EVALUATION OF PRODUCT DEVELOPMENT PROCESS MODELS FOCUSING ON THEIR IMPLEMENTATION

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ABSTRACT

The need for improving product development performance within the construction industry is widely acknowledged. In response to this challenge, different process models have been developed by academia and industry to enhance the effectiveness and efficiency of the design and construction activity. However, the effective and widespread adoption and use of process models has been limited, and the benefits resulting from these endeavours have been ambiguous at best and not existent at worst.

This paper presents a framework for evaluating product development process (PDP) models focusing on their implementation. This framework has been tested in a case study carried out on a manufacturing company that have successfully implemented a PDP model for more than 10 years. The paper concludes that the role of PDP models should be defined as means for learning rather than means for control if successful implementations are to be achieved.

KEY WORDS

Product development, process model, evaluation, implementation

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1. INTRODUCTION

The UK construction industry has been challenged to be able to deliver projects that are predictable on cost, time and quality, through an understanding of customer requirements (Egan, 1998; DTI, 2002). A key part of this broad agenda relates to the need for improving the performance of the design and construction process. Numerous government and institutional reports, for example, DTI (2002), and Fairclough (2002) have examined design and construction process management, and constantly concluded there is a need for innovation and change in process management practices.

One improvement strategy that has been proposed is the development and implementation of generic process models, which would allow for a consistent and integrated design and construction process (Kagioglou et al., 1998). Even though relationships are complex and dynamic in a project environment, the underlying generic processes remains broadly consistent (Mill and Ion, 1994; Kagioglou, et al., 1998). As a consequence, process mapping is becoming accepted as a means for improvement.

However, the effective adoption and use of process models in practice is slow, and there have been ambiguous signs of improvement resulting from these solutions (Austin et al., 2000). Hammer and Champy (2001), for instance, identified that implementation of new or redesigned processes fail in 50-70% of Business Process Reengineering (BPR) initiatives. Several reasons have been pointed out for this high failure rates. Cao et al. (2001), for example, argue that human issues often receive insufficient attention. Lawson et al. (2003) state that model failures occur due to lack of motivation, with many process maps left unused on the shelf regardless of the time, knowledge and effort invested in developing them. Therefore, the contribution of process modelling to improve product development management in practice remains relatively unexplored.

This paper proposes a framework to evaluate PDP models regarding their implementation. This framework was fundamentally designed based on a literature review, and was tested in a case study carried out on a manufacturing company in which a PDP model was successfully implemented for more than 10 years. As a result from the study, the role of PDP models within the construction industry is questioned.

2. SCOPE OF THE STUDY

The implementation of PDP models can be viewed from different perspectives. This study considered three complimentary perspectives on process implementation (i.e. process management, change management and knowledge transfer), which have been structured around a generic framework shown in Figure 1. The model aims to provide a holistic and systemic perspective on implementation.

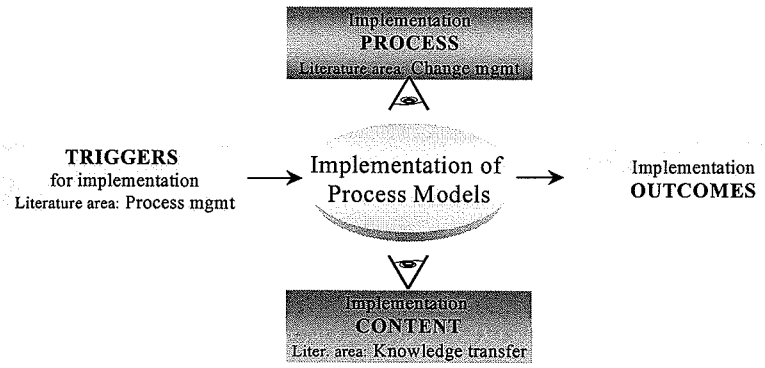


Figure 1: Framework to evaluate product development process models

Based on this framework, successful implementation outcomes (i.e. the effective adoption and sustained use of a process model within a firm) should be achieved through suitable implementation triggers (related to the improvement need), and will be determined by a appropriate implementation process (i.e. the steps used, and the way the model content is transferred to its users) as well as by the usefulness of the process model content itself.

