Institute of Architecture of Application Systems
University of Stuttgart
Universitätsstraße 38
D-70569 Stuttgart

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Intention-oriented Organizational Modeling - A Top-down Approach

Archana Kalidoss

Course of Study: Computer Science M.Sc

Examiner: Prof. Dr. Dr. h. c. Frank Leymann
Supervisor: M.Sc. C. Timurhan Sungur
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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 human resources. The processes that are accomplished through human knowledge have irregular sequence of execution steps, i.e., series of activities to be carried out are not structured. At the same time, 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 organizational intentions is of prime importance. Intentions play critical role in organizations because they motivate organizational resources to work towards the overall development of an organization. Thus, supporting modeling of intentions, strategies to achieve intentions, capabilities required by strategies, resources that provide capabilities and processes that implement 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 sequence of activities, are not suitable when sequence of activities cannot be determined in advance. Hence, there is a need for 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. Additionally, there is also need for modeling tool that stands as a proof for the validity and usability of the proposed approach. This master thesis work, proposes a modeling approach based on the derived requirements of intention-oriented organizational modeling. The proposed approach allows creating organizational models that acts as descriptive guide, e.g., providing information about required strategies to achieve an intention.

In the proposed modeling approach, intentions are realized through strategies which are associated with capabilities that are satisfied by resources. As a result, unstructured organizational processes are realized as strategies that are associated with capabilities, resources and intentions. A motivating scenario from an organization that belongs to 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

Resources such as human actors, development environments, materials, etc., of an organization play an important role to accomplish 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 process is not structured like traditional process, e.g., creating a new customer savings account. 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 process.

The process whose required activities and order of their execution cannot be determined beforehand are called *informal process* [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 organizations and they need to be supported and automated [SBBL14]. Though activities of processes that involve human knowledge are unpredictable, intentions, i.e., goals of informal processes are known before their enactment [DMR15]. Thus, this thesis work focuses on realizing 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 very important role. Thus, 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 informal processes cannot be determined beforehand, intentions of 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 intentions with 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 they serve as informal guides which preserves the information associated with 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 human performers and enables establishment of best practices [SBBL14].

1.2 Problem Statement

Though there are *activity-centric* modeling such as Business Process Execution Language (BPEL) [1] and Business Process Model and Notation (BPMN) [2], 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, 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 informal process modeling. As mentioned earlier, there is also lack of modeling tool that creates models declaratively by providing only information required in order to enact a process.

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 as intention of an informal process can be known before their enactment.

[1] http://docs.oasis-open.org/wsbpel/2.0/OS/wsbpel-v2.0-OS.pdf
[2] http://www.omg.org/spec/BPMN/2.0/PDF/

When there are multiple human resources working for a process, then there should be some sort of coordination and understanding between the humans which is called *collaboration* at an organizational level. Informal processes are collaborative in nature, which means that participants of informal process collaborate with each other to accomplish its intentions [SBLW15]. Designing these collaborations and assigning participants their respective privileges plays an important role during modeling of the respective informal processes. The research work about designing workspace collaboration tools [MWMY11] mentions that below points are the major problems in adopting to a workspace collaboration tools:

1. Lack of Methods
2. Methods that focus on individuals
3. Not well targeted groups
4. Not well supported editors for executing abstract descriptions

Due to the involvement of multiple resources during modeling, there is a need for organizations to make decision regarding strategy selection based on cost calculation and achievability estimation. Moreover, associating capabilities with resources is helpful in the following example situation. There can be a situation where resources producing more accurate results for processing a task are preferred than resources which can produce higher throughput for processing a task. Thus, during modeling business expert has to specify that required capability as *ability to provide high throughput* and match the resources with such capability. This is the reason, we associate organizational modeling elements of a process such as intentions, strategies, capabilities and resources with each other and facilitate strategy selection based on cost and achievability estimation.

1.3 Contributions

The contributions of this work can be categorized as follows:

1. Derived requirements from existing literatures and motivating scenario for supporting intention-oriented organizational modeling. Evaluated existing approaches based on derived requirements (Chapter 4).
2. An approach for intention-oriented organizational modeling that satisfies 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 following chapters:

Chapter 2 – Fundamentals and Related Work: In this chapter, 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 phases of the scenario has been provided. This aids the reader to understand the concepts of intention-oriented organizational modeling clearly.

Chapter 4 – Requirements of Intention-oriented Organizational Modeling: This chapter provides detailed requirement analysis for supporting intention-oriented organizational modeling. This chapter also provides literature review and evaluation of 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 Chapter 5. This chapter also discusses detailed system architecture and also presents the validation of the proposed approach.

Chapter 7 – Conclusion and Future Work: This chapter summarizes the results of the work and draws 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 final section discusses the Executing Informal Processes (InProXec) method which helps to realize IPE approach in organizations.

2.1 Definitions of 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 an HTML5-based environment for graph-based modeling of application topologies and defining reusable component 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 happen inside the organization. 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.

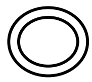
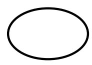
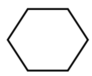
In order to manage such a dynamic environment, organizations need skilled human resources with previous knowledge of handling unforeseen scenarios. Thus, human resources are vital part of any organization as they have skills of acute future orientation to understand changing organizational environment. 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 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 re-used in web-based environments. These kind of human representation 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 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 forces 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 initial context [Sie15].	

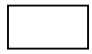
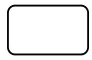
Strategy	A strategy is an approach, a manner or a means to achieve an intention [BJN+05].	
Resource	The people or tools that work towards the achievement of an intention.	
Relationship	Relationship between two elements is used to specify how the source and target element is related.	→

Table 2.1: Organizational Modeling Notations

2.4 Overview of 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 is adapted from IPE approach. Hence IPE approach serves as an important related work required to understand the proposed approach.

IPE approach defines business models based on goals. These models can be represented as graphs, state machine diagrams, linguistic descriptions, etc. Models are used in various fields like manufacturing, scientific, IT, etc. These models are mainly useful in re-using the predefined solutions. Such models have numerous benefits like process performance improvement, understanding of the process, model-driven process execution, etc., [IGRR09]. The performance of informal processes depend on dynamic nature of human knowledge, i.e., they are subject to change and carried out based on experience of previous knowledge.

