

December 2003

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## Recommended Citation

Neiger, Dina and Leonid, Churilov, "Decision Enabling Potential of a Business Process" (2003). *PACIS 2003 Proceedings*. 75.  
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# Decision Enabling Potential of a Business Process

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## Abstract

*Ability of a business process to meet organisational objectives determines the organisational effectiveness, and in turn, is determined by the efficiency of the process as well as effective decision-making within the process. A concept of a decision-enabled process introduced by Neiger & Churilov (2002) lays down the foundation for a modelling method that can be used to combine process modelling and decision modelling qualities to better achieve overall organisational objectives. As decision enabling a process is likely to increase costs and complexity of business information systems, in order to justify the implementation of this methodology in practice it is essential to understand how decision enabling benefits an organisation and which factors influence whether these benefits are realised. This paper discusses the benefits of decision enabling and, to assist with determining whether an organisation would realise these benefits, a formal framework to identify the decision enabling potential of a business process is proposed.*

## Keywords

Business process modelling, decision modelling, decision-enabled process modelling, ERP

## 1. Introduction

Business systems, including ERP systems, are concerned with improving efficiency and effectiveness of business processes. Efficient processes allow the business to do things in the right way, while an effective process ensures that the right things are done (Daellenbach 1994). Process models underlying integrated business systems are based on an Information Systems (IS) paradigm and are powerful tools in addressing efficiency objectives of the business (Scheer 2000, p.7). On the other hand, decision models based on Operations Research/Management Science (OR/MS) paradigm, are used to address effectiveness concerns by facilitating better decision-making within organisations (Winston 1994). Linking the two paradigms will enhance the capability of the information systems to better meet both efficiency and effectiveness objectives of the business.

Neiger & Churilov (2002) propose a conceptual framework for a decision-enabled process model that integrates IS and OR/MS modelling paradigms and provides a basis for an integrated business system with the enhanced decision support capabilities. The decision-enabled process model combines the descriptive power of integrated enterprise architecture tools with the quantitative power of decision modelling tools by linking external (process) and internal (decision) views of business activities. Within this framework the library of OR/MS models is linked to functions within business processes to ensure that specific

decision objectives can be met effectively and efficiently within broader organisational constraints and that information requirements of both models are met.

To determine whether such framework can be successfully implemented, it is crucial to understand *why* integration of process and decision modelling is beneficial to an organisation and *when* these benefits are likely to outweigh the complexities and costs associated with integration of information systems. As the benefits and costs vary between organisations it is not possible to provide a universal answer to these questions. The aim of this paper is to provide a methodology that will assist organisations to recognise benefits of integrating process and decision modelling and to evaluate the decision-enabling potential of a business process as a guide towards understanding the trade-offs between the benefits and costs of implementing a decision-enabled process model.

Process modelling tools have the potential to include functionality from many different systems such as workflow, decision modelling, artificial intelligence, and others. Becker, v. Uthmann, zur Muhlen & Rosemann (1999) developed a framework for evaluation of workflow modelling potential of a business process. In this paper, the framework developed by Becker et al (1999) is adopted to decision modelling context, with the objectives to:

- describe benefits that can be realised by an organisation as a result of decision enabling a business process; and
- develop a formal framework for identification of decision enabling potential of a business process.

The structure of the paper is as follows. Discussion of processes and decisions within HR context and their relationship to each other sets the background and context for the paper in Section 2. In Section 3 benefits of decision enabling a business process are summarised and briefly illustrated within an HR context. The formal framework for a decision-enabled process is presented in Section 4 as an Entity Relationship Diagram. This is followed by the discussion of why decision enabling is desirable and when it is appropriate. The paper is concluded with a brief summary.

## 2 Background and Context

Application of process and decision modelling within HR area provides a useful context for the discussion relating to the integration of the two modelling methods (Neiger & Churilov 2003b). Within this context, the concepts relating to processes and decisions are introduced as a background for identification of the decision-enabling potential of a business process.

### 2.1 Processes

Among the many definitions of a business process “a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs” is a commonly used definition by T. H. Davenport (Sandoe, Corbitt & Boykin 2001, p.6). Consistent with this definition, information system tools aimed at assisting with process modelling initially focused on the description of the order in which various activities are performed (Scheer 1999).

