Requirements Engineering for Business Advantage: the Strategy Dimension of e-Business Systems

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Abstract

As a means of contributing to achievement of business advantage for companies engaging in e-business we propose a requirements engineering approach for e-business systems that incorporates a business strategy dimension. We employ both goal modeling and Jackson's Problem Frames approach to achieve this. Jackson's context diagrams, which are used to represent the business model context, are integrated with goal-models to describe the complete business strategy. As a means of simultaneously decomposing both the optative and indicative parts of the requirements problem, from an abstract business level to concrete system requirements, we leverage the paradigm of projection in both approaches while maintaining traceability to high-level business objectives. A proof-of-concept case study from the literature shows the feasibility of our approach.

1 Introduction

Much theoretical and empirical evidence indicates that companies are able to gain business advantage over their direct competitors via strategies that leverage IT [1-8]; however, this advantage is only made *sustainable* through *managerial skills* in understanding *how to use IT* as part of a greater strategy for competitive advantage, rather than by superior IT infrastructure or competency of IT staff alone [9, 10]. Companies thus face many challenges in order to achieve sustainable business advantage over their competitors: they must not only devise effective business strategies, but it is critical that they ensure their IT systems are in harmony with and provide support for their business strategy [11].

While it is not likely that organizations that engage in e-business will call upon requirements engineers to design and develop their business strategy we believe that requirements engineers can contribute to these organizations' business advantage by helping ensure that requirements of e-business systems align with, support, and enable business strategy. To properly achieve this contribution, it is important for the requirements engineer both to understand the organization's business strategy and to have a means of representing strategic context within requirements engineering processes. Unfortunately, few requirements engineering approaches incorporate a business strategy dimension [12].

We propose a requirements engineering approach for e-business systems that incorporates a business strategy dimension as a means of contributing to a company's achievement of business advantage. Our approach integrates Jackson's problem diagrams [13] with goal modeling. We employ Jackson's context diagrams and notion of projection from the real world to the *machine* to describe business model problem context. Goal-modeling techniques capture all optative properties of the system, including business goals, strategic objectives, activities and any other business or systems requirements. The rest of this paper is organized as follows: section 2 presents the background to our work; section 3 describes our approach and shows how Problem Frames and Goal Modeling can be integrated; section 4 presents a proof-of-concept case study based on the literature describing Seven-Eleven Japan; section 5 offers some conclusions.

2 Background

In this section, we discuss previous research and describe the requirements engineering techniques we use in our own approach. In section 2.1, we present a working definition of e-business systems and review previous requirements engineering research that addresses e-business issues. In section 2.2 we discuss problem frames, their background and their potential to describe and decompose complex problem contexts for e-business systems. In section 2.3 we discuss uses of goal modeling as a means of refining business goals and strategy to system requirements.

2.1. Requirements Engineering for e-Business

An *e-business system* enables marketing, buying, selling, delivering, servicing, and paying for products, services, and information, primarily across nonproprietary networks, in order to link an enterprise with its current and target customers, agents, suppliers, and business partners [14].

There has been little *direct* treatment of issues specific to e-business systems in requirements engineering research. Most requirements engineering research that addresses e-business does so in the context of requirements engineering for Web-based systems. For example, Overmeyer proposes an approach that emphasizes graphic design and usability. Overmeyer treats Web sites as a publishing paradigm in terms of online brochures, magazines, and community forums, instead of as a means via which to conduct business transactions [15]. Also, Lowe observes the need to handle "volatility of requirements" arising from changes in business models brought about by implementation of Web-based e-business systems [16]. Lowe suggests that Jackson's Problem Frames might be used to address this problem, but leaves his observations as an area for future research without proposing specific means or methods. Zowghi and Gervasi propose future research to develop a "Design-First-Spiral-Model (DFSM)," in which the requirements engineering process is driven primarily by systems architecture and user requirements considerations [17]. The proposed DFSM approach, however, appears to give little attention to business models or objectives.