2.1. IMPLEMENTATION TRIGGERS AND OUTCOMES

Implementation triggers relate to the reasons why a company decides to invest time and effort to design and implement process models. The outcomes are the benefits that will accrue from the initiative. The main triggers for designing and implementing PDP models should be the potential to achieve some of the benefits that have been claimed by the use of models. Such espoused benefits may relate with the **client**, i.e. potential improvements to the product; the **process**, focusing on the way it is developed; and benefits for the **organisation** as a whole.

The most important espoused organisational benefit pointed out in the literature is the possibility of achieving consistency and integration and more predictable outcomes through the replication of the managerial practices embedded in the process to all company projects (Ulrich and Eppinger, 2000; Kagioglou et al., 1998; Winch, 2002; Cooper, 2001). Furthermore, a process model can act as a support for training, since it describes the company's 'way' of working (Gray and Hughes, 2001; Cooper, 2001).

A process model specifies the phases a project should go through and checkpoints along the way (Wheelwright and Clark, 1992; Cooper, 2001). Following the process model is one way of assuring the product quality (Ulrich and Eppinger, 2000), and reducing cycle times and costs (Cooper, 2001; Kagioglou et al, 1998; Reinertsen, 1997). Further, the roles of stakeholders can be clearly defined (Gray and Hughes, 2001), as well as when their contributions will be needed and with whom they will need to exchange information (Ulrich and Eppinger, 2000).

For clients, the benefits relate to the possibility of achieving better value for money through a product free of defects, which fits its purpose, and it is delivered on time (Reinertsen, 1997; Kagioglou et al., 1998; Ulrich and Eppinger, 2000).

Maylor (1997) describes that empirical studies in product development normally describe benefits, but they do so regardless of complementary activities that might be taking place within the firms. Consequently, it is difficult to determine if the benefits claimed are directly from the use of a process model or if these are by-products of the use of various techniques. Furthermore, although the organisational context is extremely important in determining the relevance of a process model (Pettigrew, 1987; Bresnen and Marshall, 2001), this issue seem to have been abstracted away from most studies on process modelling.

2.2. IMPLEMENTATION PROCESS

The 'implementation process' refers to the steps that a firm should go through in order to fully implement a process model. The literature on the PDP presents generic guidelines on the implementation process. In addition, literature on organisational change presents models to support change programmes, which have been applied to process models implementation.

The PDP literature provides information on implementation by presenting 'processes' to implement processes. Cooper (2001) presents a model with three stages: (1) defining the process requirements; (2) designing the process; and (3) implementing the process through training, internal marketing, and having a process 'owner'. Smith and Reinerstein (1995) present a similar model. Implementation has thus been described through prescriptive steps that should be executed. It can be argued that if there is a need for a process model to implement a process model, maybe there would be a need for a further process prescribing advice on the process to implement a process model, which could lead to a never-ending cycle!

Guidance on implementation is also provided through several conceptual models and methodologies found in the BPR literature. Even though such methodologies have been developed with different focuses, some common themes can be identified. First, such methodologies are one-off type models, i.e. they have a defined start and end. Therefore, they concentrate on creating change rather than managing change as a continuous event (Cooper, 1994; Stickland, 1998). Second, they provide prescriptive sequential steps through which a company should go in order to implement changes (Vakola et al., 2000).

Lindsay et al. (2003) states that BPR represent a 'repackaging' of traditional techniques derived from scientific management, which are very mechanistic in nature. Those e authors also point out that even though attempts have been made to soften such techniques the models still represent positivistic approaches that should be used to shape and structure human activities. In this way, the literature fails to address the complexity and the non-linear nature of much of the work carried out in organisations. It also assumes that humans are rational decision makers co-operating together to achieve agreed and clearly defined goals, and are concerned with past practice and promoting standardised best practice (Lindsay et al. 2003). As demonstrated by Pettigrew and Whipp (1991), companies are composed by individuals and groups who usually have differing values, needs and goals, which sometimes leads to conflicts, and these factors are generally not considered within the BPR literature.

Therefore, implementation needs to be understood as an organisational change process, which involves change at individual, group and organisational levels (Makin et al., 1996; Stickland, 1998). Individuals need to be capable and motivated to change their behaviour in some way to allow the adoption of a process model (Burnes, 2000).

2.3. IMPLEMENTATION CONTENT

'Implementation content' refers to the transfer of the knowledge embedded in a process model from the model developers to its users, thus providing an additional perspective on the implementation process. Knowledge (or technology) transfer literature provides insights that can support the better understanding of process models implementation.

