Strategy-Oriented Alignment in Requirements Engineering: Linking Business Strategy to Requirements of e-Business Systems using the SOARE Approach

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This paper proposes the Strategy-oriented Alignment in Requirements Engineering (SOARE) *approach for e-business systems. The primary objective of the SOARE approach is to enable alignment between requirements for e-business systems and the business strategies they are intended to support. The SOARE approach incorporates means for analysing and decomposing business strategy, employing goal modelling both to represent business strategy in a requirements engineering context and to link high-level strategic objectives to low-level requirements through goal* refinement. *The SOARE approach further describes a basis for deriving and leveraging recurring requirements patterns. This paper proposes a high-level process for the SOARE approach, which is then illustrated via a proof-of-concept case study from the literature.*

ACM Classification: D.2.1 (Software – Software Engineering – Requirements/Specifications)

1. INTRODUCTION

Requirements engineering is concerned with the real-world goals for functions of and constraints on software systems, as well as the relationship of these factors to precise specifications of software behaviour (Zave, 1997). This definition of requirements engineering highlights the importance of "real-world goals" that motivate the development of a software system, while also referring to "precise specifications." Together, the *real-world goals* and the *precise specifications* "provide the

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basis for analysing requirements, validating that they are indeed what stakeholders want, defining what designers have to build, and verifying that they have done so correctly upon delivery" (Nuseibeh and Easterbrook, 2000).

An e-business system enables marketing, buying, selling, delivering, servicing, and paying for products, services, and information, primarily across non-proprietary networks, in order to link an enterprise with other e-business *participants* (i.e., current and target customers, agents, suppliers, and business partners) (Weill and Vitale, 2001). In requirements engineering for e-business systems, we consider the "real-world goals" of e-business systems to be the objectives of business strategy that the e-business system is intended to support. The requirements of an e-business system thus ought to be in harmony with and provide support for business strategy.

However, current requirements engineering approaches for e-business systems tend either to treat business strategy as a peripheral issue (Conallen, 2003; Standing, 2001; Vidgen, 2002; Vidgen *et al*, 2002; Lowe, 2003), or not consider it at all (Zowghi and Gervasi, 2001; Overmyer, 2000). Instead, most requirements engineering approaches for e-business systems focus on "precise specifications" and aspects of software design rather than the strategies e-business systems are intended to support.

The aim of this paper is to propose the Strategy-oriented Approach to Requirements Engineering (SOARE) for e-business systems, which aligns requirements with the business strategies these systems are intended to support. We developed the SOARE approach via review and analysis of literature in requirements engineering, strategic alignment, models for e-business, and business strategy. We propose a high-level process for the SOARE approach, which we demonstrate via a case study of Seven Eleven Japan's e-business system that we take from the literature.

This paper makes the following contribution to requirements engineering for e-business systems:

- A framework in which to analyse and decompose business strategy
- A means to model and represent business strategy in a requirements engineering context
- A basis for identifying and leveraging recurring patterns of requirements
- A means to verify and validate system requirements in terms of achievement of high-level strategic objectives.

The rest of this paper is organized in the following way. Section 2 discusses background literature. Section 3 describes the SOARE approach to requirements for e-business systems. Section 4 presents a proof-of-concept case study of Seven Eleven Japan. Section 5 offers conclusions.

2. BACKGROUND

In this section we review literature that motivated and aided us in developing the SOARE approach. Section 2.1 discusses research in success factors in alignment of IT with business strategy. Section 2.2 discusses current requirements engineering approaches to e-business systems. Section 2.3 discusses goal-modelling techniques in requirements engineering. Section 2.4 discusses pattern-based approaches.

2.1 Strategic Alignment

Ensuring that IT is in harmony with and provides support for business strategy is commonly known as *strategic alignment* (McKeen and Smith, 2003). Research has shown that alignment of IT with business strategy can have significant positive impact on business performance (Chan *et al*, 1997; Croteau, 2001). Also, CIOs and other IT executives have consistently considered alignment of IT with business strategy as a top priority in their roles (Brancheau *et al,* 1996; Watson *et al*, 1997; Reich and Nelson, 2003).

In order to develop a requirements engineering approach for e-business systems that helps enable successful alignment between IT and business strategy, we surveyed research that identifies strategic alignment success factors (Chan *et al,* 1997; Chan *et al*, 2002; Henderson and Venkatraman, 1999; Henderson and Venkatraman, 1991; Lederer and Mendelow, 1986; Luftman, 1999; Luftman, 2000; Luftman and Brier, 1999; McKeen and Smith, 2003; Reich and Benbasat, 1996; Reich and Benbasat, 2000; Rockart *et al*, 1996; Sauer and Willcocks, 2002). The common theme in the research is the critical importance of mutual understanding of business strategy between business and IT managers, and incorporation of this understanding into IT planning and development activities. The research recommends a variety of cross-communication and collaboration between business and IT managers to achieve this.

The recommendations made in the cited research however focus uniquely on organizational aspects without recommending techniques for use in early stage development activities such as requirements engineering. In contrast, our aim in the SOARE approach is to incorporate explicit understanding of the business strategy in requirements engineering activities as a means to ensure alignment between requirements for e-business systems and the business strategies they are intended to support.

