Modeling Business Decisions and Processes
Which Comes First?

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Abstract: Decisions are often not adequately modeled. They are hardcoded in process models or other representations, but not modeled in a systematic way. Because of this hardcoding or inclusion in other models, organizations often lack the necessary flexibility, maintainability and traceability in their business operations.
We propose to first model the structure of the decision. Next, starting from this declarative model, a set of processes are built or derived, which are ultimately evaluated against a set of business criteria. This approach aims to develop a roadmap for the modeling of business processes based on decisions structures, and examines the challenges that arise when such decision structures are eventually transformed into more optimal execution-system geared business processes.

1 INTRODUCTION

Most processes and business process models **include decisions** of some kind. For example, in Business Process Modeling and Notation (BPMN) (OMG, 2006), decisions are made in flow forks or are represented by a diamond. Decisions are typically based on a number of business (decision) **rules** that describe the premises and outcomes of specific situations. Sometimes, if the decision is more complex, the entire decision can be included as a decision activity or as a service (a decision service). Typical decisions are: creditworthiness of the customer in a financial process, claim acceptance in an insurance process, eligibility decision in social security, etc. The process then handles a number of steps, shows the appropriate **decision points** and represents the path to follow for each of the alternatives.

In the business modeling community, it has been observed for some time that although a standard notation for business processes exists (BPMN), there is no standard notation for decisions up till now. That will be the mission of the OMG Decision Modeling and Notation proposal. It is indeed strange to observe how business process models are describing (and automating) the process including major decisions, without **modeling the decision logic or structure** itself. Decisions are based on decision criteria, require one or more subdecisions (Vanthienen, 1995), use a simple or complex decision technique (Vanthienen, 1996) and conclude one or more decision results.

Moreover, in a large number of cases, the process does not just contain decisions, but the entire **process is about making a decision**. The major purpose of a loan process e.g., or an insurance claim process, etc., is to prepare and make a final decision. The process shows different steps, models the communication between parties, records the decision and returns the result. The decision process, however, is not the same thing as the decision structure (Codasyl, 1982), because a specific process is only one possible way to implement the decision. There may **be many possible process models**, so it is worth **examining the relationship between decisions and processes**.

In this paper, we state that the design of the process (according to the relevant criteria) is not independent from the structure of the decision. And therefore it is worthwhile to model the decision first, and only then design, choose, or even derive the business process model.

This paper is structured as follows. Section 2 gives a summary of the relevant literature. In section 3 we discuss the decision structures for modeling decisions. Section 4 reports on the translation into decision process models that can be evaluated and

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compared to each other. Section 5 concludes the paper.

2 RELATED WORK

Browne et al. (2004) define a structure in which high level goals are decomposed into goal graphs that are finally used to design a process model. However Browne only derives one execution path where we would like to derive many and compare them to each other. Lars Braubach et al. (2010) present a goal-oriented process modeling approach, which extends concepts from goal-driven process design (Jacobs, 1995). Yet, concerning the decision making processes, especially those decisions that span across several business processes, the goals elicited for individual process are not necessarily aligned together to represent the characteristics of the final decision.

A related approach, namely Product Based Workflow Design (PBWD) is presented in (Vanderfeesten, 2007). Similarities can be found between PBWD and case handling workflow management systems, as they focus on the data elements rather than on the control flow of the process. Our approach is related, but focuses more on the decisions than on the data, and builds upon our earlier research in this area (De Roover, 2011). An interesting approach can be found in declarative process modeling which focuses on modeling the minimal business concerns, and leaves as much freedom as permissible to determine a valid and suitable execution plan. Examples of such approach can be found in (Braubach, 2010). Declarative process modeling however puts more focus on describing the process constraints.

Modeling decisions in processes is also the subject of DMN (the OMG Decision Modeling and Notation proposal, under construction).

3 MODELING DECISIONS AND DECISION STRUCTURES

Modeling processes without explicitly considering the structure of the decision has some severe drawbacks, because the real decision is then hidden in the process. Process models often contain decision tree-like flows that are hardcoded. This can lead to a lack of traceability if the decision structure changes (finding out what the impact of the change is, determining who is responsible, etc.). Additionally, these processes can be hard to maintain, because the decision structure is not available. Especially if the process is (re)designed without explicitly modeling the decision, the process may be implementing an undesirable decision procedure which is the result of historical process steps, responsibilities, roles or structures ('the procedure is like this because the decision has always been taken that way').

