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**Intention-oriented
Organizational Modeling - A
Top-down Approach**

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Abstract

The involvement of human resources is a necessity in many organizations. In these organizations, there are processes that may require decisions taken by the human resources. The processes that are accomplished through human knowledge have irregular sequence of execution steps, i.e., the series of activities to be carried out are not structured. It is also important to guide such unstructured organizational processes and resources because they work towards the achievement of an organizational intention. Thus, designing models that serve as guide in order to achieve the organizational intentions are of prime importance. The intentions play a critical role in organizations because they motivate the organizational resources to work towards the overall development of an organization. Thus, supporting modeling of the intentions, strategies to achieve the intentions, capabilities required by the strategies, resources that provide the capabilities and processes that implement the strategies everything together in a holistic way is vitally important for any organizational modeling approach. The holistic way of modeling is required, because each modeling element requires modeling of its associated element.

Traditional modeling approaches that are oriented to the sequence of activities, are not suitable when the sequence of activities cannot be determined in advance. Hence, there is a need for a modeling approach that enables creating models as guide in order to achieve an intention rather than providing sequence of steps required to achieve an intention. This master thesis work, proposes a modeling approach based on the derived requirements of the intention-oriented organizational modeling. The proposed approach allows creating organizational models that acts as a descriptive guide, e.g., providing information about the required strategies to achieve an intention.

In the proposed modeling approach, the intentions are realized through the strategies which are associated with the capabilities that are satisfied by the resources. As a result, the unstructured organizational processes realizes the strategies that are associated with the capabilities, resources and intentions. A motivating scenario from an organization that belongs to the manufacturing sector is provided to help the reader in easily acquiring the concepts of the proposed approach. The approach is realized as a web-based modeling tool through which organizational models can be created. To assess, feasibility of the proposed approach and usability of the developed modeling tool, we also provide a case study centered around the motivating scenario.

Keywords: Intention-oriented modeling, informal processes, top-down approach, descriptive guides

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1 Introduction

The resources such as human actors, development environments, materials, etc., of an organization play an important role to accomplish the organizational intentions. Though organizations can reuse available information of a process for the execution of another business process, certain process that involve human knowledge cannot be reused. These type of processes are not structured like traditional processes. An example for a traditional process is, creating a new customer savings account process. The reason for irregular structure of the process is, because the sequence of activities to be carried out in order to execute a process cannot be predefined due to its dynamic changing nature, e.g., research and development processes.

The processes whose required activities and order of their execution cannot be determined beforehand are called *informal processes* [SKL14]. These type of processes are human-centric as their dynamic nature is due to the involvement of human knowledge. These processes are vitally important for the organizations and they need to be supported and automated [SBBL14]. Though activities of the processes that involve human knowledge are unpredictable, intentions, i.e., goals of the informal processes are known before their enactment [DMR15]. Thus, this thesis work focuses on realizing the modeling of organizational processes oriented to intention.

The next section of this chapter, provides a detailed motivational statement of this master thesis work, followed by a problem statement section which is then followed by contributions of this work. The final section provides an outline about the following chapters of the document.

1.1 Motivation

As mentioned earlier, knowledge workers' decision has an effect on informal processes' sequence of activities. For example, research and development processes are of type where human decision plays an important role. Thus, the sequence of activities for such processes cannot be decided in advance because such processes are characterized with changing requirements. These type of processes are highly unpredictable in nature and this makes it quite challenging, to support modeling these type of processes. This work

is a part in realizing the modeling of such processes in organizations. Any approach that supports informal process modeling is required to be more autonomous because, the dynamic behavior of processes are enacted by some subjects. Thus, the existing modeling approaches available for traditional processes are not helpful in realizing the modeling of informal processes in organizations.

Though sequence of steps to be carried out to execute the informal processes cannot be determined beforehand, intentions of the informal processes are known before their enactment. Achieving these intentions requires, another important driving force called *resources*. These resources posses certain *capabilities* to qualify for achieving an intention. This can be achieved by modeling through associated elements, i.e., associating the intentions with the strategies, strategies with capabilities and capabilities with resources. When the models are designed descriptively, i.e., providing only information what has to be done in order to achieve an intention rather than how to achieve an intention. These kind of models serve as informal guides which preserves the information associated with the informal processes to achieve an intention. Meanwhile, it also overcomes the need for predefining the sequence of execution steps. The non-existence of business logic facilitates more autonomy for the human performers and enables establishment of the best practices [SBBL14].

1.2 Problem Statement

Though there are *activity-centric* modeling such as Business Process Model and Notation (BPMN) [Gro11] and Business Process Execution Language (BPEL) [Std07], they are not suitable for certain type of processes whose execution steps cannot be predicted in advance [SBBL14]. This is because of the challenges in determining the sequence of activities before enacting an informal process. Another key thing to remember is, the informal processes are dynamic in nature due to the involvement of human knowledge. This dynamic nature is, one of the important challenges in developing an environment that supports the informal process modeling in organizations.

Every organization contains multiple entities like (1) *resources*, e.g., humans, tools etc., (2) *intentions*, e.g., revenue based intentions, quarterly intentions etc., (3) *strategies*, e.g., improved customer help desk, expanding sales, etc., and (4) *capabilities*, e.g., web application developer, sales representatives, etc. Thus, organizations need an approach to model these different organizational elements oriented to intention, because intention of an informal process can be known before their enactment. Thus, it is important to achieve an intention, by executing its strategies as an independent informal processes.

Due to the involvement of multiple resources during modeling, there is a requirement in organizational modeling to make decision regarding strategy selection based on cost calculation and achievability estimation. Thus, any approach that enables modeling of organizational elements oriented to intention should also satisfy all of the requirements of intention-oriented modeling in organizations.

1.3 Contributions

The contributions of this work can be categorized as follows:

1. Derived requirements of intention-oriented organizational modeling from the existing literatures and motivating scenario. Evaluated the existing approaches based on the derived requirements (Chapter 4).
2. An approach for intention-oriented organizational modeling that satisfies all of the derived requirements (Chapter 5).
3. Case study on a manufacturing company (Chapter 6).

1.4 Outline

The remainder of this document is organized into the following chapters:

Chapter 2 – Fundamentals and Related Work: In this chapter, the fundamental concepts and an overview of the related work that are essential to understand the work are provided.

Chapter 3 – Motivating Scenario: In this chapter, a motivating scenario has been taken and a detailed explanation for each modeling element of the scenario is provided. This aids the reader to understand the concepts of intention-oriented organizational modeling clearly.

Chapter 4 – Requirements of the Intention-oriented Organizational Modeling: This chapter provides a detailed requirement analysis of intention-oriented organizational modeling. This chapter also provides a literature review and an evaluation of the existing work.

Chapter 5 – An Approach to Intention-oriented Organizational Modeling: This chapter discusses about the approach that realizes the requirements of intention-oriented organizational modeling.

Chapter 6 – Case Study on a Manufacturing Company: This chapter validates the approach presented in the Chapter 5. This chapter also discusses a detailed system architecture and also presents realization of the proposed approach.

Chapter 7 – Conclusion and Future Work: This chapter summarizes the results of this thesis work and draws a conclusion. This chapter also throws some light on the future work to be extended based on this work.

2 Fundamentals and Related Work

The first three sections of this chapter are the fundamental concepts that are required to understand the intention oriented organizational modeling approach to be discussed in the Section 5.3 of Chapter 5. The fourth section provides a brief introduction about Informal Process Essentials (IPE) approach. The fifth section discusses the conceptual model of the intention-oriented organizational modeling. The final section discusses the Executing Informal Processes (InProXec) method which helps to realize the IPE approach in organizations.

2.1 Definitions of the Terms

In this section, the definitions of terminologies that are used throughout this document are provided briefly.

Business Process - A business process has been defined as set of activities whose final output is accomplishment of a goal [Wes12].

Business Logic - Business logic refers to the activities that need to be done to execute the corresponding business process [Wes12].

Business Process Model - Business process model is a model to capture recurring activities during business process execution and enact them in an automated fashion for re-using the stored knowledge [Wes12].

Informal Process Essentials - Informal Process Essentials (IPE) is a resource-driven approach that enables describing process declaratively, i.e., without describing how the intention is achieved and providing only information about what has to be achieved [SBBL14].

OASIS Topology and Orchestration Specification for Cloud Applications (TOSCA) - TOSCA is an OASIS (Organization for the Advancement of Structured Information Standards) standard to describe composite applications and their management [KBBL13].

Winery - Winery is a modeling tool offering a web-based environment for graph-based modeling of application topologies and defining reusable components and their relationship types. It is an editor to create TOSCA documents [KBBL13].

2.2 Human-centric Process

The role of humans in organizations has been evolving over time. The shift from "personnel" to "human resources" acknowledges the importance of humans as organizational resources. Today's organizations are dynamic in nature due to frequent changes that happen inside the organizations. For example, organizational changes like addition of new organizational alliances, new structures and hierarchies, new ways of assigning work and a very high rate of changes like changes in the workforce, including employees' priorities, capabilities and demographic characteristics. Thus, it is impossible to do one hundred percent perfect forecasting of dynamically changing processes in an organization.

In order to manage such a dynamic environment, organizations need skilled human resources with the previous knowledge of handling the unforeseen scenarios. Thus, human resources are vital part of any organization as they have skills of acute future orientation to understand the changing organizational environment. Humans in organizations carry out many important activities. *Managers* and *Human Resource* (HR) professionals organize jobs of each and every human in the organization so that they can effectively perform these jobs. Thus, humans in any organization are viewed as resources of the organization which is a contemporary part of *Human Resource Management* [Bia16].

Collaborations exist in every level of an organization. For example, at management levels of an organization, managers and HR professionals work together to assign employees their roles and task in the organization. This helps the employees of the organization in adapting to its environment. In a flexible organization, employees' roles and responsibilities changes dynamically based on the requirements and business priorities. Thus, the need for network of representations between the human resources, that helps to identify human resources based on their roles is arising. This network of representation sets up an environment to support the collaborative work of business related process. This kind of support to represent human resource network has been realized in the work by author Canko [Can15]. The concept of *virtual human representation* described by the author is an extension of actor-concept described in the *Informal Process Essentials* [SBBL14]. The prototype *Human Resource Representation* developed in the work by author Canko, saves the information such as capabilities, roles, responsibilities, etc., as a virtual human web ontology instance which can be reused in the web-based environments. These kind of human representations are highly helpful to organizations with dynamically

changing resources. These representations can describe and match resources with their capabilities based on the requirements [Can15].

2.3 Organizational Modeling Notations

The organizational modeling element notation has been selected based on the guidelines mentioned in the literature [Moo09] and these notations are adopted from another thesis work [Sie15]. Though these notations modeling are not part of this master thesis, this is provided in this section for the sole purpose of aiding the reader to understand the concepts better through graphical representations. Also, by observing the fact that business process modelers are already well-known with the present process modeling notations such as Business Process Modeling Notation 2.0 (BPMN) [Gro11] and ArchiMate notation [Gro13], the shape depiction of organizational model elements has been designed similar to those existing process notations.

Due to the importance of shapes in expressing information visually, the notations are chosen in such a way that each element of organizational notations differ by shape. A legend holding respective name of each notation is shown in the following images to denote the meaning of each shape. The description of each element in the organizational model notation is shown in the Table 2.1.

Element	Definition	Notation
Intention	Intention is a desired objective or state that must be reached by organizations or individuals to achieve an expected outcome [DD07].	
Capability	Capability is an ability that should be possessed by a resource that work towards the achievement of one or several intentions [Sie15].	

Context	The environment that forms the setting for an event, statement, or idea and in terms of which it can be fully understood. There are two contexts: initial and final. Initial context is the situation which describes the driving force that trigger the informal process to start. Final context is the expected situation once the informal process has finished. Both initial and final context are represented by an hexagonal shape except the final context has thick edges than the initial context [Sie15].	
Strategy	A strategy is an approach, a manner or a means to achieve an intention [BJN+05].	
Resource	The people or tools that work towards the achievement of an intention.	
Relationship	Relationship between two elements is used to specify how the source and target element is related.	

Table 2.1: Organizational Modeling Notations

2.4 Overview of the Informal Process Essentials

In this section, we provide an overview about the concepts introduced in the approach Informal Process Essentials (IPE) [SBBL14]. As mentioned earlier, the modeling elements of the proposed approach in the following Chapter 5 are adapted from IPE approach. Hence, IPE approach serves as an important related work required to understand the proposed approach.