The advent of the integrated enterprise architecture tools represented by a widely adopted Architecture of Integrated Information Systems (ARIS) (Davis 2001, Klaus, Rosemann &

Gable 2000, Scheer 1999, Scheer 2000) has expanded the scope of process modelling to incorporate comprehensive descriptions of objects and flows associated with the process. Within this framework, the basic process model, described as an *extended event-driven process chain* (e-EPC), is based on a sequence of functions and events. As illustrated in Figure 1 each function within an e-EPC is assigned a goal that represents means of achieving *fundamental HR objectives* (Neiger & Churilov 2003b).

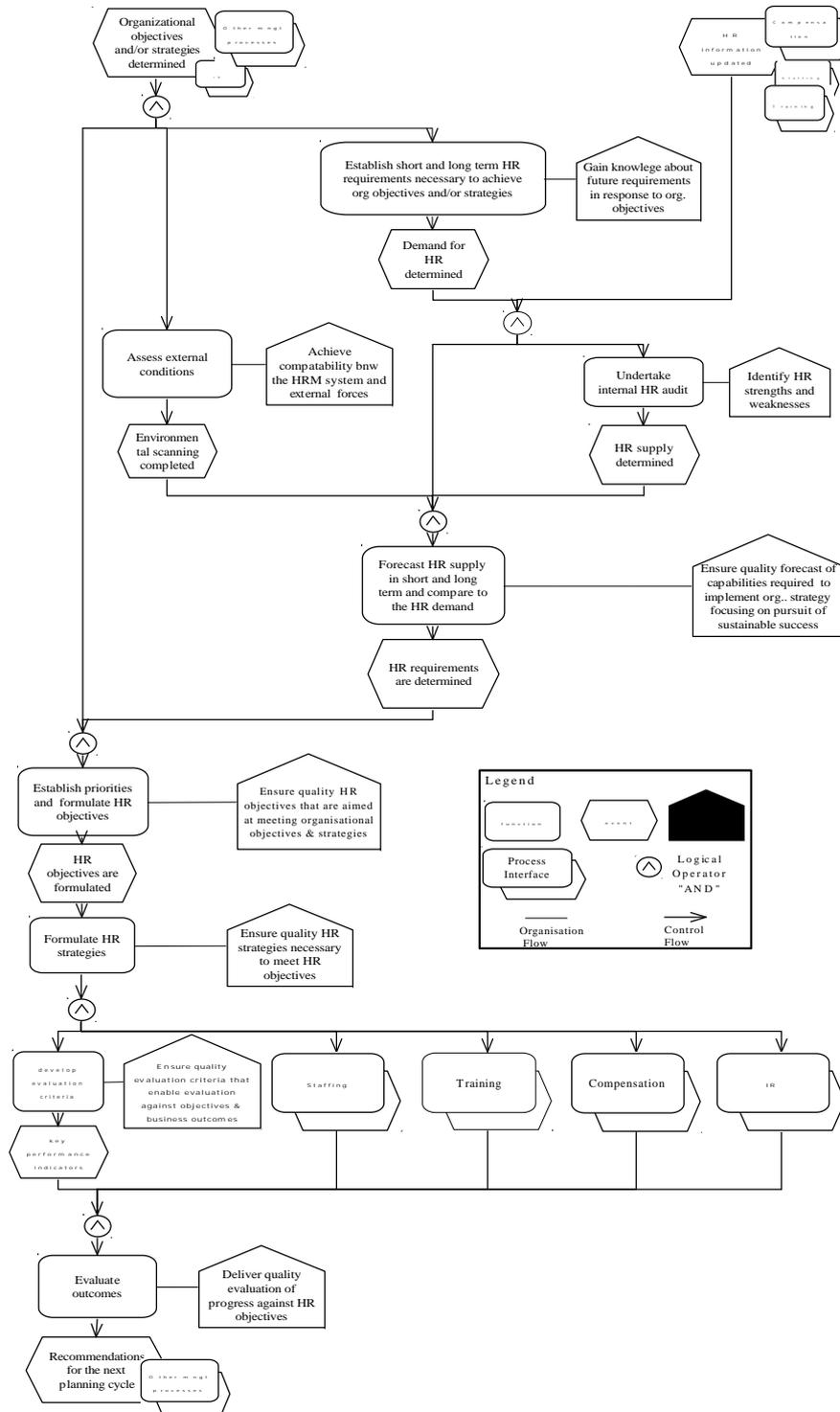


Figure 1. Business process model using e-EPC for the planning process (Milkovich 1991 – process structure, Rahman bin Idris 1998 – functional objectives)