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

The authors also provide 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 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 satisfies some of the requirements but not all the requirements completely. So the authors propose 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 the same set of resources can be selected and engaged towards collective intention of that process. It has been mentioned in the IPE approach that Informal Process Essentials (IPE) meta-model describes the following about informal process: (1) describes the constituents informal process such as performers, data and software tools and (2) describes how to make core element ready for the enactment of the informal process. IPE models begin from initial context and after achieving the main intention it results in another context. The relationship between IPE approach and 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. Strategies require capabilities and contain IPE process to realize strategies. Capabilities can be further resolved into resources. Thus starting from defining intentions, we define strategies then required capabilities and IPE models. 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*. As we mentioned before, in our context resources can be anything like people, IT tools, data that are used to accomplish the objectives, etc. Emerging intentions can result in the requirement of new capabilities, i.e., an ability required to

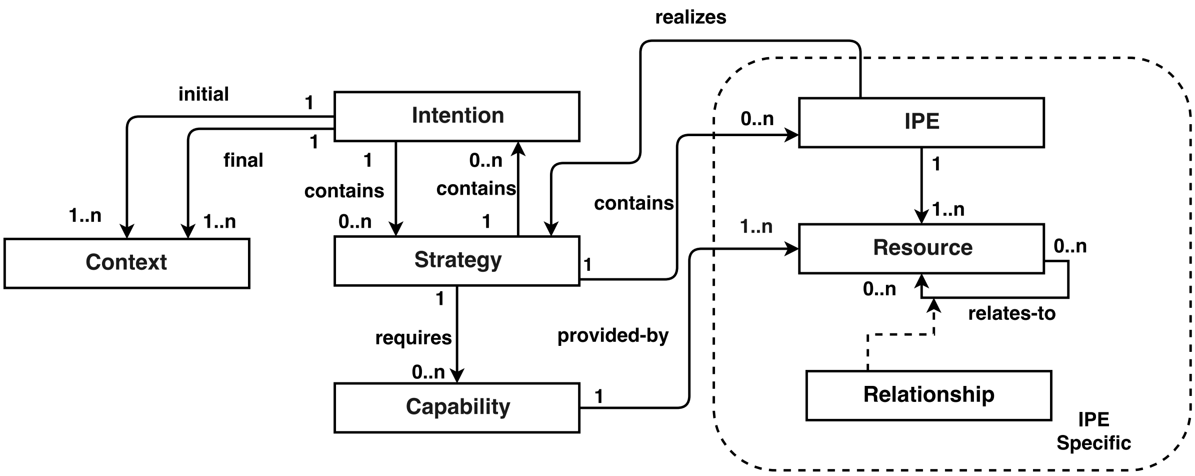


Figure 2.1: Intention-oriented Organizational Modeling - Conceptual Model

achieve an intention. Resource models are also provided in the developed prototype to make precise definition of resources needed.

The concept of *Informal Process Support Model* (IPSM) [SBBL14] has been introduced to make use of human performers' existing knowledge. In this approach, the initial creator of a model is experienced human performers such as business experts. Based on their experience, they add relevant resources of an informal process. The models are generated at runtime based on the interactions and activities of corresponding human performers. 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. This is achieved by, describing the corresponding decision makers of each informal process [SBBL14]. 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.

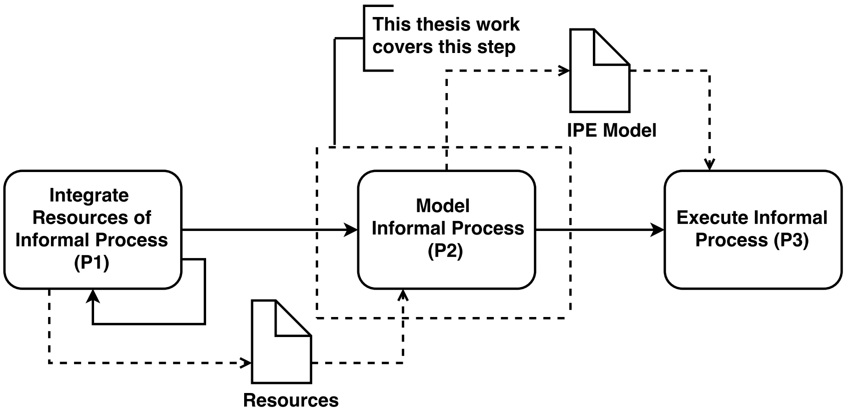


Figure 2.2: Steps of the InProXec approach

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* method is provided in the Section 5.2 of Chapter 5. As shown in the Figure 2.2 the InProcXec 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 informal processes modeling has to be presented to business experts, as they require it for next phase P2. So, the required resources for informal process modeling are allocated by *execution environment integrators* 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 execution environment integrators developed in phase P1. When an IPE Model is initialized with resources, it results in 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. In phase P2, the functionality to instantiate acquirable entities are not included. 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 of Chapter 2. This scenario also describes the scenario used in our case study, to validate the developed web-based modeling tool in the Section 6.5 of Chapter 6. The motivating scenario has been chosen based on the collected real life scenarios provided in 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 about the organizational modeling elements discussed in motivating scenario.

3.1 Intention-oriented Organizational Modeling Example

The concept of 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 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 which requires resources with matching capabilities and achievable low level intentions associated with these strategies.

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

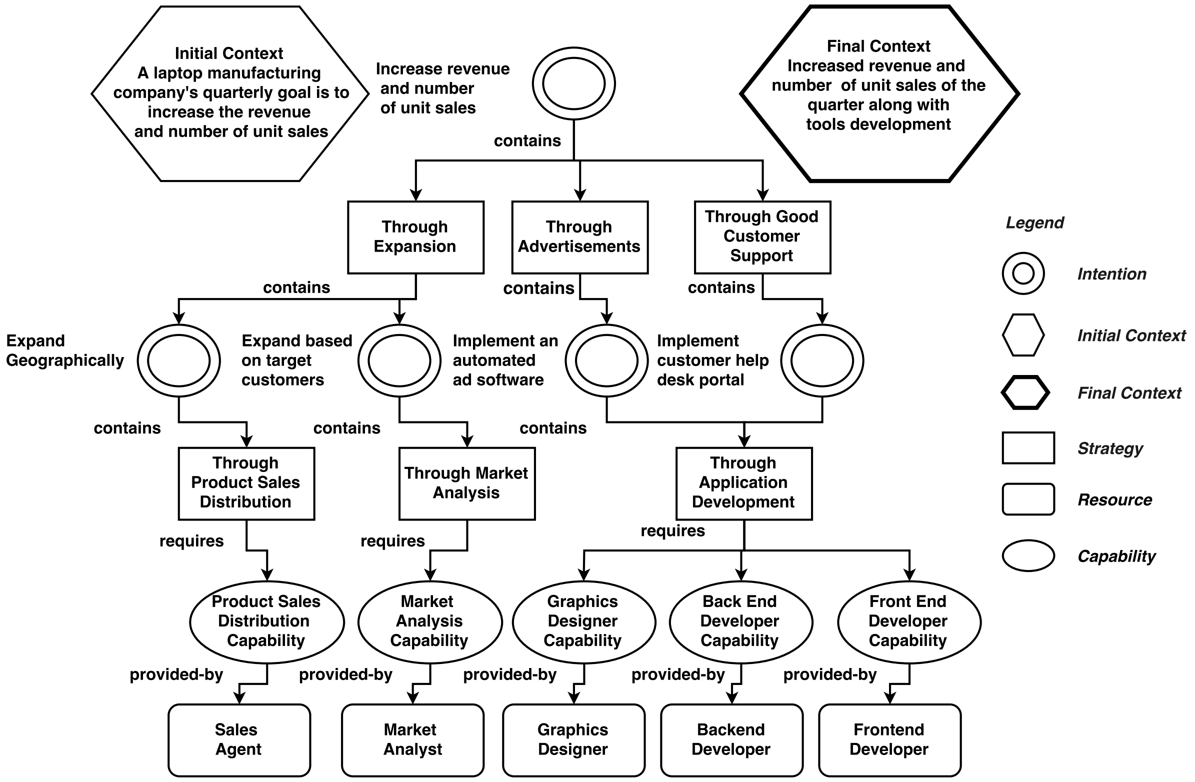


Figure 3.1: Intention-oriented Organizational Modeling - Example Scenario

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 detailed description of each modeling elements, we provide an example scenario to know the dynamic nature of 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, resource with capability to do market analysis is 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 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 software that automatically attends and records user queries. Suppose, if there arise 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 manufacturing processes such as the one provided in Figure 3.1 are not similar to 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 [SBLW16]. 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 about status before achievement of the main intention, i.e., it specifies the situation of the organization which triggers the execution of main-intention. The actual problem context is the revenue for the previous quarter was lesser than the estimated revenue. Hence, the initial context for next quarter is set as *quarterly goal of increasing the revenue and number of unit sales*, helps to decide the main intention and its related low level associates. On successful achievement of 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 [SBLW15] and same set of resources can be re-used in future executions with similar contexts and intentions.