The authors describe following as the properties of an informal process (1) business logic of an informal process is not defined explicitly before the enactment, (2) an informal process is collaborative in nature which requires resources with interrelationships, (3) a resource can participate in multiple informal processes and (4) resources associated with an informal process can change dynamically.

The authors also provide the following requirements that support informal processes with the above described properties. The summarized requirements are (1) ability to represent informal process as models and ability to execute it, (2) due to involvement of multiple resources, ability to define relationships among the resources, (3) resources should be visible in the process representations and (4) support for dynamically changing resources.

The authors also compare existing approaches in the literature with the above requirements. It has also been concluded that analyzed approaches only satisfy some of the requirements but not all the requirements completely. Thus, the authors propose the IPE approach that satisfies all the requirements. In this IPE approach, resources are related to each other and work towards achievement of an intention, i.e., a goal.

As mentioned in Section 2.1, resources are drivers to achieve intentions in the informal processes. Sungur et al. [SBBL14] state that when the desired process result is repeated, then the same set of resources can be selected and engaged towards collective intention of that process. IPE models begin from an initial context and after achieving the main intention it results in another context. The relationship between IPE approach and the conceptual model of intention-oriented organizational modeling is explained in the next section.

2.5 Intention-oriented Organizational Modeling - Conceptual Model

The conceptual model of organizational modeling elements used in intention-oriented organizational modeling is shown in the Figure 2.1. This conceptual model shows that intention contains multiple strategies. An intention can be achieved through a strategy, which is a plan of action designed to meet the intention. The strategies require capabilities and contain IPE processes. The IPE processes realize strategies. The capabilities can be further resolved into resources. Thus, starting from defining intentions, we define strategies then required capabilities and IPE models. The capabilities and process models define the required resources.

Organizational process modeling of this approach is an *intention-oriented* as they support modeling based on intention and required resources thrive to successfully achieve organizational intention by using qualified autonomous agents, i.e., actors under certain *context definitions*. Emerging intentions can result in the requirement of new capabilities, i.e., an ability required to achieve an intention.

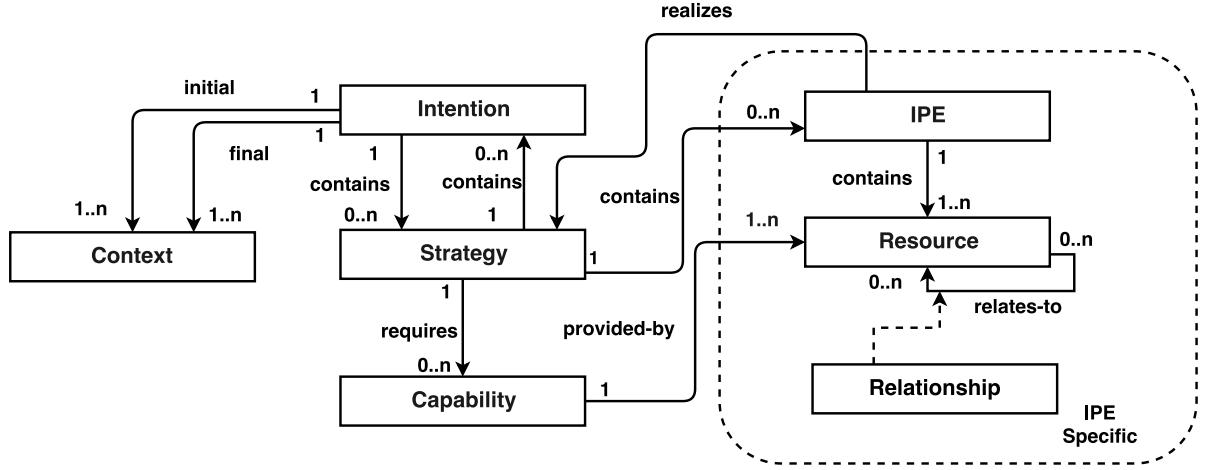


Figure 2.1: Intention-oriented Organizational Modeling - Conceptual Model

An informal process targets for accomplishment of an intention. The intention can be refined by defining strategies, which can then be further refined recursively as independent informal processes. The intention-based approach enables describing processes declaratively, i.e., without describing *how* the intention is achieved, and providing only information about *what* is achieved. The IPE approach suggests that this avoids need for predefined business logic in the representations of informal processes. Each resource can be related to another resource in the context of an informal process using predefined or custom *relationships*. Since IPE realizes strategy, each informal process starts from a context, i.e., *initial context* and aims to achieve an intention. After accomplishing the intention, there is a resulting context called as *final context*. The beginning state before achieving an intention is called as *initial context* and the end state after achieving an intention is called as *final context*.

2.6 Executing Informal Processes

In this section, we present an overview about the *Executing Informal Processes* (InProXec) method [SBLW15]. Implementing IPE approach in organization requires the application of InProXec with different phases. The InProXec method enables modeling of informal processes and automated provisioning of resources modeled in these processes. Since this thesis work, is realizing intention-oriented modeling of organizations, it covers second phase of InProXec which is "*Model Informal Process*" (P2). The method described in Figure 2.2, initializes informal process models in an automated fashion. In the following paragraphs, a short overview about different phases of the InProXec method has been provided and with a detailed description about the second phase of the *InProXec*

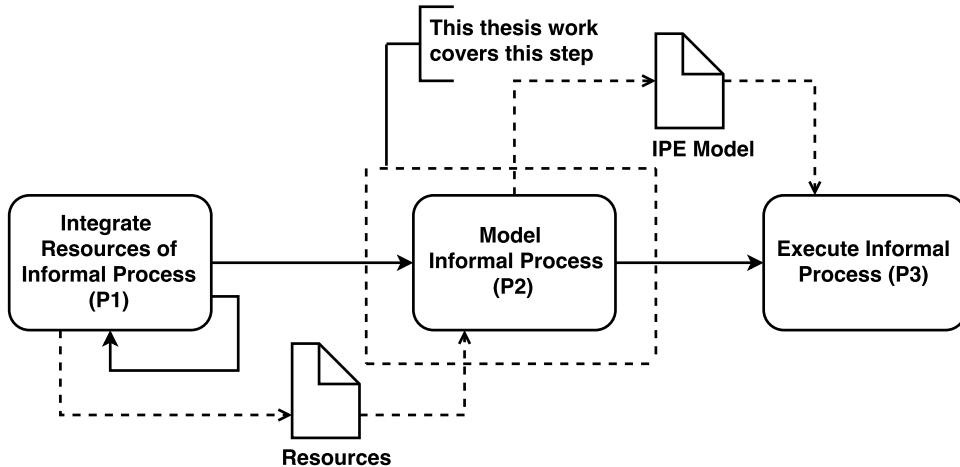


Figure 2.2: Steps of the InProXec approach

method is provided in the Section 5.2 of Chapter 5. As shown in the Figure 2.2, the InProXec method consists of three different phases:

Integrate Resources of Informal Processes (P1) - The first phase aims for creating the required infrastructure to enable modeling and automated initialization of informal processes. This is because the required modeling tools of the informal processes modeling has to be presented to the business experts, as they require it for next phase P2. Thus, the required resources for informal process modeling are allocated through services developed by technical experts during this phase. The final output of this phase, *integrated resources* are used by phase P2.

Model Informal Processes (P2) - This phase makes use of resources made available in the first phase P1. Based on these resources, business experts can create informal process models. As a contribution of this thesis, phase P2 has been explained in detail in the following Section 5.2 of Chapter 5

Execute Informal Processes (P3) - Initialization of models developed in phase P2 happens automatically using the services developed in phase P1. When an IPE Model is initialized with resources, it results in a successful initialization. This successful initialization results in an IPE Model Instance. A model instance contains additional meta-data about executed processes such as the information about start time, history of the resource model, time of changes made, etc. During this phase, the autonomous actors work towards intentions of informal processes using acquired resources and other involved resources.

3 Motivating Scenario

In order to help in understanding the concepts of organizational modeling, a motivating scenario has been taken and explained through the modeling notations mentioned in the Section 2.3. This scenario also helps to validate the developed web-based modeling tool. The motivating scenario has been chosen based on the collected real life scenarios provided in the another thesis work [Sie15]. The motivating scenario is taken from the context of manufacturing sector.

In this chapter, the first section provides a brief introduction about the motivating scenario. The last section provides an explanation of the organizational modeling elements discussed in the motivating scenario.

3.1 Intention-oriented Organizational Modeling Example

The concept of the intention oriented organizational modeling can be explained with the following scenario taken from a manufacturing organization. Consider a budding manufacturing company which designs, develops, manufactures and sells personal computers and laptops. The CEO's main intention of the quarter is *to increase the revenue and number of unit sales*. Intentions connect initial context definitions with final context definitions [SBBL14]. There are also low level intentions other than the main intention which helps in achieving main intention as a collection of several intentions in a measurable form.

The Figure 3.1 provides the details of the organizational intentions, strategies, capabilities and resources. There can be multiple strategies followed to achieve a main intention. The main intention in the motivating scenario can be achieved by following all of the below mentioned strategies. These strategies require resources with matching capabilities.

1. Through increasing the revenue, by expanding the market sales.
2. Through increasing advertisements, which helps the customer to know about the product.

3 Motivating Scenario

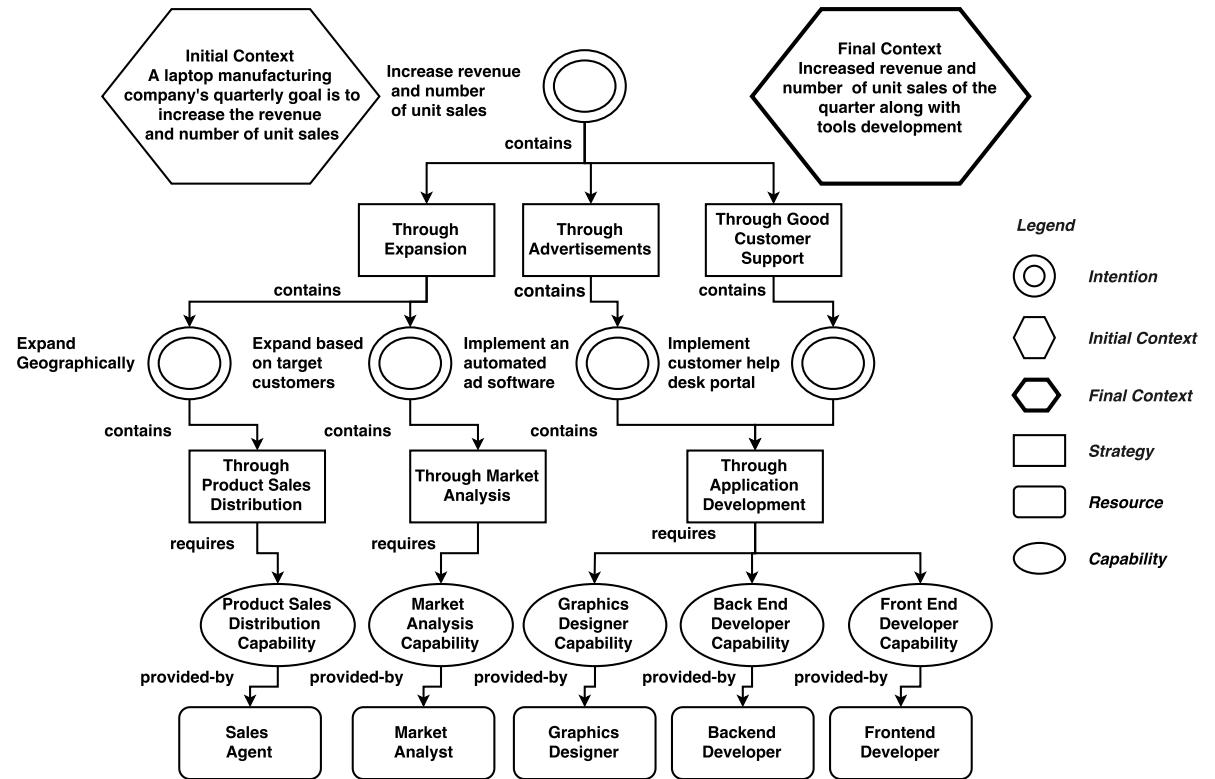


Figure 3.1: Intention-oriented Organizational Modeling - Motivating Scenario

3. Through improving the existing customer help desk portal, as it helps to maintain good customer relationship.

3.2 Intention-oriented Organizational Modeling Elements

It is important to explain each of the organizational modeling element using an example, as it helps in understanding the requirements of intention-oriented organizational modeling discussed in the Section 4.1. Before we proceed with the detailed description of each modeling element, we provide an example scenario to understand the dynamic nature of the organizational modeling. For example, in our above mentioned motivating scenario in the Section 3.1, one of the intention is to *expand sales geographically*. To achieve this intention successfully, few ground works like collection of laptop usage statistics such as average buying capacity of the consumers, average computer knowledge of the people in new geographic location has to be done. Thus, the main intention, i.e., *increase revenue and number of unit sales*, requires collaboration of people with different skills and expertise. For example, resources with capability to do market analysis are required. If in case none of the organizational resources provide required capability,

then the organization can get it served from external resources or further modularize the intention so that it can be provided by the internal resources itself. This makes to emerge new intentions dynamically. The team working towards achievement of main intention should also be ready to accommodate new resources with new capabilities and skills. For example, there is a software development team, which work towards achievement of the intention *improve customer help desk portal*, i.e., this team develops a software that automatically attends and records the user queries. There can be a new requirement of *supporting help desk through mobile applications*, then the system should accommodate new resource with *mobile application developer* capability.