2.2 Requirements Engineering and e-Business Systems

Business strategy has taken on increased importance in e-business systems development in comparison with traditional information systems development (Vidgen, 2002; Sambamurthy, 2000; Earl, 2001; Butler, 2000). Research outside the field of requirements engineering has addressed issues of business strategy related to development of e-business systems. For example, some management science research describes strategic issues and proposes frameworks for devising business strategy in e-business initiatives (Voss, 2000; Porter, 2001; Earl, 2000); however, making business strategy is not the purview of the requirements engineer. Others propose methodologies for planning of enterprise architectures and information engineering (Finkelstein, 1992; Finkelstein, 1989; Martin *et al*, 1981); however, these are general approaches to enterprise information systems rather than e-business systems. Moreover, these presume that the business strategy is already well understood, and focus on development of solutions rather than understanding requirements. In general, identifying, verifying, and validating system requirements that support business strategy are not within the scope of the methodologies and research cited above.

Requirements engineering research that addresses issues of e-business tends to do so indirectly in the context of requirements for Web-based systems. Some research focuses on highlighting differences between requirements engineering for Web-based systems in comparison to traditional software systems (Lowe, 2003; Zowghi and Gervasi, 2001; Overmyer, 2000). This research however focuses on architectural and usability design issues rather than real-world goals such as strategic business objectives. Others propose entire development methodologies for Web-based systems (Standing, 2001; Vidgen, 2002; Vidgen *et al*, 2002; Conallen, 2003). These are also design-oriented rather than requirements-oriented, and incorporate only limited aspects of business strategy. Moreover, Web-based systems approaches in general, by virtue of being "Web-based," effectively exclude e-business systems that do not use the Internet for connectivity or Web browsers for user interfaces, while including systems that use the Web for purposes unrelated to e-business.

Not all research in requirements for e-business systems however focuses uniquely on design and engineering of Web-based systems. Some research addresses real-world financial goals of e-business systems through *value analysis* of e-commerce applications development (Hahn *et al*, 2002; Gordijn and Akkermans, 2003). This research however neglects *requirements analysis*. A different view is taken in Castro *et al* (2002), who present a requirements-driven systems

engineering approach that considers organizational aspects in an industrial e-business project; however, their focus consists primarily of dependencies between organizational actors and goals rather than objectives of business strategy.

Most approaches to requirements for e-business systems tend to focus on producing end products of design or "precise specifications" rather than achieving the strategic objectives the e-business system is intended to support. Research that addresses "real-world" goals of e-business systems focuses on financial aspects or interactions between organizational actors, rather than issues of business strategy. Our aim in the SOARE approach however is to incorporate business strategy as a central part of requirements engineering for e-business systems.

2.3 Goal Modelling, Business Objectives and Strategy

Goal-oriented modelling techniques, while not considered specifically a requirements engineering technique for e-business systems, have been used as a means of linking high-level strategic goals to low-level system requirements through goal *refinement* (van Lamsweerde, 2001). In fact, a number of goal-oriented techniques have been proposed for modelling business goals and objectives in requirements engineering (Anton and Potts, 1998; Liu and Yu, 2001; Rolland *et al*, 1998; Gross and Yu, 2001; Chung *et al*, 1999).

However, these goal-oriented techniques treat business goals as discrete entities to be decomposed and refined into concrete requirements; only Kolber *et al* (2000) propose goal modelling as a means of constructing complete models of business strategy, and then anchoring requirements to the strategy model. Unfortunately, while Kolber *et al* describe a framework for such a modelling technique, they provide neither a modelling notation nor a concrete example of the proposed framework's use.

Our aim in the SOARE approach is to represent business strategy in a requirements engineering context. We use Goal-oriented Requirements Language (GRL) notation (Liu and Yu, 2001; University of Toronto, 2003) to achieve this.

2.4 Pattern Based Approaches for e-Business Systems

Since the 1990s, a number pattern based approaches for software design have come into use as a means of leveraging the cumulative experience of software engineers who have addressed common software design problems (Coad *et al*, 1995; Fowler, 1996; Gamma *et al*, 1995). A number of approaches of this type for e-business and e-commerce systems (Adams *et al*, 2001; Manolescu and Kunzle, 2001; Rossi *et al*, 2000; Weiss, 2003) as well as for e-government systems (Federal Enterprise Architecture Program Management Office, 2003) have also been proposed. While these approaches consider some aspects of business requirements, objectives of business strategy are not addressed in a coherent and comprehensive manner. These approaches focus primarily on architectural design, usability, and software solutions.

In contrast with pattern based approaches in software design, in requirements engineering pattern based approaches take the form of reusable patterns of problem analysis according to recurring categories of problem domains (Jackson, 2001; Jackson, 1995; Maiden and Hare, 1998; Sutcliffe and Maiden, 1998; Rubenstein and Waters, 1991; Fredj and Roudies, 1999). While these approaches give general guidance on problem analysis, the objective of the patterns they propose tend to be "precise software specification," rather than identifying recurring "real-world goals," such as objectives of business strategy.

Kilov (2002) takes a different approach and presents "business models" commonly found in enterprise information systems in an attempt to close the communication gap between business and

IT managers; however, Kilov's models represent only rudimentary operational business functions and do not address the scope of business strategy.

