TBIM: a Language for Modeling and Reasoning about Business Plans

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Abstract. Conceptual models of different aspects of an organization—business objectives, processes, rules, policies and objects—have been used for organizational design, analysis, planning, and knowledge management. Such models have also served as starting points for designing information systems and conducting business intelligence activities. This paper proposes the Tactical Business Intelligence Model (TBIM), a language for modeling strategic business plans. TBIM lies in between the strategic and tactical level, for strategic plans are abstract business tactics. TBIM extends the BIM strategic modeling language with primitives for business model design. In addition to presenting the syntax of TBIM, we illustrate its usage through a medium-sized case study. We also propose a method for evaluating alternative plans through a mapping to business process models and the usage of simulation techniques.

Keywords: strategic planning; organizational models; business models

1 Introduction

Organizations rely on a hierarchy of management layers, each focusing on different aspects of the organization. Conceiving an organization in terms of layers eases decision-making and management activities, for it refines the task at hand into smaller tasks at different levels of abstraction.

The topmost management level, called *strategic*, defines the direction of the organization. Notions such as vision, mission, and goal are essential components of a strategy. Once the strategy is set, a crucial decision is to be taken: *how* does the organization realize it? This question is answered by conducting *strategic planning* [1,11] activities, which lead to the definition of a high-level business *tactic* that, if implemented correctly, is expected to realize the strategy.

Strategic planning success depends on many factors, including the expertise of the management, the adoption of best practices, and the analysis of the key aspects of a business tactic (choosing the right ontology). While the topic has been widely explored in management science, there has been little work grounded on the usage of conceptual models to represent and analyze strategic plans.

In this paper, we propose the Tactical Business Intelligence Model (TBIM), a language for modeling strategic plans. The language is a link between the strategic level and the tactical level in the sense that a business plan comprises

a set of business goals, as well as the tactical plans for reaching those goals, defined in terms of value propositions, market segments, distribution channels, production and delivery activities, as well as partnerships. TBIM links these two levels by extending two state-of-the-art modeling techniques: (i) the Business Intelligence Model [10], a strategic modeling language based on primitives such as goal, situation, indicator, and (ii) the Business Model Ontology [18], which offers a core set of concepts to conceive business models at a tactical level.

Specifically, the contributions of the paper are as follows:

- We introduce the primitives of the TBIM modeling language. TBIM acts as a bridge between strategic and tactical models.
- We define a graphical notation for TBIM. The notation consists of two complementary views: the *tactical view* focuses on the internal aspects of a tactic, while the *partnership view* models the partnerships among enterprises.
- We provide a method for *reasoning* about alternative TBIM tactics through business process simulation techniques. Our method helps refining abstract TBIM tactics into more detailed tactics expressed as BPMN models.
- We illustrate our approach through snippets from a medium-sized case study concerning the organization of an international jazz festival [18].

Organization. Section 2 reviews our baseline. Section 3 introduces the TBIM language. Section 4 explains how TBIM models can be mapped to BPMN models. Section 5 shows the use of BPMN analysis techniques to evaluate alternative TBIM tactics. Section 6 discusses related work, while Section 7 concludes.

2 Baseline

Our baseline consists of BIM, a modeling language for strategic business modeling (Section 2.1), and a business ontology that defines the key factors to model a business tactic (Section 2.2). Our aim is to combine the set of modeling primitives provided by these approaches into a modeling language for strategic planning.

2.1 Business Intelligence Model (BIM)

The *Business Intelligence Model* (BIM) [10] is a modeling language for representing business strategies. BIM relies on primitives that decision makers are familiar with, such as goal, task/process, indicator, situation, and influence relations. BIM supports the notions from SWOT (*Strengths*, *Weaknesses*, *Opportunities*, *Threats*) analysis [4] by modeling internal and externals factors (situations) that are (un)favorable for fulfilling certain goals. BIM comes with automated reasoning techniques, including "what if?" and "is it possible?" analyses [10].

Figure 1 briefly illustrates the syntax of BIM by modeling part of the Montreaux Jazz Festival (MJF) organization case study [18].