Web-based systems research tends to lose sight of business aspects in favor of architectural and usability concerns. This research also fails to propose specific requirements engineering approaches, preferring instead to highlight differences between Web-based systems and traditional software. In addition, by virtue of being "Web-based," this research effectively excludes addressing issues of e-business systems that do not use the Internet for connectivity or Web browsers as user interfaces.

Gordijn and Akkermans address issues in e-business more directly in the e^3*-value* approach [18]. The e^3*-value* approach involves multiple business stakeholder perspectives, to trace requirements for business value across a *value model*. The focus of this approach is to use requirements engineering techniques as tools to identify business value in e-commerce propositions. The e^3*-value* approach, however, has been viewed as lacking some fundamental analysis that normally appears in a valuation of an e-business proposition [12, 19, 20]. In addition, e^3*-value* is an approach that *identifies business value* via requirements engineering techniques, not an approach that *identifies requirements* for an e-business system.

Overall, what little requirements engineering research that addresses e-businesses systems there is fails to propose concrete requirements engineering approaches for e-business systems. In addition, this research lacks a business strategy dimension, upon which business advantage is based.

2.2. Problem Frames

Problem Frames, as a requirements engineering approach [13], with its strong emphasis on describing and decomposing problem contexts as they exist in the real world, is potentially a powerful tool for requirements analysis of e-business systems. Most recent research on Problem Frames has focused on what one does when one has got the frame and wants to engineer from there [21-23] or on proposing variations of frames [24] or entirely new frames [25, 26]; only Cox and Phalp attempt to derive appropriate problem frames from business process models for an e-business system [27].

While problem frames serve as powerful means of linking requirements to problem context, they are somewhat weaker at relating requirements to each other when projecting from problem context towards the *machine*. This is particularly important in problem decomposition of highly complex systems, in which complex problems are projected into increasingly detailed sub-problem diagrams. The detailed description of explicit linkages (traceability) between requirements in problems and those in the projections of their sub-problems in a *progression of problems* (see [13] pp. 103-4) is missing. We thus propose the addition of goal modeling as an effective means of describing that requirements projection.

2.3. Goal Modeling, Business Objectives, and Strategy

Goal-oriented modeling techniques in requirements engineering, in contrast to the Problem Frames approach, provide a powerful mechanism for requirements projection in goal refinement. As such, goal modeling serves as a means of linking high-level strategic goals to low-level systems requirements [28]. In fact, a number of goal-oriented techniques have been proposed for modeling business goals and objectives in the context of requirements. Gross and Yu propose using the Non-Functional Requirements (NFR) Framework to model patterns of non-functional requirements linked to organizational and systems objectives, and business goals [29]. Yu and Liu propose the *i** Framework to model organizational tasks and objectives in terms of "strategic" dependency relationships between organizational actors [30]. Liu and Yu combine and extend the NFR and *i** frameworks in a more comprehensive goal-modeling notation called the Goal-Oriented Requirements Language (GRL). They demonstrate its use in reasoning about requirements decisions in the context of business goals for systems architectures [31]. Rolland *et al.* describe a process called *scenario authoring* that employs both goal modeling and scenario analysis as a means of discovering highly abstract business goals and link requirements to them [32]. Antón shows the use of the Goal Based Requirements Analysis Method (GBRAM) in identifying requirements based on analysis of abstract business objectives for an e-commerce application in an industrial project [33].

While the research into goal modeling techniques cited above treat business goals as discrete, independent entities, other approaches assemble business goals and their sub goals into structures representing complete business strategies, and then anchor requirements to the strategy model. Hay [34] proposes using the Business Motivation Model of the Business Rules Group [35] to model business strategy in the motivation column of the Zachman Framework for enterprise architectures [36, 37]. Bleistein *et al.* propose using goal-oriented requirements engineering techniques as a means of integrating modeling of business strategy with requirements for e-business systems [12].