For straightforward decisions the decision-making process is adequately described by a process model. For example, an e-EPC in Figure 2 provides a step-by-step process to decide whether to return a late application. As discussed in the next section, this approach is not practical for complex decisions such as deciding on future HR demand as part of the planning process (Figure 1). As a result, process models often totally ignore the decision-making process for complex decisions assuming that the person executing the function knows how to select the best alternative. For example, in the planning process e-EPC illustrated in Figure 1 there is no indication as to what is involved in ensuring a quality forecast.

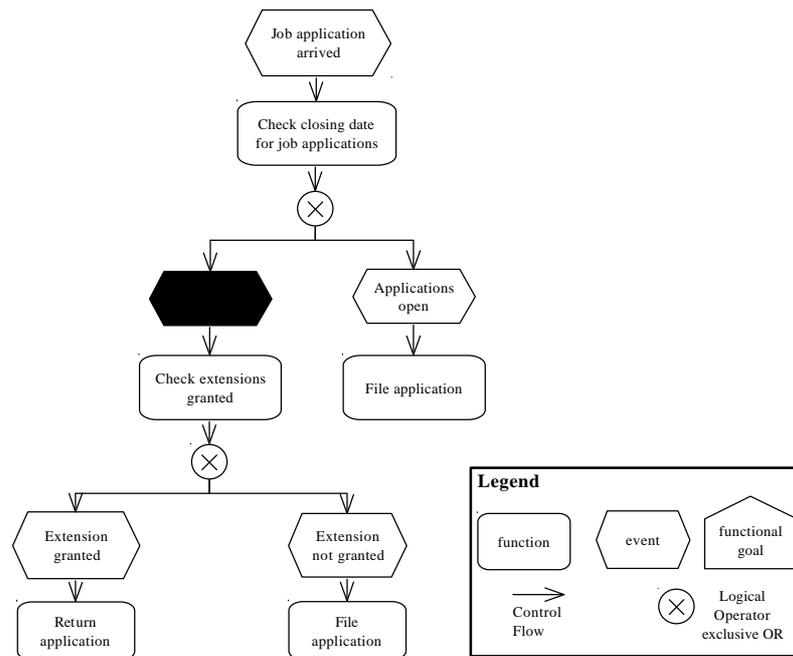


Figure 2. Representation of a structured decision within an e-EPC model

As a result, a process model does not prevent a perfect process from delivering disastrous outcomes as a result of a poor decision. Within the decision-enabled process this problem is addressed through linking functional goals and decision objectives (Neiger & Churilov 2002). For example, within a decision-enabled process model of the planning process in Figure 1, the functional goal to “provide quality forecast of capabilities required to implement organizational strategies focusing on pursuit of sustainable success” may be linked to a number of decision objectives including “determine staff numbers across organisational hierarchy in 2 years time given current distribution of staff and expected number of exits and entries”. In order to support decision-making, decision-enabled process modelling tools must have the ability to model such links.

The decision objective once formulated can be supported by a decision model such as a Markovian decision model used to forecast future distribution of staff across levels (Bartholomew 1991, Gass 1991, Gregoriades 2001, Winston 1994) and will enable quality requirements of the function to be met. The link between the decision model and the function will also ensure that data required for this decision are generated, the decision model outputs are used within the relevant processes, and decision modelling is consistent with the organisational requirements. The ability of the process modelling tools to support such links

will be referred to as *technical* requirements and in addition to supporting links between the goals and objectives include the ability of the process to support

- the information flow (input and output) requirements of the decision model adopted; and
- the operational flow requirements of the decision model by ensuring that the decision model is invoked at the appropriate point within the process and that all possible consequences of the decision are catered for by the process model.