3.2.1 Contexts

The execution of the manufacturing processes such as the one provided in Figure 3.1 are not similar to the execution of typical business processes. This is because, the execution of manufacturing processes mostly depends on the information collected from the real world, i.e., the execution context. A context definition provides mechanism to act adaptively based on the current situation. This is achieved in the production environment by describing each process with a specific context definition [SBLW16]. For example, in our motivating scenario the initial context provides details of the status before achievement of the main intention, i.e., it specifies the situation of the organization which triggers the main-intention. The actual problem context of our motivating scenario is, the revenue of the previous quarter was lesser than the estimated revenue. Thus, the initial context for next quarter is set as *quarterly goal of increasing the revenue and number of unit sales*. The initial context helps to decide the main intention and its related low level associates. On successful achievement of the main-intention, the intention reaches desired state which is called as final context. Along with successful reaching of the final context, this also provides tools such as web-based help desk portals, automated ad software, etc., that are developed as part of this intention achievement. When the final context definition has been reached the process completion starts. This process final state can be stored and the same set of resources can be reused in future executions with similar contexts and intentions [SBLW15].

3.2.2 Intentions

The intentions are defined hierarchically in the motivating scenario. The intentions are located at top level of the hierarchy, which are refined until concrete lower level of the hierarchy, i.e., until the operational level is reached. In the motivating scenario, intentions are not associated with capabilities directly instead intentions are associated with strategies which are then associated with capabilities. For example, in our

motivating scenario the main intention is associated with the strategies. The relation between strategies and intentions are denoted by the term *contains* in Figure 3.1. This because through strategies, intentions can be achieved. There can be custom relationships between intentions such as contains, contradicts, etc. For example, consider in our motivating scenario the intention *implement an automated ad software* can also contain an intention *implement a mobile ad software*.

3.2.3 Strategies

As mentioned earlier, a strategy is an approach, a manner or a means to achieve an intention [BJN+05]. Strategies are associated with both the intentions and capabilities. Each strategy needs certain capabilities to successfully accomplish an intention. We need to associate strategy with a capability that has matching resource. The resources are the potential holder of the capability, i.e., to satisfy a capability we need resources. The capability and its associated resources are also shown in the Figure 3.1. In our motivating scenario, the main intention can be achieved through strategies. These strategies further contain the intentions such as *expand geographically*, *expand based on target customers* and *implement an automated ad software*. Since, strategies contain intentions they are related through the term *contains* in the Figure 3.1. For example, consider a small part in our motivating scenario of achieving an intention *expand geographically* through strategy *product sales distribution*. This strategy is chosen because the products will reach customers in new geographic location, only when the product is effectively distributed. To achieve this intention, through a specified strategy we need resources with the product sales distribution capability, i.e., resources that has an ability to effectively distribute the products. For example, sales agents, wholesalers or other kinds of sales distributors.

3.2.4 Capabilities

The organizational resources posses certain capabilities to work towards the achievement of an intention. Each organizational capability must be provided by a resource in the organization. In our context, capabilities that are associated with resources are called as *functional capabilities*. The type of capability that contains functional capabilities are called as *cross-functional capabilities*. Strategies are associated with cross-functional capabilities, which contains functional capabilities out of which resources are created. In our motivating scenario to achieve a main intention, we need several capabilities such as product sales distribution capability, front end developer capability etc. For example, we need front end developer capability to execute the strategy *through application development*, i.e., resources that has ability to develop an application's front end. In the

Figure 3.1, strategies and associated capabilities are related through the term *requires*. This is because strategies require capabilities for execution that are provided by the organizational resources.

3.2.5 Resources

The organizational resources of an organization can be anything that satisfies required capability to achieve an intention. Each resource have different types of relationship with other resources based on how they communicate with other resources [SBLW15]. For example, in our motivating scenario described in the Section 3.1, has an intention to *improve customer help desk portal*. This intention can be achieved by providing skills improvement training to the existing employees or by recruiting newly skilled employee. Here the manager of HR department has permissions to decide whether to improve skills of existing employee or recruit new employee. But the team lead has only restricted permission like what type of skills are required for the project and also decision of the team lead depends on decision of the manager. Thus, the manager and team lead are related in this simple example.

4 Requirements of the Intention-oriented Organizational Modeling

This chapter positions the thesis work in the field of organizational process modeling with respect to the other existing approaches. The first section provides a detailed requirement analysis of intention-oriented organizational modeling. The last section provides a detailed literature review of the existing approaches. A detailed evaluation of the existing approaches with the requirements are also provided in the last section.

4.1 Requirement Analysis of the Intention-oriented Organizational Modeling

The requirements of the intention-oriented organizational modeling has been derived from the existing literatures [MHL+07; MBH+10; BCV06; Lac16; BFV12] and from the motivating scenario described in the Chapter 3.

4.1.1 Organizational Intention Transparency (R1)

An intention can be broken down into definitive actionable components upon which the organizational resources can act. When these lower level intentions are made achievable for individual resources, then they can be combined to provide successful execution of the higher level intention, i.e., main intention. This requires privilege for different organizational members to observe the lower level and higher level intentions. Additionally, intentions should also be traceable from different levels of the organizational hierarchy. This means that the status of each intention can be accessed by the members from different levels of the organizations. This level of transparency within an organization reduces inefficiencies during the intention accomplishment and is a key factor in attracting and retaining high performers in the labor market [MHL+07]. Requirement R1 has to be satisfied in the modeling phase itself as the designing of intentions, strategies and their recursive structures are done during the modeling phase. The prerequisites to satisfy

this requirement are, intentions can be refinable and organizational members can view the intentions at different levels.

4.1.2 Organizational Strategy-based Cost Estimation (R2)

Linking strategies with capabilities that has the matching organizational resources, enable us a cost estimation for each strategy. This is because, strategies are associated with the capabilities, which are further associated with the organizational resources. The cost of an organizational resource is known, which can be expressed in terms of usage per hour. To incorporate the cost estimation of strategies, we have to understand the recursive structure of the strategies associated with the process definitions and then with the resource definitions. Including resources' cost in strategy cost calculation is important, as it helps in making certain decisions during modeling. This is achieved by associating the resource models' cost with the process models' cost. The recursion is stopped when the cost calculation reaches the resource cost. Then the calculated cost, including the strategy implementation cost is the estimated cost of a strategy model. At the moment an intention is achieved, some resources should be allocated through strategy to maintain the desired state [MBH+ 10]. This helps business experts in making resource selection based on strategy cost during modeling itself. For example, if a resource is associated with a certain cost, then this cost is considered for strategy implementations cost calculation based on which the cost to achieve an intention through a strategy is calculated. This type of cost calculation based on the intention model is estimated cost of an intention. The cost of an intention's instance, is the actual cost of an intention. Since intentions are achieved through strategy we should also be able to calculate the cost of an intention based on the cost of its strategies. Allocation of resources is mainly done at the operational level, hence requirement R2 has to be satisfied during the modeling phase. This helps in making strategy selection based on the estimated cost, during the modeling phase itself. The prerequisites to satisfy this requirement are resources associated with cost and strategy cost estimation that includes all its recursive structure.

4.1.3 Organizational Strategy Achievability Estimation (R3)

The validity of an organizational strategy is assured when the strategy is associated with valid capabilities. A capability can be considered as a valid capability when there exist organizational resources providing the capability. A valid strategy can be implemented as independent informal process. When the low level strategies are achievable, then it can be used to estimate the achievability of the higher level strategies. This enables

validation of the strategies' recursive structure, i.e., as a sequence of valid strategies [BCV06]. Requirement R3 can be done during the modeling phase of the process as strategy achievability estimations are done before starting the execution of the process. For a strategy to be achievable the required prerequisites are, strategy should be associated with a valid capability which has organizational resources providing the capability and strategy can be implemented as independent informal process.

4.1.4 Intention Oriented Working Style (R4)

As each member of the organization is aware of the higher level and lower level intentions, an organizational member can engage for explicit intentions. Intention orientation is the degree, to which a person or an organization inclined and work towards the achievement of an intention. Strong intention orientation advocates that focus on a task is more. Such a focused task ends in a result that is favorable to both the employees and organization. Those with strong intention orientation will be able to accurately judge the effects of reaching the intention as well as the ability to fulfill that particular intention with current resources and skills [Lac16]. Hence we associate processes and resources implicitly with intentions through strategies which enables people to work towards certain intentions. The distinction between explicit knowledge of each low level intention should not be seen as a division but rather as a continuum which aligns towards achieving the higher level intention. Though requirement R4 seems to be part of the requirement R1, R4 happens during the modeling phase and could also happen during the execution phase due to the dynamic nature of informal process. The prerequisites for this requirement are satisfaction of R1 and organizational members requiring understanding of the intentions and how they can be reached.

4.1.5 Participative Organizational Modeling (R5)

Different members of an organization participate to create organizational intentions, as a result organizational models are shaped based on the input provided by different members of the organization but directed by the executives. The social involvement of different members in a business process model can be regarded as a process optimization phase, where the organization seeks efficiency by extending the reach of a business process to a broader class of people [BFV12]. Since, the requirement is about participative modeling of different groups of people, we also need means to specify different groups of people with different privileges, e.g., view, edit, etc., for accessing different entities such as intentions, strategies, contexts, etc. Since, the requirement itself is about developing models based on input from different organizational members,

the requirement has to be satisfied during modeling phase. The prerequisites to satisfy this requirement are satisfaction of R1 and intention-oriented organizational modeling has to be done based on the input provided by different members of the organization.

The requirement satisfaction phases and the prerequisites to satisfy each requirement are provided in the Table 4.1:

Requirement	Requirement Satisfaction Phases	Pre-requisites
R1	Modeling phase	(1) Main intention can be refinable, (2) Organizational members can view the intentions at different levels.
R2	Modeling phase	(1) Resources associated with cost, (2) Strategy cost estimation that includes all of its recursive structure.
R3	Modeling phase	(1) A valid capability which has organizational resources providing the capability, (2) Strategies can be implemented as independent informal process.
R4	Modeling and Execution phases	(1) Satisfaction of R1, (2) Organizational members require understanding of the intentions and how they can be reached.
R5	Modeling phase	(1) Satisfaction of R1, (2) Intentions has to be modeled based on the input provided by different members of the organization.

Table 4.1: Requirements Analysis

4.2 Literature Review and Evaluation of the Related Work

In the literature, several works has been done in order to support and automate the business processes such as strategy-driven [BJN+05], activity-centric [YMM09], activity-oriented [LR00], artifact-centric [CH09], capability-driven [SGHZ12] and ArchiMate [Gro12]. This section provides a detailed description and evaluation of these approaches based on the requirements mentioned in the Section 4.1.

