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Aligning Requirements with Business Objectives: A Framework for Requirements Engineering Decisions

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Abstract

As software development continues to increase in complexity, involving far-reaching consequences, there is a need for decision support to improve the decision making process in requirements engineering (RE) activities. This research begins with a detailed investigation of the complexity of decision making during RE activities on organizational, product and project levels. Secondly, it presents a conceptual model which describes the RE decision making environment in terms of stakeholders, information requirements, decision types and business objectives. The purpose of this model is to facilitate the development of decision support systems in RE and to help further structure and analyse the decision making process in RE.

1. Introduction

For many years, the study of decision making was a minor field of endeavour for researchers studying software engineering and, in particular requirements engineering (RE). However, over the past decade, there has been remarkable growth in research about decision making from a wide variety of management and social science perspectives in software engineering. This article is about decision support for RE activities.

Why is there interest in studying decision making in RE? The RE process is a complex one and an understanding of how stakeholders select requirements is an ideal starting point for the development of methodologies which facilitate and improve the decision making process and its outcomes. There are several challenges to overcome during the decision making process for selecting requirements. Firstly, it is well-known that not all requirements are equally important. Thus, there are considerations for a stakeholder to bear in mind when determining the relative importance of such requirements. Further, once a requirement is identified for inclusion in a project, a stakeholder may be required to select one of the available alternatives for implementing that requirement. To facilitate the selection of requirements and their subsequent implementation, stakeholders need an appreciation of the economic implications of their decisions in the early stages of the development process. This is especially the case when developing new products where product attributes are complex and difficult to characterize during the initial development process [6, 14]. Furthermore, it is crucial to ensure that the requirements meet business goals and are aligned with business processes. Software engineering literature has emphasized the importance of generating products that meet customer requirements and that are aligned with strategic business goals [25].

RE decisions are inextricably intertwined with business, product and project decisions as software products have a major influence on system cost, schedule and value [5]. These decisions are dependent upon the interaction between the individual stakeholders and the stakeholder group's expectations for how future businesses will evolve over time. These decisions may, for example, involve calculations of risk at business, project and product levels as well as consideration of return on investment. Some decisions are very complex as the outcome of the decision involves multi-dimensions and thus cannot be compared objectively. Hence, it is important to provide decision support to decision makers so that they can apply their preferences to a decision problem in a reasonable and reliable way. This is especially the case when dealing with unstructured or semi-structured problems where multiple stakeholders are involved, and where there is uncertainty regarding the reliability or comprehensiveness of information drawn upon during decision making [20]. The availability of reliable information sources is a key component of the decision making process. The implication of this is that good decision support to RE activities needs to consider the issues that we introduced above.

In this paper, we argue that in order to meet business objectives and align with business processes, RE decisions need to be considered in terms of product, project and business (organizational) decisions, as well as in three management levels i.e. strategic, tactical and operational levels. In other words, this paper addresses the problem of how to improve the identification and support of requirements decisions. The main objective of this research is two fold: a) to investigate the complex decision making inherent in requirements

engineering activities on different managerial levels; b) to present a model that describes and clarifies the entities involved in the decision making process in RE activities. This model relies on a conceptual modelling technique which describes the RE decision making environment in terms of stakeholders, information requirement, decision types and business objectives. The purpose of this model is firstly to facilitate the development of decision support systems in RE and secondly to help further structure and analyse the decision making process in RE. We believe that this conceptual model can also be used to derive new modeling techniques e.g. by integrating with goal modeling and scenario-based modeling.

This paper proceeds by first describing and discussing briefly the concepts related to the decision-making process in RE. In Section 3 the proposed RE decisions framework is presented. In Section 4 we attempt to model the RE decision environment by using a conceptual modeling technique. Some future research directions for the development of this work and conclusion are presented in Section 5.