The top-level strategic goal is to Organize MJF Festival. To achieve this goal, five subgoals are to be pursued and fulfilled, including Provide attractive venue, Attract star performers, and Attract attendance. The latter goal requires to achieve

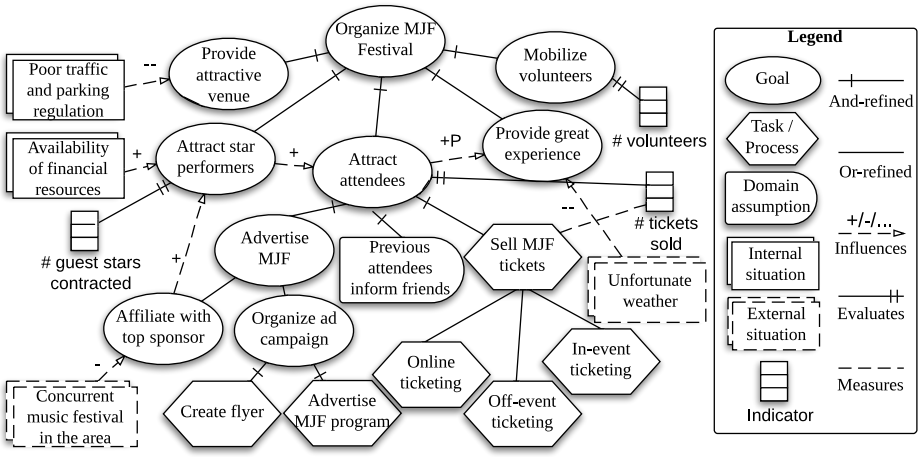

Fig. 1: Partial BIM model for the Montreaux Jazz Festival case study

goal Advertise MJF and to execute task Sell MJF tickets, assumed that Previous attendees inform their friends. The festival can be advertised by either affiliating with a top sponsor who also takes care of advertising, or internally organizing an ad campaign (which requires processes Create flyer and Advertise MJF Program). Goals and situations influence one another. The external situation Other music festival in the area influences negatively goal Affiliate with top sponsor, while the internal situation Availability of financial resources positively influences goal Attract star performers. Indicators are associated with goals so to evaluate to what extent the goal is fulfilled. For example, # volunteers evaluates goal Mobilize volunteers.

2.2 Business Model Ontology (BMO)

The Business Model Ontology (BMO) [18] argues for a set of success factors for e-business organizations. The proposed language proved to be very effective among practitioners, and has led to the creation of the renown *business model canvas* [19]. BMO is centered on four pillars:

- **Product innovation** is achieved when the company defines a *value proposition* that effectively reaches one or more *customer segments* by offering novelty, lower prices, or customer relationship excellence.
- **Infrastructure management** describes the value system configuration to deliver the value proposition, which includes defining *partnerships* and carrying out activities that use, consume, and produce *resources*.
- **Customer relationship** needs establishing high-quality client relationships, and reaching different client segments via adequate *distribution channels*.
- **Financial aspect** is a crosscutting concern in every organization. Defining a right balance between the *revenue* model and the *cost* structure is essential for the survival of the organization in the market.

3 Tactical Business Intelligence Model (TBIM)

We present the metamodel and the graphical syntax of TBIM. TBIM combines the strategic modeling framework provided by BIM with key elements from BMO that support the following set of requirements for strategic planning:

R1. *Market segments.* Products and services are typically made available to specific customer segments. The language should be able to define *what* products and services an organization offers and to *whom*.
R2. *Cross-organizational relationships.* The success of a strategic plan heavily depends on the establishment and maintenance of a network of partnerships with other organizations.
R3. *Distribution channels.* Products and services are distributed through different channels. The choice of a specific channel depends on the customer segment that is approached by the provider.
R4. *Resources and value propositions.* In order to create value, organizations use, create, consume, and transform resources [25]. Value propositions are resources that are a source of revenue for an organization [18].

TBIM consists of two complementary modeling views. The *tactical view* (Section 3.1) uses an extended version of BIM to describe the strategy of the modeled organizations as well as the high-level tactic to fulfill their goals. The *partnership view* (Section 3.2) represents a network of contractually-related organizations. Together, these two views do model alternative business plans (Section 3.3).

3.1 Tactical View

The UML class diagram in Figure 2 presents the metamodel of the tactical view. The gray-colored classes are adopted from BIM. We illustrate the graphical notation through the TBIM tactical view diagram in Figure 3.