Implementation involves the transfer of the knowledge embedded in the generic model to its users. To 'move' technology (i.e. a process model) within an organisation involves two main actions: transmission (i.e. sending or presenting knowledge to a potential user) and absorption (understanding and interpretation) by the user (Davenport and Prusak, 1998). In this way, users will be able to apply the knowledge to manage the project in hand. As a result, model users will be able to identify potential benefits (as well as problems) from the process model's use at organisational, project and individual levels. They also need to believe that the model can effectively help managing the PDP, i.e. there should be a low degree of conjecture on the utility of the model by users (Szulansky, 1999).

Furthermore, the re-utilization of the routines expressed in a process model through the different company's projects can be analysed as a replication issue (Nelson and Winter, 1982; Winter and Szulansky, 2000). This is important because the aim of process model's implementation is the use of the model not only in one project, but in all different projects developed by the company to allow for consistency. Therefore, the classification of problems related to the replication of organisational routines and to the opportunity to transfer (Szulanski, 1999) could be used also to understand problems that might occur during implementation efforts.

2.4. DISCUSSION

Product development literature suggests a set of valuable insights on the benefits and possible outcomes from applying process models in practice. However the focus is usually on the process model design, and implementation issues are inadequately described.

The implementation of a process model occurs through a set of steps or activities that need to be defined at the organisational level and conducted at its operational level. Much of the literature present prescriptive models, which generally approach change as a one-off activity, and do not consider that change should be managed as a continuous event within organisations. Empirical results have suggested that the use of such frameworks has led to outcomes that do not seem to be successful. Therefore, the need to appropriately link implementation to the organisational context and to soft people issues (such as consensus, collaboration and motivation) has not been properly addressed.

The importance of explicitly accessing the usefulness of the model content in the organisation and project levels has also not been sufficiently emphasised in the literature. It appears that it has been assumed that any change or innovation proposed in such models would be beneficial, regardless of the type of organisation and project to which it is being applied. As a consequence, the literature does not explicitly describe means to assess such usefulness. This gap is addressed in this paper by the development of the framework to evaluate process models regarding their implementation.

3. RESEARCH METHOD

The epistemological option for this study is based on the interpretative school of thought. The research uses Qualitative approaches are used to inductively and holistically understand human experience in context specific settings. As pointed out by Silverman (1998:3), a "particular strength of qualitative research ... is its ability to focus on actual practice in situ, looking at how organisations are routinely enacted". Thus, the implementation process was analysed with an emphasis on the meanings, facts and words in order to reach a broader understanding of the phenomena.

Within this context, a case study approach with exploratory and explanatory characteristics was used for the purpose of learning about the process models being developed within companies and understanding implementation in its context. Six case studies were developed, one in a manufacturing company and five within construction companies. This paper describes the main findings from one case study, conducted in a manufacturing company. This was the only case in which the PDP model implementation was successful.

The company involved in the case study is a telecommunications company that develops broadband switching, access products and optical networks. It was selected due to the fact that it has a well-established high-level PDP that had been used to manage their new product development for more than ten years.

Data was collected through (a) semi-structured interviews; (b) participation of one of the researchers in workshops in which the implementation process was discussed; and (c) document analysis. The interviews were verbatim transcribed, generating a detailed report on the process model design, its evolution along years, strategies adopted for implementation, and factors that were perceived to have affected implementation.

The data analysis was developed with the aid of both content analysis (using QSR NVivo software) and cognitive mapping (using the Decision Explorer software). According to Krippendorff (1980:21) 'content analysis is a research technique for making replicable and valid inferences from data to their context', and its purpose is to provide knowledge and new insights through a representation of facts. The recording unit used for coding was based on phrases, and the codes reflected concepts that were then used to construct mental models through cognitive mapping. The theme for each model derived from the literature, describing business objectives through which a process model can be evaluated.

A cognitive map is a description of an individual' or several individuals' mental models, being composed by ideas and links between these ideas (Rodhain, 1999). The links between ideas are causal links, being understood as: (a) A is the explanation of B; (b) B is the consequence of A; or (c) A is the means and B is the goal. Cognitive maps were used in this research to test the process models evaluation framework derived from the literature. They also helped to generate new theoretical insight with regards to the role of process models within firms. The framework for evaluating process models developed from the literature is presented in the next section.