3. THE SOARE APPROACH

In this section we present the SOARE approach to requirements engineering for e-business systems. Section 3.1 presents the principles of the SOARE approach based on lessons learned from the review of literature in Section 2. Section 3.2 discusses decomposing business strategy into components of best practice and competitive advantage. Section 3.3 discusses recurring patterns of requirements. Section 3.4 presents a high-level process for the SOARE approach.

3.1 Principles of the SOARE Approach

In this section we describe the principles for the SOARE approach to requirements engineering for e-business systems. We lay out the way in which we address the gaps in research discussed in Section 2.

In our view, a strategy-oriented requirements engineering approach ought to include the following:

1. **Identification of business objectives within strategic scope.** As the strategic alignment research cited in Section 2.1 indicates that IT managers' understanding of the strategic objectives of the business is a critical factor in successful alignment between IT and business strategy, representation of strategic objectives ought to be built into requirements engineering processes and techniques. Oliver (2001) offers a working definition of *business strategy* based on a broad survey of modern 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." We use this definition as the basis for understanding what is meant by "business strategy" and "strategic business objective." At the same time, we leverage Porter's (1996) distinction between *best practice* and *strategy for competitive advantage* as a means of decomposing business strategy into non-recurring and recurring parts, which we discuss in Section 3.2.

2. **Traceable linkages between high-level strategic objectives and low-level system requirements.** Goal modelling techniques in requirements engineering have been used for this purpose and have been proposed for representing complete business strategies as discussed in Section 2.3. We propose using goal modelling in the SOARE approach.

3. **Inclusion of explicit statements of business strategy.** Research in strategic alignment success factors recommends a variety of cross-communication and collaboration between business and IT managers as mentioned in Section 2.1. Reich and Benbasat (2000) in particular recommend explicit cross-referencing between both written business and IT plans. In our view requirements engineering techniques ought similarly to reference explicit statements of strategic objectives. We advocate inclusion of formal expressions of business strategy by executive management in documents as they appear in business plans, annual reports, and published executive interviews, as well as stakeholder interviews with the executives, which we illustrate in the case study in Section 4.

3.2 Decomposing Business Strategy

Porter's (1996) concept of competitive strategy makes a distinction between strategy for competitive advantage and operational effectiveness, to which we refer as *best practice*. Both competitive advantage and best practice are essential to a successful business strategy.

Strategy for competitive advantage concerns what a company does differently from its rivals in processes, use of resources, and use of technology in order to provide advantage for itself over its rivals. Strategy for competitive advantage ought to be unique, and non-recurring among rival firms. Operational effectiveness, however, is about performing activities and using technology according to known best practices. In essence, strategy for competitive advantage is about how a company does things differently from rivals, and best practice is about how companies do, or should do, things in the same best way. Therefore, in our view a representation of the strategic objectives of a business ought to contain models of both best practice and strategy for competitive advantage. We represent each of these using goal modelling.

3.3 Recurring Requirements of Best Practice

Weill and Vitale (2001) propose a set of eight recurring business models in e-business initiatives based on flows of product, money and information, which they call "atomic models for e-business." The chart in Figure 1 summarizes the business aspects of the atomic models. The models are "atomic" because they represent basic business models that are modular, meaning that the atomic models can be assembled in different combinations to provide complete coverage for modelling e-business initiatives of all scopes and complexities.

From each atomic model, Weill and Vitale identify critical success factors, core competencies, and IT infrastructure requirements according to a survey of e-business initiatives around the world. These in essence represent best-known business practices for each type of model, and thus recur. As atomic models can be combined to model complex e-business initiatives, the resulting cumulative requirements for best practice are the collection of requirements for best practice associated with each atomic model. Thus we consider goal models representing best practice associated with atomic models to be recurring patterns of requirements. Therefore, we propose that Weill and Vitale's (2001) atomic models serve as a basis for reusable patterns of business requirements for best practice in e-business systems. Best practice like other objectives can be represented as a goal model, an example of which we show later in Section 4.

Model Name	Brief Description of Business
Content Provider	Provides content (information, digital products, and services) via intermediaries.
Direct to Customer	Provides goods or services directly to customer, often bypassing traditional channel members.
Full Service Provider	Provides full range of services in one domain (e.g. financial, health) from own products and best of breed, attempting to own primary customer relationship.
Intermediary	Brings together buyers and sellers by concentrating information.
Shared Infrastructure	Brings together multiple competitors to cooperate by sharing common IT infrastructure
Value Net Integrator	Coordinates activities across the value net by gathering, synthesizing and distributing information.
Virtual Community	Creates and facilitates an online community of people with a common interest enabling interaction and service provision
Whole of Enterprise/ Government	Provides a firm-wide single point of contact, consolidating all services provided by a large , multi-unit organization.

Figure 1: Atomic Business Models Adapted from (Weill and Vitale, 2002).