4.2.1 Strategy-driven

Strategy-driven approach is a decision oriented modeling approach that focuses on goals of the processes and refine goals until the operational level. This approach defines business process in terms of the goals and strategies in order to achieve the goals. It also uses map representation system that contains goals and strategies. In this approach, goals are refinable and it recognizes the concept of the goals, i.e., intentions. Thus, this approach satisfies both the prerequisites of requirement R1. The details about cost of a resource and strategy cost calculation is not addressed. Thus, requirement R2 is not satisfied as both of its prerequisites are not met. The approach does not provide any information about the capability and association of a capability with a resource. Thus, the first prerequisite of requirement R3 is not met. The approach does not provide any information regarding the execution of a strategy as an independent informal process. Thus, the second prerequisite of the requirement R3 is also not met. So, the requirement R3 is not satisfied by the approach. Requirement R4 is satisfied, as it satisfies R1 and this approach also requires understanding of the goals by the organizational members. The requirement R5 is partially satisfied, as the approach satisfies requirement R1. But another prerequisite, i.e., intentions has to be modeled based on the input provided by different members of the organization, is not addressed by the approach.

4.2.2 Activity-oriented

Traditional business process modeling techniques such as BPMN [Gro11], BPEL [Std07], etc., are activity-oriented process models and executed based on these models. Requirements R1, R4 and R5 are not satisfied as details of modeling based on intentions are not provided because the approach itself is activity-oriented, i.e., based on the sequence of activities. Due to the lack of concrete cost calculation method in activity-oriented approach, there are integrated modeling or complementary modeling approaches [BN13; Sam13] proposed to support the cost calculation based on the resources. Thus, first prerequisite of requirement R2 is satisfied. The second prerequisite, i.e., strategy cost estimation that includes all recursive structure, is not addressed by the approach. Thus, requirement R2 is partially satisfied. Since, both the prerequisites of requirement R3 are not addressed, the requirement R3 is also not satisfied by the approach.

4.2.3 Activity-centric

The activity-centric approach also supports knowledge workers by providing shared activity constructs (i.e., activity-oriented constructs) as a computational unit for orga-

nizing the work. Though this approach provides team level view of past and ongoing work by supporting propagation of completed activities to the existing activities, the approach is not intention-oriented. Thus, requirements R1, R4 and R5 are not met as the approach itself is activity-centric. The details about cost calculation is not addressed. Thus, requirement R2 is not satisfied as both the prerequisites are not satisfied. The prerequisites of requirement R3 are not addressed by the approach. Thus, requirement R3 is also not satisfied.

4.2.4 Artifact-centric

Artifact-centric is a data-centric approach to model business processes based on business relevant data. The artifact-centric approach combines business data (artifacts) and business process in a holistic way. Requirements R1, R4 and R5 are not satisfied as details of intentions and modeling based on intentions are not provided as the approach itself is artifact-centric. The requirement R2 which is about cost calculation is also not addressed. The prerequisites of requirement R3 were not addressed by the approach. Hence, requirement R3 is also not satisfied.

4.2.5 Capability-driven

The capability-driven approach also proposes to support the changing environment of the organizations. This approach aims to aid the development of the business models by connecting goals and capabilities. The requirement R1 is satisfied by the approach, as it satisfies both the prerequisites related to the intentions. In this approach there is no clear details about how cost calculation is done, hence requirement R2 is not addressed. In this approach, capabilities and resources can be associated. Thus, it satisfies the first prerequisite of requirement R3. The second prerequisite, i.e., strategies can be implemented as independent informal process is not addressed by the approach. Thus, requirement R3 is partially satisfied. The first prerequisite for requirement R4 is satisfied and second prerequisite is also satisfied by the approach. Thus, requirement R4 is satisfied by the approach. The first prerequisite for requirement R5 is satisfied and second prerequisite is not addressed by the approach. Thus, requirement R5 is also partially satisfied.

4.2.6 ArchiMate

ArchiMate provides an integrated modeling approach by allowing to model based on both activities, i.e., business process and business functions such as knowledge, resources,

etc. ArchiMate allows modeling based on goals and provides visibility of whole process, supports viewpoints in different levels of modeling. Thus, requirement R1 is addressed. ArchiMate does cost calculation based on goals and resources. Thus, requirement R2 is partially satisfied, because cost calculation details regarding the strategy that includes all recursive structure are not provided. In this approach, capabilities and resources can be associated. Thus, it satisfies the first prerequisite of requirement R3. The second prerequisite is also satisfied by the approach, because strategy models can be implemented through this approach. Thus, requirement R3 is satisfied by the approach. Requirement R4 is satisfied because both the first and second prerequisites are satisfied. Similarly, requirement R5 is also satisfied because the approach satisfies first and second prerequisites.

4.2.7 Summary of the Evaluation

The Table 4.2, shows the evaluation of the related works based on the derived requirements. From the table one could comprehend that none of the evaluated approaches satisfy all the requirements together. Thus, we propose a new intention-oriented organizational modeling approach in the following Section 5.3 that satisfies all of the derived requirements of intention-oriented organizational modeling.

4 Requirements of the Intention-oriented Organizational Modeling

Approach	R1	R2	R3	R4	R5
Strategy-driven	(1)+Addressed, (2)+Addressed	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed	(1)+Addressed, (2)+Addressed	(1)+Addressed, (2)-Not addressed
Activity-oriented	(1)-Not addressed, (2)-Not addressed	(1)+Addressed, (2)- Not addressed	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed
Activity-centric	(1)-Not addressed, (2)-Not addressed				
Artifact-centric	(1)-Not addressed, (2)-Not addressed				
Capability-driven	(1)+Addressed, (2)+Addressed	(1)-Not addressed, (2)-Not addressed	(1)+Addressed, (2)-Not addressed	(1)+Addressed, (2)+Addressed	(1)+Addressed, (2)-Not addressed
ArchiMate	(1)+Addressed, (2)+Addressed	(1)+Addressed, (2)-Not addressed	(1)+Addressed, (2)+Addressed	(1)+Addressed, (2)+Addressed	(1)+Addressed, (2)+Addressed

Table 4.2: Summary of the Evaluation

5 An Approach to Intention-oriented Organizational Modeling

This chapter describes in detail the approach to solve the problem mentioned in the Section 1.2 and to satisfy all of the requirements mentioned in the Section 4.1. The first section of this chapter provides an overview of the intention-oriented organizational modeling process. The second section discusses in detail the phase (P2) of the InProXec method, i.e., Model Informal Processes. The third section discusses in detail the *top-down modeling approach*, which helps to realize the intention-oriented organizational modeling.

5.1 Overview of the Modeling Process

The main focus of this approach is, to enable modeling of organizational elements such as intentions, strategies, contexts, informal processes and capabilities. Additionally, the approach should also satisfy all of the requirements of intention-oriented organizational modeling discussed in the Section 4.1. Coupled with the main focus, the abstract concepts of the approach should also be realized. Also in this thesis work, the scope of modeling is limited only to the descriptive type of modeling i.e., models that describe processes declaratively by providing only information about what has to be done. For example, information like which strategy should be selected to accomplish an organizational intention. The reason for following the descriptive modeling approach is, due to the fact that models reuse descriptive data and these stored models provides means of execution for the phase P3 of the InProXec method.

5.2 Second Phase of the InProcXec - Model Informal Process

This step of Informal Process Modeling is directed towards modeling the informal process based on their intentions rather than their activities. Since this phase is a part

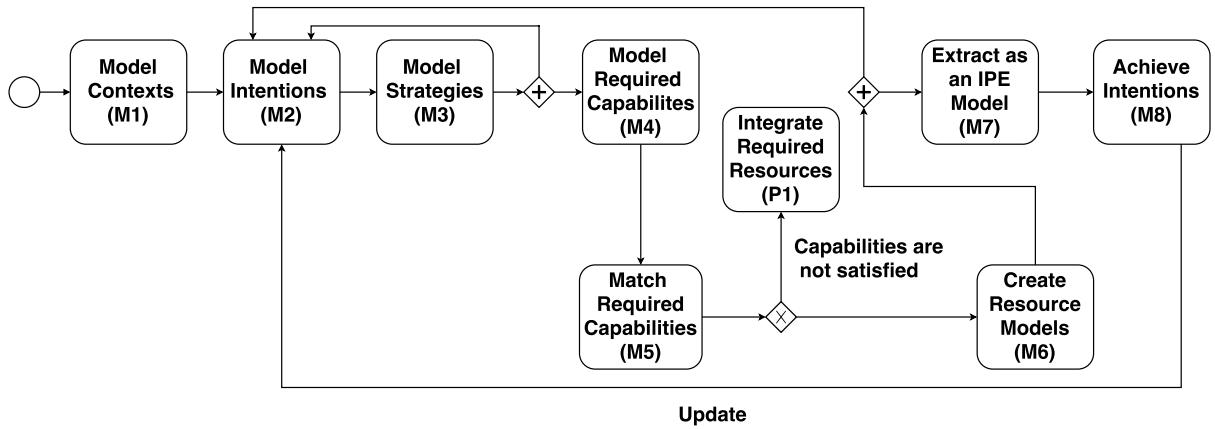


Figure 5.1: Steps of the Model Informal Process

of InProXec method, the properties and requirements of informal process described in the previous approaches [SBBL14; SBLW15] also applies to informal process modeling phase. Since, phase (P2) receives resource definitions as input from phase (P1) of InProXec method, we can apprehend that resource definitions are the lowest level in the hierarchy of intention-oriented organizational modeling approach. The sequence of steps to be carried out in this phase are shown in the Figure 5.1.

Model Context Definitions (M1)

The first step is to model context definitions, where we can model both (1) basic properties like name and target namespace of a context definition and (2) entity specific properties like contained contexts, entity definitions, etc., of a context definition. For example, consider initial context from our motivating scenario in the Section 3.1, we can provide meaningful name such as *quarterly initial context*. We can also provide any valid target namespace of the context. Similarly, the user can also provide other entity specific properties of the initial context.

Model Intentions (M2)

Similar to context definition modeling (M1), the second step is to model the intentions. In this step, (1) basic properties like name and target namespace of an intention definition and (2) entity specific properties like achieving strategies, related intentions, etc., of an intention definition are provided. The context definitions created in step M1 can be used to specify initial and final contexts of an intention. Intentions have any type

of custom relationships among different intentions. For example, contain, contradict, etc. These type of related intentions are also modeled as intentions in this step and their type of relation to a specific intention is provided. Intentions are associated with the strategies. The strategies required to achieve an intention are added to entity specific properties of the intention. For example, in our motivating scenario the main intention *increase revenue and number of unit sales* has three achieving strategies such as, (1) *through expansion*, (2) *through advertisements* and (3) *through good customer support*. These three strategies are added as achieving strategies under entity specific properties of the intention.

Model Strategies (M3)

Once intentions are identified and modeled, the third step is modeling of strategies, to achieve a specific intention. Similar to the previous modeling steps (M1) and (M2), in this step also (1) basic properties such as name and target namespace and (2) entity specific properties like target intentions, required organizational capabilities are modeled. Strategies are associated with capabilities. The capabilities required by a strategy are added to the entity specific properties of a strategy in this step. For example, consider the strategy *through expansion* from our motivating scenario. The target intention of this strategy is the main intention, i.e., *increase revenue and number of unit sales*.

Model Required Capabilities (M4)

After modeling of strategies, capabilities required to achieve an intention through a specific strategy are modeled. The strategies require the capabilities to accomplish an intention. A capability describes the ability provided by a resource or required by an intention. The performers of an informal process should possess certain skills and roles to achieve the intention. These type of required skills are modeled during this step. For example, consider the intention *expand geographically* in our motivating scenario, to accomplish this intention through the strategy *through product sales distribution*, we require *product sales distribution capability*. This capability can be provided by an organizational resource *sales agent*. Thus, in this step we model capabilities details such as (1) basic properties of a capability such as name and target namespace and (2) entity specific properties of a capability such as organizational resources providing the required capability, etc.

Match Required Capabilities (M5)

After modeling required capabilities, the step (M5) is to match the organizational resources that provides required capability and the required capability. A capability can be considered as valid when there exist organizational resources that provide the required capability. In this step, we consider the capabilities of all the organizational resources are known and matching of the capabilities of organizational resources and the required capability are done during this step. The network of human representation that we discussed in the Section 2.2 are highly helpful in organizations to match resources with their capabilities based on the requirements.