However, despite their application to modeling business goals and strategy, goal-oriented modeling techniques have a number of shortcomings. First, they tend to be deficient in describing problem context [35]. Second, goal models tend to bloat quickly, threatening manageability [38]. This is potentially a show-stopping problem in development of large e-business systems, which can be exceedingly complex. Third, as goals are inherently hierarchical, at times it is difficult to discern where a business goal is situated in the hierarchy and how it relates specifically to the business problem domain and context. Moreover, for every business goal, there is always a discoverable super goal, and thus goal-modeling techniques require explicit upper bounding of the problem domain [13, 39].

3 Problem Frame Based Approach

We present our justification for applying the Problem Frames approach to business strategy in section 3.1. Then in section 3.2 we discuss both the idea of a *progression of problems* and why it is appropriate to the e-business domain as a means of expressing context. Section 3.3 shows how goal modeling can represent the requirement.

3.1. Business Strategy as Problem Diagrams

Oliver offers a working definition of *business strategy* based on a broad survey of strategy research as "the understanding of an industry structure and dynamics, determining the organization's relative position in that industry and taking action either to change the industry's structure or the organization's position to improve organizational results" [40].

This notion of strategy is not unlike that of a *problem* according to Jackson [13, 41]. The "understanding of an industry structure and dynamics," and "determining the organization's relative position in that industry" in essence means *describing the business model*. We define business model as *a macro-level model of interaction of participants in a business system describing generating of value* based on business model descriptions adapted from [14, 42].

The business model is in fact *problem context*, and represents the *indicative* part of *strategy* [13, 41]. "Taking action either to change the industry's structure or the organization's position to improve organizational results," is the organization's strategic business plan. This is the *optative* part of the *strategy* [13, 41], that describes the way in which the organization desires to change the real world. We take this as *requirements*.

We thus propose that an e-business strategy can effectively be represented as a *problem diagram*. The e-business system can be represented as the *machine* in the problem diagram. We recognize that an e-business system is in fact a collection of many machines working in concert, but at this level of abstraction, we represent the entire system as one *machine*, in accordance with Jackon's rule [13]. The participants in an e-business system, the suppliers, customers, third-party service providers, each represent *domains of interest* [13, 41]. The *requirements* are the *optative* part of the strategy; i.e., the objectives and activities of the firm through which it attempts to succeed in its business, in large part via its e-business system. We consider all optative properties of a system to be requirements, including business goals, objectives, activities and any other business or systems requirements.

3.2. E-Business Problem Frames as a Progression of Problems

While problem frames may serve to describe an e-business problem at the highest strategic level, such a high-level problem diagram does little to describe the details at the machine level. E-business problems at the highest level of business strategy are in fact very distant from the *machine*, or what Jackson describes as "deep in the real world" [13].

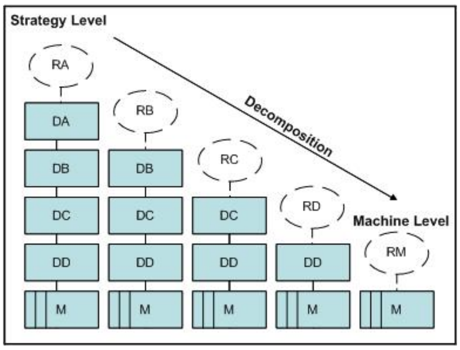

Fig. 1. A Progression of Problems (adapted from [13] p. 103)

To refine requirements from high-levels of abstraction down to the *machine*, the paradigm of a *progression of problems* is particularly useful (Fig. 1). The complexity of e-business systems as well as the need to align requirements with the highest levels of business strategy has in fact pushed the domain model deep into the real world. A discussion of problem progression appears in [13]. We have adapted parts of that discussion to illustrate the application of a progression of problems to e-business systems below.