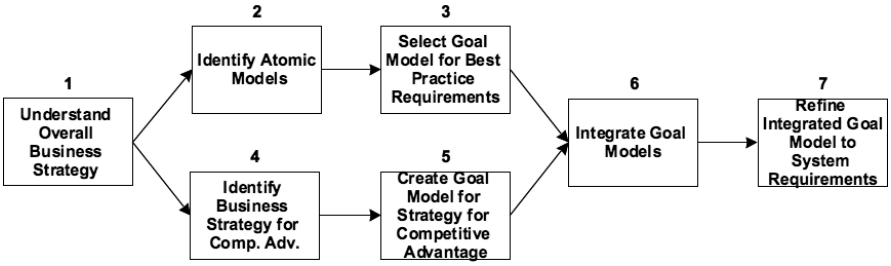

Figure 2: High-Level Process for SOARE Approach

3.4 SOARE Process

In this section, we describe a basic high-level process for the SOARE approach, which we also illustrate in Figure 2. The box entities describe activities, which we have numbered in accordance with descriptions of these activities below. We base this process on discussions in Sections 3.1–3.3. Please note that activities related to decomposing strategy into best practice and competitive advantage components are performed in parallel, and that their numbering does not necessarily imply sequence.

This process (Figure 2) takes a "divide and conquer" approach to business strategy. From an overall understanding of business strategy (1), we separate *best practice* (2) from *strategy for competitive advantage* (4), representing each as separate goal models (3, 5). We then integrate the two goal models into a single goal model (6), which we refine down to system requirements (7). These activities are described in greater detail below.

1. **Understand the overall business strategy.** This activity includes first understanding the macro-level business strategy of the e-business initiative, including the business model in terms of flows of money, product, and information. The understanding is based on business plans, annual reports, and published executive interviews, as well as stakeholder interviews with executives.

2. **Identify atomic models present in the business model.** Understanding the business model in activity 1 enables its decomposition into modular atomic e-business models. These modular models describe recurring patterns of best practice, which we take as recurring patterns of requirements.

3. **Select goal models of requirements for best practice.** The first time an atomic business model is encountered, the requirements engineer must develop the goal model of best practice. Because requirements for best practice are recurring, however, it is only necessary to develop the related goal model pattern once. In the future, it may be reused.

4. **Identify business strategy for competitive advantage.** In performing this activity it is necessary to identify the unique strategy for competitive advantage from the overall understanding of the business strategy in activity 1.

5. **Create goal model of business strategy for competitive advantage.** Defining the business strategy should yield major strategic objectives. These can be represented as goals in the goal model. It is necessary to decompose the strategic objectives into tactical objectives, or sub goals that support the strategic objectives. Tactical objectives may be stated explicitly in research

material or stakeholder interviews, or they may need to be derived through analysis and goal refinement.

6. **Integrate best practice model with model of strategy for competitive advantage.** The model of best practice and the model of strategy for competitive advantage ought to mutually support and reinforce each other. Goals in each model ought to contribute to goals in the other, and lowest-level business requirements should be in alignment with both models. In integrating the two models, the requirements engineer may encounter inconsistencies in the models derived. It may be necessary to re-iterate activities (2, 3) and (4, 5) to resolve these.

7. **Refine goal model down to system requirements.** Through analysis, it is possible to refine the integrated goal model down to system requirements. By using goal modelling to do this, each system requirement is traceable to the higher-level business objectives it supports. The goal model thus serves as a means of verification and validation of requirements.

4. CASE STUDY: SEVEN-ELEVEN JAPAN (SEJ)

In this section, we present the case of the e-business system of Seven Eleven Japan as a proof-of-concept of the SOARE approach. We take this case from a number of sources in the literature (Bensaou, 1997; Whang *et al*, 1997; Rapp, 2002; Weill and Vitale, 2001; Kunitomo, 1997; Makino and Suzuki, 1997; The Economist Newspaper Limited, 2001). We represent goal models in Goal-oriented Requirements Language (GRL) notation, a legend for which is described in Figure 3. Overviews of GRL are available in Liu and Yu (2001) and University of Toronto (2003).

In Section 4.1, we apply the SOARE approach consisting of seven "activities" (described in Section 3.4) to the SEJ case. In Section 4.2, we demonstrate the bottom-up traceability from require-

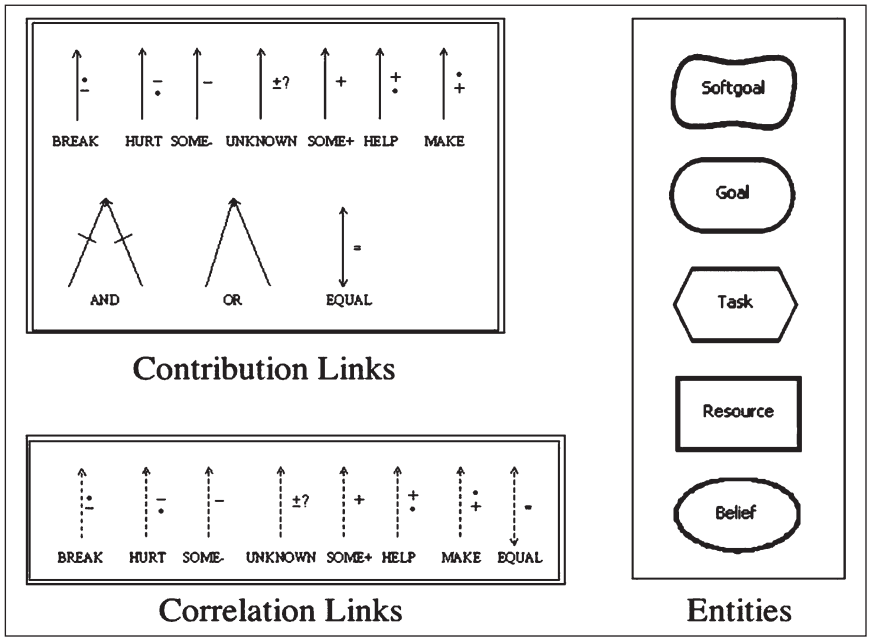

Figure 3: GRL Legend Adapted from Liu and Yu (2001) and University of Toronto (2003)

ments to higher-level objectives by example from the goal-model. In Section 4.3, we discuss lessons learned from the case study. In Section 4.4, we discuss caveats and threats to validity to the SEJ proof-of-concept case study.