Agent and role. *Agents* represent a concrete organization or person. An agent is an active entity that carries out actions to achieve goals by exercising its knowhow [28]. Agents are *intentional*, for they carry out activities to achieve their goals. *Roles* are an abstract characterization of the behavior of a social agent within some specialized context or domain of endeavor. The term *Actor* refers generically to an agent or a role (is-a relationship in Figure 2). In Figure 3, for example, MJF is an agent that represents the festival organizers, while Local customer, Loyal customer, etc. are roles representing different types of customer.

Unlike BIM, TBIM models consist of multiple actors. Consequently, BIM entities such as goals and tasks fall within the scope of a specific actor.

Resource and value proposition. *Resources* are anything of value for the company being modeled. A *resource* can be animate (e.g., human, animal, etc.) or inanimate (e.g., wood, chair, money, etc.). In Figure 3, Blank papers are resources for the agent MJF. TBIM also includes value propositions as a specialization of resources. A *value proposition* is the statement of benefits that are delivered by the firm to its external constituencies [3]. They differ from plain resources as

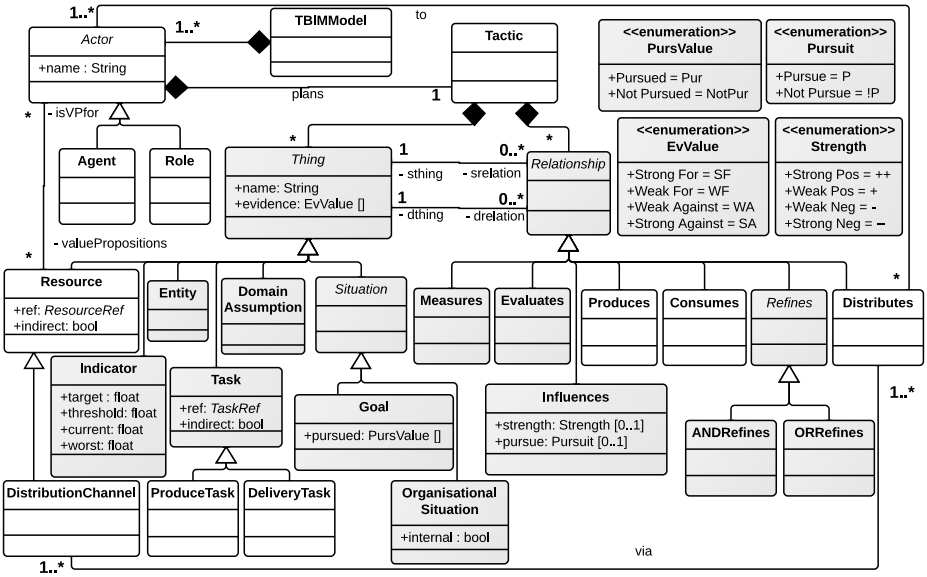

Fig. 2: Metamodel of the tactical view. Classes in gray are adopted from BIM

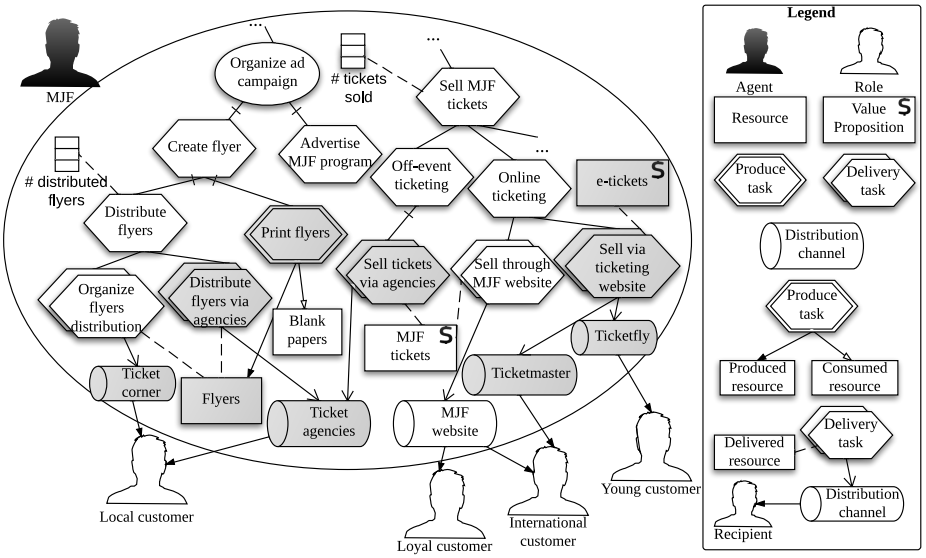

Fig. 3: Partial TBIM tactical view for the MJF case study. Gray-colored elements are indirect (obtained from other actors)