3.2.2 Intentions

Intentions are defined hierarchically, in our approach intentions are located in top level of the hierarchy, which are refined until concrete lower level of the hierarchy is reached. In this thesis context, 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 to increase revenue and number of unit sales which also has other low level intentions such as *improving the customer help desk portal* and strategies such as (1) through expanding sales and (2) through advertisements. 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 situation where an intention can be related to another intention. 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 intention *implement a mobile application*.

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 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. Resources are the potential holder of the capability, i.e., to satisfy a capability we need resources. Capability and its associated resources are also shown in the Figure 3.1. In our motivating scenario, the main intention can be achieved through two strategies *through expansion* and *through advertisements*. These two strategy further contain 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. As mentioned earlier, informal process models are realized through strategies. This is achieved through strategy containing capabilities and resources. 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 customer only if it is effectively distributed. To achieve this intention, through a specified strategy we need resources with product sales distribution capability , i.e., resources that has ability to effectively distribute the products such as sales agents, wholesalers or other kinds of sales distributors. A strategy associated with capability that has matching resource then it can be realized as independent informal process. This results in informal process as a strategy that has capabilities, resources that are created out of capabilities and an intention of that contains specific strategy.

3.2.4 Capabilities

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 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.

3.2.5 Resources

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 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 team lead depends on decision of manager. Thus, manager and team lead are related in this simple example.

4 Requirements of Intention-oriented Organizational Modeling

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

4.1 Requirement Analysis of Intention-oriented Organizational Modeling

The requirements of 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 Chapter 3.

4.1.1 Organizational Intention Transparency (R1)

An intention can be broken down into definitive actionable components upon which individual resources can act. When these lower level intentions are made achievable for individual resources, then they can be combined to provide successful execution of higher level intention, i.e., main intention. This requires privilege for different organizational members to observe 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 members in different levels of the organizations. This level of transparency within an organization reduces inefficiencies during intention execution 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 intentions at different levels.

4.1.2 Organizational Strategy-based Cost Estimation (R2)

Linking strategies with capabilities that has matching resource enable us a cost estimation for each strategy. This is because, strategies are associated with organizational capabilities which in turn are associated with organizational resources. The cost of organizational resources 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 process definitions and then with the resource definitions. Further on, the cost of a strategy can be analyzed using the costs of derived process definitions and then with resource definitions. Including resources cost in strategy cost calculation is important. This is achieved by associating resource models' cost with process models' cost. The recursion is stopped when each resource definition is associated with cost. 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 resource is associated with a certain cost then this cost is considered for strategy implementations cost calculation based on which cost to achieve an intention through a strategy is calculated. This type of cost calculation based on intention model is estimated cost of an intention. The cost of an intentions's instance, is the actual cost of an intention. Since intentions are achieved through strategy we should also be able to calculate cost of intention based on 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. The prerequisites to satisfy this requirement are resources associated with cost and strategy cost estimation that includes all 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 low level strategies are achievable, then it can be used to estimate the achievability of the higher level strategies. This enables validation of strategic alignment of 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 achieveable 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 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 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 requirement R1, R4 happens during modeling phase and could also happen during 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 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, follow, 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 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 Related Work

In the literature, several work has been done in order to support and automate the business processes such as strategy-driven [BJN+05], activity-centric[YMMS09], activity-oriented [LR00], artifact-centric [CH09], capability-driven [SGHZ12] and ArchiMate [Gro12]. This section provides, a detailed description about these approaches and evaluation of these approaches based on requirements mentioned in the Section 4.1.

4.2.1 Strategy-driven

Strategy driven approach is a decision oriented modeling approach that focus on goals of the processes and refine goals until the operational level. This approach defines business process in terms of 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 concept of goals (intentions) during modeling. Thus, this approach satisfies both the prerequisites of requirement R1. The details about cost of a resource and strategy cost calculation is not addressed. Hence, 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. Also, the approach does not provide any information regarding the execution of a strategy as an independent informal process. Thus, second prerequisite of 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 goals by the organizational members. The requirement R5 is partially satisfied, as the approach satisfies requirement R1. But another pre-requisite, i.e., intentions has to be modeled based on the input provided by different members of the organization to satisfy R5 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. The information about cost of achieving a strategy is not mentioned. 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 cost calculation based on resource. 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 pre-requisites of requirement R3 are not met, 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 organizing 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 organizations. This approach aims to aid development of business models by connecting goals and capabilities. The requirement R1 is satisfied by the approach, as it satisfies both the pre-requisites related to intentions. This approach claims that, it overcomes the challenge of high cost in developing applications but 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 pre-requisite for requirement R4 is satisfied and second pre-requisite is also satisfied by the approach. Thus, requirement R4 is satisfied by the approach. The first pre-requisite for requirement R5 is satisfied and second pre-requisite 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 is 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 pre-requisites are satisfied. Similarly, requirement R5 is also satisfied because the approach satisfies first and second pre-requisites.

4.2.7 Summary of the Evaluation

The Table 4.2, shows the evaluation of 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 Section 5.3 of Chapter 5 that satisfies all of the derived requirements of 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)+Addres-sed, (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	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed
Artifact-centric	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed	(1)-Not addressed, (2)-Not addressed
Capability-driven	(1)+Addressed, (2)+Addressed	(1)-Not addressed, (2)-Not addressed	(1)+Addres-sed, (2)-Not addressed	(1)+Addressed, (2)+Addressed	(1)+Addressed, (2)-Not addressed
ArchiMate	(1)+Addressed, (2)+Addressed	(1)+Addres-sed, (2)-Not addressed	(1)+Addres-sed, (2)+Addres sed	(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 that has been taken to solve the problem mentioned in the Section 1.2 and to satisfy all of the requirements mentioned in the Section 4.1 of Chapter 4. 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. The fourth section discusses the design methodology followed to realize this approach as a web-based modeling tool.

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 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, what strategy should be selected to accomplish an organizational intention. The reason for following 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 InProXec.