3.1. FRAMEWORK TO EVALUATE PROCESS MODELS WITH A VIEW TO ITS IMPLEMENTATION

The PDP literature presents concepts that can be used to evaluate process models. Nonetheless, those concepts are described in a scattered manner. To address this gap, a framework has been proposed aiming to support the evaluation of a PDP model content regarding its implementation. The framework was organised in three hierarchical levels: (a) the high-level evaluation criteria; (b) headline criteria, describing concepts that are part of overall criteria; and (c) attributes that describe each headline criteria. The framework is presented in Figure 2.

Two high-level evaluation criteria were determined, i.e. *applicability* and *usefulness* of the model. The applicability of a model in the business context (Smith and Morrow, 1999) is concerned with its capability to be used to support PDP management. Model usefulness (or importance) addresses the model pertinence in terms of what it adds to the business.

The concept of model applicability is described through three headline criteria, i.e. the model *flexibility* (Cooper, 2001), its *easiness to use* (Kagioglou et al., 1998; Bresnen and Marshall, 2001), and model *credibility* (Smith and Morrow, 1999). Process model flexibility is necessary to allow the model application and replication through the company's projects. Kagioglou et al. (1998) regard flexibility in terms of the process phases, as the number and content of such phases should be adaptable to the project in hand. Flexibility is also considered in terms of the functional roles, the deliverables, and the distribution of workloads between professionals in accordance with the specific project needs (Cooper, 2001).

A process model needs to be easy to use so that it can be applicable to support PDP management. Easiness of use can be assessed in terms of the simplicity and clarity in the presentation and structure of the process model, as well as through the simplicity and clarity of its knowledge content. Smith and Morrow (1999) point out that the simpler the model is, subject to reproducing the behaviour observed in the world to a necessary level of precision, the better it is. Kagioglou et al. (1998) supports this idea, stating that process models need to be transparent, defined simply, and it should be related to a straightforward icon to which people could attach their interpretations of it.

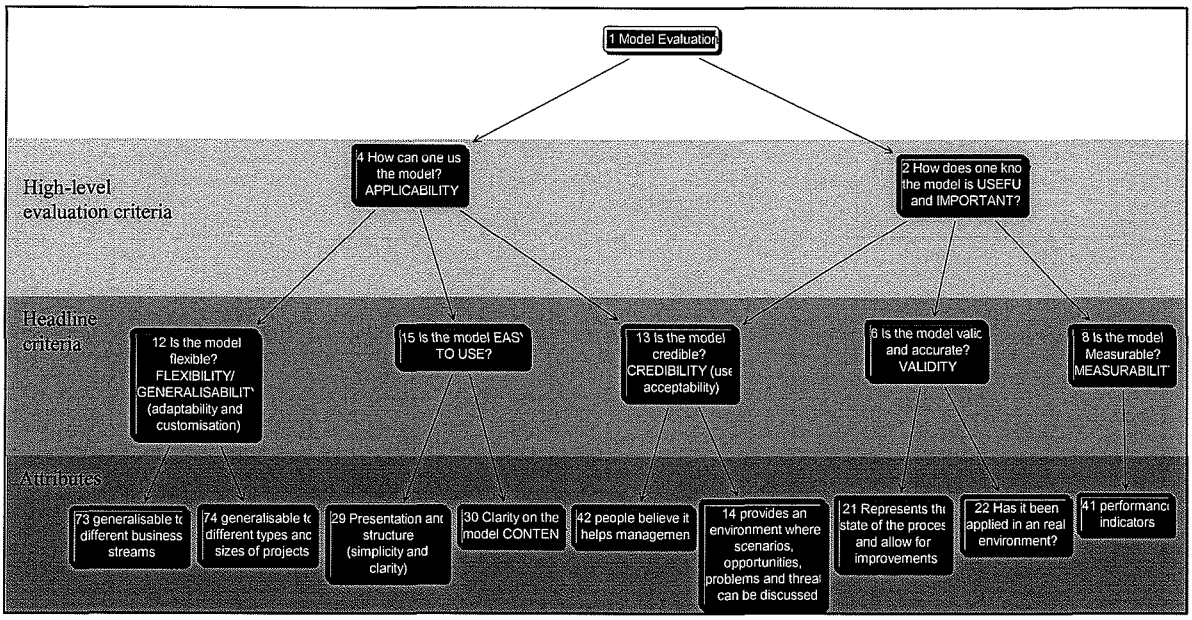


Figure 2: Framework to evaluate product development process models

The knowledge content of a model should be clearly defined, and have an obvious internal coherence, otherwise the model could be perceived as a bundle of loosely related practices (Bresnen and Marshall, 2001). In this way, the model should present proper codification in a commonly held set of principles and practices. It can be assumed that when a process model lacks a clear definition of its objectives and of the improvement principles included, it will be difficult to be used.