they carry an intrinsic value for the company, and they form its primary source of revenue. For instance, MJF tickets are a value proposition for MJF, because their sales produce revenue for the festival. On the contrary, Flyers are a resource that does not carry revenue directly. TBIM distinguishes between *direct* entities (resources, tasks, distribution channels) that are internal assets of an actor, and

indirect entities that are acquired from others via partnerships (see Section 3.2). For example, Flyers are an indirect resource, meaning that MJF obtains them from another actor. In our graphical notation, indirect entities are gray-colored.

Produce task, produces, and consumes. A *Produce Task* is a set of activities that results in the production of *resources*. A produce task is linked to produced resources via *Produces* relationships, and it can be connected to some resources via *Consumes* relationships, to indicate that the production process consumes those resources. Produce tasks specialize BIM tasks. While BIM tasks can decomposed to produce tasks, the latter type of tasks can not be decomposed, for their semantics is already very specific. In order to express that multiple produce tasks are needed, one can decompose a generic task into multiple produce tasks, each connected to an individual resource. In Figure 3, Print flyers is a produce task that consumes resource Blank papers and produces resource Flyers.

Distribution channel and delivery task. *Distribution channels* are means through which customers are delivered resources. *Delivery tasks* are tasks indicating that resources are distributed to other actors. These tasks include the whole process of distributing a product, including packaging, shipment scheduling, and delivery. A delivery task is connected to at least one distribution channel. Multiple distribution channels can be associated with a delivery task to reach different market segments. Delivery tasks can not be further refined, but they can be refinements of a generic task. In Figure 3, Sell through MJF website is a delivery task, which encompasses the delivery of the value proposition MJF tickets through the channel MJF website to two types of customers: Loyal and International.

3.2 Partnership View

Maintaining an effective network of partnerships is key to the competitiveness of a company [9,18,24]. In TBIM, partnerships enable fulfilling strategic plans. Partnerships are stipulated through contractual agreements (*commitments*) that specify which products and services are made available, to whom, and in exchange for what. TBIM supports partnerships modeling through the partnership view. Its metamodel is shown in Figure 4 and illustrated in Figure 5.

Commitments. They are the principal element of the partnership view, and represent contractual agreements among actors on the execution of tasks, exchange of resources, and provision of distribution channels. A commitment [21] is a quaternary relation: a *debtor* actor commits to a *creditor* actor that a *consignment* will be delivered, if (optionally) a *reward* is provided by the creditor.

Commitments relate elements that appear in the tactical view: debtor and creditor are chosen among agents and roles, while resources, tasks (of all types), and distribution channels constitute the consignment and the reward. Since resources, tasks, and distribution channels appear (are contained in the tactical view within the scope of an actor, the metamodel of the partnership view includes references to those objects: *ResourceRef*, *TaskRef*, and *DistributionChannelRef*. The consignment and reward indicate the commitment of the involved actors to:

- *Resource provision*: a resource shall be transferred.