2. Background

Decision making primarily involves making a choice between options which are earlier identified. In this selection process there is rarely a single perfect solution to a problem among the alternatives. Researchers have extensively studied the individual elements of complex decisions where the decision process is unstructured, consequential and preference-based. They have defined the ideal complex decision making process by using the classical decision views and incorporated these insights into decision support system models [16].

Decision making is recognized as an activity that involves *intelligence*, *design* and *choice* phases [27]. Anthony [2] notes three types of decision making activities in organizations based on the purpose of management activities: *strategic planning, management control* and *operational control*. In addition to the above, managerial decisions may have unstructured, semi-structured and structured decision components.

Indeed structured problems are more open to quantitative techniques, whereas many unstructured or semi-structured problems are solved by qualitative means using analytical tools. Decision makers apply intuition, experience, and their beliefs when solving such problems. Furthermore, when dealing with structured problems, a decision maker may always need to employ their own intuitive assessment in addition to analytical tools.

2.1. Decision Making in RE

All projects begin with a statement of requirements. RE decisions include selection of the requirements of the product to be developed, the choice of methods and tools for different activities, the identification of stakeholders, the feasibility, validation, and prioritization of requirements, and the selection of requirements to implement during release planning. Key decisions during the management of requirements engineering activities include decisions on product scoping or activity releases, planned benefits of the product, deciding which type of quality assurance technique is likely to give the best return on investment etc. In many situations conflict is inherent in requirements, thus some requirements need to be negotiated between stakeholders. The discussion between stakeholders is generally informal and unstructured, involving many decisions and review points with iterations and design implementation activities. These decisions are generally continuous and, in numerous cases, uncertainties in the final cost, schedule, performance, and functionality are inevitable.

Evans et al., [13] emphasize the importance of recognizing requirements as design decisions in order to achieve a fully integrated software system. Aurum and Martin [3] point out the resemblance between the activities involved in organizational decision making and those in the requirements engineering process by referring to classical decision making theory. They present an approach that facilitates problem solving activities for requirements engineers. Regnell et al., [23] also discuss descriptive and prescriptive research issues for understanding and supporting the requirements engineering decision making process. Rolland et al., [24] introduce a decision-oriented process meta-model that aims to capture not only how activities are performed during the RE process but also why and when these activities are performed. In general, researchers agree that the requirements engineering process is a semi-structured or unstructured complex decision making process [3, 13]. Aurum and Wohlin [4] describe the fundamental nature of requirements engineering activities in the decision making process and examine the integration of classical decision making models into requirements engineering process. Alenljang and Persson [1] discuss RE decisions from a decision theory perspective. Jiang and Eberlein [17] present a decision support model for the selection of RE processes models and techniques. A detailed analysis of current research related to RE decisions can be found in [22].

2.2. The Role of Stakeholders in RE

RE decisions are made by stakeholders. In essence, requirements engineering aims at transforming potentially incomplete, inconsistent and conflicting stakeholder goals into a complete set of high quality requirements. Typical stakeholders are product managers, various types of users and administrators from the client side, and the software team members from the software development side. Note that this view is somewhat limiting when considering software

development for markets. In other words, for market-driven software products customers may not necessarily have direct involvement in the development process. Furthermore, the degree of stakeholder involvement and the types of stakeholders may change depending on the software product and the project. For instance, the communication style e.g. negotiation process between the stakeholders will be quite different for in-house software development as opposed to customer-specific software development or the alignment of business objectives with customer requirements.

As software projects become increasingly complex, software developers face the challenge of identifying the goals of stakeholders who come from a diverse range of backgrounds. It might also very difficult to represent the essential requirements of software in a way which is accessible to all stakeholders, as software is effectively intangible [7]. The importance of stakeholder involvement in requirements engineering activities is widely accepted given that the quality of the software product is largely determined by the accurate identification of stakeholder needs.