3.1 Separating Rules and Processes

Taking the decision rules and decision details out of process models is already common practice. When decision rules for a process task are isolated (e.g. in a BPMN rule task), the process is simplified and more flexible, because it is reduced to its essence.

There is more however. For a given decision (structure), the decision process could be organized in different ways, according to various criteria (Reijers, 2005):

- The process can try to optimize the company's resources, given a minimum service level
- The process can focus on minimal average waiting time, from the customer's point of view
- The process can try to minimize customer contacts (touch points), by having all information available upfront
- The process can try to minimize redundant information requests, only asking the customer information when and where it is needed
- The process can focus on other criteria, such as collaboration, organizational structures, etc.

3.2 Modeling Decisions without Hardcoding Execution

Modeling decisions is not (at first) about process steps, but about the (declarative) structure of the decision. It is examined how the logic of a decision can be represented, independent of its implementation. What are elements of a decision? What types of subdecisions exist? What are possible relations between decision elements? This research question builds on earlier research about decision structures and normalization and factoring (Vanthienen & Wets, 1995; Vanthienen & Wijsen, 1996; Vanthienen & Snoeck, 1993).

This is the common concept of a decision-goal tree, **a partitioning of a decision into subdecisions**. It captures the business logic that is needed to make a decision by subdividing the decision. Hence a model is created that governs the essence of a decision namely the structure and the internal logic of the decision. The concept of a decision goal tree is similar to a general goal tree (Letier & Van Lamsweerde, 2002; Kavakli and Loucopoulos, 2006), but each decision and lower level decision can have a number of extra **attributes**: data requirements, data sources, processing time, required lower level decisions in different constellations (all are required, one is required, etc.).

A (preliminary) possible representation for a decision structure is given in the figure below, where the student visa example is modeled in terms of criteria, subdecisions, conjunctions and disjunctions, etc.

3.3 A Running Example: Obtaining Citizenship

Naturalization is the acquisition of citizenship by somebody who was not a citizen of that country when born. Not everyone can request naturalization and the decision whether someone can apply for a new nationality is restricted by several requirements. The requirements for the Belgian citizenship are formulated by the following decisions:

- Is the applicant of legal age?
- Does the applicant has a legal residence? (What does it mean to have a legal residence?)
- Has Belgium been the applicant's main country of residence?
- Can the applicant show that he is socially and culturally integrated?

Data inputs for each (sub) decision can be collected from applicants or systems. Some of the data are always required (e.g. nationality), some are not, depending on the situation.

The decision structure (Figure 1) reflects the relationship between lower and upper decisions and stays unchanged unless the most fundamental business rules change. Therefore the model is not subject to minor policy changes and is stable enough to serve as a foundation for the process.

4 FROM DECISION TO PROCESS

The decision structure can be used as a guide to develop various execution paths for the decision process. These execution paths could be generated by applying different strategies to the decisions and subdecisions in the decision-goal tree.

4.1 Process Model Generation Strategies

Strategies constrain the order in which the subdecisions are performed, add timing constraints, allocate decision to specific workers, etc. We list some possible strategies, based on the search strategies that can be used in knowledge-based systems, and which will have to be adapted to this problem setting:

- The **sequencing strategy of** the subdecisions. The process might attempt to make the decision according to a goal-driven or a data-driven strategy (not unlike reasoning strategies in