The process capability to support decision making, describe the information and operational (or control) flows are referred to as *decision capability*, *information capability* and *operational capability* respectively. These capabilities are easily mapped to ARIS views of the process extended to include a decision view providing a vehicle for practical implementation of the decision-enabled process (Neiger & Churilov 2003a).

Formal definitions of decision, decision model and other associated concepts such as decision consequences are provided in the next section.

## 2.2 Decisions

While any computer or modelling aid aimed at improving decision processes and outcomes can be described as decision support (Briggs & Arnott 2002), within the decision support systems (DSS) discipline the definition of decision support is narrowed down to decision support of unstructured and semi-structured decisions with automation of well structured decisions not being considered decision support (Sage 1999). The continuum of unstructured, semi-structured and structured decisions was first defined by Gorry and Scott Morton in 1971 (Gorry & Scott Morton 1989).

According to the DSS literature, structured decisions can be easily decomposed into a sequence of steps (Sage 1991). Decisions represented within a process model (such as an EPC) with the use of a decision fork clearly belong to the structured decisions category. For example, a decision as to whether a job application for an advertised job should be accepted is easily automated within the process model as illustrated in Figure 2. Such decisions are of little relevance to this paper, as a process model already represents them using standard process modelling functionality. Many business decisions do not fall into this category, as they require more sophisticated structures and solution algorithms available within the OR/MS disciplines.

Those decisions that require complex structuring and/or solving using decision modelling methodology would not be effectively represented by a process model due to the many differences between process modelling and decision modelling paradigms (e.g. semantics, objectives, computational requirements, etc.). For example, a selection of an applicant decision made with the help of a Multi-Criteria Decision Analysis (MCDA) model may require solving a parametric optimisation problem (e.g. Vincke 1989). Obviously, this decision would need to be represented as a decision model in its own right supported by a decision module able to solve the computational problem.

The exact position of such decision on an unstructured-structured continuum is debatable. At the initial stages, this decision is likely to be a highly unstructured decision, however as various elements of the problem become resolved the decision becomes more and more structured until finally it is solved and therefore can in principle be described as a sequence of steps leading to the solution.

Therefore, in order to structure the decision, an underlying *decision model* has to be defined. A generic *decision model* consists of a set of elements (Table 1) including alternatives, constraints, states of the world, consequences or outcomes, optimality criteria and a choice of modelling routine (Clemen & Reilly 2001, Mallach 2000, Winston 1994). As can be seen from Table 1 not every element is required for each decision model (e.g. optimality criteria or states of the world may not be applicable for some decisions).

Component	Description
Alternatives	Generally speaking, a set of possible <i>actions</i> or <i>choices</i> defines the <i>decision variable space</i> . To construct a <i>decision model</i> , <i>decision variables</i> should be selected to adequately quantify a set of possible <i>actions</i> . The decision variables could be discrete or continuous, and could take on positive, negative or integer values depending on a specific decision situation.
Constraints	<i>Functional constraints</i> on the <i>decision variables</i> define a feasible set of possible actions. Constraint functions could be quite complex including linear, non-linear and probabilistic functions.
States of the world	Depending on the decision situation, there may be one or more <i>states of the world</i> describing circumstances that affect the consequences of the decision and are completely outside of the decision maker's control. Some decision making situations, such as a team assignment problem, require the decision maker to choose an optimal combination of staff to achieve a pre-specified mix of skills and levels within a team, are fully deterministic and therefore do not explicitly specify the state of the world. In a decision model, <i>states of the world</i> are usually described by a set of <i>environment variables</i> .
Consequences or outcomes	One of the essential elements of a decision situation is the <i>consequence</i> or <i>outcome</i> of the decision. In a decision made <i>under uncertainty</i> the <i>outcome</i> would depend not only on the <i>action</i> chosen but also on the <i>states of the world</i> . In some cases, <i>uncertainty</i> could be associated with <i>outcomes</i> as well as <i>states of the world</i> . In a <i>decision model</i> , <i>utilities</i> are used to quantitatively describe the outcome of the action via <i>utility functions</i> that model the <i>objectives</i> of the decision.
Optimality criteria	Most decision-making situations and models include <i>optimality criteria</i> that specify utility preference such as maximum profit or minimum costs. However, there are some models, such as <i>feasibility</i> or <i>constraint satisfaction</i> models that do not require optimality criteria to be specified.
Decision modelling routine	Mathematical techniques and programming routines that are used to solve decision models constitute a subject of extensive operational research literature. For the purpose of this paper, it is assumed that once the <i>decision model</i> is formulated, it can be solved using one of the existing mathematical and/or programming routines.