The *domain* DA in Fig. 1 represents the *indicative* macro-level business model. *Requirement* RA represents the *optative* strategy. Through analysis of DA and RA, it is possible to find a requirement RB that refers only to DB while satisfying RA [13]. DB represents the projection of DA, but at a lower level of abstraction. Through this process of analysis, problem projection, and refinement, ultimately the requirement refers to just to the *machine*.

While the paradigm of a *progression of problems* serves as a powerful framework for decomposing e-business strategy down to *machine* requirements, the Problem Frames approach provides little explicit linkage between requirements at different levels of the progression. In the example above, requirement RB must satisfy requirement RA, and RC must satisfy RB, which satisfies RA, and so on. In order to insure that system requirements are indeed in harmony with and provide support for business strategy, explicit traceability from lower level requirements to the highest level is necessary; however, while Jackson proposes analysis of DA and RA in order to find RB [13], a framework for or means of doing this is not described. Moreover, the Problem Frames approach provides no direct linkages between RA and RB.

3.3. Integrating Goal Modeling with Progression of Problems

Goal modeling is a useful technique to describe explicit linkages between lower-level requirements and higher-level objectives [28], and therefore using goal-models to represent the requirements part of the problem diagram is a possible means to trace requirements between problem diagrams in progression. Goals represent objectives that the system ought to achieve, and refer to properties that are intended to be ensured [39]. Goals are thus requirements at a higher level of abstraction. Therefore, we treat goals as *optative*, as we would a requirement, equally bounded by the problem domain [13, 41]. Goals may be formulated at different levels of abstraction, from high-level strategic concerns to low-level technical ones [28]. The optative nature of goals, their flexibility in representing objectives at different levels of abstraction, and their traceable linkages upward to super goals, downward to sub goals and ultimately to *machine* requirements, make goal modeling a useful tool in describing the requirements part of problem diagrams when developing e-business systems. We therefore propose the integration of goal modeling with problem frames as a means of helping ensure that the requirements are in harmony with and provide support for business strategy.

Fig. 2. Goal Model Integrated with Progression of Problems

The integration of a goal model with a progression of problems is illustrated in Fig. 2. The optative requirements at each level are described in terms of a portion of a larger goal model. The goal portions represent requirements at a level of abstraction equivalent to that of the *domain* to which they refer within the progression of problems. Each goal entity refers to specific *domains of interest* within the referred domain. The goal model enables explicit connections to requirements at adjacent levels in terms of super goals and sub goals. The sub goals are in fact projections of their super goals, and satisfaction of the sub goals guarantees satisfaction of the super goals in the same way that satisfaction of RB guarantees satisfaction of RA (Fig. 1).

Thus the goal model effectively ensures that the requirements are in harmony with and provide support for business strategy from highest-level to lowest-level requirements while enabling traceability from *machine* requirements to strategic objectives. The problem diagrams in the progression of problems complement the goal model by providing problem context at various levels of abstraction with explicit linkage to requirements. Moreover, the integration of problem diagrams with goal modeling also improves manageability of goal models of complex systems. The sub problems enable a decomposition of the requirements, represented as portions of the goal model, into manageable chunks, while still maintaining explicit linkages. Also, individual business goal entities are explicitly situated in the context of the problems at explicit levels of problem abstraction. Finally, the context diagram describes the problem context that bounds the goal model.

4 Proof of Concept Case Study: Seven Eleven Japan

We use a business case from literature of Seven Eleven Japan's e-business system to illustrate our problem frame approach using integrated progression of problems with goal modeling. We take the case of Seven Eleven Japan (SEJ) from a number of sources [14, 43-48].