Integrate Required Resources (P1)

If there is no suitable matching capability, then phase P1 of the InProXec method can be carried out again until a matching capability is found. In this phase of the InProXec method, technical experts develop services (1) to retrieve required information about the resources, (2) to acquire the resources and (3) to release the resources on process completion. Thus, this phase of the InProXec helps in using the information available about resources during modeling [SBLW15]. If capabilities are satisfied, then the next step of creating resource models can be proceeded.

Create Resource Models (M6)

After matching the resources and capabilities, the resource models are created. The need for modeling a new intention may arise in parallel during modeling of the resources. As mentioned earlier, in our motivating scenario there can be a new requirement to support help desk through mobile. This results in requirement of a resource that provides *mobile application developer capability*. A resource can be a people or tool that drive towards the successful execution of the process and it is a key for achieving specified process intentions. Thus, in this step the required resources and relationship between other resources are modeled.

Extract as an IPE Model (M7)

After the completion of above mentioned steps, the modeled strategy which is associated with a valid capability can be extracted as an IPE model. The IPE models realize the execution of a strategies.

Achieve Intentions (M8)

When all of the achieving strategies of an intention are successfully executed, i.e., IPE models realize the execution of strategies, it results in accomplishment of an intention. After achieving the intention, the intention is moved to its final context. For example, in our motivating scenario when the main intention *increase revenue and number of unit sales* is accomplished then it reaches the final context of *increased revenue and sales for the quarter*.

Another important information to mention here is, realizing the abstract concepts of steps (M5), (M7) and (M8) are not part of the current functioning system. The functioning system is developed to realize the proposed approach, this is explained in detail in the following Chapter 6.

5.3 A Top-down Modeling Approach

As we mentioned earlier, the modeling approach in our context is descriptive modeling approach which starts from top level intention and refines modeling until the operational bottom level is reached. Thus, it is called as *top-down modeling approach*. The purpose of selecting top-down modeling approach is because based on the suggestions provided in the existing literatures [MBH+10; BJR+05; SBLW16]. These literatures suggest that the value of an intention at the top of the hierarchy propagates till the lower level and helps in making investment-related decisions while at the same time integrating cost and benefit estimates from all levels. Moreover, by creating declarative models, i.e., models that provide information in order to accomplish an intention, models are easily changeable as they are decoupled from their operational terms, i.e., process execution. The integration of declarative models and top-down modeling approach provides coupling of the above discussed benefits. The proposed approach is realized in the organizations, using the modeling steps discussed in the previous Section 5.2.

In the Figure 5.2, it is shown how this modeling approach starts modeling from the top level intentions and does modeling until the operational lower level is reached. It also shows how the organizational modeling elements are associated with each other. In this approach, intentions at different levels can be viewed by the organizational members. Also, in this approach the intentions are associated with the informal processes through the strategies. This makes the approach oriented to intention, when the participating processes are associated with the intentions. To successfully accomplish an organizational intention through this approach, members require understanding of the intentions and its associated elements. This approach also enables modeling of intentions based on the input from different members from different groups of the

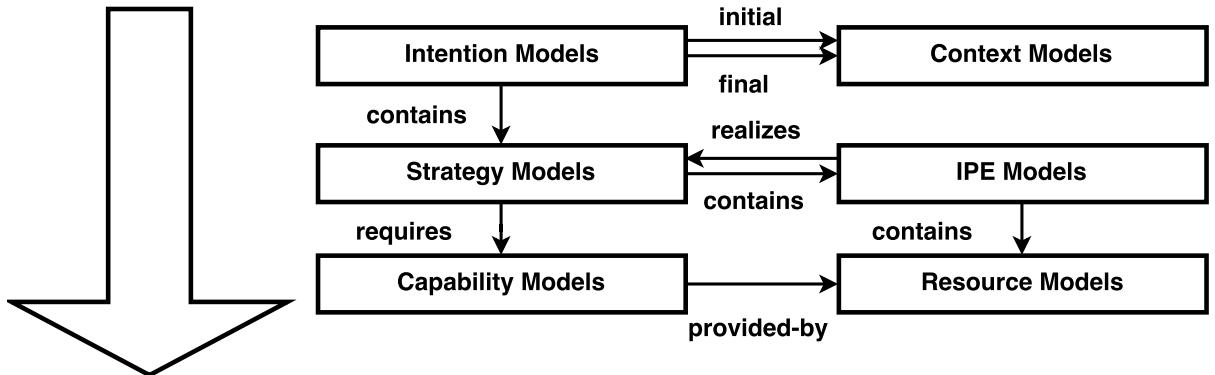


Figure 5.2: Intention-oriented Organizational Modeling - A Top down Modeling Approach

organization. From the Figure 5.2, we could see that the required capabilities are provided by the organizational resources. When there exist organizational resources that can provide a capability, then the capability is called as *valid capability*. In this approach, it is considered that cost of organizational resources are known and cost of executing a strategy can be estimated based on its association with resources through the required capabilities. In this approach, valid strategies that are associated with capabilities that can be provided by the organizational resources are implemented as independent informal processes.

The approach is evaluated based on the derived requirements in the Section 4.1 as follows :

Organizational Intention Transparency (R1) : From the Figure 5.2, one could understand that (1) intentions are refinable and as per the current design of the approach and (2) the organizational members can view the intentions at different levels. Thus, requirement R1 is satisfied by the approach as it satisfies all of the pre-requisites.

Organizational Strategy-based Cost Estimation (R2) : In this approach, (1) the organizational resources' cost are known (2) the cost estimation of strategies include its association with low level structures. Thus, requirement R2 is satisfied by the approach as it satisfies all of the pre-requisites.

Organizational Strategy Achievability Estimation (R3) : In this approach (1) a capability is considered as valid when there exist matching organizational resources and (2) from the Figure 5.2, one could understand how independent informal process realizes strategy. Thus, requirement R3 is satisfied by the approach as it satisfies all of the pre-requisites.

Intention Oriented Working Style (R4) : This approach (1) satisfies requirement R1 and (2) this approach requires understanding of the intention and its associated elements

for successfully achieving the main intention. Thus, requirement R4 is satisfied by the approach as it satisfies all of the pre-requisites.

Participative Organizational Modeling (R5) : This approach (1) satisfies requirement R1 and (2) also enables the intention modeling based on the input received from the organizational members. Thus, requirement R5 is satisfied by the approach as it satisfies all of the pre-requisites.

Thus, the approach of top-down modeling satisfies all requirements of the intention-oriented organizational modeling.

6 Case Study on a Manufacturing Company

In this chapter, the first section provides the implementation details along with the reason for making certain decisions regarding the implementation of the web-based modeling tool. The second section provides architecture of the functioning system. The third section provides details of the user interface design of the modeling tool. The fourth section explains the realization of modeling of the motivating scenario taken from a manufacturing company using the approach discussed in the Section 5.3. Successful modeling of the motivating scenario using the developed tool serves as a proof for the validity and usability of the approach.

6.1 Technologies and Frameworks

In order to, realize the approach presented in the Section 5.3, a formal inquiry was done to choose suitable technologies and frameworks required. The below specifications were finalized and *single page web application* (SPA) using *client-side scripting* was chosen. The single page web application is a web application that fits on a single web browser page with user experience similar to the desktop application. In a SPA, the necessary code is retrieved within a single page load and they are easily updated and distributed, usually without requiring any action from the user [MP13]. The client side scripting refers to the script code that is executed on the user's web browser instead on the web server [SV12]. The reason for selecting client side scripting is because of their advantages such as, (1) no refreshing of the page while using the application, (2) suitable for applications that uses Javascript framework for evaluating SPA, etc. The technologies and frameworks that were finalized are as follows:

1. *ClojureScript*¹ as the programming language
2. *Model-view-controller (MVC)* [Dea09] as the architecture pattern

¹<http://clojure.org/about/clojurescript>

3. *Re-frame*² as the pattern for writing SPA in ClojureScript, using Reagent³

Other than the above listed frameworks and technologies, frameworks like *react-bootstrap*⁴, *jquery*⁵ were also used, to provide more optimal view of the tool. Along with this, we have also used libraries like *bidi*⁶ and *pushy*⁷, to handle the page navigation from current location to the desired location in the URL (Uniform Resource Locator) of the browser.

6.1.1 MVC Architecture

The architecture of the developed user interface, is based on the MVC design pattern. The MVC paradigm allows to separate business logic from the code that controls presentation of the user interface and event handling [Ora16]. Each entity view in the web page is made as a combination of at least one model, view and one or more controls.

Model stores the required data structure for web-based modeling tool. In the developed model, the data structure of the modeling elements with their values are stored.

View contains HTML (HyperText Markup Language) elements and HTML constructs that describe the way of displaying the data from model to the user. Most of the common functionalities that render user interface components were reused to reduce redundancy.

Control contains the handler functions which can only change the model. Even the initial values of the model are put inside the control. A control has functions that updates default database, which then renders the view again.

Apart from the above MVC design components, there is another important component that registers subscription functions, i.e., query layer of the data. A subscription function returns values that change over time, i.e., based on the user events.

²<https://github.com/Day8/re-frame>

³<http://reagent-project.github.io/>

⁴<https://react-bootstrap.github.io/>

⁵<https://jquery.com/>

⁶<https://github.com/juxt/bidi>

⁷<https://github.com/kibu-australia/pushy>

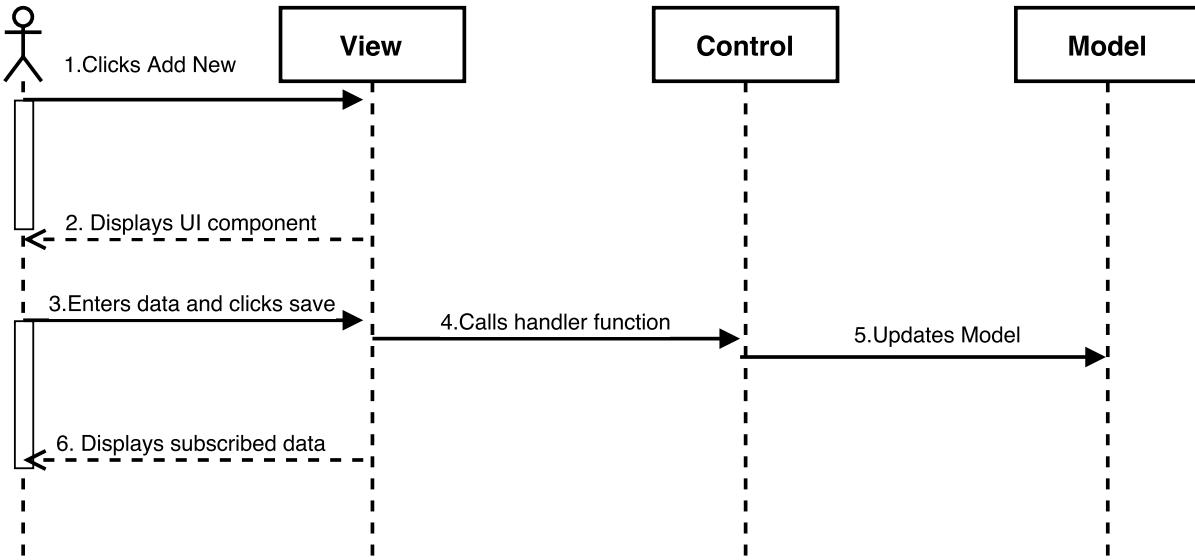


Figure 6.1: MVC Pattern of Adding New Modeling Element

Example: Component using the MVC Pattern

The Figure 6.1 shows how components interact with each other using the MVC pattern with a simple example of adding a new modeling element. This functionality is same for all the types such as contexts, intentions, strategies, capabilities and informal processes.

1. User clicks the button for adding new modeling element in the tool.
2. In response to the user click, view displays the respective user interface component for entering the new modeling element details.
3. User enters the required basic details for adding new element and clicks the save button.
4. View dispatches the data to the control, as control can only modify the model.
5. Control inserts the data into the model.
6. View displays the updated model as it has been subscribed to the model.