Table 1. Decision model components.

Given the dynamic nature of decision-making, the classification of a decision is time dependent as the *process of identifying* (applicable) *decision model* elements moves decisions along the unstructured-structured continuum – the more we know about a decision the closer it is to a structured decision. At a point in time, the term “*structured decision*” is used in this paper to describe decisions for which relevant decision model components described in Table 1 are easily identified by a decision maker. The term “*unstructured decision*” refers to decisions for which none of the decision model components are readily apparent. With the term “*semi-structured decision*” being used for decisions with some (but not all) components clearly defined.

This classification deviates from some definitions of decision structures (e.g. Eom 2002, p. 124) in that it allows problems with conflicting objectives, uncertainty and complex variable structure to be classified as structured provided there exists a well defined decision routine that can provide solution to the problem. This is consistent with the decision classification based on “whether the decision making process can be explicitly described prior to the time when it is necessary to make a decision” Sage (1991, p. 2) as the availability of a well-defined decision routine (along with other decision model elements) guarantees that the decision process can be explicitly described (although it would not necessarily be the most effective way of making a decision in the business context).

The limitation of the currently existing decision support tools and systems is their “failure to model interactions between the decisions and other business processes required for a holistic solution” (Neiger & Churilov 2002, p. 152). An integrated decision and process-modelling framework overcomes this limitation. Within this framework, the decision model can assist with structuring a decision problem and/or delivery of the solution for a structured decision model within an overall business context. Furthermore, decisions become an integral part of the business process reducing the risk of conflicting or inappropriate (from the overall business perspective) decisions. Benefits of the decision-enabled process model are discussed and illustrated within the HR context in the next section.

### **3. Benefits of Decision Enabled Processes**

Since the benefits of process modelling and decision modelling and support have been well documented within the relevant disciplines (Davis 2001, Keen 1981, Mallach 2000, Sterman 1991), the purpose of this section is to explore how the combination of the two approaches could benefit a business. Process modelling allows “the documentation, analysis and design of the structure of business processes, their relationships with the resources needed to implement them and the environment in which they will be used” (Davis 2001, p.2). This has many advantages for a business, including improved documentation and rigour, integration of processes, systems and information, and increased capability for validation and testing (Davis 2001, p.4).

A perfect process model would meet resource, process and market efficiency demands (Scheer 2000, p. 7) but, as mentioned earlier, it doesn’t guarantee that the demand for rational or effective decision making required for business goals is going to be met. For example, a selection process model would describe the steps used in the selection process but wouldn’t guarantee that the choice of applicants was optimal given the objectives of the selection process. This latter demand can only be met through the use of a process model for decisions in which there are few well-defined and easily eliminated alternatives or trivial decisions that can be evaluated explicitly at the level of the human decision maker without the assistance of

decision modelling aids. Other types of decisions require the use of models to ensure that “logical consequences of the modeller’s assumptions” (Sterman 1991, p. 4) are computed. With the use of decision modelling and support tools the efficiency and quality of rational decision-making within business processes is improved (Mallach 2002, pp. 18-23).

For example, Multiple Criteria Decision analysis and support have been demonstrated to improve selection processes (e.g. Gardiner & Armstrong-Wright, 2000), as discussed in Section 2.1 the use of Markovian models and supporting software is often necessary to solve planning problems, data envelopment analysis enables better assessment of performance management (Tsai & Mar Molinero 2002), efficiency of shift assignment and scheduling is substantially improved with the use of optimisation techniques (e.g. Winston 1994), etc.