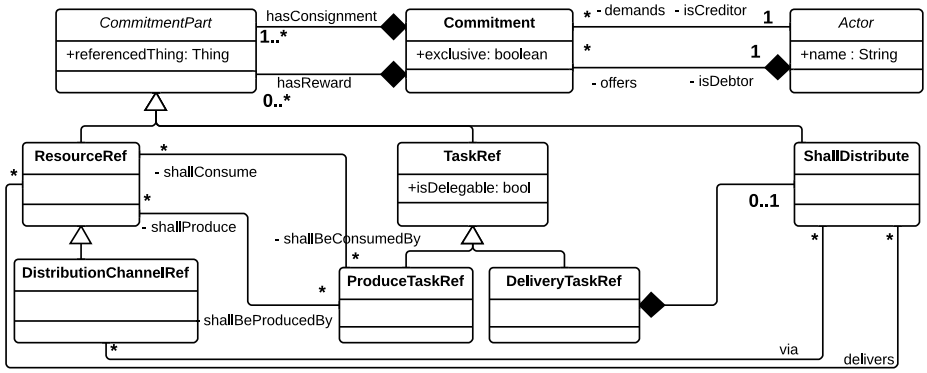

Fig. 4: Metamodel of the partnership view

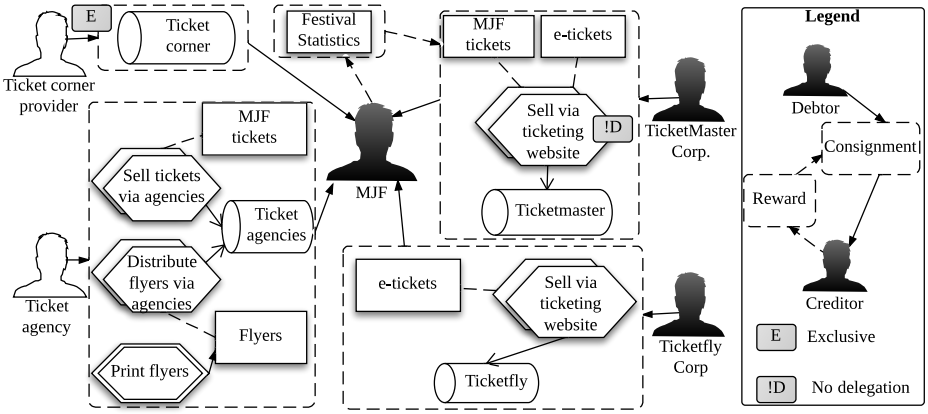

Fig. 5: Partial TBIM partnership view for the MJF case study

- *Task execution*: a generic process/task shall be carried out.
- *Produce task execution*: a production line is provided for producing resources.
- *Delivery task execution*: a delivery service for some items is made available.
- *Distribution channel provision*: a distribution channel is provided to enable a distribution process.

In Figure 5, role Ticket agency commits to agent MJF to execute produce task Print flyers (to produce Flyers), and delivery tasks Distribute flyers via agencies and Sell tickets via agencies. For both deliveries, the channel Ticket agencies will be used. The commitment from TicketMaster Corp. to MJF shows rewards: tickets are sold via the Ticketmaster channel only if Festival Statistics are provided from MJF.

A commitment defining a partnership can be further constrained:

- *ShallDistribute* (Figure 4) indicates that a delivery task shall deliver a specified set of resources via a specified set of distribution channels.
- A commitment may be *exclusive*, meaning that the consignment shall be provided to the creditor only. The commitment from Ticket corner provider is exclusive: the Ticket corner shall be used for selling MJF tickets only.

– A task reference in a commitment can be *delegable* (default) or not. If delegable, the debtor is authorized to delegate task execution to another actor. TicketMaster Corp. commits to not delegate task Sell via ticketing website.

3.3 Business plans

TBIM allows representing alternative *business plans* to achieve the strategic business goals in the considered domain. A business plan is the process by which the entrepreneur, in exploiting an opportunity, creates a vision of the future and develops the necessary objectives, resources, and procedures (plans) to achieve that vision [20]. Business plans incldue value propositions, market segments, distribution channels, production and delivery activities, and partnerships [18].

Figures 3 and 5 show alternative business plans. Goal Organize ad campaign requires tasks Create flyer and Advertise MJF program. The former task requires the indirect production task Print flyers, which consumes Blank papers and produces Flyers, and is supported by the commitment from Ticket agency (Figure 5).

To distribute flyers, alternatives exist: either flyers distribution is organized internally, or the delivery task Distribute flyers via agencies is chosen. The latter alternative distributes Flyers to the market segment of Local customers through channel Ticket agencies. The commitment from Ticket agency supports this plan.

4 From Business Plans to Business Processes

The Business Process Modeling Notation (BPMN) [15] is the de-facto standard modeling language for business processes. BPMN models consist of activities (tasks and subprocesses) connected by a control flow. These models can be automatically analyzed to identify path execution times, bottlenecks, costs, etc.

BPMN modeling and analysis can be used to compare alternative TBIM tactics. To do so, we define a conceptual mapping between a TBIM model and a set of BPMN models. We assume that the indirect tasks and resources within the scope of an actor A appear in the consignment (reward) of at least one commitment made to (by) A by (to) actor B, and are also in the scope of B.

Actors. Every *agent* and *role* has to appear in at least one process as *pool*, as *lane* within a pool, or as *additional participant*. The same actor can be mapped to different elements and element types. For instance, actor MJF can be mapped to pool MJF Administration and additional participant MJF Vice-President.

Resources. Every direct *resource* that is produced or consumed by some task has to be mapped to at least one *data object*. In BPMN, a data object is information about what activities require to be performed and/or what they produce.