The final issue with regards to process models applicability refers to the model credibility, or user acceptability of the model. The model credibility refers to the degree of conjecture on the utility of the process model (Szulanski, 1999; Dixson, 2000). If a process model is not perceived as credible, it will probably not be used to guide decision making within a project environment. Credibility therefore is important for both the model applicability and its usefulness.

A process model usefulness can be assessed through two other headline criteria i.e. the model *validity* and *measurability*. The validity of a process model can be addressed by analysing if it adequately captures the actual state of the process, as well as analysing if it adequately describes the changes to be introduced in the process. Smith and Morrow (1999) further propose that a model's validity can be assessed through the application of the model to guide decision making in the real world in pilot implementations, which also support the model credibility.

Measurability concerns the existence of performance measures as part of the process model. A difficult implementation problem relates to the difficulties in producing clear evidence of performance effects (Bresnen and Marshall, 2001), as it is hard to compare projects with one-off characteristics. In any case, it is important to try and measure at least partial aspects of the process model application, in order to provide some evidence of the improvements achieved.

5. CASE STUDY RESULTS

A 'story'[5] related to the implementation of process models within the company involved in the case study is presented bellow. Implementation triggers and history are briefly presented, followed by the evaluation of the process model regarding its implementation.

5.1 IMPLEMENTATION TRIGGERS: WHY A PDP MODEL IMPLEMENTATION WAS NEEDED?

In the case study company, product development is very complex. There is great variability between projects as different products with varied levels of complexity are developed. Linking product development, marketing and physical production is important and challenging, as it involves people from different parts of the company, i.e. engineering, technology, design for manufacturing, product installation, training, services and long-term support. The company also faces high risks in introducing new products to the market. The business case for each product needs to be updated constantly, as competitors could introduce similar products at lower costs at any time.

The company has decided to invest in process models to reduce the occurrence and the effects of such problems. The main objectives for designing and implementing process models were:

- To define a 'best practice' process that embodies the discipline and business planning to help the company achieve success in all projects;
- To support the definition of the size, scope and timing of each project; This should enable the company to meet costs, time and reduce risks;
- To provide stakeholders with a whole project view, enabling a similar understanding of project priorities and client requirements;
- To define, implement and continually improve phase reviews;

Hence, the main triggers of designing and implementing processes was to allow the company to establish one generic process that could be used to guide decision making in project execution, allowing for consistency in all projects and between all stakeholders involved. The expected benefits from implementation were achieving increased predictability on projects outcomes, especially in terms of avoiding project failures and the development of projects that do not fit market needs. A further benefit related to enabling better planning for NPD projects, which would allow for better communications and timely information exchanges, as well as for more predictable timing for the release of project deliverables. It is then clear that, initially, the main role of the process model within the firm was to provide the means for product development planning and control, which is in accordance with what is advocated as benefits from processes in the literature.

5.2. IMPLEMENTATION HISTORY

The company has designed three different models over more than ten years. The first process model designed described five key processes, i.e. strategy, planning, product development,

[5] For the concept of story telling in case study research see Eisenhardt, 1991

costumer requirements fulfilment and installation and commissioning. During the design of this model the company appreciated the need for hierarchy and different levels of abstraction in a process model.

Due to the need for inputting support information to process activities, the company decided to develop a more detailed model. The IDEF0 modelling technique was then used, and the final model presented more than 100 pages of activity descriptions, being considered too complex by the company members. The shortcomings of this approach were soon realised, as the model did not allow for any interpretation or adaptation and therefore could not be applied throughout the company.

As a consequence, the model was redesigned, resulting in a high-level, generic model presenting key improvement principles. This model describes product development as a business-driven process that encourages a holistic approach to project management by viewing the project through a complete set of phases, with gates attached to each phase.

When the PDP model was initially designed in the company, there was a belief that it should be high-level and abstract enough to be describing all product development processes for all the different business units at all geographical locations. Nonetheless, as the model is generic, it does not provide specific information on how to execute activities at operational levels. This generated a need to design local variations of the model within each of the different business units, which embedded the same key principles of the high-level model, but at the same time described the way that the different business areas apply the model.