6.2 Architecture of the Functioning System

Also from the Figure 6.2, it is clear that we followed the MVC architecture to design the user interface. Business experts can use the web-based modeling tool to view and update

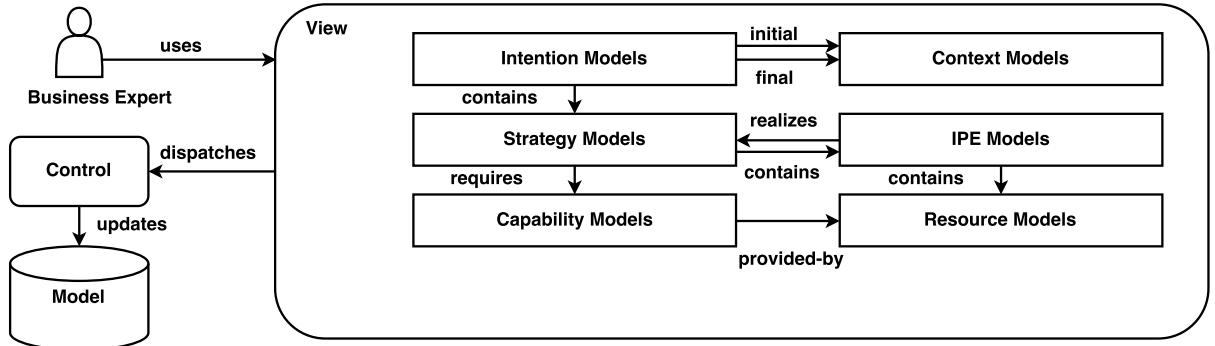


Figure 6.2: Architecture of the Functioning System

the descriptive information of the modeling elements. Whenever a change in the model data is detected respective handler function is *dispatched* and the corresponding handler function can only *update* the model. Since we associate every modeling element with another modeling element, model data of an element is required by another element which are resolved using the unique reference identifier. For example, intention model's unique reference identifier of intention *improve help customer help portal* is required by the strategy *through application development*. This is because, for strategy (through application development), intention (improve help customer help portal) is the target intention.

6.2.1 Application Flow

In this subsection, we provide an overview about how page navigation from current location to the desired location happens in the URL of the browser. The external libraries used for route navigation, parses the URL into data structures and generates URL from the data structure and then define them as the required routes. We call a function to dispatch the route, with the matched route. Then we also have another function that parses the URL, to turn the URL into data structure representing it. From the Figure 6.3, it is clear that route navigation for each entity items happens based on their entity type, e.g., intentions, strategies, etc., and its own unique reference identifier.

Each modeling element has basic properties such as *name* and *target namespace*. The elements are identified using their unique identifier which is generated using the unique combination of name and target namespace. The entities, i.e., modeling elements that are associated with a particular entity are resolved through unique identifier. It is important to discuss the functionality of the unique identifier, as it helps in the URL navigation and helps to associate each modeling element with another modeling element. For example, in our motivating scenario consider the intention *improve the customer help*

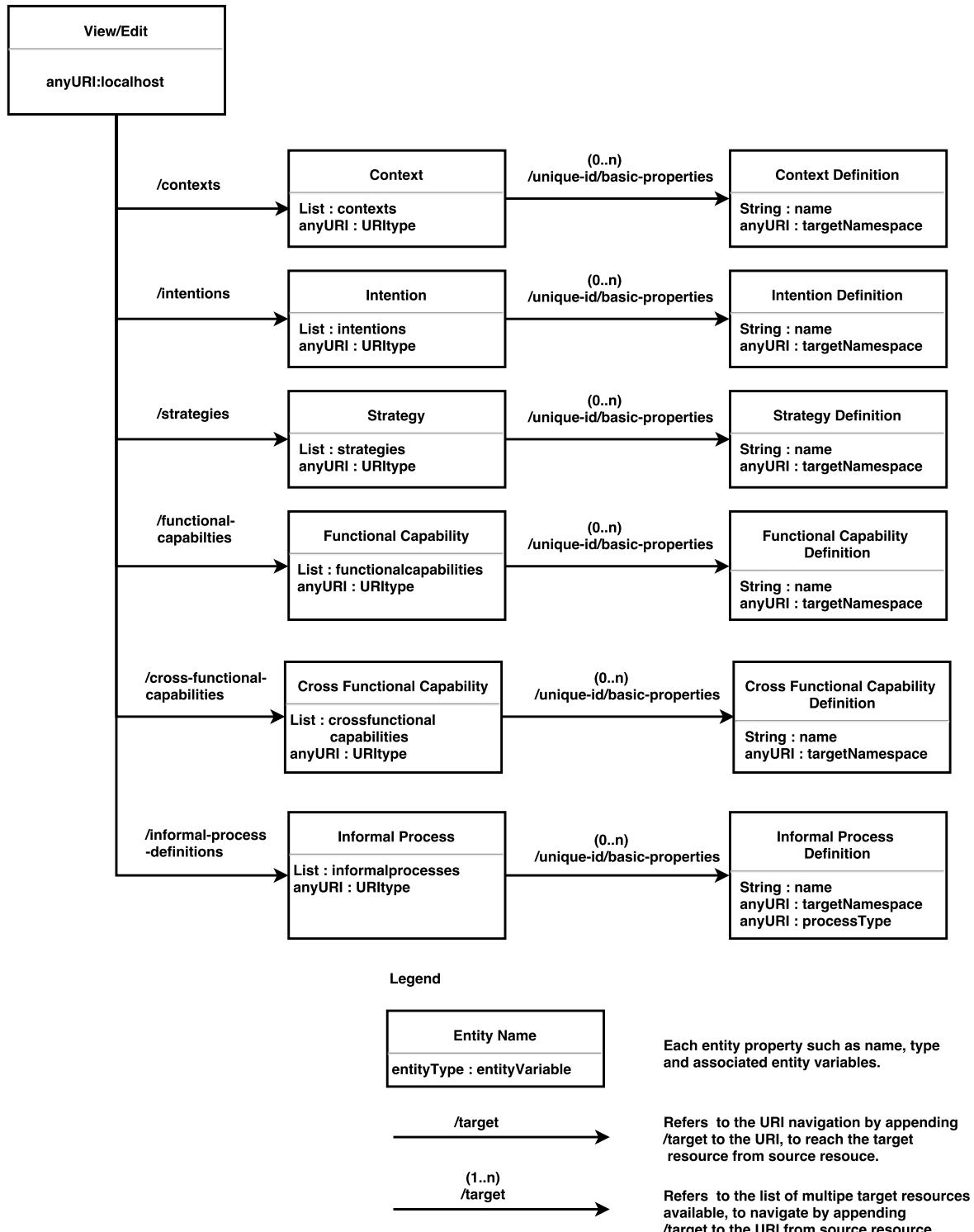


Figure 6.3: Implementation of the URL Navigation

desk portal when creating model for this intention, business expert provides name and target namespace for this intention and add it to the database. A unique identifier is generated for the intention model using the combination of name and target namespace by the tool.

6.3 User Interface Design of the Modeling Tool

This section discusses in detail the methods followed for designing the web-based modeling tool. The developed tool realizes the approach proposed in the Section 5.3. When designing the user interface components and functionalities, most of the similar functionalities are designed as common functions for the purpose of reusing the functions. This reduced unnecessary functional redundancies and overhead. It is also important to provide an introduction about the user interface design of the modeling tool, as it helps in understanding the following sections. Also to ensure consistency of the design, all the modeling elements' layout have similar user interface design as follows:

6.3.1 Basic Properties

From the Figure 6.4, we could see that basic properties such as name and target namespace of a modeling element are displayed under the basic properties tab. For informal process models alone, we have another basic property that holds the process type value of the process.

Entity Type - Informal Process Definitions

Namespace and Name - {http://www.example.org/TOSCA/PHPApp}Customer support process

Basic Properties Entity Specific Properties Instance Data Participant List Resource Model

Name: Customer support process

Target Namespace: http://www.example.org/TOSCA/PHPApp

Process Type: http://www.uni-stuttgart.de/ipsm/ipe-process

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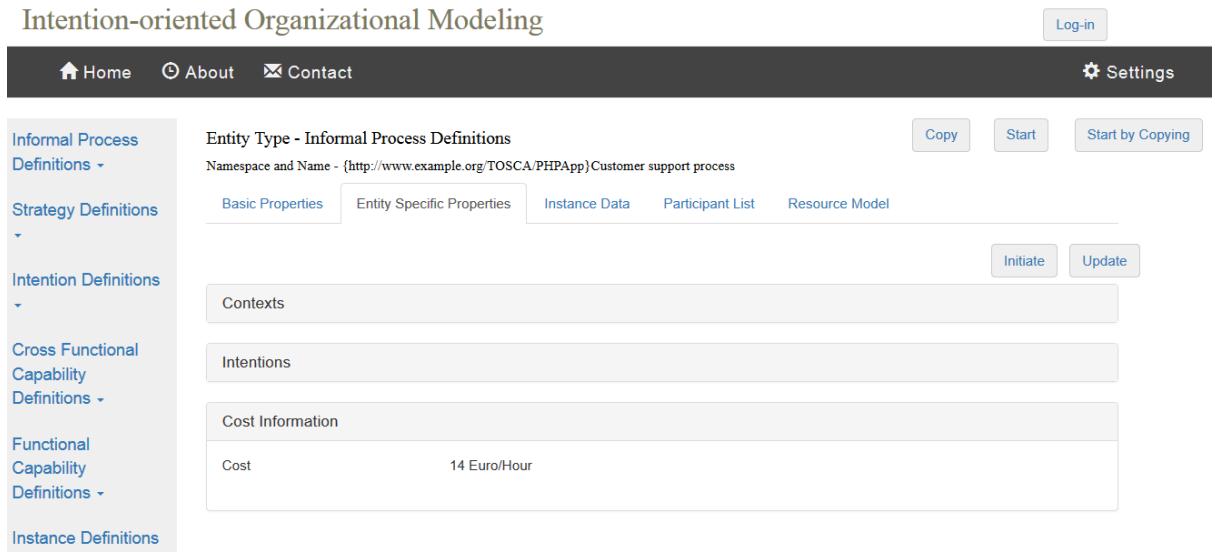
Update

Figure 6.4: User Interface Screen Design of the Basic Properties

6.3.2 Entity Specific Properties

The entity specific properties of a modeling element are displayed under this tab. The entity specific properties differ for each entity type, i.e., intentions, strategies, etc. For example, intention models contain achieving strategies, related intentions, etc., under entity specific properties tab but strategy models contain details like target intentions, required organizational capabilities, etc. From the Figure 6.5, we could see that entity specific properties of a process model includes the details of associated contexts, intentions and estimated cost of the process model.

6 Case Study on a Manufacturing Company



The screenshot shows a web-based application for organizational modeling. The top navigation bar includes links for Home, About, Contact, Log-in, and Settings. On the left, a sidebar lists categories: Informal Process Definitions, Strategy Definitions, Intention Definitions, Cross Functional Capability Definitions, Functional Capability Definitions, and Instance Definitions. The main content area is titled 'Entity Type - Informal Process Definitions' with the namespace and name '(http://www.example.org/TOSCA/PHPApp)Customer support process'. It features tabs for Basic Properties, Entity Specific Properties (which is selected), Instance Data, Participant List, and Resource Model. Under Entity Specific Properties, there are sections for Contexts, Intentions, and Cost Information. The Cost Information section shows a Cost of 14 Euro/Hour. Action buttons at the top right include Copy, Start, Start by Copying, Initiate, and Update.

Figure 6.5: User Interface Screen Design of the Entity Specific Properties

6.3.3 Participant List

Since intention-oriented organizational modeling satisfies the requirement of participative organizational modeling, we realize this by providing the participant list tab. This tab holds details of organizational members and their respective privileges. The current design includes only adding and removing of the organizational members as participants. The design also includes assigning privileges to participants such as privilege to edit, view, follow and own. But the current functioning system, could not check if the members do work based on their privileges. For example, consider a participant who has privilege to only view an intention model and suppose if the participant edits the model then the current functioning system does not include functionalities to prevent the member from editing the models. From the Figure 6.6, we could see that participant list tab of a modeling element contains the details of participants those who can edit, view, follow or own a particular model. Also from the Figure 6.7, we could see how privileges for a particular participant can be assigned by adding or removing a participant under particular privilege.