<b>Benefit Categories<sup>1</sup> for</b>					
	<b>Process Modelling<sup>2</sup></b>	<b>P</b>	<b>Decision-Enabled Process</b>	<b>Ü</b>	<b>Decision Modelling &amp; Support<sup>3</sup></b>
<i>Efficient and effective use of resources to meet organisational objectives</i>					
	integration & rapid process engineering	<b>P</b>	efficient processes focused on effective solutions to organisational problems	<b>Ü</b>	personal efficiency in decision making, solving problems faster or better
<i>Communication</i>					
	single & consistent record, multiple view points	<b>P</b>	transparency of decision making mechanisms as well as processes	<b>Ü</b>	group decisions, explicit assumptions & decision model
<i>Learning &amp; Training</i>					
	validation, walk-through, testing, evaluation of scenarios	<b>P</b>	evaluation of flow on effect from process changes to decision alternatives, feedback mechanisms	<b>Ü</b>	expert systems, simulation models, feedback models
<i>Organisational Control</i>					
	rigour, method	<b>P</b>	common standards for process and decision making activities	<b>Ü</b>	management information, standard modelling tools

Figure 3. Benefits of decision-enabled processes

Both process modelling and decision support tools improve communication by providing a common basis for business processes (Davis 2001, p.4) and decision making (Mallach 2000, p. 21) respectively. By linking process and decision stakeholders and requirements a decision-enabled process will facilitate more effective communication by articulating what problems need to be solved when and what information and methods are available to solve these problems in order to achieve overall organisational objectives.

<sup>1</sup> Mallach 2002, p.22, Daellenbach 1994, p.13

<sup>2</sup> Davis 2001, p.4, Scheer 2000, p.7

<sup>3</sup> Mallach 2002, p. 22, Sterman 1991

Promotion of learning and training is a benefit of some decision support systems (Mallach, p. 22) and is an accepted advantage of analytical modelling (Savage 1998, p. 3) and process modelling (Davis, p. 4). For example, evaluating “what-if” scenarios within a business process model facilitates learning about critical time lines, resources, information and data requirements. Learning from such evaluation is substantially enhanced if the impact of these changes on decisions such as shift assignments and future forecasts is simultaneously evaluated with simulation models and fed back using System Dynamics models into the appropriate processes such as budget and resource allocation (Sterman 1991).

Another important benefit of process modelling (Davis 2001, p. 4), decision modelling (Sterman 1991, p. 4) and decision support (Mallach 2000, p. 22) is increased organisational control through enforcement of common standards resulting in consistency. However, as businesses are not separated along decision and process lines the organisational control requires common standards to be applied across process and decision making activities (as well as within them). The use of an integrated modelling tool will minimise occurrences of disparate requirements, incompatibilities and contradictory instructions (Neiger & Churilov 2002).

While there is no universally accepted way of summarizing benefits of these complex and varied modelling paradigms, the framework provided by Mallach (2000, p. 22) is concise, complete and can be applied across the disciplines. This framework is used in Figure 3 to summarise benefits of process and decision modelling and support, and benefits resulting from their integration into a decision-enabled process model. As noted by Mallach (2000, p. 23) the categories in Figure 3 are not independent, as changes in one necessarily affect the others.

## 4. Identification Framework

The decision enabling potential of a business process is measured by the benefit the organisation is expected to derive from the decision support provided by a decision-enabled process. While not all benefits discussed in the previous section would be realized for each decision enabled process and there may be other benefits that have not be included, Figure 3 provides the basis for an initial set of *operational* criteria for evaluation of the decision enabling potential of a process (Sandoe et al 2001, ch. 3). The specific *operational* criteria would vary from business to business reflecting individual business requirements, resources and time constraints. It is expected that some criteria could be easily measured (e.g. cost savings from an improved staff roster) and therefore be used in a cost-benefit analysis, while others would be more intangible (e.g. transparency of decisions in a selection process) and would require analysis of value rather than cost (e.g. Keen 1981).

The capability of the process to support decision model from a *technical* perspective is discussed in Section 2.1. Availability of resources, cost and timing associated with the implementation of software functionality necessary for the integration of two methodologies and corresponding systems are the key factors in assessing decision-enabling potential of the business process.