In the beginning the model developers thought that this was not a good idea, as those local models would not be translatable throughout the company. Nonetheless, after some time it was observed that designing these local models was very much beneficial, as it allowed for an increased understanding of the generic model and of the principles behind it throughout the company, enabling successful implementation. Therefore, the importance of the role of the process model as a learning and thinking tool became explicit.

Nonetheless, a major change in the business was taking place during the time the interviews were executed, mainly due to downsizing of the telecommunications market and consequent financial problems faced by the company. To overcome such problems the company changed its strategic direction from selling products to selling *solutions* to the customer, i.e. developing and installing networks and enabling communication exchanges. As a consequence, a new process model was designed linking product development and the business processes related to delivering a solution to a client.

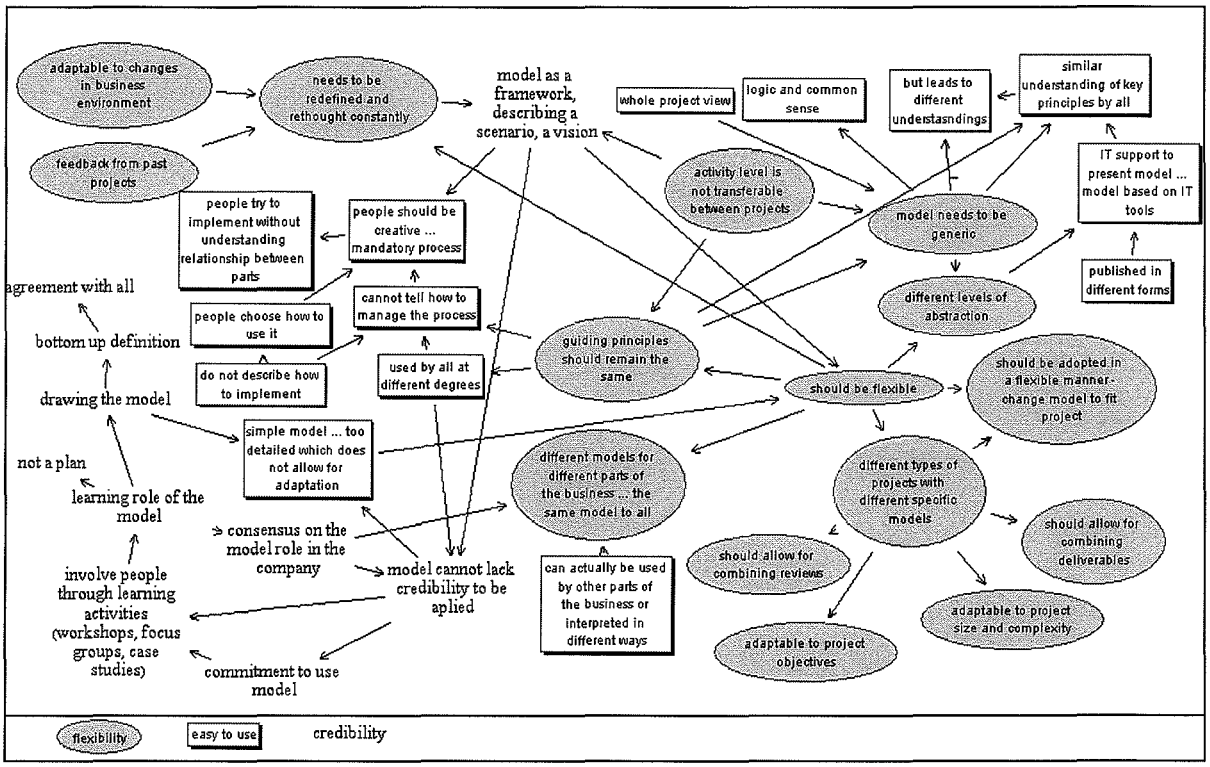
This brief description of the implementation history makes explicit the need for process model flexibility to adapt not only to different project contexts, but also to changes imposed to the company by the market. Furthermore, it is possible to observe that the design and implementation the model was not a one-off activity, but rather a process of continuous change and improvement within the company.

It also demonstrates that the process models were developed aiming to allow the company to control the product development process. As a planning and control tool, the model could not be successfully implemented, as resistance to change occurred. Therefore, the role of the process model shifted from a control perspective to a more flexible one, in which the model is approached as a framework that should allow people to learn, think about

the process and be creative in the way it is managed while considering key improvement principles.

