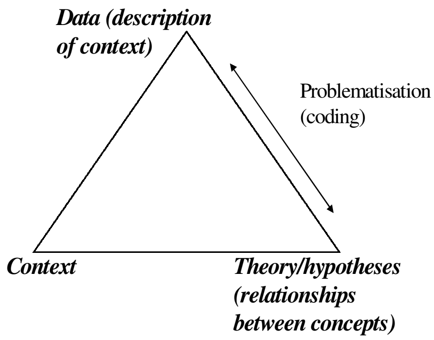

Fig. 3. From data to theory/hypotheses (adapted from [19] p32)

GT has some important underlying philosophical assumptions:

1. The researcher should be as open as possible to new data and ideas during the research process.
2. In data collection the researcher can (and oftentimes should) switch between different techniques. The goal is to obtain as rich data as possible.

3. Hypotheses are created and revised throughout the whole process to guide further data collection and analysis.
4. Coding of data visualises chains of thought.

Data collection
In qualitative research data means text/statements, verbal or written. Primary data sources are people and secondary data sources are literature/documents. Often a combination of techniques is used, such as interviews, observation, document analysis etc. [17]

Coding
Coding of data is a technique to aid analysis. It is comparable to conceptual modelling in that it provides a way to structure, categorise and describe relationships between concepts. Codes are of two types, substantive and theoretical (Table 1). Substantive codes represent the concepts themselves and theoretical codes relate concepts to each other to form theory/hypotheses [19].

Type of coding	***Codes***	***Result***
Open coding	Substantive codes	Concepts (for example "model quality and "method knowledge"
Selective coding	Theoretical codes	Combination of concepts to form theory/hypotheses (for example "*Method knowledge* improves *model quality*")

Table 1 Coding of data (adapted from [19] p39)

Coding is carried out in two stages: open coding and selective coding, which are iterated whenever there is new data to be analysed. Open coding is categorisation (generalisation/specialisation) of concepts (substantive codes). Selective coding means looking for and documenting relationships (theoretical codes) between groups of concepts. It focuses on so-called "main variables" [19]. Main variables then set the direction of further data collection. There are families of theoretical codes such as cause-effect, process, degree, type, interaction etc. Table 1 shows an example of the cause-effect family: "Method knowledge improves model quality".

Method triangulation
The notion of richness and openness is very strong. In particular in the data collection stage, where the use of several techniques within one study is advocated. It is not surprising to, therefore, to find that the method has an idea of its own role in relationship to other research methods. In order to obtain further validation of the results from a GT study, the method suggests what is called "method triangulation". This means that some other, perhaps also quantitative, research method is used. According to Myers [17] GT approaches are becoming increasingly common in the IS research literature. He claims that the reason is its usefulness in developing context-based, process-oriented descriptions and explanations of various social phenomena in IS development. Examples of such research can for instance be found in [23] and [24].

Following our discussion in section 5 and 6.1 we see this stage in our research as a combination of hypothesis justification and hypothesis generation. Our framework of situational factors is an initial theory/hypothesis, which needs justification and further development (theory generation). The justification of our initial theory needs to be systematic, although building on inherently subjective data. New data, also inherently subjective, needs to be systematised in order further to develop our theory. We therefore believe that the coding procedure in GT is a valuable feature, which supports validation of results. Furthermore, the coding procedure resembles the type of modelling carried out in our research so far. We have used two Enterprise Modelling methods: From Fuzzy to Formal [3] and Enterprise Knowledge Development [16]. Both methods include a model type, called the Concepts Model, aimed to describe the concepts within a certain domain and their relationships in terms of binary relationships (such as the relationship described in Table 1 above "*Method knowledge* improves *model quality*"), part of relationships and specialisation/generalisation relationships. Actually, in one of our empirical studies [9], we "translated" existing text documents to Concepts Models. This experience may prove helpful in using GT, especially in the coding stage. In conclusion, we believe that a GT approach is suitable for our investigation.

5.2 An outline for a research approach

We propose the following GT based approach for a study on the impact of situational factors on Participative Enterprise Modelling. The study contains three sub-activities, of which data collection and coding are carried out in parallel.

