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Peter Kueng
University of Fribourg, peter.kueng@unifr.ch

Peter Kawalek
University of Manchester, pk@cs.man.ac.uk

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Peter Kueng
Institute of Informatics, University of Fribourg, 1700 Fribourg, Switzerland. Email peter.kueng@unifr.ch
Peter Kawalek
Department Computer Science, University of Manchester, England. Email pk@cs.man.ac.uk

Introduction

It is widely reported that organizations are increasingly dynamic as they seek to rationalize, innovate and adapt to changing circumstances (Handy, 1992; Kawalek and Leonard, 1996). Influenced by recent literature, many enterprises are currently engaged in intensive redesign of their business processes. By implementing process-based structures, process teams and process-oriented IT systems they seek to improve their competitiveness. In this context a process is understood to be a specific ordering of work activities, with a beginning, an end, and clearly identified inputs and outputs. A process can be further characterized by actors (who carry out the activities), customers, and process goals. By the term model we refer to an abstraction of a real world situation. A model will thus have a formal, or otherwise appreciable, mapping between elements in its composition and elements in the real world.

The place of process modelling in such redesign programmes has been contentious. Some have argued that the whole point is to be as radical as possible and that analysis of existing situations will serve only to constrain the imagination (e.g. Hammer and Champy, 1993). Hence, process models are restricted to roles in design and implementation. Others are more tentative and argue that process modelling of existing business operations can be valuable (e.g. Ould, 1995). Process models may be used towards this end much as an architect will use models in order to ascertain the views of users, to communicate new ideas and to develop a shared understanding amongst participants.

Elsewhere there have been innovative uses of process models to program workflow systems (e.g. Agostini et al., 1994), and as a conceptual basis for an executable, text-based Process Modelling Language PML (Snowdon and Warboys, 1994). This implementation-oriented modelling is sometimes referred to as workflow modelling. These innovations clearly perceive process modelling to be central to the lifecycle as a whole, embracing implementation as much as analysis and design. (Due to space limitations we do not discuss the usefulness of process models in the maintenance/evolution phase.)

The practical accounts are taken from the authors' work in various industries. In addition, we report the experiences of investigators working at Wilde Petrochemicals and Donleavey Engineering (pseudonyms). These are UK based companies who have been working with the University of Manchester on process modelling projects which span the lifecycle. Here a questionnaire featuring open and closed questions was submitted to three on-site investigators. The reported cases mainly utilized Role Activity Diagrams (Ould, 1995), IDEF0 (Rock-Evans, 1992), Petri net-based diagrams (Billington and Reisig, 1996) and the Process Modelling Language PML (Snowdon and Warboys, 1994).

Process Models in the Analysis Phase

A number of sources comment upon the use of process models in analysis. Ould (1995) points out that the role of a process model in the analysis phase is less that of a diagnostic instrument, than that of a searchlight. The purpose of the process model must be to reveal the process, the roots of its problems, and potential ways of attacking the trouble.

The interviewees were asked to grade the degree of usefulness of process models in the analysis phase of their projects. They were offered the scale 'essential', 'very useful', 'some marginal use', 'no use' and 'cannot comment/no relevant experience'. Two of the investigators chose 'essential' and one 'very useful'.

It is emphasized by Davenport (1993) that process analysis can help to ensure that problems of an existing process are not repeated in the new process. According to the interviewees, process models do not offer great help in this field: two chose 'some marginal use' and one 'no use'. Maull et al. emphasize the communication benefits gained from developing a process model, viz: "The benefit of developing a business process model do not necessarily result from having a completed or totally accurate model. The benefits are more likely to result from the change team communicating their understanding" (Maull et al., 1995). Similarly, Ould (1995) stresses that process models have to play a role as communication facilitator. This judgement is in line with our experience and that of the interviewees who deemed process models 'very useful' in facilitating the communication between users and IT experts. They help focus the subject of discussion and they contribute to the development of a common vocabulary.

Process Models in the Design Phase

The design phase refers to investigations aimed at facilitating the decision making process in the development or redevelopment of an aspect of the organization's operation. It is commonly agreed that through the design phase an idea should be put into concrete form, and that a judgement must be made as to whether a design can and should be realized. How are process models used in regard to these two aspects?

To put an idea into concrete form: Process models are commonly used in defining core elements of business processes; for example the activities needed and their dependencies, the dataflow, the roles and actors involved, and the goals set (cf. Kueng et al., 1996). However, process models are of little help to define the 'soft aspects' of an organization: the power and control mechanisms, the reporting relationships, the management practices, the organizational norms and symbols, etc.