2.3. The Role of Information in Decision Making

One reason for studying decision making in RE is that it provides a basis for identifying the nature of the information requirements at each stage and a framework for assessing the potential impact of decision aids (or technologies) on the decision making process. In many situations, incoming information to a stakeholder is external, ambiguous and its accuracy is a question mark. It is crucial to seek information about potentially important aspects of the problem. This leads to a way of relating pieces of information to each other in order to better understand the product in a business context. As a result, developers have an improved understanding of the company business, as well as business opportunities and they analyze, evaluate and select strategies to eliminate, manage or mitigate potential risks. Further discussion on information requirements for RE decisions can be found in [4].

Although to date researchers have not identified a particular method for clarifying which information is relevant to the making of decisions, information gathering plays an important role in decision making. Thus, an effective decision support system should facilitate a stakeholder's understanding of the problem under investigation as well as meet the stakeholder's information needs for making better decisions [20].

There are several attributes that describe high quality information. This includes *timeline, relevancy, reliability, accuracy, consistency, precision, completeness, reputation, objectivity* and so on. There is a large body of Information Systems literature that discusses information quality [18]. Although there is a vast amount of information available to stakeholders, it is a challenge for them to identify and absorb large volumes of information and utilize such information quickly and efficiently during the complex development process.

2.4. Business Objectives/Processes/Rules

An important issue in RE is that RE decisions need to meet business goals and must align with business objectives.

Business processes are structured organizational guidelines that illustrate how to meet business objectives. In other words a business process is '*a set of logically related tasks performed to achieve a defined business outcome*' [11]. Business objectives or business goals show how an organization will direct its efforts. When developing software, it is important that the software product meets business needs. Dawson [12] points out the relationship between the software process and business process, as most business processes involve the extensive use of software products that are embedded in business environments. On the one hand, Champion and Moores [8] point out that requirements which are elicited from stakeholders will inevitably have an influence on business rules and procedures. On the other hand, if the business objective or procedures are decided prior to requirements elicitation then software requirements will be influenced by these practices. Lubars [19] discusses how important it is to understand the effect of business changes and to record decisions made about their impact on requirements. Neumann-Alkier [21] also argues that software applications need to be well aligned with business strategies of organizations, especially in a global market where the effective management of information systems is an important contributory factor to the efficiency of organizations. In a similar way, Rosca et al., [25] argue that business rules which represent decisions about functional and non-functional requirements are requirements that arise from business objectives. In other words, business objectives determine business rules which govern software systems. The implication of the above discussion is that software developers and managers need to have a very good understanding of business objectives and ensure that their (requirements engineering) decisions meet these objectives.

3. Proposed RE Decisions Framework

The manageability of the requirements process is important as the quality of the process affects the quality of the product. By studying the decision-making process in requirements engineering activities in more detail, we can develop a better understanding of how the decision making operates within the requirements engineering process. In our earlier work, we investigated the integration of classical decision making models with RE process models [4]. Following this, based on Anthony's [2] three level managerial decisions, we briefly introduced and further developed a framework that takes into account RE decisions in

terms of product, project and business decisions [5]. In this article, we extend this work by discussing the framework of RE decisions in more detail and argue that consideration of RE decisions at three different management levels facilitates tighter integration between business objectives and RE decisions.

Table 1 illustrates classifications of software requirements. Each cell includes examples of requirements activities, namely *organization-oriented, product- oriented* and *project-oriented* decisions, and requirements decisions at three levels, namely *strategic, tactical (management control) and operational levels.* Table 1 also provides some examples of the types of decisions that can be made at the different levels. As illustrated in the framework, organizational and product level decisions are also classified as *pre-project* requirements engineering decisions (as they are intertwined), whereas project level decisions are classified as *in-project* requirements engineering decisions. The objective of software developers is to align *in-project* requirements engineering activities with *pre-pro*ject requirements engineering activities. Ideally, it is expected that product decisions are aligned with business process and project decisions are aligned with the product decisions. Although there are a large group of stakeholders in a project, when it comes to the decision making process, only a subset of the stakeholders participate e.g. product managers and project managers. Furthermore, a decision is rarely explicit. While the product requirements change during the development process, it becomes a challenge to meet project requirements if the development team has not participated in the decision making process. The objective of the decision taxonomy in Table 1 is not to illustrate that decisions are isolated from each other but to show the nature of these decisions in the context of software development. So far the research in requirements engineering has inadequately acknowledged the need to separate these two levels. To the best of our knowledge, this research is unique, in the sense that it clearly differentiates between the *pre-* and *in-project* levels of software development and then establishes and builds on the connection between them.