4.1. An Overview SEJ's Business Strategy

Seven-Eleven Japan, like its US progenitor, manages a national network of convenience stores. Unlike Seven-Eleven USA, SEJ generates value by leveraging and controlling ownership of information to optimize efficiency across a value chain with an unparalleled manner of sophistication. SEJ actually owns very few physical assets. The company positions itself in the center of a value chain that includes manufacturers, distributors, third-party logistics providers, and franchise shops, all of whom are independently-owned companies, yet all of whose objectives are maximizing throughput of products ultimately sold to franchise shop end-customers. SEJ's macro-level business model includes the participants mentioned above and their shared phenomena in terms of transactional flows of money, information, and products, based on the description of e-business models appearing in [14].

SEJ bases its strategy for competitive advantage on an extremely high level of competency at anticipating consumer purchases store-by-store, item-by-item, hour-by-hour, and then providing customers with products they want when they want them. SEJ's strategy leverages information technology to accomplish its strategic objectives. Its ownership of information enables sophisticated supply chain management to reduce inventories, lower costs, and increase sales. SEJ moves information between itself and its partner companies via an ISDN network (incidentally, SEJ's e-business strategy is *not* Internet-based, nor are its systems Web-based). SEJ actively gathers and analyses purchasing information in real time, and correlates this with other social and environmental factors, including neighborhood demographics, planned local events like festivals, and the weather, to better understand customer demand. SEJ then uses a highly acute just-in-time (JIT) delivery system to meet that demand generating remarkable value. It is these activities and their objectives that constitute the optative part of the SEJ e-business problem.

4.2. Progression of Problems of SEJ

Let us examine the progression of problems of SEJ's e-business system from the top, macro-level of business strategy down to machine devices used in the franchise shops. (Please see Figure 3, to which we refer throughout this section. Note that for the purposes of describing the approach we are only concerned with a particular sub-problem within Figure 3 and that Figure 3 describes only part of the SEJ e-business system problem.) The macro-level business strategy is the top-level problem that is deepest into the world. It is here that we bound our problem, because it here that SEJ bounds their problem.