Tasks. *TBIM tasks*—of any type—describe conducted activities in an organization. Every direct task shall be mapped to at least one *BPMN task* in a BPMN process. These BPMN tasks shall appear in a pool or lane whose performer is the actor that owns the task in the TBIM model.

Resource consumption and production. Produce tasks do produce and consume resources. For direct produce tasks, we require that at least one corre-

sponding BPMN task has incoming and outgoing *data association* links to *data objects* that preserve the semantics of consumption and production, respectively.

Delivery. Delivery tasks denote routines for transferring a resource to another actor. For direct delivery tasks, we require the existence of a *message flow* from the pool/lane corresponding to the actor that owns the delivery task to the pool/lane corresponding to the recipient actor. *Distribution channels* are mapped indirectly (e.g., via tasks and/or messages), for BPMN has no primitive that carries the semantics of a distribution channel.

Commitments and indirect elements. The guidelines above take into account direct elements (tasks and resources). We examine now indirect elements (gray-colored, which appear in at least one commitment as consignment or reward). We show the case where the indirect element appears in the consignment. The mapping inverts debtor and creditor if the element is in the reward.

- *Resources* shall be modeled via BPMN *message flows* between pools or lanes. There should be at least one message from the debtor to the creditor where the *message* corresponds to the resource.
- *Produce tasks* shall be modeled as a two-way message flow: the creditor requests the production process, and the debtor provides the process outcome.
- *Distribution channels (without delivery task)* shall be modeled as a message flow from the debtor to the creditor, where the *message* is the provided channel (in TBIM, a distribution channel is a resource).
- *Delivery tasks* shall be modeled as a message from the creditor to the debtor, where the *message* requests the initiation of the distribution process.

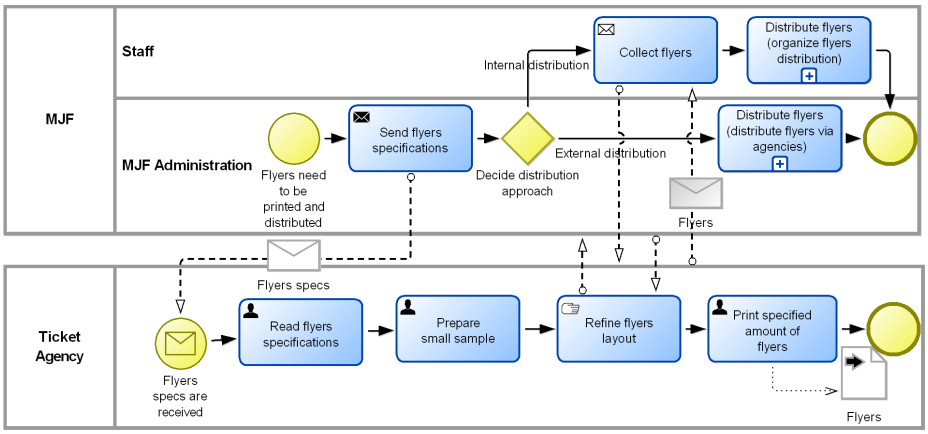

Fig. 6: Overall BPMN model for the distribution of MJF flyers

Figure 6 depicts a possible mapping of the Distribute flyers task refinement of Figure 3. In the topmost lane, MJF Administration sends flyers specifications to the Ticket Agency company, which provides flyers according to the partnership

specifications (Figure 5). After some interactions, the process terminates with a gateway to evaluate two different strategies (subprocesses): relying on an external distribution company, or handling distribution internally.

Our mapping defines compliance criteria between a set of processes and a TBIM model. The analyst can possibly derive process skeletons, but she would typically enrich them with fine-grained information, including additional BPMN tasks, different types of control flow, and structuring in subprocesses.

5 Evaluating alternative TBIM plans

Business process simulation enables evaluating processes and the alternatives therein in terms of execution time, usage of resources, and costs [23]. Simulation has been used for the analysis of organizations at design-time as well as in real-time environments as strategic and operational decision support tool [27].

We show how, given a set of processes for a TBIM model (Section 4), simulations can be run to compare alternative TBIM plans. TBIM models support alternative business tactics through OR-refinements and multiple partnerships for the same task or resource. To obtain such insights, we enrich the process models with information about cost, assigned resources, and execution times.