Table 1. RE Decisions Framework (Adopted from [5])

RE decisions in three levels		**Strategic Decision**	**Tactical Decision**	**Operational Decision**
Organizational level	*Pre project requirements engineering*	*business strategy *competitiveness *technology *marketing *economic value of the product	*pricing *planned benefits of the product	*Tradeoff between technology push and market-pull
Product level		*software product road mapping *packaging requirements for a specific release *software product architectures	*engineering decisions *personnel management	*change management *requirements volatility, e.g. whether a particular requirement is subject to a syntactic or semantic change
Project level	*In-project requirements engineering*	*project planning *feasibility study *recruiting people	*project management *quality control	*validation in terms of which requirements will go to the next release

3.1. RE Decisions in Different Levels

3.1.1. Pre-Project Requirements Decisions. Decisions at the *pre-project level* generally focus on making requirements comparable and supporting product management in eliciting, analyzing and prioritizing requirements to enable the initiation of projects. For example, analyzing the economic value of a software product is complex since such analysis cannot be carried out simply by understanding the functionality and characteristics of software technologies. It is necessary to appreciate the connection of this technology to business as well as to all aspects of the national and international economy. Such an analysis must portray the future demand for software product usage accurately. This requires estimation of productivity increases from technical changes as well as estimation of economic growth and cost of software technology. During a software product's life cycle, market values change and different characteristics become dominant and drive business. If we can understand how market values vary during the software product life cycle, this will simplify the identification of software process models with attributes that highlight market values in a particular stage. Enhancements to software products (releases) require the handling of requirements on a product level as well as, when suitable, the initiation of development projects. This includes ensuring that requirements are comparable so that they can be prioritized [15]. Different stakeholders often formulate requirements on different levels, for example, customers requiring some functionality and standards requiring fulfillment of a specific protocol.

Decisions at the Organizational Level: The senior management team of an organization may have strategic objectives and long-term goals in terms of market share and so forth. The goals and strategies at the organizational level will inevitably influence which products that an organization ought to develop. Thus, requirements posed on products must first be evaluated at an organizational level to ensure that the requirements are aligned with the goals and strategies of the organization. One of the main challenges faced when successfully developing software products is that

of determining how the end product will support business objectives.

Decisions at the Product Level: The requirements of software products must be aligned with the business goals of the software development organization. One of the crucial questions is how to balance customer and developer concerns. The requirements are typically both functional and non-functional requirements. The product management team has to ensure that requirements are aligned with the goals and objectives of the product. This may mean selecting the requirements for the product that are best aligned with the overall goals and strategies of the organization.

3.1.2. In-Project Requirements Decisions. The *in-project* part is a process that lasts for the duration of a project. In many development models it is assumed that requirements engineering in a project is conducted up front. On the contrary, requirements engineering needs to be a continuous process within the project because requirements are volatile and any changes have to be handled within the project as they occur. The research on the *in-project level* is focused on supporting project management. This includes prioritization within the project. A key issue is that of the order in which requirements should be implemented. Given that requirements are volatile, it may be best to have a strategy for how to select which requirements to design and implement first.

Decisions at the Project Level. Requirements on the product level must be packaged into parts that go into specific projects or releases of the software. It is important that requirements are prioritized and selected based on their fulfilment of both product and organizational goals and strategies. Requirements may be chosen for implementation based on whether they fulfil the needs of a specific and important customer, or whether they potentially open up a new market segment to the organization. These requirements define the conditions under which the project will be run, including issues related to project planning, risk management, budget and cost**.**

4. Development of RE Decision Making Conceptual Model

A good understanding of the structure of RE decisions and decision making process is the first prerequisite to building an effective DSS and for the effective management of requirements.