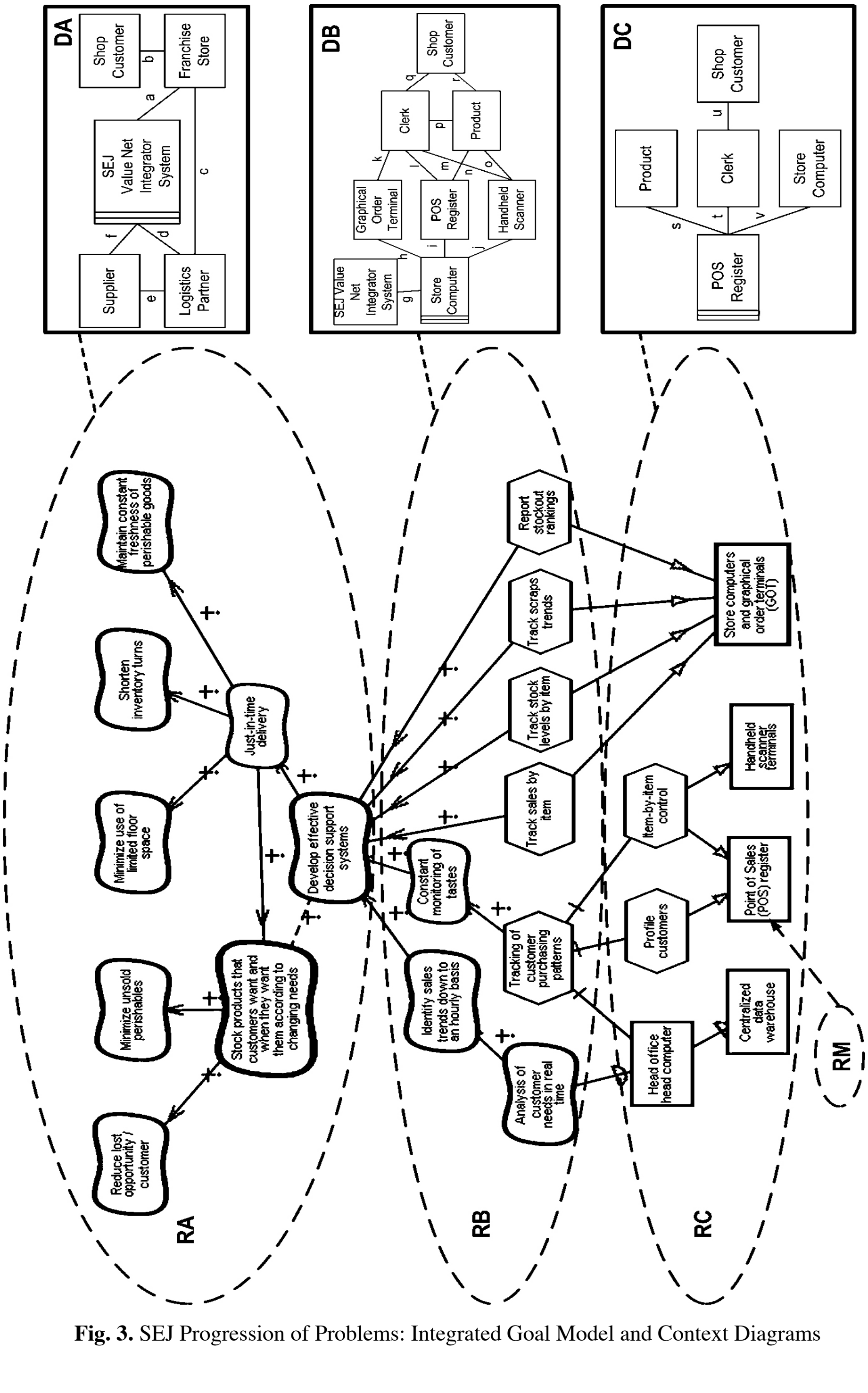

Fig. 3. SEJ Progression of Problems: Integrated Goal Model and Context Diagrams

The progression of problems consists of an indicative part, which we describe as a progression of context diagrams, and an optative part, which we describe as a goal model. We represent the goal model in GRL notation, overviews of which are described in [31, 49]. We chose the GRL notation because of its expressiveness in being able to represent both abstract and non-abstract goals, tasks, and resources, which we felt would be helpful in modeling requirements for SEJ's complex e-business system. Please note that the entities in the goal model are grouped by dashed-line ellipses (RA, RB and RC in Fig. 3). The goal entities within the ellipses represent requirements referring to context diagrams in the progression at equivalent levels of abstraction (DA, DB and DC in Fig. 3). The integration of the goal model and the context diagram at each level in the progression presents a *problem diagram* for that particular level of abstraction.

We now describe this progression in finer detail. Our aim in the example presented here is to demonstrate traceability and alignment with requirements at higher-levels, deep into the real world. To understand the context we explore the goal model at its highest level (RA) that we are concerned with, i.e. business strategy. SEJ's requirement is to *Stock products that customers want when they want them according to changing needs*. This meets the goals *Reduce lost opportunity / customer* and *Minimize unsold perishables* and is achievable by *Just-in-time delivery*, which in turn supports the goals of *Maximize use of limited floor space, Shorten inventory turns* and *Maintain constant freshness of perishable goods*. These requirements and goals can be met by *Development of effective decision support systems*. The scope of the requirement set can only be understood by an exploration of its context.

The corresponding context diagram (DA) shows the *machine* domain *SEJ Value Net Integrator System*. This retrieves the *Just-in-time* data it needs from the *Franchise Store* domain (interface *a*). To know what to deliver just in time (a goal in RA), the needs of the *Shop Customer* must be understood (interface *b*). This meets the main requirement of RA (*Stock products that customers want and when they want them* achieved through *just-in-time delivery*) and also meets its supporting goals. The *machine* domain provides the necessary information to the *Supplier* (interface *f*), which in turn uses a *Logistics Partner* to deliver the goods, supporting the goal *Just-in-time delivery*. The shared phenomena *e* represents the delivery schedule, the goods themselves and delivery address. The *Logistics Partner* must also provide its schedule details back to the *SEJ system* (interface *d*) about its delivery (interface *c*). The *Franchise Store* also provides details of the sales of perishable goods, how the store is stocked and how this affects the sale of goods. Inventory and sales information is highly automated; its requirements can only be understood by continuing the progression of problems.