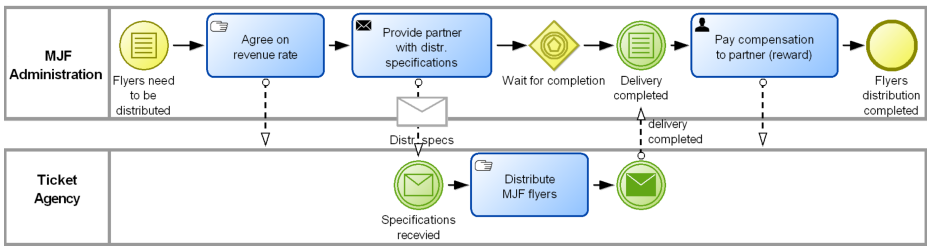

Fig. 7: BPMN model for the *external* organization of flyers distribution

Figure 7 shows the business process for distributing flyers through an external company (Ticket Agency). The process requires MJF Administration to agree on the revenue rate (a TBIM reward). Once agreed, the distribution is taken care of by the ticket agency, with no further involvement of the MJF administration.

Figure 8 shows a process for the internal organization of flyers distribution. MJF Administration hires people among the candidates provided by Temporary job agency. The candidates are interviewed and possibly hired. After a training period, the ticket corners are set up and provided with flyers, and the distribution starts. MJF administration copes with personnel sick leaves and resignations.

Enriching BPMN models. Given a set of BPMN models created for a TBIM model using our guidelines, they need be enriched with information from the organizational context (e.g., BPMN can be assigned costs, execution times, and specific performers). While our mapping provides coarse-grained information

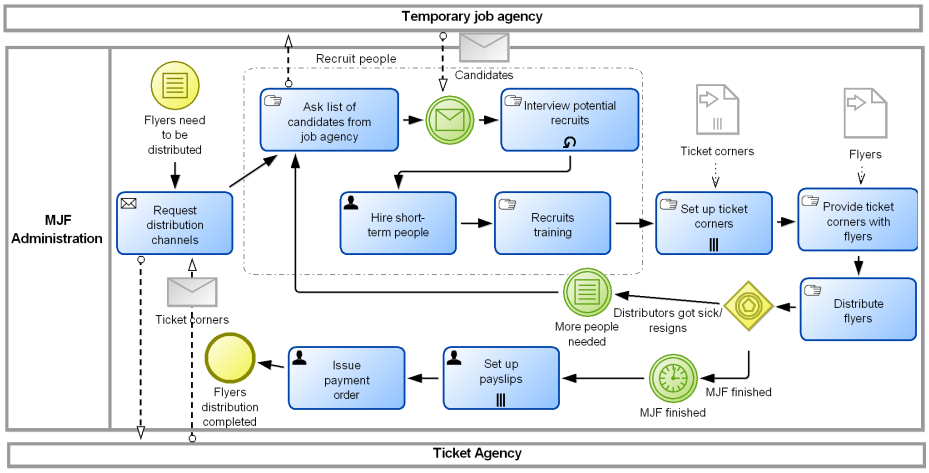

Fig. 8: BPMN model for the *internal* organization of flyers distribution

about performers, the analyst may include more fine-grained details, specifying, e.g., the specific person who is in charge for a task. This enables defining values for hourly wages and availability for each performer involved in a business process. We have enriched the BPMN models of Figures 6–8 with fictional values to illustrate our approach (details in our technical report [7]).

Table 1: Simulation results for the MJF flyers distribution process. Times are in business days, costs are in units

Organizational Unit	**Time**		**Pers. Costs**		**Other Costs**	
	Ext.	**Int.**	**Ext.**	**Int.**	**Ext.**	**Int.**
Volunteer	0.0	1.71	0.0	0.0	0.0	0.0
Staff	0.37	3.55	30.0	145.71	0.0	100.0
MJF Administration	0.31	1.35	25.0	138.42	500.0	175.07
Recruits	0.0	17.25	0.0	1104.0	0.0	0.0
Ticket Agency	20.0	0.0				
Total	*20.68*	*23.86*	*55.0*	*1388.13*	*500.0*	*275.07*

Interpreting the results. The results from the simulations include process costs, time spent in cycles, frequencies for each task, etc. We have applied the simulation component of the Adonis BPM toolkit [5] to our models. The results (Table 1) evidence that the internal approach is more time consuming. This is due to set-up activities for flyers distribution. The internal process is significantly more expensive in terms of personnel and other costs. Also, both staff and MJF administration would be relieved from some effort by relying on a partnership.