4.1 Activities of the SOARE Approach

In this section, we apply the seven-activity SOARE approach to the case of the e-business system of Seven Eleven Japan (SEJ).

Activity 1: Understand SEJ's Overall Business Strategy.

In illustrating this activity, we give an overview of SEJ's business, presented in italics, based on the case study literature (Bensaou, 1997; Whang *et al*, 1997; Rapp, 2002; Weill and Vitale, 2001; Kunitomo, 1997; Makino and Suzuki, 1997; The Economist Newspaper Limited, 2001). Information from the business overview will be important to subsequent activities, which we indicate. Please note that we do not present all the details of SEJ's business strategy here due to space limitations.

> *Seven-Eleven Japan (SEJ), 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 optimise efficiency across a value chain with an unparalleled manner of sophistication. SEJ positions itself in the centre of a value network that includes suppliers, 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.*

The discussion above describes aspects of SEJ's business model. This information will be important in Activity 2, in which we identify atomic models present in the larger business model.

> *SEJ gains advantage over its competitors via its 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 IT to accomplish its strategic objectives, and gain advantage over its competitors. SEJ moves information between itself and its partner companies via an ISDN network. Its ownership of information enables sophisticated supply chain management to reduce inventories, lower costs, and increase sales. To better understand customer demand, SEJ actively gathers and analyses purchasing information in real time, and correlates this with other social and environmental factors, including neighbourhood demographics, planned local events like festivals, and the weather. SEJ then uses an acutely tuned just-in-time delivery system to meet that demand, generating remarkable value.*

The discussion above lays out SEJ's strategy for competitive advantage. This will be important in Activity 4. Incidentally, SEJ's e-business strategy is not Internet-based, nor do its systems use Web browsers as user interfaces.

Activity 2: Identify atomic models present in the business model.

We present some aspects of the SEJ business model in Activity 1. Weill and Vitale (2001) present a more detailed description and analysis of SEJ's business model (i.e., the participants in the e-business system, and the flows of money, products, and information) revealing that it is in fact

representative of the *Value Net Integrator* (see Figure 2) atomic e-business model. This is the only atomic model present in SEJ's business model.

Activity 3: Select goal models of requirements for best practice.
The *Value Net Integrator* model has a number of associated critical success factors, core competencies, and required IT infrastructure. We take these as recurring requirements for best practice, and assemble these into a goal model below in Figure 4.

Activity 4: Identify business strategy for competitive advantage.
As discussed in Activity 1, SEJ's strategy for competitive advantage is based on maximizing sales throughput via highly effective demand planning and efficiently managing its supply chain. SEJ's strategy leverages information technology to accomplish this, anticipating customer demand item-by-item and hour-by-hour while using a remarkably flexible just-in-time (JIT) delivery system to meet that demand. Incidentally, SEJ founder and CEO Toshifumi Suzuki considers SEJ's capability of anticipating and meeting consumer demand far more sophisticated than Seven Eleven USA's system and current best practice in retail in the United States (Makino and Suzuki, 1997).

Activity 5: Create goal model of business strategy for competitive advantage.
Based on understanding the business strategy in Activity 1, we identify a number of strategic business objectives that constitute SEJ's strategy for competitive advantage. Please note that while we do not describe these objectives in detail in Activity 1 due to space limitations, these objectives are described in detail in the case study literature (Bensaou, 1997; Whang *et al*, 1997; Rapp, 2002; Kunitomo, 1997; The Economist Newspaper Limited, 2001). We assemble these objectives into a goal model representing requirements for SEJ's strategy for competitive advantage (Figure 5).

Activity 6: Integrate best practice model with model of strategy for competitive advantage.
We develop an integrated goal model (Figure 6) consisting of the goal model of requirements for best practice (Figure 4) with the goal model of requirements for competitive advantage (Figure 5).