To meet the goal to *Develop effective decision support systems* (in RA) that helps achieve the requirements of RA, the Requirement Set RB has three goals and a number of supporting tasks. RB now focuses on how the *Franchise Store* can work effectively to meet SEJ's requirements. Thus, in order to *develop effective decision support systems* one must *identify sales trends down to an hourly basis*. To meet this requirement one must have *analysis of customer needs in real time*. Allied to *sales trends* is the *constant monitoring of tastes*.

The context diagram at this level is a progression from that of DA. To meet the Requirement RB, DB's context shows the composition of the *Franchise Store* of DA. The *Franchise Store* domain in DA is composed of several domains, two of which are also present in DA. The *Shop Customer* is present in both DB and DA since it is the *Shop Customer's* needs that are the basis for identifying sales trends down to an hourly basis (meeting two of the goals in RB). The other domain to appear in DA and DB is the *SEJ Value Net Integrator System*. This receives all the *Store Computer* data critical to the success of the strategy captured in RA. In DB, the *machine* domain *Store Computer* performs the tasks described in RB. The *Shop Customer* must present the *Clerk* with *Products* for purchase, and must also pay for the goods (interface *q*). The *Clerk* scans the *Products* (*p*) into the *Point of Sale Register* (*l*). Upon successful scan of a product's barcode (*m*), the *POS* automatically passes product data to the franchise *Store Computer* (interface *i*) in real time. The *Store Computer* processes and then relays information to the *SEJ Value Net Integrator*, again in real time (interface *g*), thus meeting the goals in RB. The other domains of interest, present the franchise store context diagram DB, are other devices that are not part of the focus of this example.

Referring to the goal model, the requirement set RC contains a number of devices. However, our focus in this example is the *Point of Sale register (POS)*, represented as a GRL *resource*. It has two tasks that have to be performed to satisfy the task in Requirement Set RB, *Tracking customer purchase patterns*. We thus present the domains of interest in the context of the *POS* in DC. Here, the *Clerk* interacts with the *Customer* at checkout (interface *t*). The *Clerk* is required to *Profile the customer* (a task in RC), and accomplishes this by inputting the gender and the approximate age of the *Shop Customer* (clerks determine gender and approximate age by sight, and do not actually query the customer). One of the requirements of the *POS* is that the cash drawer not open and sales cannot complete until the clerk has entered this information. The second task in RC is *Item-by-item control*, meaning that when products are scanned, the *POS* is tracking products item-by-item as they are sold off the store's shelves (which meets tasks at the RB level that help enable the strategic goals of RA). This product data is also associated with customer profile, and time and date of purchase. Finally, this information is sent to the *Store Computer* (interface *v*) for storage, processing, and transmission to SEJ, meeting its goal in RB (analysis of customer needs in real time) and task (tracking of customer purchasing patterns). Both of these are required in order to meet further goals in RB that support those in RA.

While in our model, our requirement RM refers to the *POS* register directly, we recognize that the *POS* is in fact a fairly complex machine. Its problem context would likely be decomposed into a domain DD, and further into recurring problem frames. We do not illustrate this here, because this is not the focus of our paper. Jackson describes numerous examples of this type in his book [13].