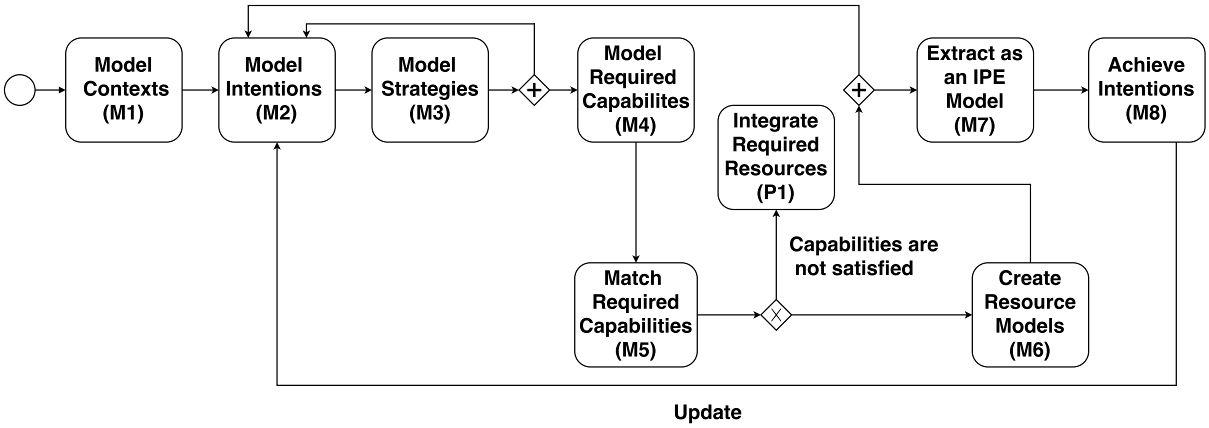


Figure 5.1: Steps of Model Informal Process

5.2 Second Phase of the InProcXec - Model Informal Process

This approach 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 of InProXec method, the properties and requirements of informal process described in 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 using the developed modeling tool has been 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 URI of the context. Similarly, the user can also provide other entity specific properties of the context.

Model Intentions (M2)

Similar to context definition modeling (M1), the second step (M2) is to model intentions. The context definitions created in step M1 can be used to specify initial and final contexts of an intention. Intentions has any type of custom relationships among different intentions. For example, sub-intentions, contradicting intentions, etc. These type of sub intentions and contradicting intentions are also modeled as intentions in this step and their type of relation to a specific intention are mentioned. Intentions are associated with strategies. Strategies, required to achieve an intention are added to entity specific properties of intention as achieving strategies in this step. 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*. After providing basic properties of an intention such as name and target namespace, the user can provide entity specific properties such as details of achieving strategies, related intentions, etc.

Model Strategies (M3)

Once intentions are identified and modeled, the third step (M3) is modeling of strategies, to achieve a specific intention. As mentioned earlier in the Section 2.5, an intention can have multiple strategies. A strategy is a method or plan chosen to bring desired results, such as achievement of an intention or solution to a problem. Strategies are associated with capabilities. The capabilities required by strategy are added to entity specific properties of strategy in this step. For example, consider the strategy *through expansion* from our motivating scenario. This step includes providing basic details of strategy such as name and target namespace. This step also includes providing entity specific properties of strategy such as target intention. For the strategy *through expansion*, the target intention is 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 in a specific strategy are modeled. Strategies require 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 posses certain skills and roles to achieve the intention. These type of required skills are modeled during this step.

Create Resource Models (M6)

After matching the resources and capabilities i.e after finding the correct resource that has the capability to carry out the process, the resource models are created. The need for modeling a new intention may arise in parallel during modeling of 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. It is key for achieving specified process intentions.

Extract as an IPE Model (M7)

After the completion of above mentioned steps, the modeled entities can be extracted as an IPE model which can be reused.

The steps matching of required organizational capabilities (M5) that are satisfied by resource models and integration of required resources (P1) are not part of the current functioning tool. If there is no suitable matching capability, then phase P1 of InProXec can be carried out again until a matching capability is found. If capabilities are satisfied resource models can be created. The created resource models (M6) along with modeled capabilities can be extracted as an IPE Model (M7) which can be provided as input for the next step achieve intentions (M8). After achieving an intention, the status of intention is updated inside the specific intentions's property.

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. Hence, it is called top-down modeling approach. The purpose of selecting top-down modeling approach is because based on the suggestions provided in the literatures [MBH+10; BJN+05; SBLW16], that value of intention in the top of hierarchy propagates till the lower levels 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 using top-down modeling approach. Models are easily changeable as they are decoupled from their operational terms. Such declarative approaches provide more flexibility and enable easier to change the business process models. The integration of declarative models using top-down modeling approach, also provides coupling of cost-benefit and strategy achievability estimation with operationally

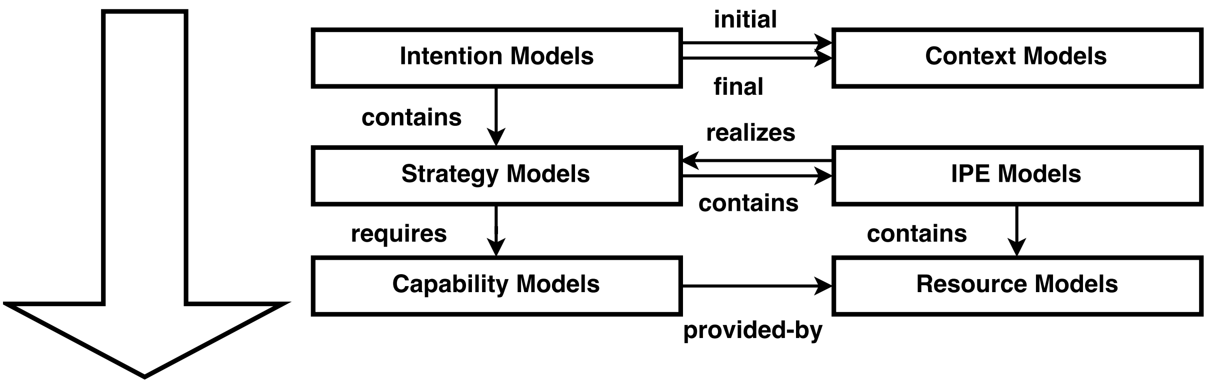


Figure 5.2: Intention-oriented Organizational Modeling - A Top down Modeling Approach

measurable business intention and supports the evaluation of business intention's success and the effectiveness of the chosen strategies. In the Figure 5.2, it is shown how this modeling approach starts modeling from top level intentions and does modeling until the operational lower level is reached and how the organizational modeling elements are associated with each other.

The approach is evaluated based on the derived requirements in the Section 4.1 of Chapter 4 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, (2) 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) : During the modeling phase itself, business executives can make decisions based on the strategy cost estimation. In this approach, (1) resources are associated with cost and (2) the cost estimation of strategies include all its low level structures. Thus, requirement R2 is satisfied by the approach as it satisfies all of the pre-requisites.

Organizational Strategy Achieve-ability Estimation (R3) : Similar to requirement R2, strategy achievability estimation based on strategy's association with valid capability is also estimated during modeling phase itself. In this approach (1) a capability is considered as valid only when it is associated with matching resource 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) when modeling through this approach members require understanding of 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) intentions are modeled collaboratively based on input received from different members of the organization. Thus, requirement R4 is satisfied by the approach as it satisfies all of the pre-requisites.

6 Case Study on a Manufacturing Company

In this chapter, the first two sections provide implementation details along with the reason for making certain decisions regarding the implementation of web-based modeling tool. The third section provides an architecture of the functioning system and fourth section provides application flow of the functioning system. The fifth section explains how motivating scenario has been realized using the proposed modeling approach. Successful modeling of the motivating scenario using the developed editor serves as a proof for usability of the web-based modeling tool. Hence, the final section validates the system by evaluating it with the requirements for supporting intention-oriented organizational modeling.

