Identifying Domain Context for the Intentional Modelling Technique MAP

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Abstract

Context identification is an important feature of goal modelling techniques. It helps to understand wider organisational systems during requirements engineering. The goal of this paper is to identify domain context for the process driven requirements modelling technique MAP. We present our preliminary research on adding domain context to MAP by using Jackson’s context diagrams. The resulting model shows a clear picture of domain entities involved in the MAP processes. We validate our approach on a case dealing with the Point of Sale system of Seven Eleven Japan (SEJ).

1. Introduction

Goal modelling techniques often use the terms actor, agent and context to denote organizational context [1-4]. These terms are synonymous and all refer to the organizational context, where wider organizational goals can be identified. In this paper, we will also use the term domain entity to refer to elements of domain context (i.e. people, devices).

Identification of actors helps in understanding systems effectively [5]. Jackson describes understanding a problem and its context as an iterative process in which one cannot be understood without the other [6]. Agents are active system components that in general require cooperation between them to achieve goals [1]. i* is a goal modelling approach that models information systems in terms of heterogeneous actors and goals during requirements analysis [2]. Tropos, an extension of i*, helps us better understand the software environment through an agent-oriented software engineering approach that explicitly identifies agents in both early and late requirements models [3]. Anton identifies agents as important elements of her goal-based requirements analysis technique [4]. B-SCP is a requirements analysis and refinement approach that uses Jackson’s problem diagrams to elicit strategic goals and their domain context [7]. Problem diagrams provide a mechanism to identify an organisational context explicitly in terms of physical domain entities via a context diagram. A context diagram bounds the problem at all levels of refinement and avoids broadening the problem too far [6].

MAP is a goal strategy modelling technique that has been used to illustrate Enterprise Resource Planning (ERP) requirements driven process [8]. However MAP does not identify the domain context explicitly in terms of physical domain entities in its model. Thus, we formulate a research question:

RQ: How can one identify and clearly represent physical domain entities relevant for a MAP model?

In this paper, our objective is to present an approach of integrating Jackson’s context diagram with MAP. In doing so, we will be able to address the domain context of a MAP in terms of physical domain entities. We use context diagram with MAP for two reasons:

1. it enables identification and representation of physical domain entities and their shared phenomena for MAP processes.
2. it makes the model more readable and understandable compared to other modelling techniques such as [2][3] whilst maintaining all the relevant concepts.

Therefore, in this paper we present our preliminary research on integrating context diagram with MAP. We validate the framework by using the Point of Sales (PoS) case from Seven Eleven Japan (SEJ).
The rest of the paper is organized as follows. Section 2 presents a brief overview of MAP and context diagrams. Section 3 presents motivation for the integration. Section 4 presents a summary of our integration approach. Section 5 presents an example of MAP contextualisation. Section 6 discusses the integration approach. Section 7 concludes the paper.

2. Background

A MAP is a process model expressed in intentional terms [9]. A MAP is generally composed of several facets or sections in a non-deterministic order. Each facet is an aggregation of two kinds of intentions, source and target, linked via a strategy. A MAP intention represents a goal. A MAP strategy represents an approach, a manner or means to achieve an intention. MAP is considered to have advantages over traditional AND/OR goal modelling techniques because it captures variability through requirements analysis. Here, variability means the ability to change, customise or configure software systems according to the user’s requirements [10]. MAP offers a mechanism of As-Is model (current) and To-Be model (wished) to address evolution of requirements [11]. For more on MAP’s features, we refer the reader to the references provided in this subsection.

Jackson’s context diagram [6] is a means of scoping the context of a problem. A context diagram locates the problem and parts of the real world the problem relates to. It identifies machine domain and several problem domains. A context diagram shows the interfaces between the domains that describe how the machine is connected to problem domains and how problem domains are connected to each other [6]. Machine domain is a general-purpose computer that must be designed and built by creating its software. Domain entities represent physical actors that interact with the machine and each other. Interfaces between domains are physical and direct. They represent events and states and values being shared between the connected domains. Shared phenomena consist of observable behaviour phenomena that occur between domain entities of context diagram. By taking domains and interfaces into account, we find out about them, describe them and reason about them [6]. We are unable to show an example of a context diagram due to the space constraint and refer the reader to [6].