In Section 3, based on Table 1 at the horizontal level, we mentioned that product decisions are not made independent of project or business level decisions. Often, business objectives influence product decisions while project decisions are generally intertwined with product decisions. In this section, we focus on the columns of Table 1 and aim to study requirements decisions from a managerial perspective.

When investigating requirements decisions, the following components need to be considered.

a) Business process/objectives/rules
b) Stakeholders involvement
c) Information requirements
d) Decisions at three different organizational levels.

We further argue that business objectives also determine business processes and business rules. The following relationship is anticipated.

Business Objectives → Business Processes → Business Rules → Software Product Requirements

To describe the above components in a decision context, a model is needed to structure the decision making environment. We used a conceptual modeling technique to represent this model.

4.1. Selection of Conceptual Modeling Notation

We have selected to employ an Entity-Relationship (ER) model as a conceptual modeling technique for this research. An ER model forms the basis of an ER diagram (ERD) and is used to model business data. Since Chen [8] introduced the original ERD in 1976, the concept has undergone intensive further developments. ERDs are commonly used to represent meta-models in literature [26] and have been widely accepted as a de facto standard for data modeling in Information Systems and Computer Science. The version of the ER model used in this research is based on Chen's model.

4.2. Components of ERD Notation

The ERD represents the conceptual database as viewed by the end users, in terms of *entities* in the business environment, the *relationships* or associations among those entities, and the *attributes* of both the entities and their relationships. An *entity* is an object for which the system is required to hold data. It is represented as a rectangular box in the ER model diagram with the name of the entity inside. Each entity type has a set of attributes associated with it. An *attribute* is a property or characteristics of an entity that is of interest to the organization. The *value* of an attribute is the value of that attribute for a particular entity instance. Attributes have a domain. A *domain* is an attribute's set of possible values. A *relationship* is a significant link between two entities. The *degree* of a relationship is the number of entity types that participate in that relationship e.g. *unary, binary* & *ternary.* The relationships between entities can be one-to-one, one-to-many or many-to-many.

In ER diagrams, *connectivity* is used to describe the relationship classification. The ER diagram indicates

connectivity by using a specific notation. In other words, if the relationship is one-to-many from the left hand side to the right hand side, a vertical bar next to the left entity represents the one side, while a crow's foot on the right hand side represents the many side.

4.3. Components of RE Decision Making

We identified the following entities, relationships and attributes that are relevant to RE decision making. Note that we show only a subset of the attributes required for the corresponding entities. The list is not exhaustive and can change according to the business objectives, nature of the product and the context in which the decision has been made.