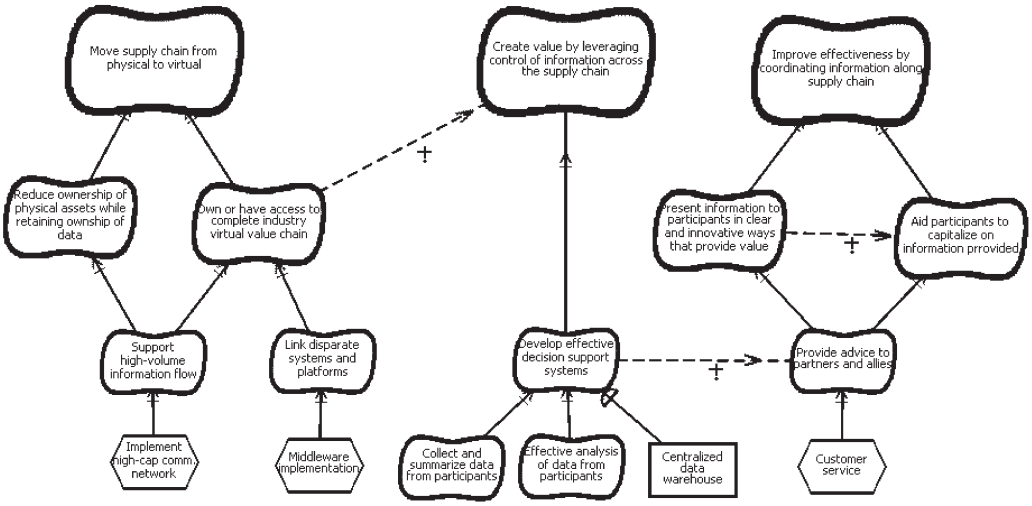

Figure 4: Value Net Integrator Model Goal Pattern

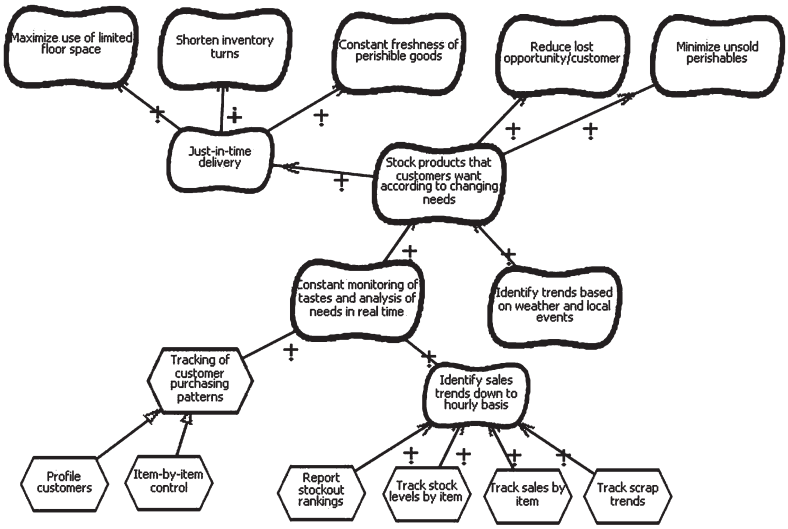

Figure 5: SEJ's Strategy for Competitive Advantage Represented as a Goal Model

The *contribution relationships* (see GRL legend in Figure 3) between the entities of strategy and best practice show how best practice and strategy for competitive advantage mutually reinforce each other in the integrated model.

Activity 7: Refine goal model down to system requirements.
The integrated goal model in Figure 6 shows some goal refinement down to lower level requirements; however, these are still at a relatively high-level of abstraction. Further analysis and refinement is necessary, but we do not show this here given space limitations. Literature describes goal refinement in requirements engineering in detail (Liu and Yu, 2001; Rolland *et al*, 1998; Chung *et al*, 1999; Darimont and van Lamsweerde, 1996). Lower-level entities in the model representing lower-level requirements are upwardly traceable to higher-level business objectives. At the same time, higher-level strategic objectives are refined down to lower level requirements. In this way, the goal model ensures that lower-level requirements provide support for and are in harmony with strategic objectives of SEJ's business.

4.2 Traceability and Validation

In this section we illustrate linkages and upward traceability from the *Point of Sales (POS) Registers*, represented as a GRL *resource*, via a short walkthrough the integrated goal model (Figure 6). We trace lower-level requirements of the *POS Register* to higher-level strategic objectives. As we trace the requirements in the goal model, we provide some additional background on SEJ's business.

The *POS Registers* use barcode scanners, commonly used in retail checkout. These had originally been developed and used in the United States in order to reduce data entry error by checkout clerks; however, SEJ introduced these in the early 1980s primarily to collect sales data and use the information for merchandising and item-by-item control of inventory. At SEJ, the cash drawer of the *POS Register* does not open until the clerk has also entered information on the client's approximate age and gender, a practice that is now not uncommon in retail today worldwide. In this way, SEJ is able to capture a profile of customers associated with purchase data (the products selected, date, and time of day) while simultaneously controlling inventory as items are sold off shop shelves.