The “people issues” are one of the significant obstacles towards successful implementation of integration systems (Sandoe et al 2001, ch. 3). Criteria relating to people issues presented by Becker et al (1999) within the workflow context as *organisational* criteria are transferable to the decision-modelling context. A conceptual framework presented in Figure 4 as an Entity

Relationship Diagram combines *operational*, *technical* and *organisational* criteria to determine the decision enabling potential of a process. The framework is based on the workflow potential of the business process framework proposed by Becker et al (1999) in order to

- enable emphasis of the discussion to be on the decision-enabling context rather than technical aspects of the framework; and
- facilitate cost-benefit comparison of add-on functionalities for process modelling tools by ensuring consistency between conceptual frameworks.

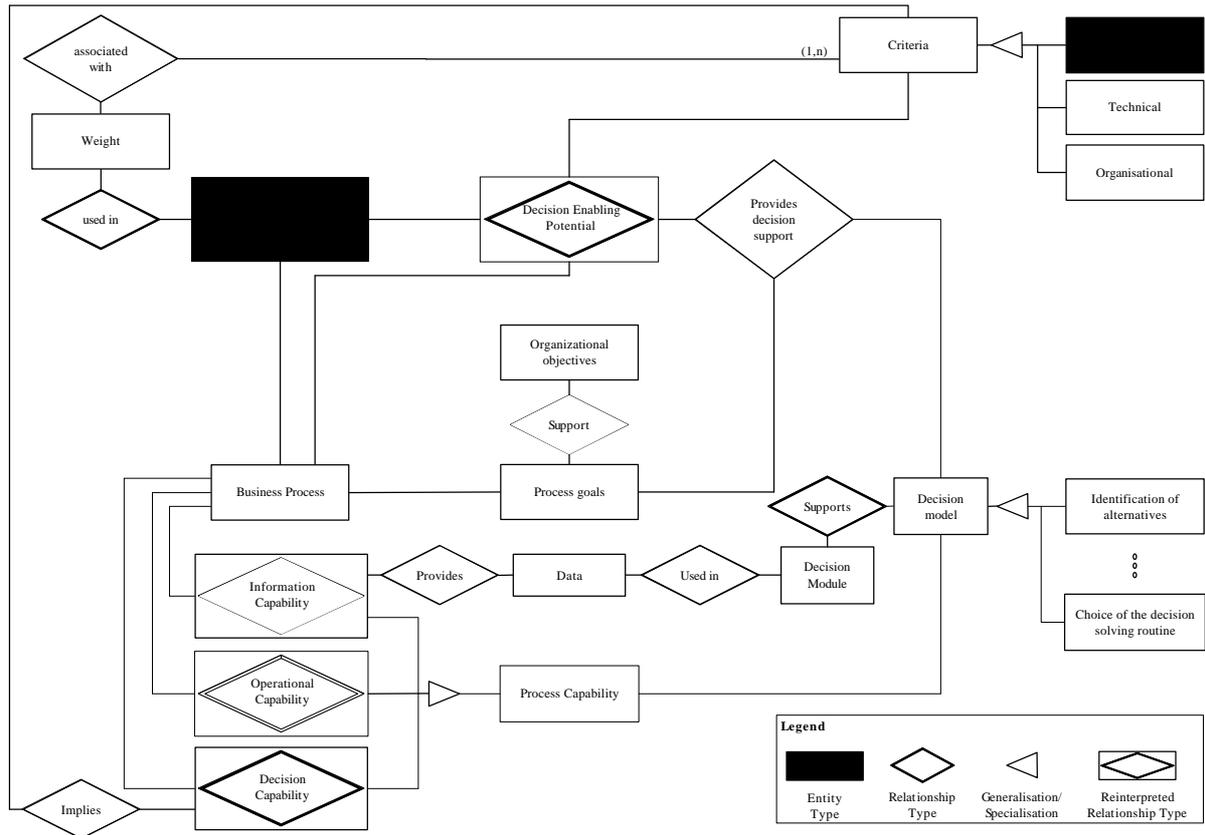


Figure 4. Framework for identification of decision enabling potential of a business process

The framework includes the following elements: The *decision module* using the data provided by the *business process* enables decision support (through a *decision model*) for the *business process goals* that in turn support *organisational objectives*. The degree of support is dependent on the *decision enabling potential* of the process. The decision enabling potential of the process is the result of the match between the business process and a given set of *criteria* that can be *weighted* to enable *evaluation* of the overall decision enabling potential of the process. The weights may vary, depending on the *process goals* associated with the *business process* being modelled. The criteria relate to the *decision capability* of the business process supported by the decision model. The decision model also supports *information* and *operational capability* of the business process through quantitative output and operational directives respectively.

