ADDRESSING DECISION MAKING ISSUES IN ENTERPRISE PROCESS MODELLING

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Abstract

Process modelling is a key technology for studying the behaviour of business processes. Yet, process-modelling techniques do little in supporting decision making, which is an organisational activity of paramount importance. This paper proposes a framework for supporting decision making aspects in an organizational context. The framework is modelled as a business process and can be adapted to different enterprise settings. It is designed to support the coordination between the different participants in the decision-making process, and between the participants and the available decision analysis technologies.

Keywords: Decision analysis; process modelling; ProcessWeb; workflow technology.

1. Introduction

Decision making is a central managerial activity. It usually involves the choice of an appropriate course of action in the presence of ambiguous information, time constraints and uncertainty. The organizational decision-making paradigm assumes that decision makers intend to be rational but are 'bounded' by uncertainty and cognitive limitations. Not withstanding this very real problem, there is little IT (Information Technology) support available to business.

The techniques of modelling business processes are now highly developed but the development of effective IT support for such processes, so as to allow their enaction, is less well developed. Process or Workflow technology is generally understood to support activity at lower levels in an organisation. There may be a number of reasons for this, such as the difficulty in modelling knowledge-intensive processes, or an absence of sufficient justification for investing in more powerful models and systems needed to support knowledge-intensive process (such a the design process).

Yet, the concept of 'process' is fundamental in structuring organizational activity and models of processes can serve as a dynamic integration medium among business users and diverse applications that support the business.

Enaction is limited to workflow-type processes. If the benefits of process modelling are to be extended to managerial processes and other business processes that involve decision making, then the process of decision making itself needs to be incorporated into the modelling.

Oquendo *et al* (2000) identified the need to address decision-making issues in process modelling. This paper extends the above work by proposing a framework for coordinating the decision making process in an enterprise setting. Its implementation in a process support system, which is ongoing, is briefly described.

2. Decision making issues

A common classification of decision types in information and management systems is the following (French, 1999):

1. Strategic decisions are related to choices of policies or strategic plans, high-level objectives and their associated resource allocation. The implementation of strategic decisions can last from months to years.
2. Tactical decisions are about applying short term strategies and determining tactics in order to assure effectiveness in the implementation of organizational plans and the management of resources.
3. Operational decisions are concerned with the day-to-day execution and performance of operations.

Simon (1960) suggested that managerial decisions range from highly structured through semi-structured to unstructured. Operational decisions are more likely to be well structured than strategic decisions. This is because operational decisions tend to be repetitive and happen so frequently that simple problem solving techniques such as ‘habit’ and ‘rules of thumb’ can be employed. However, strategic decisions are often complex, involving multiple objectives and uncertainty, respond to one-off events and can have far-reaching consequences.

Simon (1976) states that “human behavior in organisations is, if not wholly rational, at least in good part intended to be so”. The decision maker tries to take rational decisions but is faced with the following barriers:

- Incomplete or erroneous information about the organizational environment.
- Time and cost constraints.
- Limited cognitive capabilities when processing large amounts of information.
- Lack of knowledge about preferences.
- Uncertainty about what is happening in the organizational environment or what should be done.

Decision analysis can help the decision makers:

- think systematically about their own values, organizational values and value tradeoffs (Keeney, 1992);
- replace a complex decision problem with simple ones (Keeney and Raiffa, 1976);
- gain insight into the decision problem at hand by exploring it thoroughly through appropriate presentation of information and extensive discussion (Belton, 1990);
- handle uncertainty (von Winterfeldt and Edwards, 1986).

In an enterprise setting the effectiveness of decision making has two dimensions: firstly achieving objectives and goals, and secondly learning. Many strategic decisions require judgement, creativity and intuition and are primarily concerned with attaining objectives whereas many operational decisions can be structured by taking into account past experience and identifying patterns in decision making processes.

Organizational decision support systems have been developed to support organizational activities or decisions that affect several organizational units. They are usually based on computer and communication technologies (George, 1992). However, these decision support systems tend to ignore the coordination between people and between people and systems that may be needed in coming to a decision.

3. The decision making process

The process of decision making can be decomposed into the following phases, which are not strictly sequential, (Holtzman, 1989):

- *Formulating*. This requires the formulation of the decision problem in terms of identifying alternatives and evaluation criteria.
- *Appraising*. This is concerned with the refinement of decision parameters (e.g.