6.3 User Interface Design of the Modeling Tool

Intention-oriented Organizational Modeling

Log-in

Home About Contact Settings

Informal Process Definitions ->

Entity Type - Informal Process Definitions

Namespace and Name - {http://www.example.org/TOSCA/PHPApp}Customer support process

Basic Properties Entity Specific Properties Instance Data Participant List Resource Model

Update

Editors

Followers

Viewers

Owners



Figure 6.6: User Interface Screen Design of the Participant List

Intention-oriented Organizational Modeling

Log-in

Home About Contact Settings

Informal Process Definitions ->

Entity Type - Informal Process Definitions

Namespace and Name - {http://www.example.org/TOSCA/PHPApp}Customer support process

Basic Properties Entity Specific Properties Instance Data Participant List Resource Model

Update

Editors

View Participant 2

Name : Participant 2

View Participant 1

Name : Participant 1

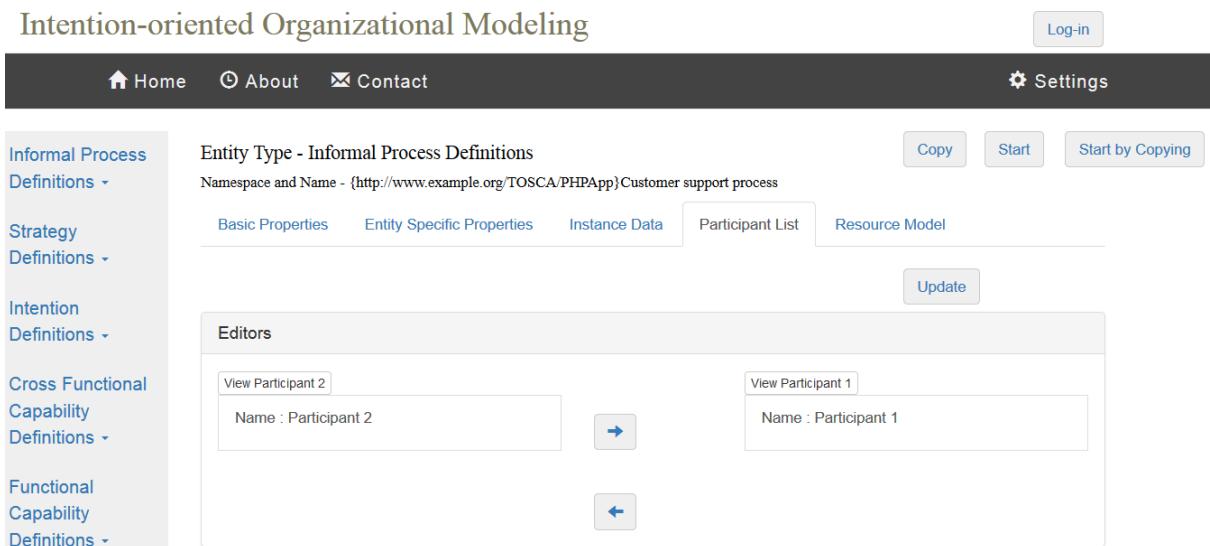
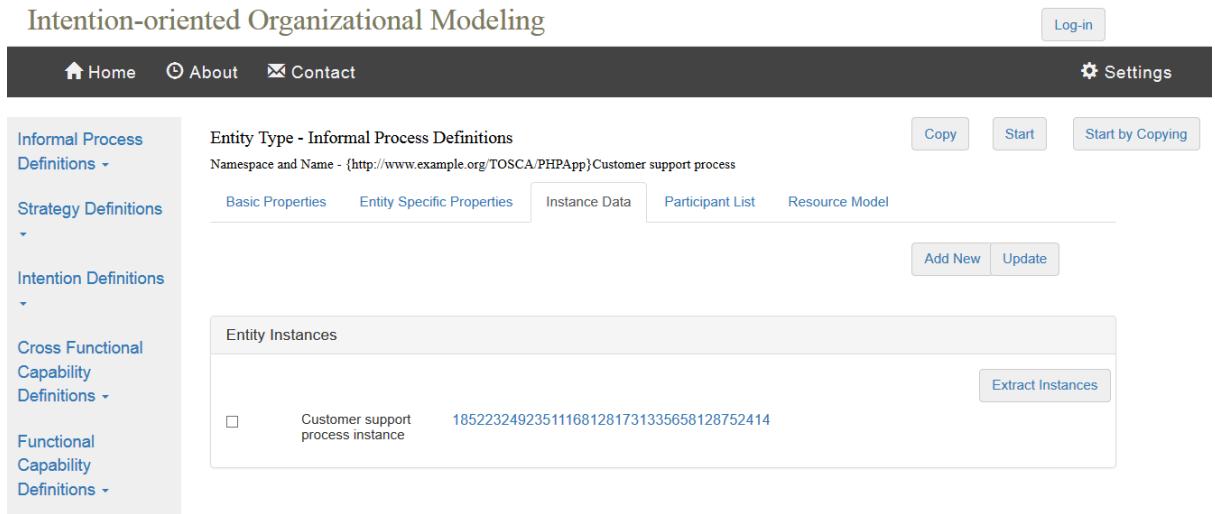


Figure 6.7: User Interface Screen Design of the Participant as an Editor of the Model

6.3.4 Instance Data

When a model is initialized, it results in a model instance. The instances contained under a model are shown inside the instance data tab. For example, the Figure 6.8 shows the instance contained under an informal process model.

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The screenshot shows a web-based application for organizational modeling. The top navigation bar includes 'Home', 'About', 'Contact', 'Log-in', and 'Settings'. The left sidebar has a tree structure with categories: 'Informal Process Definitions', 'Strategy Definitions', 'Intention Definitions' (selected), 'Cross Functional Capability Definitions', and 'Functional Capability Definitions'. The main content area is titled 'Entity Type - Informal Process Definitions' with the namespace and name 'Customer support process'. It features tabs for 'Basic Properties', 'Entity Specific Properties' (selected), 'Instance Data', 'Participant List', and 'Resource Model'. Below these are buttons for 'Copy', 'Start', 'Start by Copying', 'Add New', and 'Update'. The 'Instance Data' section is titled 'Entity Instances' and contains a table with one row: 'Customer support process instance' with the identifier '185223249235111681281731335658128752414'. A 'Extract Instances' button is also present.

Figure 6.8: User Interface Screen Design of the Instance Data

Some of the important methodologies followed with respect to user interface components design are (1) multiple items to be selected from multiple list items are displayed as *list group* and (2) selecting single item from multiple items are displayed as *drop down*. For example, to select multiple strategies from a list of strategies, available strategies are displayed as a list from which the user can select desired number of strategies. Another important methodology followed during user interface design is, for every entity the properties should be displayed only under the respective properties tab. For example, in the Figure 6.4, the basic properties such as name, target namespace and process type of an informal process model should be displayed only under the respective basic properties tab and similarly for all other tabs. This methodology is followed uniformly throughout the design of all the entity types such as intention definitions, strategy definitions, capability definitions, context definitions, instance definitions and informal process definitions.

All data are stored only under the model component. This applies to the labels and text fields of all user interface elements and this data can be updated only through the handler function. Through the *settings* option, user can add new target namespace type and intention relation type. From the Figure 6.4, it is clear that a consistent design methodology has been followed to display the list of available entity types such as intentions, strategies, capabilities etc., and to display their respective properties such as basic, entity specific, instance data, etc. The top-down modeling approach discussed in the Section 5.3, mentions that definition of each entity type is contained within another entity type. This is realized through separate entities referencing each other using the unique reference identifier but does not contain all properties of the referenced entity. For instance, a strategy containing an intention should contain only the intention's

unique reference identifier but not the actual intention itself. Later in the view of strategy, actual intention properties are fetched and displayed based on the unique reference identifier.

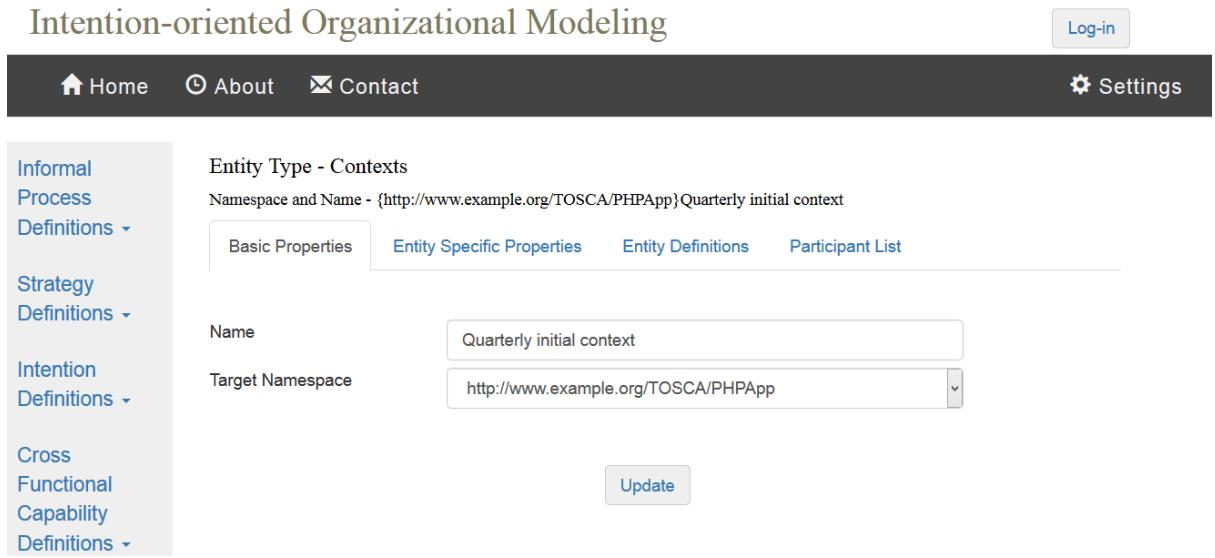
6.4 Realization of the Approach

In order to validate the proposed approach in the Section 5.3, we create models using the developed web-based modeling tool for the motivating scenario discussed in the Chapter 3. It is also important to model them step by step as mentioned in the Section 5.2. This is because to realize the approach in organizations, we model the motivating scenario step by step as mentioned in the second phase of the InProXec method. As each models are designed in an individual modeling step, details of individual modeling steps are provided in the following subsections. This section helps to understand the usability of the approach in the organizations. The user interface screen design of the below modeling elements are consistent and similar to the screen designs explained in the previous Section 6.3.

6.4.1 Modeling of the Contexts

In the informal process modeling approach, the first modeling step is to model the context definitions (M1). Each informal process starts from an initial context and aims to achieve an intention [SBBL14]. After reaching an intention, there is resulting IPE Context. To model the contexts, we added new contexts by providing basic properties such as name of the context and target namespace of the context. After successfully adding the basic properties, we provided the entity specific properties such as the contained contexts inside the main context, entity definition details about the contexts are also provided. The required context definitions are modeled first because these definition are required for modeling intention definitions and process definitions. The participant list details were also provided during modeling of the contexts. From the Figure 6.9, we could see that in this step we modeled the contexts of our motivating scenario using the modeling tool.

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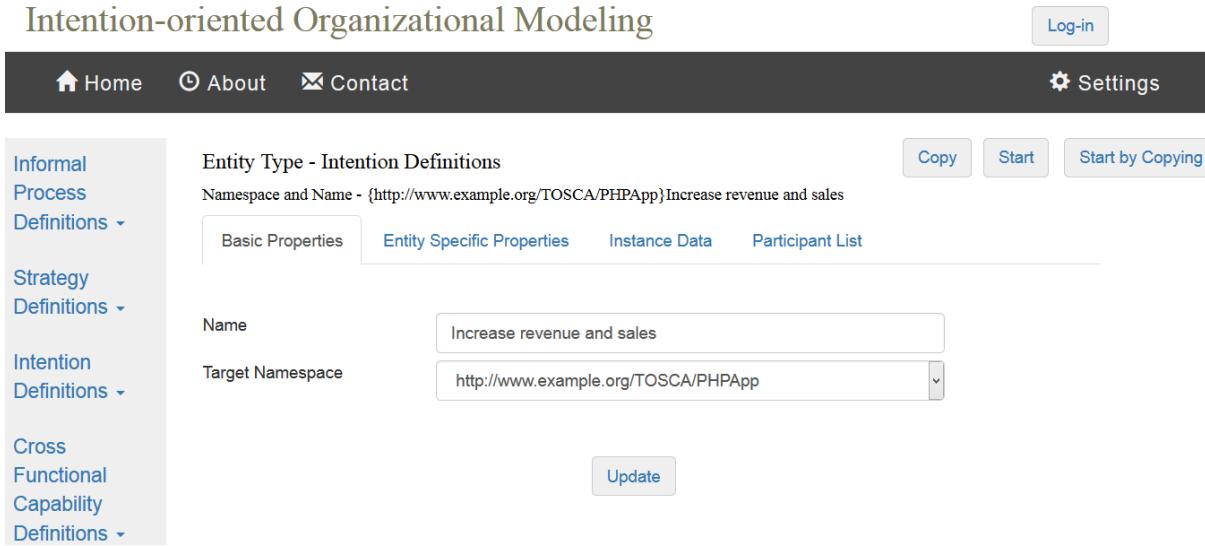


The screenshot shows a web-based application for organizational modeling. The header includes a 'Log-in' button, a 'Home' link, an 'About' link, a 'Contact' link, and a 'Settings' link. On the left, a sidebar menu lists 'Informal Process Definitions', 'Strategy Definitions', 'Intention Definitions', and 'Cross Functional Capability Definitions'. The main content area is titled 'Entity Type - Contexts' and shows a namespace and name: '{http://www.example.org/TOSCA/PHPApp}Quarterly initial context'. Below this, tabs for 'Basic Properties', 'Entity Specific Properties', 'Entity Definitions', and 'Participant List' are visible. Under 'Basic Properties', fields for 'Name' (set to 'Quarterly initial context') and 'Target Namespace' (set to 'http://www.example.org/TOSCA/PHPApp') are shown. A blue 'Update' button is located at the bottom right of this section.