5.3. EVALUATION OF THE PRODUCT DEVELOPMENT MODEL REGARDING ITS IMPLEMENTATION

Figure 3 presents the concepts identified in the interviews related to process model applicability. In the proposed framework drawn from the literature, three headline criteria were associated with applicability, i.e. *flexibility*, *easiness to use* and *credibility* of the model.



When you see '…' within a box describing a concept, please read 'rather than'; Map key: Ovals present concepts related to the model flexibility; boxes present concepts related to the model easiness to use; loose concepts relate to the process model credibility

Figure 3: Cognitive map describing concepts related to the process model applicability in the case study company;

Decision explorer allows the identification of the 'centrality' of an idea, which is used to identify strategic issues on a map, by identifying concepts with a greater number of links (Rodhain, 1999). The analysis of the centrality of each concept demonstrated that the following were the strategic issues with regards to applicability: (a) the process model should be flexible; (b) it should be approached as a framework, describing a vision; (c) it needs to be generic; and (d) it needs to be redefined frequently. This corroborates the literature findings in the need to evaluate a process model considering its flexibility, easiness to use in terms of

the need for the model to be generic and simple, and credibility as the model should be describing a scenario, which needs to be consensual.

It was found that the model being mandatory throughout the company was an ineffective implementation strategy, as it generated resistance to change. This problem generated discussions in the company with regards to the role of the model, and the importance of involving people through workshops and focus groups in order to achieve a similar understanding on its key principles and increase the model acceptability in the company.

The model easiness to use was addressed by the structure of the model, presented through a one-page high-level model describing process stages and stakeholders. This map is published in the company intranet, which presents support information behind the process stages and activities. In this way, IT is used to support the model presentation and dissemination.

In terms of the knowledge content, the central issues identified were with regards to the need for the model to be generic, presented as a framework describing a scenario. This was necessary for two reasons. First, having a generic model was the only way to address the need for flexibility necessary for its successful implementation. Second, as the model was high-level, it allowed managers to think over the process, be creative and innovative while considering the key process principles.

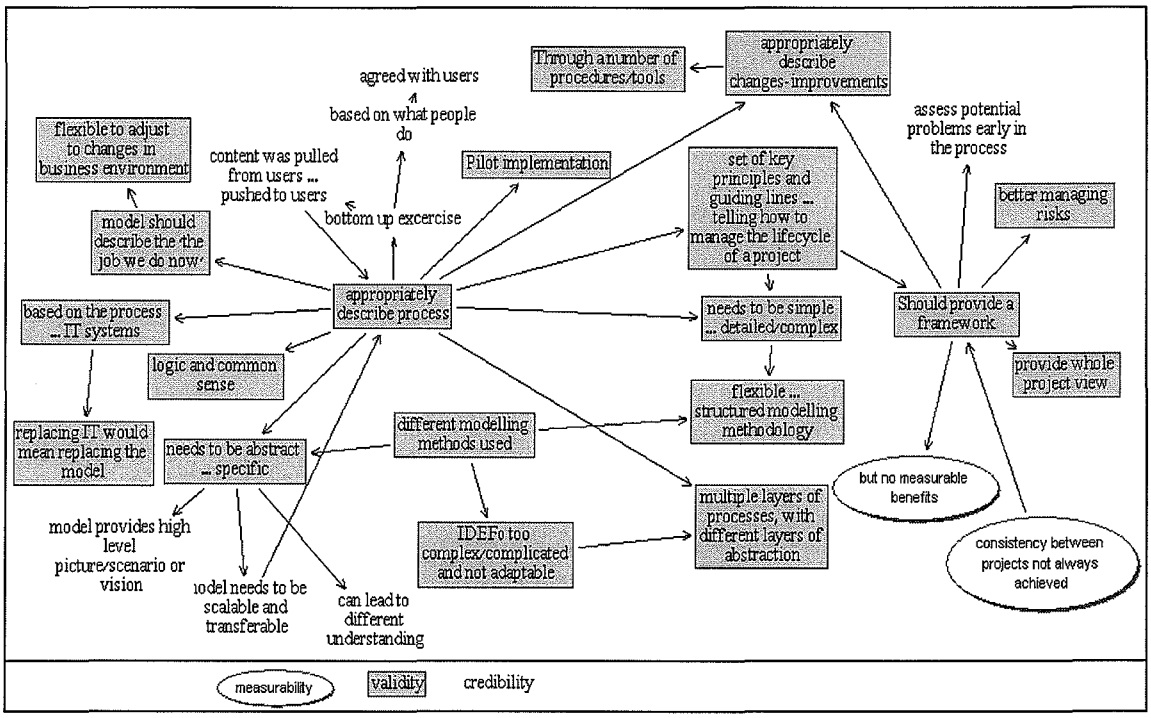
Figure 4 presents the cognitive map describing the process model usefulness in the case study company. In the proposed framework drawn from the literature, three headline criteria were associated with usefulness, i.e. *credibility* of the model, *validity* and *measurability*.