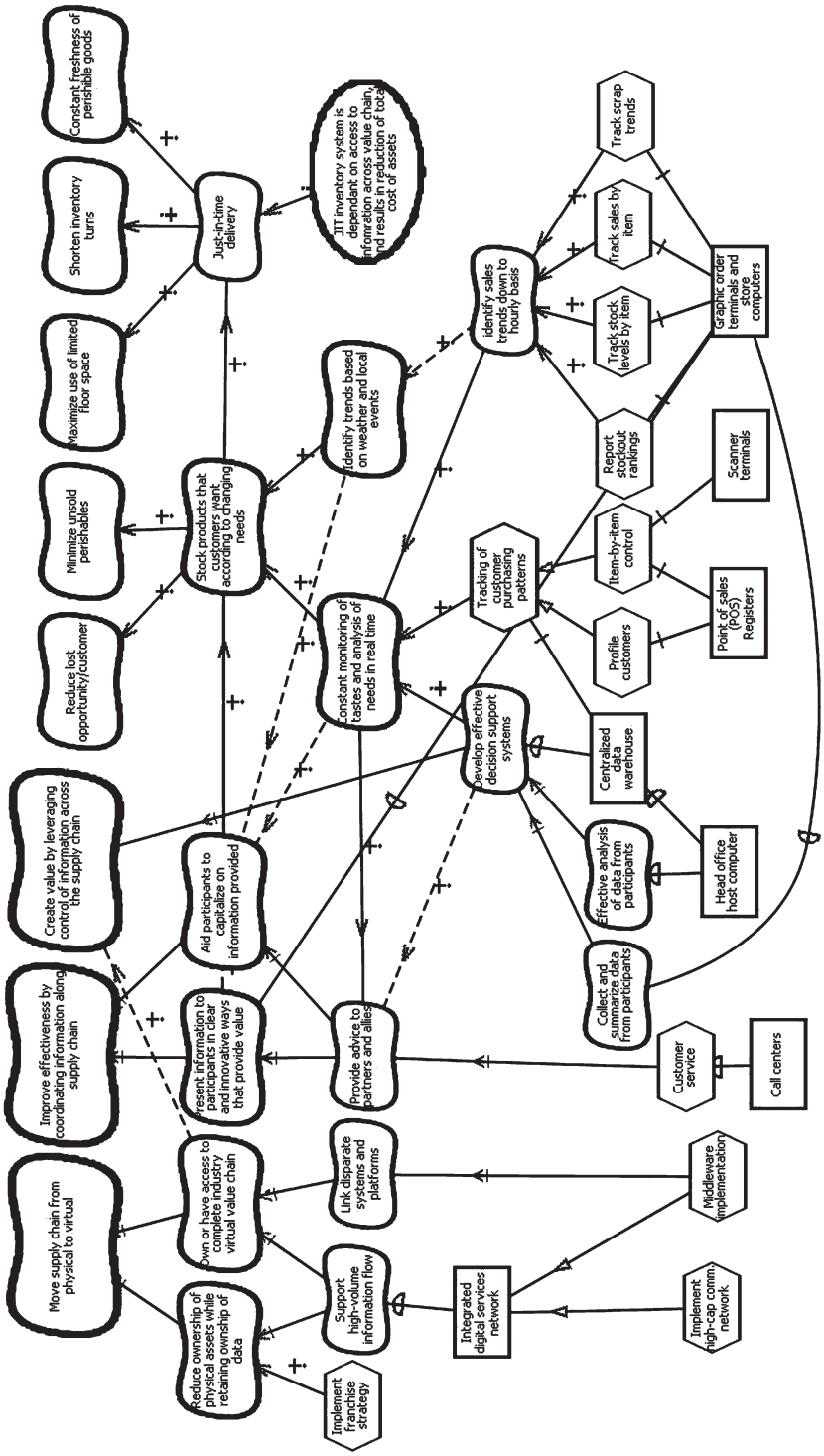

Figure 6: Integrated Goal Model of Requirements for Best Practice Business and Competitive Advantage

Referring to the goal model in Figure 6, SEJ uses the *POS Registers* to fulfil two tasks or processes represented as hexagons, *Profile customers* and *Item-by-item control*, which we can trace upward from the *POS Register* resource. These two tasks support a larger process of *Tracking of customer purchase patterns*. This process in turn supports the tactical objective, represented as a GRL *soft goal*, of *Constant monitoring of [customer] tastes and analysis of [customer] needs in real time*. This objective further supports the objective of *Stock products that customers want according to changing needs*, which in turn supports two of the highest-level strategic themes of SEJ's strategy for competitive advantage: *Minimize unsold perishables*, and *Reduce lost opportunity/customer*. The latter strategic objective refers to both losing a sale when a customer does not find the product he seeks but also to losing the customer. SEJ has found that when a customer does not find what he wants in a convenience store once, the chances are high that he will never return for anything else. We also trace a contribution link to *Just-in-time delivery [of stock]*, which further supports three other highest-level strategic objectives. Via this upward tracing, we are able to validate low-level functional requirements of the *POS register (Profile customers* and *Item-by-item control*) according to their support for high-level strategic business objectives of SEJ.

In the paragraph above, we trace requirements of the *POS register*, and show how they provide support for and are in harmony with SEJ's strategy; however, let us return to the goal entity of *Constant monitoring of [customer] tastes and analysis of [customer] needs in real time* in Figure 6. Please note the dashed line to the objective of *Aid participants [in the value chain] to capitalize on information provided*, which is one of the requirements of best practice for the *Value Net Integrator* atomic business model (Figure 4). In integrating the two goal models in Activity 6, we identified the correlation link, represented by a dashed line, during the integration of the goal models for best practice (Figure 4) and competitive advantage (Figure 5). This correlation link illustrates some of the mutual reinforcement that occurs between the goal patterns for best practice and competitive advantage.

In sum, tracing requirements upward through the integrated goal model in Figure 6 provides justification and validation of requirements in terms of higher-level objectives of business strategy. Similarly, following linkages from higher-level objectives downward through the goal model enables understanding in increasingly fine detail how higher-level objectives are achieved. In this way it is possible to use the goal model to ensure that requirements are indeed in harmony with and provide support for business strategy.