6.1 Technologies and Frameworks

In order to realize the web-based modeling tool of intention-oriented organizational modeling, a formal inquiry was done to choose suitable technologies and frameworks required. The below specifications were finalized and *client-side scripting* [SV12] was chosen, due to the fact that developed tool is web-based single page application (SPA) [MP13].

1. *ClojureScript*[1] as the programming language
2. *Model-view-controller (MVC)* [Dea09] as the architecture pattern
3. *Re-frame*[2] as the pattern for writing SPA in ClojureScript, using Reagent[3]

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[1]http://clojure.org/about/clojurescript
[2]https://github.com/Day8/re-frame
[3]http://reagent-project.github.io/

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 page navigation from current location to the desired location in the URL (Uniform Resource Locator) of the browser. *Clojure*[8] is a dynamic, general-purpose programming language, combining the approachability and interactive development of a scripting language. *ClojureScript* is a compiler for Clojure that targets JavaScript which has been designed to emit JavaScript code. In our implementation, we have used both Clojure and Clojurescript artifacts. We also used *Reagent* which provides minimalistic interface between ClojureScript and React[9]. *Re-frame*[10] is a pattern for writing applications in ClojureScript, using Reagent.

6.1.1 MVC Architecture

The architecture of the developed user interface is based on the *Model-View-Control (MVC)* design pattern. The MVC paradigm allows to separate business logic from the code that controls presentation of 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 artifact stores the required data structure for web-based modeling tool. In the developed model artifact, the data structure of modeling elements with their values are stored.

View artifact 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 are re-used.

Control artifact contains the handler functions which can only change the model. Even the initial values of the model are put inside the control. This artifact has functions that updates default database, which then causes a re-render of view that makes the user to see a new view.

Apart from the above artifacts, there is another important artifact that registers subscription functions, i.e., query layer of the data. As view components never source

[4]https://react-bootstrap.github.io/
[5]https://jquery.com/
[6]https://github.com/juxt/bidi
[7]https://github.com/kibu-australia/pushy
[8]https://clojure.org/
[9]https://facebook.github.io/react/
[10]https://github.com/Day8/re-frame

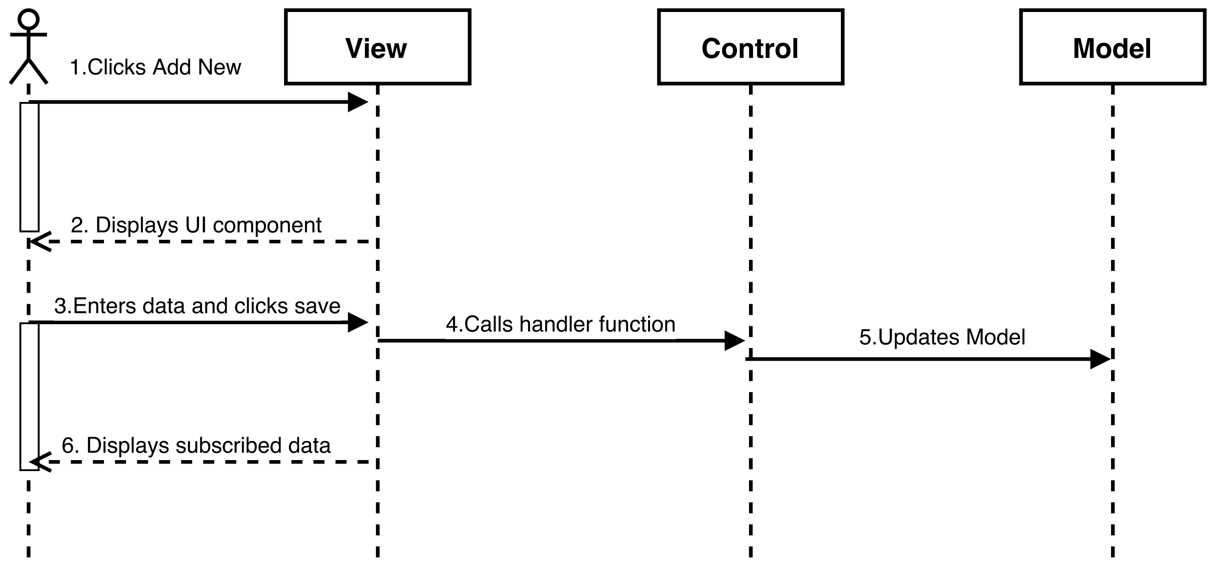

Figure 6.1: MVC Pattern of Adding New Entity

data directly from default model, we use *subscription* functions. Subscription functions returns values that change over time, i.e., based on user events.

Example: Component using the MVC Pattern

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

1. User clicks the *Add New* button in the developed editor.
2. Responding to the user click, view displays the respective user interface component for entering the new entity data details.
3. User enters the required basic details for adding new entity data and clicks save button.
4. View dispatches data to control, as control can only modify the model.
5. Control inserts/updates data into the model.
6. View displays the updated model as it has been subscribed to the model.

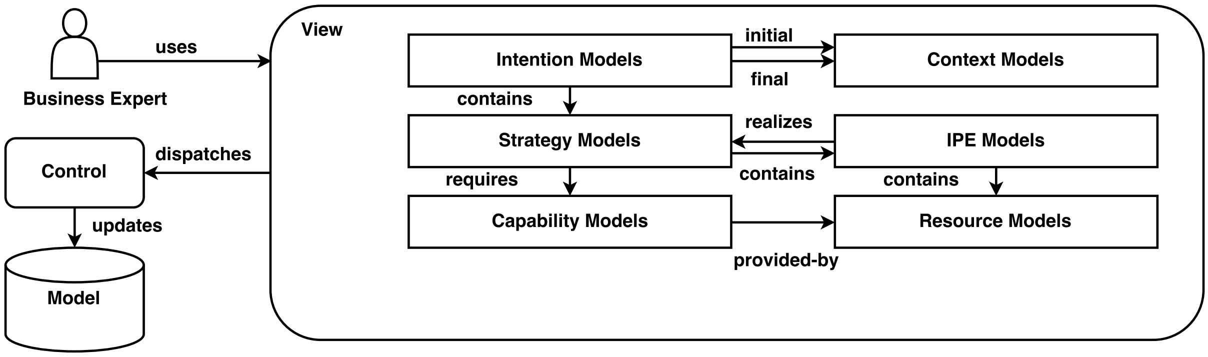

Figure 6.2: Architecture of the Functioning System

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/update the descriptive entity details. 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 sub-section we provide an overview about how page navigation from current location to the desired location happens in URL of the browser. The external libraries used for route navigation, parses URL into data structures and generates URL from data structure defined as required routes. We call a function to dispatch route, with the matched route. Then we also have another function that parses the URL, to turn 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 and its own unique reference identifier.