The analysis of the centrality of each concept demonstrated that the following were the strategic issues with regards to a model usefulness: (a) the model should appropriately describe the process; (b) model should appropriately describe changes and improvements proposed; (c) model needs to be simple; and (d) the model needs to present a set of key principles and guiding lines rather than tell people how to manage a PDP project. This corroborates the literature findings in the need to evaluate a process model considering its validity by analysing if it appropriately describes the process and improvements through a set of key principles. It also supports the importance of credibility, e.g. need for simplicity, and the model not being prescriptive to allow acceptability.

For the model to be appropriately describing the process, it should be abstract, generic, and simple, presenting what was described in the interviews as 'logic and common sense'. Also, the model should be updated regularly so that it would remain appropriate over time. Finally, the model should be describing the process regardless of the IT that is used to support its development.

The need for simplicity in the process model demonstrates the importance of adopting flexible modelling methodologies. As stated previously, the use of a structured modelling methodology (IDEF0) was not appropriate as the resulting model was excessively complex to be adaptable to the different types of projects. It was not possible to successfully implement a process model describing in detail how the product development process should be managed. In contrast, implementation was successful in the case study company as the PDP model designed presented a set of key principles and guiding lines, which were generic, flexible and adaptable.

The process model credibility was linked to its validity in terms of appropriately describing the process. In this way, for the process model to be credible, achieving user acceptability, it needed to be (a) scalable and transferable, and (b) based on what people do and agreed with its users, and so a bottom up approach to modelling was considered appropriate. This also allowed for the content of the model to be pulled from users, rather than imposed or pushed to them, which increased its acceptability.



Map key: Ovals present concepts related to the model measurability; boxes present concepts related to the model validity; loose concepts relate to the process model credibility

Figure 4: Cognitive map describing concepts related to the process model usefulness / importance in the case study company

Finally, the existence of performance measures was not considered as essential for the model usefulness in the company. The importance of using performance measures throughout the process was acknowledged, aiming to clearly demonstrate improvements resulting from the model use. Nonetheless, difficulties in keeping the measures relevant in an environment of constant market and process change lead the company to renounce the use of such measures as part of the process model implementation.

In summary, it is possible to state that the framework to evaluate PDP models is applicable in terms of describing the main issues that need to be considered to evaluate a process model with a view to its implementation. One shortcoming of the model, which represents a shortcoming in the literature, regards the consideration of the role the process

model has within the company, which should be included as a business objective in the framework.

6. CONCLUSIONS

The role of product development process models in the literature is generally approached from a 'control' perspective. In practice, on a successful implementation environment, this role has moved from this 'control' perspective to an approach more focused towards learning and commitment, as a result of the understanding of the importance of people being capable and committed to process innovation and improvement. This calls for a rethinking of the way through which process model design and implementation should be approached in real settings. Involvement of all users in the model design switches from being desirable to being compulsory, if learning is to be achieved. Also, the way 'use of the model' is understood should be considered not as a means to provide for planning the product development process, but as a framework through which suitable managerial practices can be adopted accordingly to the organisational and project environment.

The central role of people in management is often misconceived in product development process models through this 'control' approach. This has been evidenced by the low rates of implementation success achieved when prescriptive implementation steps were used to enable the use of processes focusing on enabling process control. This was also confirmed through the case study, as the implementation of the PDP model became more successful as the model started to be approached more as a framework to enable learning.

As the role of processes in a company environment changes, as a misalignment between the benefits from processes described in the literature and the benefits that are seek for and effectively achieved in reality emerges. Therefore, alternative approaches to implementation need to be thought with a view to the role that such processes can have in real implementation settings, i.e. the approach to how models are to be used needs to be rethought.

For an effective evaluation of a process model with a view to its implementation, issues on the model applicability, easiness to use, credibility and validity were identified as being important. The model credibility, or user acceptability, was found to be one of the most important issues to allow the successful implementation of process models. Also, the need for flexibility and learning through the model use was evidenced through the data analysis.

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