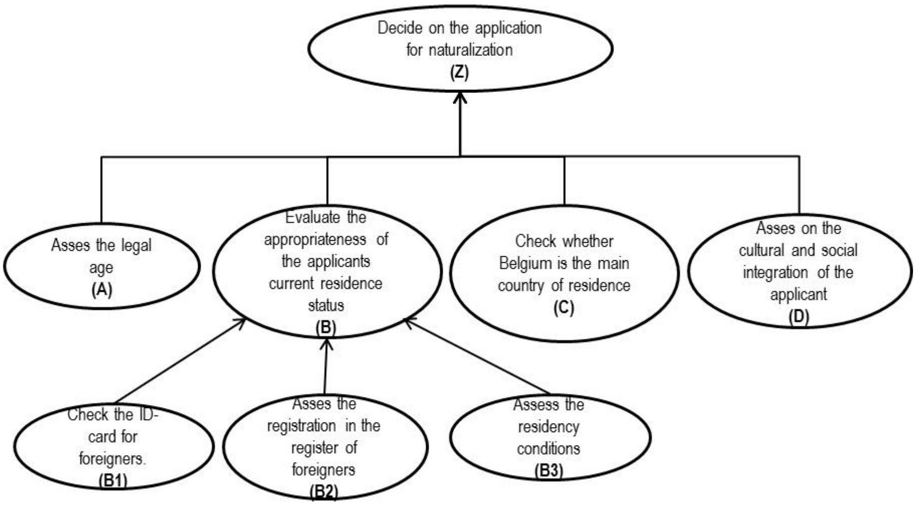

Figure 1: Decision structure.

knowledge-based systems). Data-driven means that once all data for a specific subdecision are available, the subdecision can be executed (even if this later turns out to be an unnecessary path because the goal decision was obtained in other ways). Goal-driven, on the other hand, means that different paths leading to the goal are explored, and subdecisions and data are only examined or requested whenever necessary.

- **Parallelism** of subdecisions. Whenever decisions are executed in parallel, there may be time gains, but if some of the decisions turn out to be redundant, a lot of useless work has been performed.
- Differences in **complexity** of (sub)decisions based on type and outcome. Acceptance decisions (accept/reject) often include large differences in decision complexity or data requirements. Some requirements may be easy, others very hard. If the decision examines acceptance criteria, it might be a good strategy to first evaluate criteria that can be easily rejected because they are not labor-intensive or are easy to answer.

The process to reach a decision can be organized in different ways. If a decision requires all subrequirements to be true (AND), the corresponding activities can be executed in a certain order or in parallel, but any negative result will lead to a negative total outcome. If only one subrequirement is necessary (OR), any positive result will trigger a positive total outcome. This information can be used to structure the process.

Depending on the structure of the decision, various transformation patterns can be applied to structure the process, e.g.:

Parallel Pattern. When the criterion is to achieve minimal throughput time, the parallel pattern is best suited to build the process.

Sequential Pattern. When the criterion is to minimize execution cost, the sequential pattern is best suited to build the process.

Using one strategy or a combination of strategies for a specific decision structure model could result in a collection of different process models, as rudimentarily expressed in the following figure (Figure 2):

With the development of this approach we aim at a process model generation method based on the decision structure, such that the requirements of traceability, maintainability and understandability are now kept intact.

Evaluating Process Models

As various process models can result from one decision goal tree, the choice between different process models becomes an important issue. There is a need for criteria to rate the process models such that models can be compared to each other and the process model that best matches the business strategy can be chosen.

Some possible process modeling criteria are indicated in (Reijers, 2005). It will be necessary to examine for each specific perspective how the criteria are related to the decision strategy and how any shortcomings can be avoided:

- **Customer Perspective.** This criterion improves the relations and contacts with the customer such that the contacts happen in an efficient way and customer friendly manner (e.g. single point of contact).
- **Business Process Behavioral Perspective.** This criterion implements the workflow in an efficient way. An example: eliminating redundant activities.
- **Business Process Optimization.** This criterion optimizes the time aspect of the execution.
- **Organizational Perspective.** This criterion optimizes the organizational structure and the involved resources.
- **External Environmental Perspective.** This criterion improves the collaboration and communication with third parties.
- **Informational Perspective.** This criterion uses best practices for the usage of information in business processes (e.g. minimal data lookup strategies).

Not only should the derived business process structure correctly implement the decision structure and optimize a set of important business criteria, it should also be **compliant** to a set of process controls. A possible approach is to take the controls into account during the translation of the decision structures into process structures. This approach is based on the genetic mining algorithm (Alves de Medeiros, 2007) and would use multi-objective **evolutionary optimization algorithms** to search for process structures which implement the decision structure correctly, do not violate the process controls and optimize the business criteria.