4.3 Discussion

This case study, as a proof-of-concept for the SOARE approach, yields valuable lessons that validate the broader aspects of the SOARE approach while highlighting areas requiring further development. We discuss these lessons below.

First, goal modelling appears to provide a means of representing business strategy in a way that integrates modelling of strategy with modelling of requirements. Goal modelling techniques in requirements engineering moreover serve as a mechanism by which to link requirements to strategic objectives anchored in the context of an overall model of business strategy; however, we find GRL somewhat constraining when attempting to model business strategy. All abstract business objectives are represented as soft goals in GRL, which limits our options when modelling business strategy. In business strategy there exist distinct types of business objectives, such as strategic, tactical, and operational, which Kolber *et al* (2000) describe. We might consider extending GRL notation to accommodate modelling of business strategy accordingly.

Second, the SOARE approach advocates inclusion of explicit statements of strategy articulated by management or written in formal business plans as part of requirements engineering activities.

As goal-modelling techniques can serve as a means by which to understand business strategy in a requirements engineering context, the SOARE approach offers a possible solution to cross-communication, mutual understanding, and cross-referencing of plans between business and IT functions as research in strategic alignment recommends. At the same time, we feel somewhat uncomfortable with our informal and ad-hoc process of mapping text documents discussing strategy to goal models. We perform this merely by reading the documents and noting strategic objectives. In the end, many of the modelling decisions we made were quite subjective. It is difficult for us to gauge how much variance there would be from one requirements engineer to another using this approach, and to what degree this would effect decisions about requirements.

Third, the requirements engineer can indeed leverage existing research in business literature on recurring business models to identify a set of requirements that ought to be part of the system according to known best practice. In the SEJ case study, we referred to best practices associated with the atomic e-business models proposed in Weill and Vitale (2001). This potentially provides the requirements engineer with a means of leveraging cumulative wisdom, similar to other pattern-based approaches discussed in Section 2.4; however, we find that while the atomic models provide high-level guidance for business requirements of specific e-business initiatives according to identifiable business models, these still leave significant work to the requirements engineer at lower levels of abstraction. We recognize that the more high-level and generic a model may be, the less useful it is in describing details of the system it represents.

4.4 Some Caveats

Our research is still very much in the preliminary stages. The case study is meant more as a proof-of-concept rather than a validation. We recognize and acknowledge some of the threats to validity in our proof-of-concept case study.

First, the seven "activities" in the SOARE approach are described at a very high level, and it is not clear that this approach is amenable to a sequential process. In particular, decomposing business strategy into components of best practice and competitive advantage can be performed in parallel without any particular order. Also, as mentioned above, we have not as yet proposed a specific process for extracting strategic objectives from documents or for modelling business strategy. In addition, we suggest that some activities (2, 3) and (4, 5) may need reiteration if inconsistencies are discovered in integrated the two goal models in Activity 6 according to our experience, but at this stage we propose no formal methodology.

Second, the proof-of-concept is based primarily on business case studies in Bensaou (1997); Whang *et al* (1997) and Rapp (2002). This implies that much of the analysis and synthesis work on SEJ's strategy has been conveniently pre-packaged and delivered to the authors. In a real requirements analysis situation, a requirements engineer might have to perform much of this work using raw data, business plans, and executive interviews.

Third, the lowest level of decomposition of requirements in the case study is still at a relatively high-level of abstraction. Concrete systems requirements have yet to be identified in this case study. While we propose that this is possible through further goal refinement (Liu and Yu, 2001; Rolland *et al*, 1998; Chung *et al*, 1999; Darimont and van Lamsweerde, 1996), we do not show this.

5. CONCLUSION

In requirements engineering for e-business systems, we consider the "real-world" goals of the system to be the objectives of business strategy the system is intended to support. While there is much evidence that aligning IT with business strategy is critical to success, very few requirements

engineering approaches incorporate a business strategy dimension in a coherent and comprehensive manner. To address this need, we propose the Strategy-oriented Approach to Requirements Engineering (SOARE) for e-business systems.

The meaning of "strategic objective" in the SOARE approach is based on a definition of business strategy according to modern research in the field (Oliver, 2001). SOARE further leverages Porter's (1996) distinction between best practice and strategy for competitive advantage to decompose strategy into recurring and non-recurring parts. SOARE uses goal modelling techniques not only for representing strategy in a requirements engineering context, but also for linking high-level strategic objectives to low-level requirements via goal *refinement* (van Lamsweerde, 2001). SOARE also provides a basis for leveraging recurring patterns of requirements, represented as goal models, according to atomic models for e-business proposed by Weill and Vitale (2001).

This paper presents a high-level, seven-activity process for the SOARE approach. In this process, from an overall understanding of business strategy, *best practice* is separated from *strategy for competitive advantage*, each of which is represented as a goal model. The two goal models are then re-integrated into a single model, in a "divide and conquer" approach. System requirements are derived via goal refinement of the integrated model.

This research is still in its early stages. While the proof-of-concept case study of Seven-Eleven Japan demonstrates some promise for the SOARE approach, it helps us identify some weaknesses as well. As we continue this research, we intend to address these weaknesses and further validate SOARE via industrial studies.

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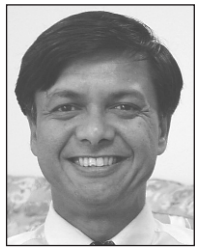

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