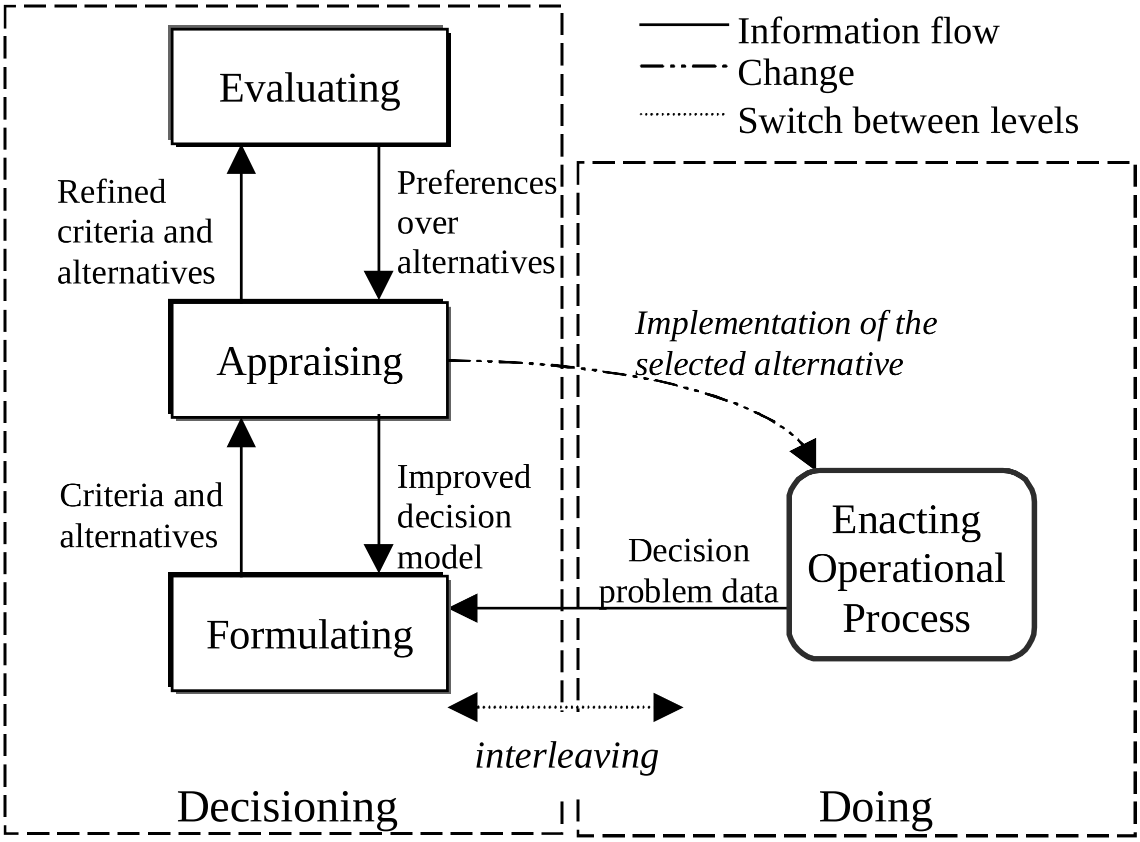

Figure 1. Architectural Model of Decisioning for Decision Support in Processes

alternatives, importance of criteria) and the interpretation of the decision analysis results.

- *Evaluating*. This involves impact analysis assessment and the evaluation of alternatives in the face of uncertainty.

Evaluation criteria are often conflicting in an organizational setting. Proudlove *et al* (1998) outline such criteria including: quality, costs, flexibility, responsiveness to customers, integration with other business functions, variety, inventory and product life-cycles. Decision problems involving multiple and conflicting criteria are often referred to as multiple criteria decision problems.

Different phases of the decision process can be undertaken by individuals or shared between individuals. Although much work has been done to support DMs, little has been done to study the essential coordination needed when carrying out decision-making activities, especially in different computer environments.

4. A decision making framework

In process modelling we have to take on board the lessons learned from decision analysis. Decision making should be a first-class citizen of the modelling language. For this reason, we have introduced D2P (Decisioning for Decision Support in Processes), an architecture for modelling and co-ordinating decision-making activities (see Figure 1).

The main idea is to allow decision-making considerations to be introduced into the operational processes of organisations (the processes that achieve organisational goals). At any time at which the need to take a decision is identified in the enacting operational process (Doing), the system 'escapes' to a different level (Decisioning) where a D2P is launched. D2P can be thought of as a meta-process i.e. a process for changing another process. While the D2P is being enacted, the operational process either halts or continues to be executed while passing any new information, which is relevant to the decision problem, to D2P. In the former case, control is passed to D2P whereas in the latter case, both processes run in parallel but at different levels.