Improving TBIM models. Simulation results can be used to ameliorate the TBIM tactic and/or to choose among alternative business plans (e.g., different

tasks in an OR-refinement, or alternative partnerships). This activity relies on the expertise of the analysts. In our example, the results clearly suggest that the partnership with a Ticket agency (Figure 5) is significantly better. The delivery task Distribute flyers via agencies is preferable over Organize flyers distribution (Figure 3), and channel Ticket corner is thus disposable/useless.

6 Related work

We review related work about modeling different aspects of enterprises.

Business ontologies. They define concepts to conceive enterprises. Two key approaches are Uschold's enterprise ontology [24] and the Resource/Event/Agent generalized accounting model [14]. The Business Motivation Model [16] defines business plans by starting from the motivations of a company. These works provide sets of concepts (e.g., resources, duality, agents, strategy, activities, motivations) that are at the basis of several modeling languages, including TBIM.

Enterprise architectures. They provide principles, methods, and models for the design and realization of an enterprise. TOGAF [17] promotes a requirements-centered design of the architecture, which begins with a vision of the architecture, and includes governance and change management. The Zachman framework [29] models enterprises by filling all the cells in a matrix where rows define the granularity level, and columns specify different aspects (why, when, what, how, where, who). These approaches do not offer a specific modeling language.

Business modeling languages. They represent different aspects of a business. The e^{3}value [8] methodology models a network of enterprises creating, distributing, and consuming resources having an economic value. BMO and e^{3}value share similar primitives [2]. Lo and Yu [13] suggest the usage of extended *i** [28] agent- and goal-oriented models to design collaborations—including resource exchange and task execution—among organizations. TBIM brings this notion further by suggesting different types of tasks (production, distribution), and uses commitments for relating business partners. *i** and e^{3}value have been combined [9] to support e-service design. In their approach, the gaps between two models are filled in by the analyst. TBIM, instead, relies on a unified conceptual model.

Social commitments. They are relationships that tie together autonomous participants through declarative contracts [21]. Telang et al. [22] rely on commitments to propose an agent-oriented approach for specifying and verifying cross-organization business models. TBIM relies on a more fine-grained ontology for both intentional elements and commitments.

Business Process Modeling (BPM). It is concerned with the creation of models of business processes. BPMN [26] is the de-facto standard notation for BPM, and relies on the notions of activity and control flow. BPMN 2.0 [15] introduces support for the collaboration between different organizations. We use business process models to analyze and evaluate alternative tactics. Our future work includes investigating the effectiveness of alternative BPM languages. An

interesting candidate is the approach by Laurier *et al.* [12]. They simulate financial and operational performance through a mapping of concepts from the REA ontology to hierarchical, colored and timed Petri nets.

7 Discussion and future work

We have proposed TBIM, a conceptual modeling language for representing business plans. TBIM builds on the BIM language, and extends it with primitives from the BMO e-business ontology. We have also provided guidelines to map TBIM tactics to BPMN processes, and have shown how to use business process simulation techniques for evaluating alternative TBIM tactics.

A key feature of TBIM is that it decouples the internal tactics of an enterprise (*tactical view*) from the partnerships with other enterprises and customers (*partnership view*). This distinction enables determining if there exist unneeded partners, and if some tactical choice is not supported by any partnership.

Evaluation. We have illustrated TBIM and the usage of business process simulations with snippets from the MJF case study. Extensive models and results are available in our technical report [7].

Implementation. We have developed a proof-of-concept modeling tool to support the TBIM graphical notation. The tool is built using the meta-modeling development platform ADOxx [6]. This choice aims to facilitate integration with the Adonis BPM toolkit, which supports BPMN modeling and features sophisticated analysis and simulation algorithms.

Future work includes (i) improving the modeling tool to enable public use; (ii) developing features for automatically generating BPMN skeleton processes from TBIM models; (iii) evaluating TBIM on industrial case studies; and (iv) empirical evaluation of the language aimed at improving the modeling primitives.

Acknowledgments

This work has been partially supported by the ERC advanced grant 267856 for a project titled "Lucretius: Foundations for Software Evolution" (`http://www.lucretius.eu`), and by the Natural Sciences and Engineering Research Council (NSERC) of Canada through the Business Intelligence Network.

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