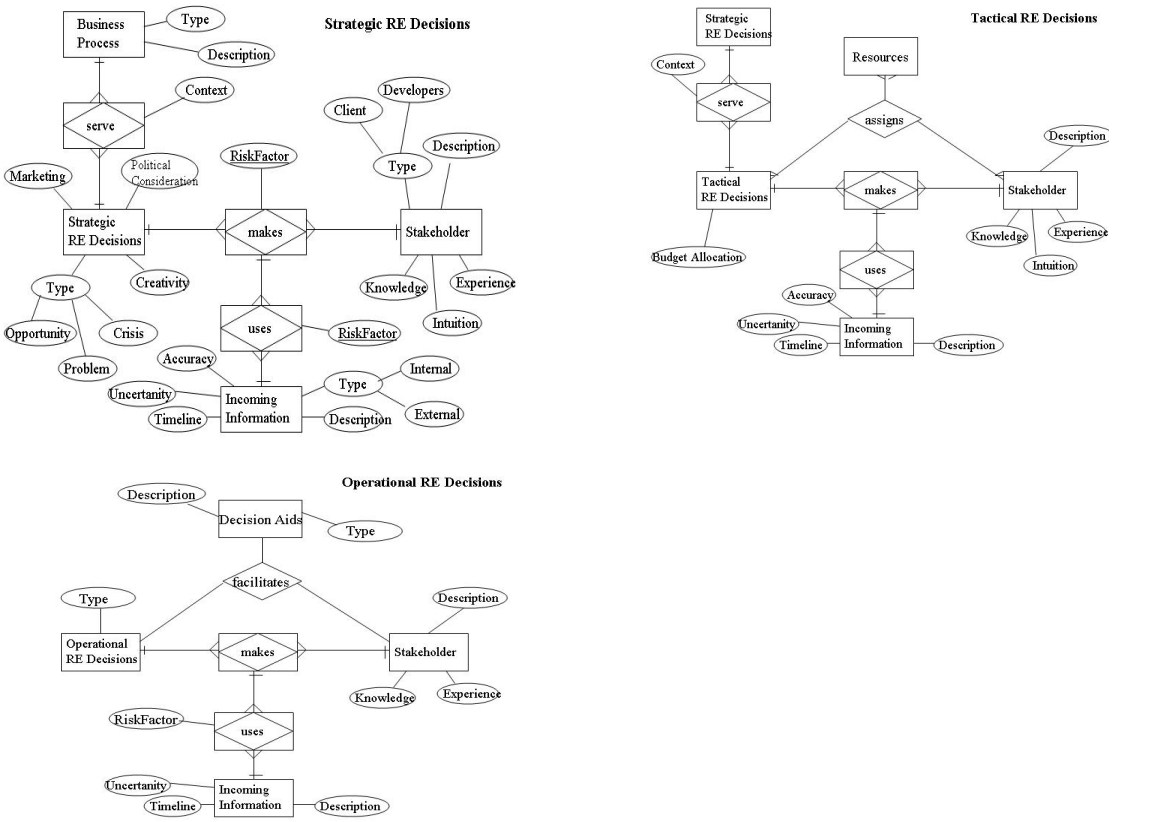

Figure 1-3. Strategic, Tactical and Operational RE Decisions

Entities and Attributes

- *Business Process/Objective:* Type, Description
- *Strategic REs Decisions:* Decision type e.g. opportunity, problem, and crisis; creativity, marketing, political considerations and so on.
- *Tactical RE Decisions:* Decision type, creativity, marketing, political considerations, budget allocations and so on.
- *Operational RE Decisions:* Decision type e.g. opportunity, problem, and crisis; creativity, marketing, political considerations and so on.
- *Stakeholders:* Stakeholder type, description, knowledge, experience, and intuition.
- *Incoming Information:* Accuracy, type, uncertainty, timeline, description, relevancy and so on.
- *Resources:* Stakeholders use several resources when making tactical decisions. Resource type and resource descriptions are examples of attributes.
- *Decision Aids:* There are several types of decision aids, including decision trees, decision support tools. Type and description are examples of the attributes

Relationships

- *Serves:* This relationship is between the Business Process and RE decisions and is a many-to-many. The nature of this relationship may change according to context in which a decision is made.
- *Makes and Uses:* Stakeholders use information when making decisions. The relationship between strategic RE decisions, stakeholders and Incoming information is ternary. Risk factor is an attribute that belongs to relationships.
- *Assigns:* Stakeholders use resources when making tactical decisions.

Facilitates: Operational decisions generally use quantitative tools. Stakeholders may use decision aids when making operational decisions.

4.4. RE Decision Making Environments

This section illustrates the entities of RE decisions at three different levels, namely strategic, tactical and operational levels. Figures 1-3 show the components of a RE decision making environment. Note that some of the attributes are not displayed in the figures because of the space limitations. Note also that Figures 1-3 do not distinguish between pre- and in-project decisions. It takes a more generic view of the entities involved during the decision making process.