In Formulating, the decision makers define their decision model by identifying suitable alternatives and expressing the criteria or factors that drive their decisions. This decision model is passed to Appraising where the decision makers get another opportunity to study thoroughly and refine the decision parameters. These parameters are then given to Evaluating which has access to a library of multi-criteria decision analysis methods. A method is selected based on the needs of the decision makers and it can be used for the evaluation of the alternatives. The output of Evaluating depends on the method used. For example, it could be a ranked list of alternatives or an outranking graph that illustrates preferences, indifferences and incompatibilities among alternatives. Then, the decision makers assess the results of the decision analysis in Appraising. If they are satisfied with the decision analysis and feel able to take a decision, they can choose an alternative. In this case, Appraising implements in the enacting operational process (Doing) the pattern of activities associated with the decision makers' most preferred alternative. If the decision makers are not satisfied with the results, or they become aware of a change in the organisational environment, they can modify or add decision parameters (e.g. further alternatives) to the decision model. In this case Appraising sends the improved decision model to Formulating in the form of a feedback and the decision problem is restructured.

The D2P is the result of a synergy between decision analysis and process modelling. This is demonstrated through the enacting process model that represents the decision-making process. D2P is a high-level interpretation of a process of decision making derived from earlier work on the meta-process (Warboys, 1999).

This work, together with the research undertaken by Papamichail (2000), leads us to believe that the D2P may be a generic process model that reflects, at a high level of abstraction, all the decision-making activities that are likely to occur. In an organisational setting, the actual decision making process would be a specialisation or adaptation of the D2P. The intention for the D2P is not to provide prescriptive support. For example, some decision makers might for certain problems want to skip the formulation phase.

This specialisation will eventually result in each of the D2P phases (Formulating, Appraising and Evaluating) being populated with support for complex human behaviours (as more than one decision maker can be involved in the formulation of a decision problem), and complex technology behaviours (e.g. using diverse and heterogeneous decision analysis and group decision support system technologies as and when necessary).

The proposed framework is not about providing new technologies but is about using process modelling in order to deliver appropriate technology timely or upon request. The framework is flexible enough because it allows plugging in or plugging out of technologies such as negotiation support systems or experience databases depending on the application requirements. This allows the co-ordination of heterogeneous decision-aiding tools.

One of the main characteristics of the D2P as implemented is its reflexive nature. This is needed because there are many decision processes in the decision process itself. For example, if it is not clear enough how many people are going to be involved in the formulation of a decision problem or what technology will be used to support this activity, then another D2P can be invoked to address this separate decision problem.

5. Technology

The process support technology used in this work is ProcessWeb, developed at the University of Manchester. ProcessWeb combines the ProcessWise Integrator (PWI) developed by TeamWARE[1] (Bruynooghe *et al*, 1994) with a Web server. This allows users to interact with the system through the familiar medium of their Web browsers, and also allows the linking-in of enterprise Intranet information.

The ProcessWeb system calculates and assembles html pages as required by the execution of process model instances. These pages include links and standard Web CGI (Common Gateway Interface) forms, through which users provide input. This user interface communicates through the PWI external application interfaces that can be used to communicate with remote applications.

The enactable modelling language is PML (Process Management Language). PML is a class-based language with single inheritance and incremental compilation, where a source PML class definition is compiled in the context of a set of existing classes. The basic constructs include a Role (a thread of behaviour with its own local data), and Interaction (an asynchronous buffer which is used to communicate messages between roles). Primitive behaviour (manipulating entities, interactions or roles) is encapsulated in roles as a series of actions. The Role is the module of change.

The core of PWI is a process engine that schedules the above actions for execution, depending on the conditions expressed in guards to actions having been met. These actions are executed either internally, by interacting with an application, or by interaction with a human user.

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6. Discussion

This paper describes D2P, an implementable framework for supporting decision making in an organisational context. It is modelled as a business process and is enactable in ProcessWeb. This is on-going work, during which several issues have arisen.

The D2P framework requires the development of several user interfaces for the display of information to the different DMs and for the elicitation of values e.g. criteria or alternative outcomes. This means that we need to experiment with what data to obtain from the enacting process model or elicit from the DMs, how to process this data and what information to present to the DMs.

Within an organisation, it is not always straightforward to determine who is responsible for taking a particular decision concerning a business process. If more than one person is accountable then we may have to decide whether to make data about values and outcomes more widely accessible. This also raises the question as to whether all managers would be expected to use decision support technology in the same way as other forms of technology e.g. e-mail or workflow.

It is envisaged that tangible benefits could arise from providing decision support within an organizational environment, especially at the managerial level and for processes involving professional staff. Encouraging a decision maker to explore a decision problem and to use a normative model for the evaluation of alternatives increases the likelihood of choosing a more suitable course of action. However, the benefits would have to be measured against the cost of building a library of multiple criteria decision analysis models and the cost of obtaining and processing all the relevant information from the enacting process models.

There is clearly the need to understand how the decision makers interact with the decision analysis technology. The potential of enactable support for knowledge processes, such as these that involve decision making, will give an impetus to modelling of such processes as well as the development of suitable techniques for modelling such processes. Some process support technologies (such as ProcessWeb) are easily adaptable at run time, so when such decision processes are modelled and encoded, consideration will need to be given as to how they might usefully evolve in the context of the enterprise.

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