3. Motivation

In this section, we briefly describe reasons for integrating Jackson’s context diagram with MAP.

(i) A MAP is a strategy driven business process modelling technique that defines a requirement as couplet <intention, strategy> [8]. A business process has goals and it crosses organizational boundaries and concerns the collaboration between organizational actors [12]. Therefore, we believe that domain context identification is as necessary for MAP as for any other goal modelling technique. A business process often involves more than one activity so there is possibility of involvement of more than one domain context. In figure 1, we represent the possibility of more than one domain context for a MAP requirement by using the 1..n multiplicity convention.

(ii) Other goal modelling approaches, such as [1-3] identify domain context and generally attach domain entities of the domain context to their relevant goals. This approach seems feasible for these techniques, as they identify goal entities as snap shots in time and attach responsible domain entities to them. For example, read [1]. However, in MAP, each requirement is a process consisting of a goal and a strategy. If we attach participating domain entities (which can be many) with each process of a MAP, it is possible we will produce an unreadable figure of MAP requirements. The major reason for this is the process-oriented nature of the MAP modelling technique that often requires involvement of more than one domain entity for a given requirement. Therefore, we depart from attaching domain entities directly to requirements and use a context diagram to address the MAP context.

4. Our integration approach

In this section, we present our step-by-step approach to develop a contextualised MAP (see figure 2). We do not describe each step in great detail, as this is not our objective in this paper.

Step 1. We develop a requirements model by employing the MAP modelling technique as described in [8]. Although the MAP technique contains several steps, they are all grouped as one step in our approach to emphasize the subsequent original steps.

Step 2. Analyse of the MAP model generates a list of
facets (i.e., goals and strategies).
Step 3. We identify physical domain entities associated to the MAP model and list them and relationships between facets and domain entities.
Step 4. By analysing the list of physical domain entities, we choose exactly one entity as a machine that will work as a general-purpose computer.
Step 5. Domain entities collaborate to perform MAP processes. A context diagram describes collaboration as shared phenomena [6] and we list the relationships between domain entities and machine and each other.
Step 6. We classify relationships between domain entities and facets of the MAP into constraints (arrow-head lines) and references (dashed lines).
Step 7. We develop a complete contextualised MAP model by applying the principles of Jackson’s context diagram [6] that identifies the MAP model into the requirements part of the context diagram.
We use Jackson’s context diagram that satisfies the condition of shared phenomena of domain entities clearly and also presents requirements references and constraints. This approach does not clutter the MAP model while it still presents all the important information about the relevant domain entities.
In this paper, we do not present in detail semantics of notations used to denote links between domain entities and MAP diagram, due to space constraints. However, we present an approach that can make the use of these notations to achieve MAP contextualisation.

5. Example of MAP contextualization

We describe the domain context of Point of Sale (PoS) systems of Seven Eleven Japan (SEJ) where five domain entities are involved in completing the MAP processes: a Cash drawer, clerk, product, customer and a machine (see figure 3).

The PoS system plays vital role in addressing SEJ’s organizational strategy. SEJ uses PoS systems to help run franchise stores’ business. Through the integrated network, PoS communicates directly with SEJ business partners such as suppliers, delivery centers, weather services and SEJ management. Under the arrangements, franchise stores provide PoS data to SEJ headquarters through a computer network and SEJ notifies suppliers who automatically deliver goods to the store to replenish stock. This sharing of data helps avoid both inventory accumulation and lost opportunities, providing a win-win-win for supplier, franchise stores and customer [13][14].

We develop a MAP model based on the research literature on SEJ’s PoS system [13][14]. In Figure 3, we use MD and DD identifiers for MAP and context model, respectively. In the MAP MD we identify the intention, Enter Customer Profile Data on PoS, which is achieved by applying two strategies: by scanning products and by sighting customer, emanating from the Start state. Intention Enter Customer Profile Data has two recursive strategies, Entering age strategy and Entering gender strategy, which help classifying the customer into demographic classes. Second intention Perform Payment transaction is achieved by the strategy By opening till. Two subsequent strategies emerge from this intention: Generate receipt and By customer’s departure. These strategies lead to achieve the special intention Stop. The MAP MD shows a number of processes in the model performed to achieve the two main intentions. It is important to know what domain entities are involved in the processes.