Judgement concerning realization: After creating a model on a conceptual level, we want to know, as far as possible, if the designed business process is feasible or not, and what its value might be to the organization. It is proposed (cf. Kueng and Kawalek, 1997) that an evaluation of a process model delivers only a partial result; i.e. models are useful where one wants to evaluate process autonomy, job autonomy, and operational costs. On the other hand, they are of little help in checking more subtle aspects such as the consistency of a process or the degree of job integration.

Asked to grade the combined usefulness of Role Activity Diagrams (RADs) and State Transition Diagrams in the design of a project management system at Donleavey Engineering, the two researchers chose 'essential' and 'very useful'. The designer at Wilde Petrochemicals also found the use of process models in the design phase 'very useful'. He wrote that RADs were "... extremely useful for modelling people intensive, cross departmental, task intensive processes. Data Flow Diagrams were inappropriate." However, RADs also had limitations. The designer wrote: "Identifying 'exceptions' to a process is key to finding improvements, or defining more specific requirements for a new IT system. RADs were not successfully used but SSM (Soft System Methodology) offered a more flexible approach."

The questionnaire also considered the aspect of generating and evaluating ideas. Senge (1990) argues: "Human beings learn best through first hand experience." In order to realize this, Senge proposes "the usage of a microworld of reality where it is safe to play." The interviewees were asked to assess the usefulness of process models in providing such an environment where new scenarios, problems, opportunities and threats can be discussed. Two reported that process modelling is 'essential' and one that it is 'very useful'.

Process Models in the Implementation Phase

The implementation phase covers the activities associated with putting design decisions into practice; i.e. realizing business processes using IT systems. One class of IT systems is that of the so called workflow management systems (WFMSs), which support the coordination, control, and communication of workflow execution. In order to implement a process on an IT system a workflow specification language is needed. Today's commercial WFMSs use rules, constraints, and/or graphical constructs to describe the

synchronization of the tasks in a workflow, their attributes, and the roles to perform them (Georgakopoulos et al., 1995).

Many commercial WFMSs support graphical process definitions. From this, it seems possible that process models composed in the design phase can be mapped/transformed automatically into executable models which can be interpreted by a computer. However, there are still some barriers: (1) different WFMSs support different notations; (2) code generators do not have enough information about the implementation domain to translate design into code; (3) the execution of business cases - sometimes referred to as process instances - is usually dependent on legacy systems which cannot be adapted automatically. As Glass (1996) points out: "Closing the gap between the provided design and the necessary design is still a task requiring some creativity."

That said, through these innovations in workflow and related developments in the software process and elsewhere (e.g. Kawalek, 1995), it is clear that the implementation activity can be seen as a modelling activity. One of the investigators at Donleavey Engineering has experience of using RADs and the Process Modelling Language ProcessWiseIntegrator™ (PWISE). He reported that RADs were of 'some marginal use' whilst PML was 'very useful'. He wrote: "The most effective way to facilitate change has been in building the PWISE prototype. The diagrams (RADs) were too abstract - they (the users) wanted to see what it (the design) would translate to."

Conclusions

A critical commentary upon the use of modelling methods in general has been given by Wastell (1996) who argues that techniques such as process and data modelling can be used as a social defence to avoid meaningful engagement with the task at hand. Wastell's commentary showed how the application of structured methods in software engineering can lead to a ritualistic way of working (e.g. users sign-off the presented documents without having a sound understanding) and may inhibit creative thinking: "Methodology (...) may operate as an irrational ritual, the enactment of which provides designers with a feeling of security and efficiency at the expense of real engagement with the task at hand" (Wastell, 1996).

Given that the development of new working methods and new IT systems is a highly complex activity, the question is probably not *whether* models are used but *how* they are used. Whether they are a help or a burden will ultimately be determined by how we understand them, and by their contribution to the overall intervention (analysis/design/implementation). Recent innovations in process modelling are particularly interesting in this regard, for we see the model play different roles in different phases of the lifecycle and, because this is a modelling process, it leads us to consider the essentially approximate and uncertain nature of the designer's task. This need to better understand the contribution of process models has motivated our study. We believe it is important to rigorously report the usefulness of models in different projects so that we are better able to consider which facets of a modelling notation are necessary at each phase of the lifecycle. This in turn shall affect our understanding of the modelling process as a whole and how different methods can be used to shape different outcomes.

In conclusion, taking some licence from the reported cases, we observe that process models are an important instrument when used by talented individuals and groups in order to facilitate the formation and then the realization of their ideas. Overall, through the literature and the reported cases, we also observe that the traditional areas of analysis and design still benefit most from the successful application of process modelling techniques and that newer uses in the implementation phase are not as well understood.

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