Figure 6.9: Modeling of the Contexts

6.4.2 Modeling of the Intentions

After modeling context definitions(M1), the second step of the modeling is to model the intentions (M2). For example, in our motivating scenario we have main intention as *increase revenue and number of unit sales* and other low level intentions that emerged out of main intention and strategies of the main intention. Thus, we provided descriptive information of the intentions of our motivating scenario as intention definitions using the modeling tool. Similar to the context modeling, in this step we provided basic properties such as name and target namespace required for unique identification of the entity. After providing basic properties, we provided entity specific details of the intention such as due date and time for intention completion, priority of the intention, cost of the intention, other related intentions that are contained under this particular intention. The strategies to achieve this intention and contexts of the intention were also provided as entity specific properties using the modeling tool. The participant list details were also provided during modeling of the intentions. From the Figure 6.10, we could see that in this step we modeled the intentions of our motivating scenario using the modeling tool.



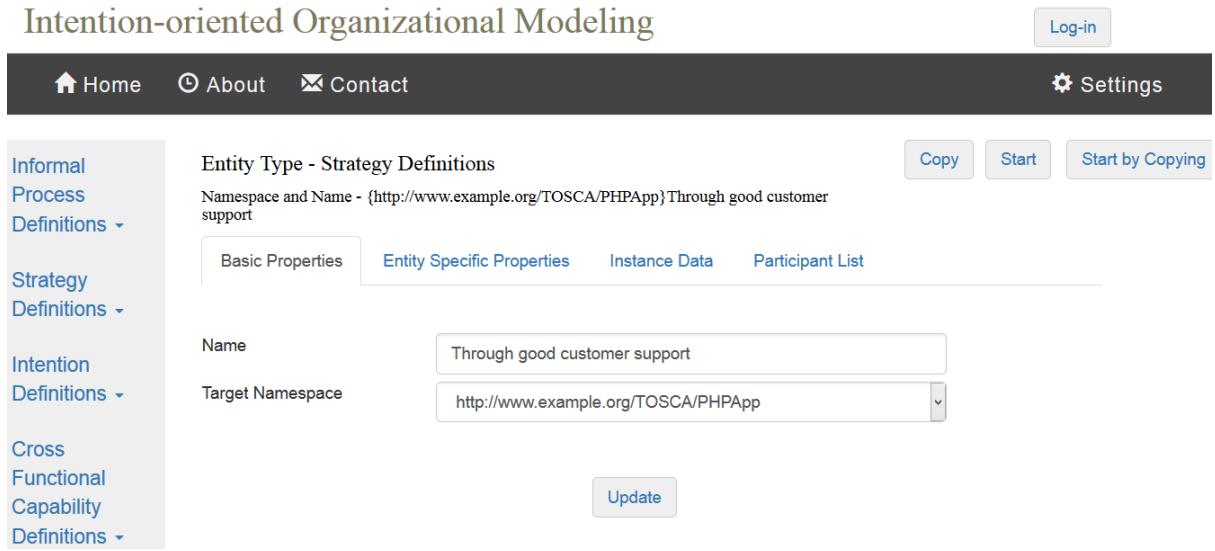
The screenshot shows a web-based application for organizational modeling. The top navigation bar includes links for Home, About, Contact, Log-in, and Settings. A sidebar on the left lists categories: Informal Process Definitions, Strategy Definitions, Intention Definitions, and Cross Functional Capability Definitions. The main content area is titled 'Entity Type - Intention Definitions' and shows a namespace and name: '{http://www.example.org/TOSCA/PHPApp}Increase revenue and sales'. Below this, there are tabs for Basic Properties, Entity Specific Properties, Instance Data, and Participant List, with 'Entity Specific Properties' currently selected. The 'Basic Properties' section contains fields for 'Name' (set to 'Increase revenue and sales') and 'Target Namespace' (set to 'http://www.example.org/TOSCA/PHPApp'). At the bottom right of this section is an 'Update' button. To the right of the main content area are three buttons: 'Copy', 'Start', and 'Start by Copying'.

Figure 6.10: Modeling of the Intentions

6.4.3 Modeling of the Strategies

After modeling the context definitions (M1) and intention definitions (M2), the next step is to model the strategies (M3). In this step, we modeled the strategies such as *through expansion*, *through advertisements* and other required strategies as third step of the modeling process. Similar to earlier modeling steps, during modeling of the strategy we provided basic properties such as name and target namespace. After providing the basic properties, entity specific properties such as target intentions of the strategy, capabilities and process definitions associated with strategy were also provided. The participant list details were also provided during modeling of the strategies. From the Figure 6.11, we could see that in this step we modeled the strategies of our motivating scenario using the modeling tool.

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The screenshot shows a web-based application for organizational modeling. The header includes a 'Log-in' button and a navigation bar with 'Home', 'About', 'Contact', and 'Settings'. A sidebar on the left lists categories: 'Informal Process Definitions', 'Strategy Definitions', 'Intention Definitions', and 'Cross Functional Capability Definitions'. The main content area is titled 'Entity Type - Strategy Definitions' and shows a namespace and name: '{http://www.example.org/TOSCA/PHPApp}Through good customer support'. It includes tabs for 'Basic Properties', 'Entity Specific Properties' (which is selected), 'Instance Data', and 'Participant List'. Under 'Entity Specific Properties', there are fields for 'Name' (set to 'Through good customer support') and 'Target Namespace' (set to 'http://www.example.org/TOSCA/PHPApp'). A 'Copy', 'Start', and 'Start by Copying' button are at the top right, and an 'Update' button is at the bottom right.

Figure 6.11: Modeling of the Strategies

6.4.4 Modeling of the Capabilities

In modeling of the capabilities, there are two types of capabilities. Functional capabilities and cross-functional capabilities. Functional capabilities are the capabilities that are associated with other entity types. Cross-functional capabilities contain multiple functional capabilities. Similar to earlier entity types' basic properties such as name and target namespace are added to get the unique reference identifier and entity specific properties for capabilities are added. Since cross functional capability contains functional capabilities, it holds the identifiers of the functional capabilities contained in it. Functional capability definitions also has participant list details similar to the intention definitions and strategy definitions. In this step, we created required models for capabilities of our motivating scenario. From the Figure 6.12, we could see that in this step we modeled the capabilities of our motivating scenario using the modeling tool.

Figure 6.12: Modeling of the Capabilities

6.4.5 Modeling of the Resources

Each resource that provides certain capability can be related to another resource which are defined using predefined or custom *relationships* [SBBL14]. In the developed modeling tool, the resource models are managed by embedding the open source modeling tool Winery [KBBL13] in the modeling tool's resource model tab. This is because Winery offers resources which we can model using their tool that is embedded under the resource model tab. Thus, using the modeling tool we created the resource models.

6.4.6 Modeling of the Instances

A model instance contains additional meta-data about the executed processes such as the information about the start date and time, end date and time, instance status, cost, source model etc. From the partial screenshot image 6.13 of the modeling tool, it is clear that these properties of an instance can be edited through the developed tool. The developed tool supports creation and updation of descriptive information about instances. Each instance is of any entity type such strategies, intentions and informal processes. Any modeling element that has instances are also listed inside the *Instance data* tab of each modeling element.

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Source Model Entity Type	Strategy Definitions
Source Model	Through market analysis
Start Date	2016-07-22
Start Time	11:11:10
End Date	2016-07-22
End Time	12:11:10
Parent Instance	Increase revenue and sales instance
Instance URI	http://www.example.org/InstanceURI1
Instance State	Running
Instance Status	1 out of 2 instances completed

Figure 6.13: Modeling of the Instances

6.4.7 Realization of the Requirements

This section provides details of realizing the requirements of intention-oriented organizational modeling that are satisfied by the proposed approach. Though we validated the approach using the requirements in the Section 5.3, it is important to mention the realization of the requirements by the tool.

Organizational Intention Transparency (R1): Using the modeling tool intentions at different levels can be modeled which satisfies the first prerequisite of R1. With the current functioning system any user can view the intention at different levels which satisfies the second prerequisite of R2. Thus, the functioning tool realizes the requirement R1.

Organizational Strategy-based Cost Estimation (R2): The cost of the organizational resources are stored in the model component. The modeling tool itself calculates and displays the estimated strategy cost calculation based on strategy implementation and resource cost. This cost information helps the business experts to make certain decision based on cost calculation during modeling. Thus, the functioning tool realizes the requirement R2.

Organizational Strategy Achievability Estimation (R3): Similar to the cost calculation, strategy achievability estimation based on its association with valid capability is also determined and displayed during the modeling phase itself. Thus, the functioning tool realizes the requirement R3.

Intention Oriented Working Style (R4): The tool realizes the requirement R1 and as per the current design, any user can create intention models, strategy models, informal process models, etc., through the tool provided the user has understanding about main intention and its recursive structure. Thus, the functioning tool realizes the requirement R4.

Participative Organizational Modeling (R5): The tool realizes the requirement R1 and with the current functioning system, any user can provide inputs by updating the models. Thus, the tool satisfies the requirement R5.

Thus, we evaluated the usability of the top-down modeling approach in the organizations through the case study on a manufacturing company.

7 Conclusion and Future Work

In this document, we first provided the motivational statement and problem statement of this master thesis work. We also provided, the fundamental concepts and related work from the existing literatures to aid the reader in understanding the concepts of intention-oriented organizational modeling. We then provided a motivating scenario taken from a manufacturing organization and explained it based on the guidelines and real life scenarios discussed in the existing literatures. This helps in understanding, the requirements of intention-oriented organizational modeling derived from existing literatures. The derived requirements were evaluated against few of the existing approaches. Since none of the considered approaches satisfied all of the requirements, we proposed a new approach that satisfied all of the requirements. We then provided a detailed case study on a manufacturing company. The case study helped to assess the feasibility of the proposed approach. A web-based modeling tool was developed to realize the proposed approach. The usability of the approach in the organizations was also confirmed by creating models for the motivating scenario through the developed modeling tool.

To be more precise, this work provided an approach that satisfied all of the requirements of the intention-oriented organizational modeling and realized the proposed approach as a web-based modeling tool. The models developed through this approach act as an informal guide for accomplishing intention-oriented organizational modeling, i.e., provides information required for intention-oriented organizational modeling.

Future Work

The web-based modeling tool developed as a part of this master thesis work, will be integrated with the back end such that the created models can be initialized. The future work also includes providing mobile modeling approach, enabling logging in functionality through few of the popular social network accounts and enhancing the user interface features of the modeling tool.

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All links were last followed on August 1, 2016.

Declaration

I hereby declare that the work presented in this thesis is entirely my own. I did not use any other sources and references than the listed ones. I have marked all direct or indirect statements from other sources contained therein as quotations. Neither this work nor significant parts of it were part of another examination procedure. I have not published this work in whole or in part before. The electronic copy is consistent with all submitted copies.

place,date,signature