Now, we integrate the context diagram DD with the MAP MD and describe the roles of domain entities and their shared phenomena in the context of MAP processes. In this paper, we present only the final results of the process and do not go through all
As SEJ relies heavily on PoS for gathering customer profile and purchase data, the first intention *Enter Customer Profile Data on PoS* is achieved by employing two processes as strategies, *By scanning products* (q) and *By sighting customer*. Clerk (r) is the domain entity who performs scanning of the product (r1) and sighting of the customer for profiling (r2). Three domain entities clerk, product and customer have shared phenomena to complete the process are the MAP requirements have references (qq) and (ss), to the domain entities in figure 3.

The clerk performs the process of entering the customer profile – approximate age, gender, the product purchased at the PoS. This process achieves the same intention *Enter Customer Profile Data on PoS*, but it changes the state of the intention

The PoS shares phenomena with *Cash drawer* (p) that opens only after the clerk has entered customer profile data. This is a pre-requisite process for the clerk to achieve the intention *Perform Payment Transaction*. The PoS machine prints a receipt for the customer and customer departs with the product.

By applying our integration approach presented in Section 4, we are able to identify physical domain entities explicitly for MAP MD, their shared phenomena and relationships between facets and domain entities (Figure 3).

The MAP technique allows for refinement of facets of a MAP to achieve the next level MAPs [8]. By using this approach, we have developed three levels of MAP in [15]. For MAP MD in this paper, we refine facet *<Start, Using PoS, Collect Customer Purchase Data>* of the MAP MC identified in [15]. In this way, we can show traceability between MAP MD requirements and organisational business strategy.

### 6. Discussion

We have presented an integration approach of MAP and B-SCP in [15], which is used to address evolution of organisational strategic IT. However, this paper presents an integration approach of MAP and context diagrams, which is about identifying domain entities for a MAP model. This integration addresses the limitation of MAP and B-SCP approach [8] in which it does not show what domain entities are contributing to MAP processes and what constraints and references are between them as seen in Figure 3.

Identifying domain entities for MAP MD brings improvement to the MAP model. Domain entities show participants of MAP processes and their shared phenomena. It also clearly shows the MAP requirements that should be addressed in terms of constraints and references by the domain entities and the machine. Domain entities of a MAP can be identified by using other approaches such as those employed in i* [2]. We do not use them because this will clutter the MAP model. The reason is that MAP is a process driven goal modelling technique and each process often has shared phenomena of participating domain entities.

A contextualised MAP model presents a concept probably closest to the B-SCP framework but with considerable difference. B-SCP identifies domain context for goals that are represented as snap shots in time. However, MAP identifies context for intentions and strategies that are represented as processes. By
identify domain context of a MAP, we present organisational goals, how these goals are achieved and the participants of the processes (see Figure 3).

7. Conclusion

We have presented the preliminary idea of integrating context diagrams with MAP in order to address physical domain entities to a goal model.

MAP is a goal/strategy modelling technique that has been used to address requirements of ERP systems [8]. MAP’s process driven nature necessitates identification of domain entities involved in the MAP processes. Practitioners would like to know who the participants of those processes are. Jackson’s context diagrams seem very useful to describe the environment of the MAP.

In this paper, we argued for using Jackson’s context diagrams to identify and clearly represent physical domain entities relevant for a MAP model. We outlined the steps in our integration approach and presented an example contextualized MAP model. The resulting model allows identifying physical domain entities clearly for a MAP without cluttering the information. Identification of shared phenomena for MAP processes is a necessary element which is addressed by context diagram effectively. Domain entities of the MAP MD are clear and elaborative and present all the relevant information. Therefore we consider it as a significant improvement on MAP model.

Contextualisation of MAP is our long-term project. In future research, we will explicitly present underlying semantics for the notations used to denote links between domain entities and MAP diagram. In addition, we will test further our approach in industrial settings.

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References