Each entity item has basic properties such as *name* and *target namespace*. The entities are identified using their unique id which is generated using the unique combination of name and target namespace. The entities that are associated with a particular entity are resolved through unique identifier. For example, in our motivating scenario

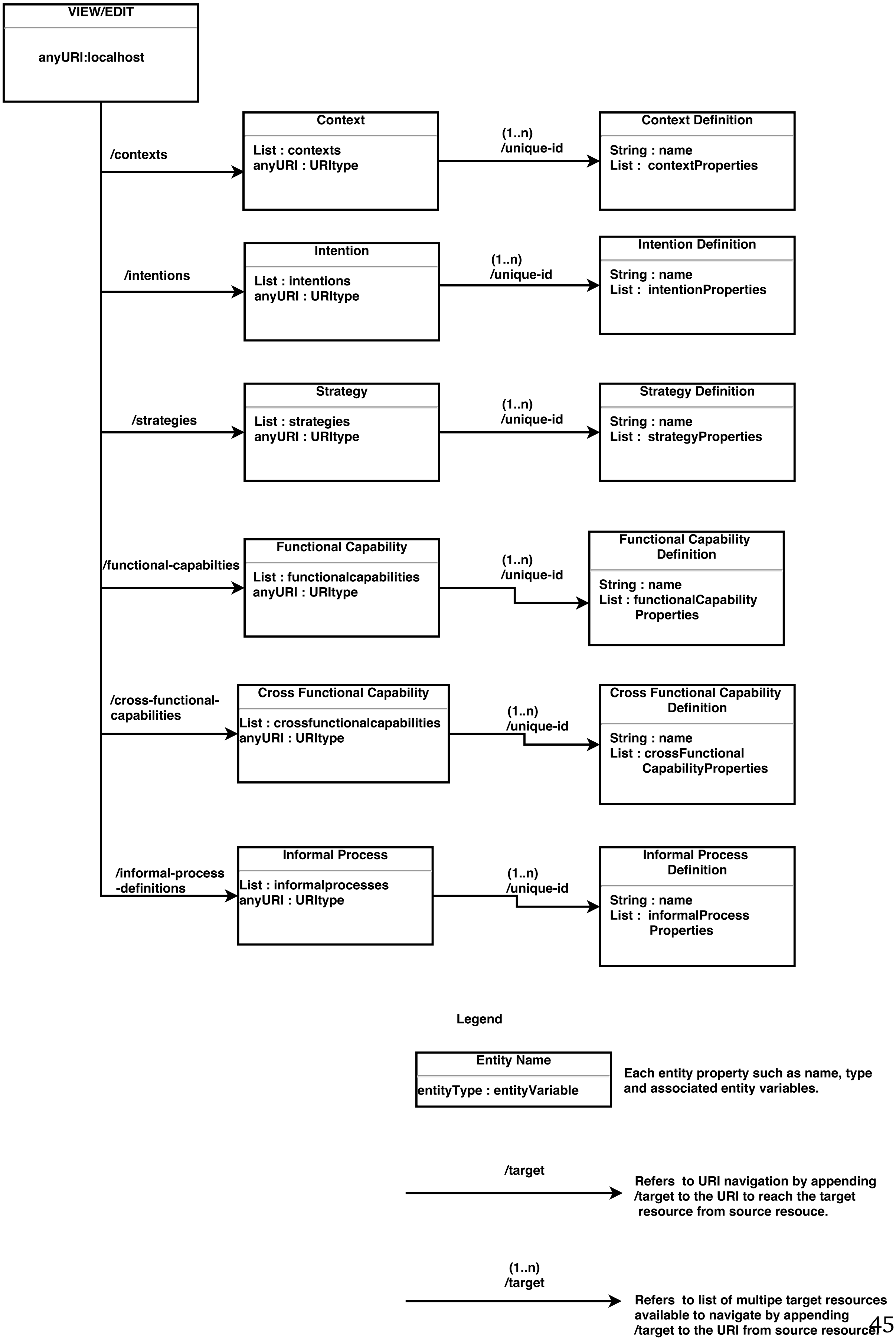

Figure 6.3: Implementation of URL Navigation

consider the intention *improve the customer help desk portal* when creating model for this intention, business expert provide name and 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 namespace by the system. For example, the strategy in the motivating scenario *through application development* that is associated with an intention, contains only the unique identifier of intention as reference.

6.3 Design Methodology

This section discusses in detail the method of designing the web-based modeling tool, that realizes the approach proposed in the Section 5.3. When designing the user interface components and functionalities required to develop the tool, most of the similar functionalities are designed as common functions for the purpose of reusing the functions. This reduced unnecessary functional redundancies and overhead. 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 data artifact. 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 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., properties. Though the top-down modeling approach 5.3, shows that definition of each entity type is contained within another entity type, as per the user interface design, separate entities references each other using the unique reference identifier but does not contain all properties of referenced entity. For instance, a strategy containing an intention should contain only the intention's unique reference identifier

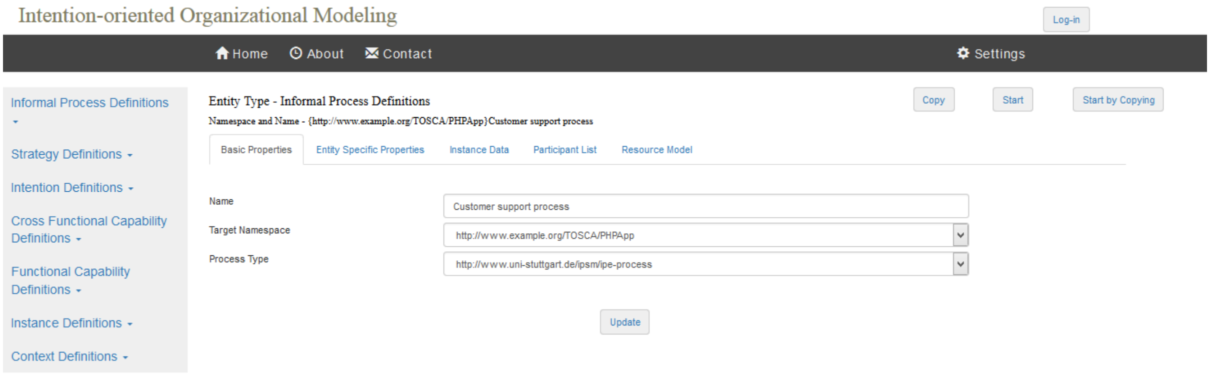

Figure 6.4: User Interface Design of the Modeling Tool

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 Motivating Scenario

The realization of motivating scenario is explained by integrating the concepts discussed in Chapter 3 and the informal process modeling approach discussed in the Chapter 5. From the Figure 6.5, it is clear that to realize the motivating scenario using the proposed approach it is important to model them step by step as mentioned in the informal process modeling approach. The developed modeling tool also supports dynamic changes in the models whenever there is a need to add new models. As each models are designed in individual modeling step, details of individual modeling steps are provided in the following sub sections.