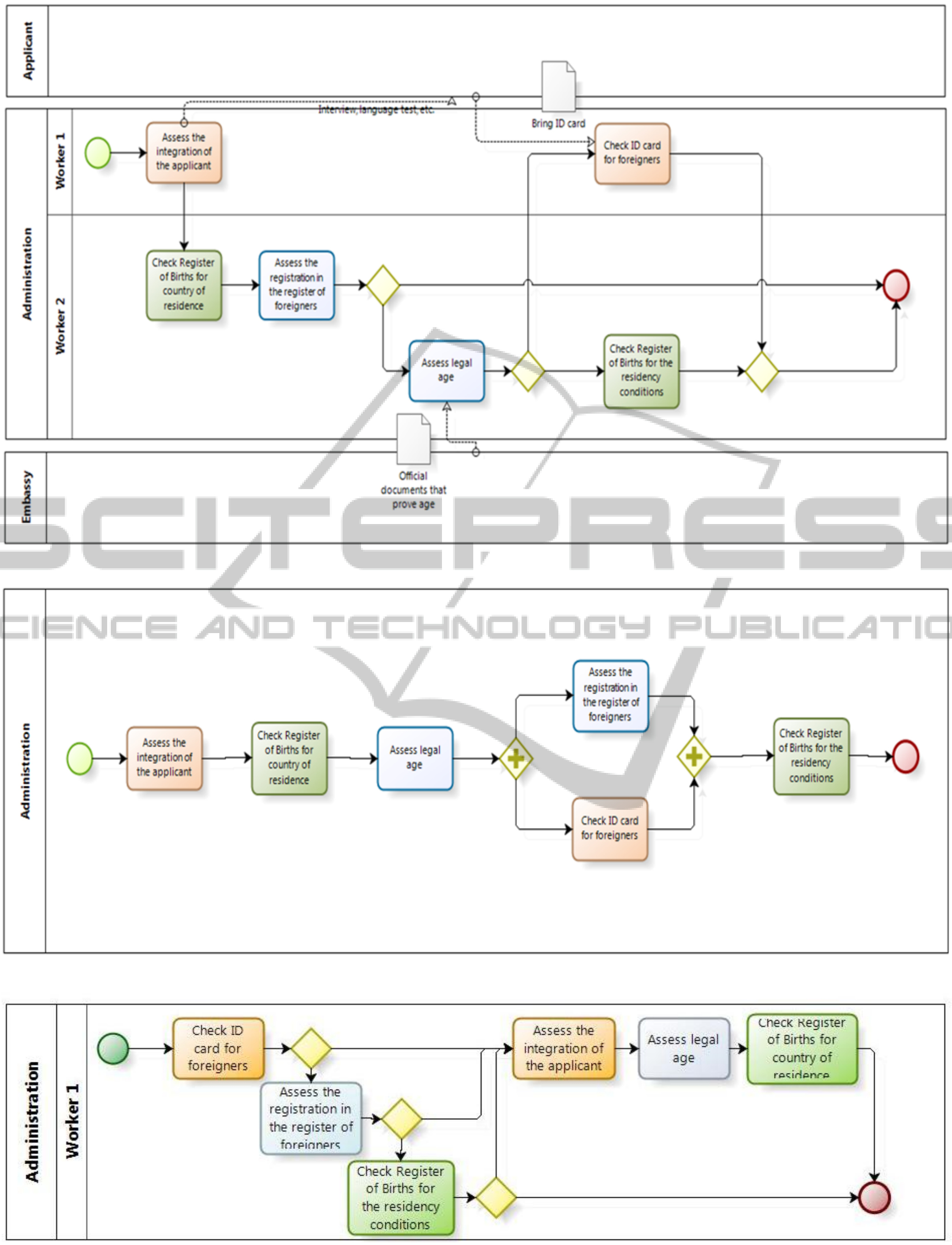

Figure 2: Possible process models.

5 DISCUSSION AND CONCLUSIONS

The proposed method results in a better separation between business decisions and execution processes, which makes it easier and clearer to achieve the above objectives. Business decisions that have been properly modeled can be better evaluated and improved throughout their lifecycle. Moreover, the transformation strategy allows for added operational agility when the characteristics (e.g. time and cost) for obtaining lower level elements change. Future research must focus on transformation patterns that take into account different characteristics (e.g. the organizational aspect where the goal would be to limit the number of handovers) or a combination of characteristics. The approach will increase the flexibility, traceability and maintainability of the underlying decision making processes, while at the same time, it minimizes the impact from changes caused by modification of specific decision logic.

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