Data collection
We propose three techniques of data collection as described below. Following the GT approach the techniques will be mixed during our study.

Interviews
As we have pointed out earlier, we see the knowledge and experience of people as our most important source of data in our investigation, which is why recorded interviews will be our main data collection technique. In pure GT the questions are very open, but in our case we have a tentative framework, which we want to validate and develop. Therefore, the interviews will be guided by the framework. This does not mean that we will put our framework in front of the respondents for them to accept or reject. We mean to use the framework as a checklist for ourselves and add a few very open questions as probes. One possible example of an open question is to ask the respondents to "tell stories" about projects that they have worked in and to try and find chains of reasoning by e.g. asking them questions like "What happened next?", "Why did you do that?" or "Which strategy would you suggest in a situation like this and why?". We want to identify the important situational factors, understand their impact and collect suggestions and motivations for guidelines.

Firstly we rely on the experiences of PEM method users, i.e. people who work with setting up modelling activities, facilitating group modelling and using models in different types of development work. They are seen as *suppliers* of PEM. Secondly we rely on the experiences of the *customers* of PEM. They are people in organisations where PEM has been a part of development work. They may be responsible for development projects, participants in modelling activities, users of models etc. We find it important to cover both these types of stakeholders, since they may experience and evaluate a situation quite differently.

Literature study

Our secondary source of data is different types of documents, which is why a literature study is relevant. Modelling is an important part of Information Systems Development. We know that there is a body of literature related to situational or contingency factors in the field of Information Systems Development that we need to take into account [25][26]. We therefore need to study this literature to investigate the commonalities between the use of Information Systems Development methods and the use of PEM methods. Also, we are aware of literature in the field of risk management (see e.g. [27)], which might prove useful to include in our study. In the PEM literature [3][4][7][16][28] situational factors are discussed although no systematic account is made. Important input to our investigation can be found here.

Observation (optional)

A third type of data collection technique, which could be relevant for our study, is observation of ongoing PEM projects. This could give important additional and first hand information. The problem here is the limited time frame, which is why we see this as optional.

Analysis and presentation of results

Analysis of data will be carried out in accordance with the GT approach. Conceptual models showing the result will be built and refined throughout the investigation. We expect the models to describe important influences between situational factors and also their impact on the result of PEM. We also expect, through descriptions of how factors are related to each other, to be able to operationalise factors to some degree. This improves the possibility of finding ways to evaluating them and to formulate guidelines. The results will be presented in two ways. Firstly the models resulting from the analysis will be presented as base data. Secondly we will present our findings as an initial sketch of a "PEM handbook".

6. Expected results and concluding remarks

It could be claimed that this type of investigation is futile, since we most likely will not be able to create a "complete picture" of the influence of situational factors on PEM. Let us therefore make it clear, that we are not aiming at this. It is clearly questionable if there could ever be such a complete description since new situations, not covered by our investigation, most certainly will arise in the future. The research problem can be characterised as a "wicked problem" [29], meaning that there is no definitive stopping rule, which defines when we have an effective way of dealing with all situational factors. We cannot determine if our guidelines are the optimal ones and combinations of situational factors are innumerable. Considering these problems, the outlook seems not to be very positive for success in researching the area of situational factors in PEM. However, we believe that the outlook *is* positive and that even quite a modest result will move this rather immature research area forward quite substantially. We are convinced that a our investigation will give the following contributions:

1. It systematises and makes the knowledge of practitioners available for future method developers and method users. If we can provide some well-grounded scenarios and guidelines, this would facilitate method training and hence improve maturity in method use. Ultimately this could contribute to improving the utility of EM and hence stimulate the use of EM methods in practice.
2. It provides an important baseline for future research and theory building within the area of situational factors in PEM.

In this paper we have focused on describing the complex and problematic nature of situational factors in PEM along with the challenges of investigating the area. An outline of a research approach for this inherently complex area has also been briefly described. The motivation for this research comes from our strong belief that method constructors need to understand the use of methods in practice. Without this understanding they will not be able to construct effective methods, which will actually be used by practitioners.

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