4.3. Discussion of the Integrated Approach

The indicative problem context diagrams in the progression of problems and the optative goal model mutually complement each other via integration of goal-oriented modeling techniques and the Problem Frames approach. This integrated approach addresses a number of issues associated with both problem frames and goal modeling separately discussed in sections 2.2 and 2.3 respectively. In the integrated approach, goal modeling provides explicit linkage between requirements in problem diagrams at different levels of abstraction as determined by the context diagrams. The domains and interfaces in DA describe the context for the *Value Net Integrator System* derived from what is deemed necessary to meet the goals in RA whose focus is the strategy of SEJ. For instance, it is impossible to understand how SEJ *Maintains freshness of perishable goods* by itself, without some notion of the context to which that relates. Namely, that to achieve this goal there needs to be a supply and logistics network in place (domains in DA) that can respond rapidly to the just-in-time demands of SEJ and respond accurately (the right goods) and efficiently (goods arrive fresh at the store). None of this makes sense without a customer and none of this can be done without decision support systems that work (Figure 3).

We also suggest problem context diagrams improve manageability of goal models of complex systems, by breaking down requirements into more manageable goal model portions. Moreover, the context diagrams enable explicitly situating individual business goal entities in the context of the problems they address at equivalent levels of abstraction. Finally, the context diagram at the top-level of the progression of problems bounds the goal model as it bounds the problem from SEJ's point of view.

The integration of goal-oriented modeling techniques and the Problem Frames approach also offers a means of helping ensure that the requirements are in harmony with and provide support for business strategy, which in turn helps enable business advantage (assuming that the strategy is correct), as requirements are aligned top-down from the highest level of problem context and business strategy. The strategy in RA is to *Stock products that customers* *want and when they want them*, all done through *Just-in-time delivery* and meeting the supporting goals at this level. Software and systems requirements are aligned top-down from the highest level of problem context and business strategy. At the same time, it is possible to validate requirements in terms of achieving the highest business goals and strategy via bottom-up traceability in the goal model.

Integrating goal-modeling techniques with the Problem Frames approach is however not without its difficulties. First, we found some awkwardness in mapping GRL goal-models to context diagrams, particularly regarding GRL *resources*. GRL *resources* are a type of entity that attempts to describe a limited aspect of problem context within the goal model. At times, we found it frustrating trying to reconcile GRL's means of describing context with that of the Problem Frames approach, as they are not equivalent.

Both goal modeling and problem frames represent a *projection* paradigm of decomposition. However, GRL *resources,* representing domains of interest, occur only once in a goal model and their role at different levels of the goal model is made clear via GRL links. Yet, in the Problem Frames approach, the same domain of interest may recur in several problem diagrams and can be re-expressed in different projections of the problem. For example, many of the domains of interest in DB appear as resources in RC, and would also re-appear as domains in DC when we address their particular problem description.

This suggests that when integrating goal-modeling techniques with the Problem Frame approach, it may be better to refrain from expressing problem contextual entities, such as *resources,* in the goal model. Rather, it may be better show explicit links between goals and specific domains of interest in the context diagrams.

5 Conclusion

To gain business advantage, the scope of requirements of an e-business system must include business strategy. It is at this level companies engaging in e-business, like Seven-Eleven Japan, bound the problem when seeking definitive business advantage over their competitors. While we do not propose that requirements engineers make business strategy, they can contribute to achievement of business advantage by ensuring that IT systems requirements are aligned with, provide support for, and enable business strategy.

We present an integration of recognized requirements engineering approaches to address the needs of the e-business domain. Problem diagrams provide context for the indicative properties of a system based on the business model. Coupled with this, goal modeling captures optative properties of the system, including business goals, strategic objectives, activities and any other business or systems requirements. As a means of simultaneously decomposing both the optative and indicative parts of a requirements problem, from an abstract business level to concrete system requirements, we leverage the paradigm of projection while maintaining traceability to high-level business objectives.

While the approach we propose is based on research that is still in its early stages, the integration of goal-oriented modeling techniques and the Problem Frames approach offers promise as a requirements engineering tool for e-business systems. We are continuing this research; the next step is to apply this approach in an industrial setting, evaluate it, and refine it as appropriate.

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