## 5. Discussion

One of the accepted advantages of using process modelling within a business context is increased efficiency of the business. However, efficiency on its own is not always sufficient to meet business goals, as one can be very efficient while doing the “wrong thing”. Decision modelling provides tools for the best action to be chosen, thus increasing the scope of process modelling goals by combining effective decision-making with efficient execution of business activities. At the same time integration of process and decision modelling facilitates better decisions through expanding a narrowly defined decision context to take into account links to and impact of other business decisions and activities. However, the implementation and use of decision-enabled process modelling tools will incur additional costs associated with integration of two separate sets of tools and will increase complexity as modelling requirements increase.

In order to assess whether the additional cost and complexity is justified each business process can be assessed in terms of its decision-enabling potential. For example, the framework can be used to assess a process associated with receiving and filing job applications. This process has purely transactional goals with most (if not all decisions) likely to be described by the process model using logical connectors. Such process would not meet the operational criteria, making it an unlikely candidate for decision enabling.

On the other hand, the HR planning process is likely to have strategic goals requiring a number of complex decisions both in terms of structuring and solving planning problems such as forecasting and environmental assessment. Quality of decision-making within this process is highly dependent on the by-product of other processes within the organisation and the ability to incorporate organisational goals into the decision-making process. Outcomes of decisions within this process are likely to have a large impact on other processes within the organisation and the delivery of future organisational objectives. While on the surface this process would benefit from decision enabling, whether the additional investment and complexity is justified can only be determined through careful evaluation of the *operational*, *technical* and *organisational* criteria within the context of each business.

The framework proposed in the previous section provides the first step in identification of decision enabling potential of a business process through assessment of *operational* benefits, *technical* capabilities of a process model and associated tools, and the *organisational* environment. As decision enabling a process may impact on other processes within the organisation (through additional information requirements, changes to operational directions, system implications, etc) System Dynamics tools (Sterman 1991) should be used to model the effect of decision enabling of each process on other processes within the organisation and corresponding impact on the evaluation criteria.

To enable application of the framework to a real-world business it needs to be complemented by a procedural models for the implementation of the framework, more detailed meta-model for the evaluation procedure using Multi-Criteria Decision Analysis to synthesize many different and often conflicting criteria that are likely to arise, in-depth knowledge of the business being modelled, and (as any successful modeller would know) a knack for extracting the relevant and discarding the irrelevant.

## 6. Summary

Integration of business process and decision modelling provides opportunities for a more holistic approach to business modelling. While some existing tools such as ARIS can be enhanced to integrate process and decision modelling the business benefit of such integration needs to be assessed. In this paper, a formal framework for evaluation of decision-enabling potential of a business process is provided incorporating a set of criteria based on the benefits and technical requirements of the integrated model, and people issues associated with implementation of technology within the organisational environment.

The aim of the framework is to provide a guide for decision makers as to the key factors and relationships that should be considered in the evaluation of the decision-enabling potential of business processes. The specific criteria and methodologies for evaluation of the criteria would depend on the organisational requirements, budgets, priorities and technical capabilities. Ultimately, it is up to each decision maker to develop specific criteria that would accurately reflect the needs and wants of the organisation. Practical application of the theoretical framework proposed in this paper to real world businesses is one of the directions for future research in this area.

In the overall context of increasing decision support capability of ERP systems, this paper provides the next step in building a decision-enabled process. This is achieved by using links between process and decision modelling objectives identified in Neiger & Churilov (2003b) to add evaluation tools to the conceptual model proposed by Neiger & Churilov (2002, 2003a).

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