6.4.1 Realization of Context Definitions

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 realize the motivating scenario, user can add new contexts by providing basic properties such as name of the context and target namespace of the context as they serve as unique reference identifier for these contexts. After successfully adding the

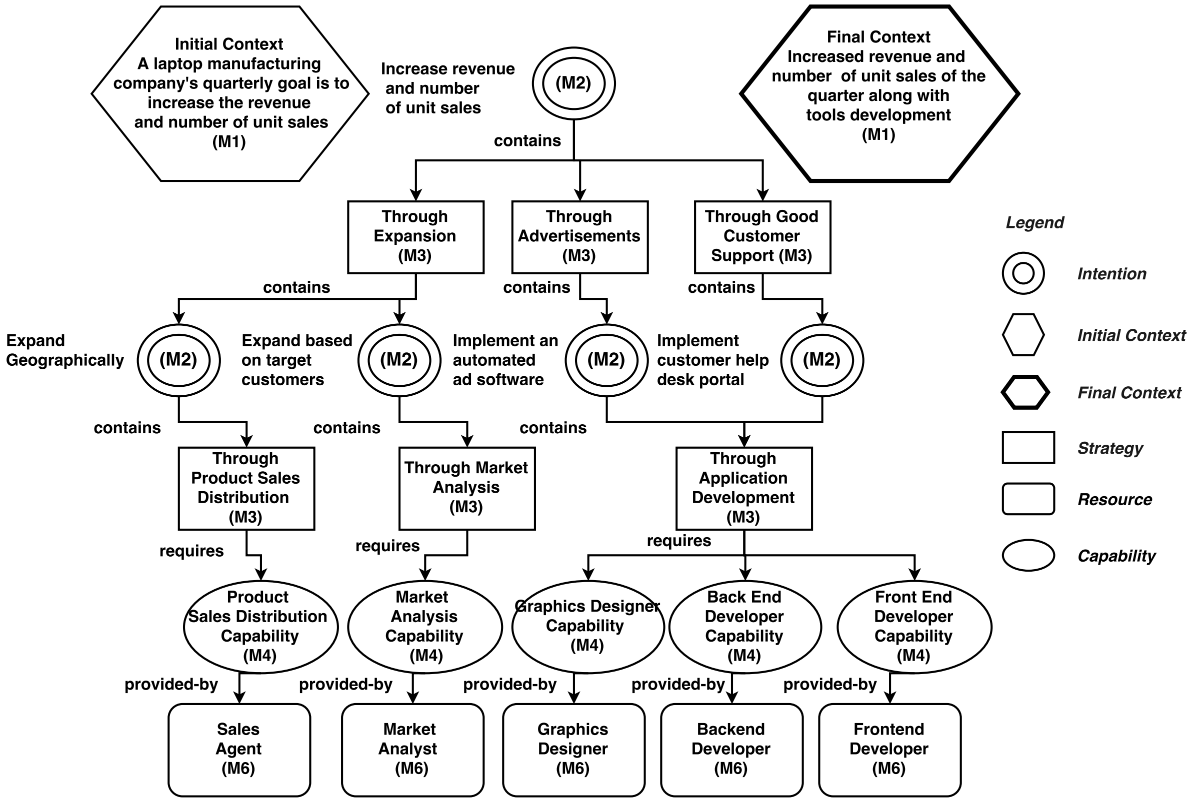

Figure 6.5: Realization of Motivating Scenario

basic properties, user can provide entity specific properties such as contained contexts inside the main context, entity definition details about the contexts and participant list with respective privileges for each participant are also provided. The required context definitions are modeled first because these definition are required for modeling intention definitions and process definitions.

6.4.2 Realization of Intention Definitions

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. The user can provide descriptive information about particular intention as intention definition. Similar to context modeling, the user has to provide basic properties such as name and target namespace required for unique identification of the entity. After providing basic properties, the user has to provide 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 are also provided as entity specific properties. The participant list with respective privileges for each participant are also provided when an entity is of type interactive acquirable entity.

6.4.3 Realization of Strategy Definitions

After modeling context definitions (M1) and intention definitions (M2) user can proceed to model the strategies (M3) which is third step of the modeling process. For example, in our motivating scenario user can model 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 strategy user required to provide 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 are also provided. Since, strategy is also an interactive acquirable entity similar to intention, participant list details are also provided during modeling of strategies

6.4.4 Realization of Capability Definitions

Modeling of capability (M4) is the fourth step in intention-oriented organizational modeling. There are two types of capabilities. Functional capabilities and cross-functional capabilities. Functional capabilities are the capabilites that associated with other entity types. Cross-functional capabilities contains 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 intention definitions and strategy definitions.

6.4.5 Realization of Process Definitions

By modeling the business processes based on resources that work towards certain intentions, informal processes are modeled without predefining their business logic [SBBL14]. Also as mentioned earlier each informal process starts from an initial context and aims to achieve an intention that results in a final context. Thus, we require context definitions and intention definitions before modeling process definitions. Similar to earlier modeling of entity types, process modeling also requires basic properties such as name, namespace and entity specific properties such as associated intentions, contexts and resources. Process definition also has participant list similar to other entity types.

6.4.6 Realization of Resource Definitions

Each resource that provides certain capability can be related to another resource which are defined using predefined or custom *relationships* [SBBL14]. These resources are managed through *resource organizers*, this is because resource organizers are used to bring together the relevant interrelated resources that work towards to achieve an intention. TOSCA [BBKL14] can be used to model all nodes and relationship among them. In this work, authors consider resources as nodes to make use of the TOSCA's service. In the developed modeling tool, the resource models are managed by embedding the open source modeling tool Winery web page [KBBL13] in the modeling tool's web page. This is because it creates a new service template that contains an application topology by using the topology modeler. Winery also offers all available node types in a palette. From there, user can drag the desired node type and drop it into the editing area. There the node type becomes a node template i.e., a node in the topology graph. Node templates can be annotated with requirements and capabilities, property values, and policies. The screen shot of modeling sample resource has been provided in the Figure 6.6.

In order to achieve this, we use TOSCA repository URL referring to winery and topology modeler of the winery. Using these values we create corresponding URL required for our modeling based on the name and namespace properties of an entity. The functionality to generate resource model page, using TOSCA repository URL and topology modeler URL is provided below.

```
{topology-modeler-url}?repositoryURL={encoded-tosca-repository-url}&ns={encoded-target-namepsace}&id={encoded-identifier}#
```

6.4.7 Realization of Instance creation

Initializing resource-centric processes require acquiring and engaging interrelated resources [SBLW15]. As mentioned earlier, the phases of compiling and initializing of informal process models are not within scope of this work. Only the functionalities such as creating instances, extracting instances and editing instances are part of the functioning tool. This is because initializing informal process models starts after the initial context defined in an IPE model [SBLW15]. Thus, it is important to discuss realization

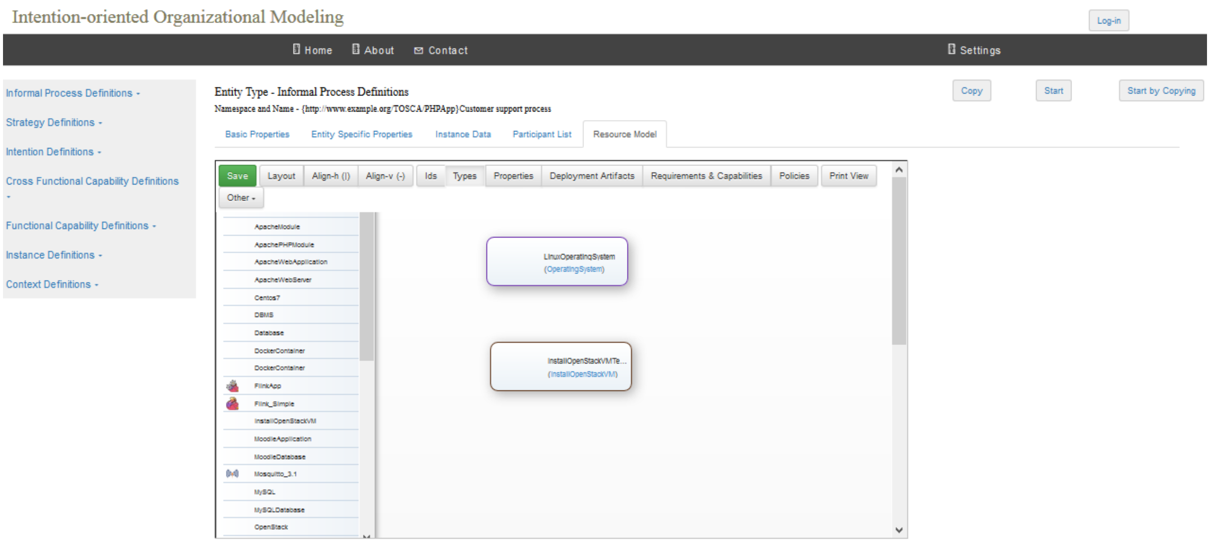

Figure 6.6: User Interface Screen of Resource Model

of instance creation which are required for phase P3 of Executing Informal Processes (InProXec) method. Acquirable entity types' models can be converted into instances. For example, process definition is converted into *process instance* when the model is compiled and engaged with resources. 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 screen-shot image 6.7 it is clear that these properties of an instance can be edited through the developed tool. Only when a acquirable model is successfully initialized it can be engaged to adapt the process execution of emerging requirements [SBLW15].

The developed tool supports creation and updation of descriptive information about instances. Each instance belong to any one of the acquirable entity type such strategies, intentions and informal processes. Any entity that has instances are also listed inside the *Instance data* tab of each entity. From the user interface screen Figure 6.8, it is clear that the editor has ability to add, remove and extract instance descriptors for any entity type. An instance descriptor of a functional capability refers to a resource definition meaning that a capability is provided by a resource.

6.5 Validation of Requirements

This section evaluates the current functioning tool against the derived requirements of intention-oriented organizational modeling.

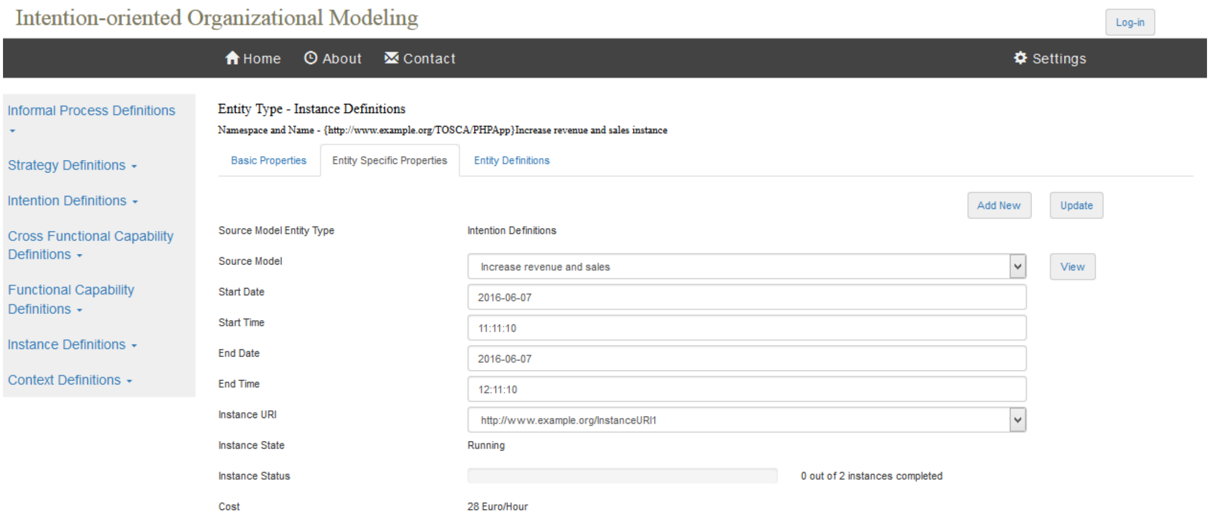

Figure 6.7: User Interface Screen of Instance Descriptor

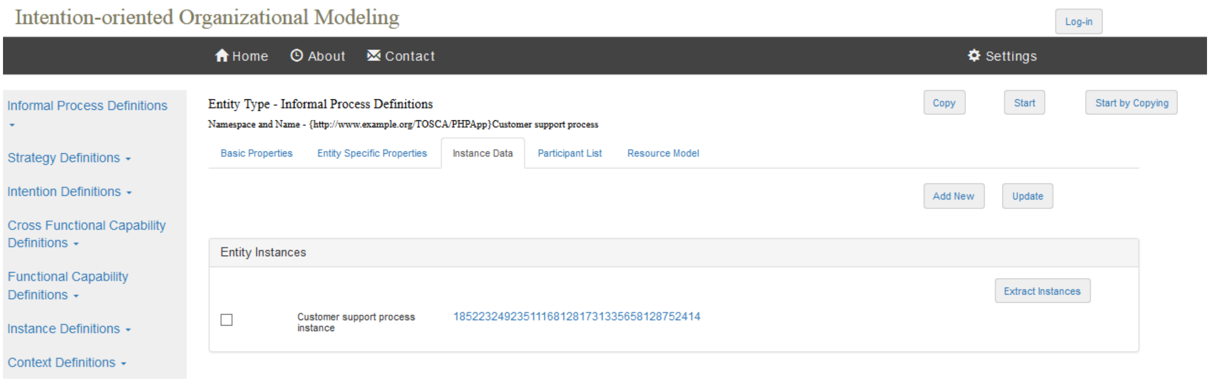

Figure 6.8: User Interface Screen of Acquirable Entities

Organizational Intention Transparency (R1): Using the modeling tool intentions at different levels can be modeled which satisfies first pre-requisite of R1. With the current functioning system any user can view intention at different levels which satisfies second pre-requisite of R2. Thus, requirement R1 is satisfied by the functioning system as both of its pre-requisites are satisfied .

Organizational Strategy-based Cost Estimation (R2): The modeling tool itself calculates and displays the 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. The functioning tool satisfies requirement R2 as both of its pre-requisites are met by the tool.

Organizational Strategy Achievability Estimation (R3): Similar to cost calculation, strategy achievability estimation based on its association with valid capability is also determined and displayed during modeling phase itself. The functioning tool satisfies requirement R3 as both of its pre-requisites are met by the tool.

Intention Oriented Working Style (R4): Any user can create intention models, strategy models, informal process models etc., through the developed tool provided the user has understanding about main intention and its recursive structure. The requirement R4 is also satisfied by the functioning tool as it satisfies both the pre-requisites of R4.

Participative Organizational Modeling (R5): Each entity type that can be interactively acquirable has list of participants with their corresponding privileges. The users can edit, view, own or follow based on their privilege. Thus, the tool satisfies the requirement R5.

7 Conclusion and Future Work

In this document, we first provided motivational statement and problem statement. We also provided, the fundamental concepts and related work from 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 some previous work. 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. The case study taken on a manufacturing sector helped to assess feasibility of the proposed approach. A web-based modeling tool was developed to realize the proposed approach. The case study also validated the web-based modeling tool. The usability of the tool was also confirmed by creating models for the motivating scenario.

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, 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 back end such that it 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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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