RE Strategic Decisions: Strategic decisions in requirements activities require creativity and opportunistic inputs, and should be based on an accurate understanding of current business processes and a detailed understanding of the software product. An example of strategic decisions includes that of packaging requirements for a specific release of a software product. In the early stages of product development, developers need to decide which requirements to include in the next release and which ones to postpone to the following release. This is a strategic decision from a product point of view as some crucial features of the product, i.e. requirements, may signify the difference between gaining and loosing market share.

RE Tactical Decisions: Tactical decisions are about the implementation of strategic decisions. The decision maker is constrained by the availability of key resources, *i.e*. human and non-human resources. For example, decisions may involve answering the following questions: What kind of development and implementation strategy will be taken? What sort of project management do we have? What are the planned benefits? What are the resource reductions? What are the product enhancements? What priorities are placed upon the achievement of these benefits?

RE Operational Decisions: Decisions made during this stage involve a solution to a given situation. Accuracy of information is an important issue in decision making at this level. The activities involved here are concerned with the implementation of requirements. The information involved in this stage is quite detailed and arises from organizational sources. Decision makers may consider several tools and decision aids when making decisions. In operational control project managers are concerned with delivery of the software product and meeting the project budget.

5. Conclusion and Future Study

The growth in strategic importance of IT brings with it the need for tools, techniques and processes to be integrated with software system requirements so that they are aligned with the strategic business objectives and business models of the organizations they support. Business change is a part of system development. As systems become more integrated and involve more users from diverse backgrounds, software developers are pressured to understand the implications of their decisions in relation to cost/benefit analysis, particularly during early life cycle activities.

The research presented focuses on decision making during RE activities and provides a framework that addresses the decision making process within early life cycle activities. We address two major issues in this article: a) ensuring that requirements decisions are aligned with business process/objectives throughout the RE activities and b) provision of better decision support for RE activities.

Table-1 presents a framework of RE decisions that differentiates among the various perspectives on RE decision making and incorporates them into a single framework. We argue that in order to ensure that RE decisions are aligned with business objectives, we need to first understand which types of decisions are made in software development, namely organizational, product and project level decisions which are intertwined with each other.

It is also essential to capture all relevant information during the requirements engineering process so that stakeholders can select the best alternatives when deciding on requirements. Hence, it is important to understand the relationship and interactions between business processes, stakeholders, RE decision types in terms of strategic, tactical and operational decisions and information usage, Figures 1-3 have been constructed to illustrate the relationships between these elements. Figures 1-3 harness the simplicity of a straightforward and well recognised modelling technique (ERD) to simplify and represent the complexities of the decision making environment for software developers, and in turn facilitate the development of decision support systems in RE. Note that this model should not be viewed as a static representation of database design waiting to be developed/implemented and populated.

We believe that this model has the potential to facilitate the derivation of new modeling techniques e.g. by integration with goal modeling and scenario-based modeling. This is yet to be studied.

There is still further opportunity to analyse and model the decision making environment as Figures 1-3 only represents the main entities, ignoring lower level entities. For example, stakeholders are classified as a single entity, although they could easily be decomposed into further separate entities, such as developers and customers, which would improve the readability of the model. Furthermore, some of the entities covered in, for example, Figure 3 may be used in Figure 1 as well.

The contribution of this paper lies in its synthesis of classical decision making frameworks with RE decisions and its development of a conceptual model that describes the entities involved in a decision making environment. We expect that this conceptual model will enhance the body of current academic knowledge on the subject of RE decisions. The research can also benefit practitioners in this field, by understanding the factors that influence effective decision support to RE activities, and software developers can better plan for their RE activities. This conceptual model has not yet been empirically evaluated. We currently have two PhD and two Honours students at the University of New South Wales, Australia and three PhD students at Blekinge Insitute of Technology, Sweden who are conducting further explorations into this project.

Reference

1. B. Alenljung, A. Persson, "Supporting requirement-based decision-making in the software engineering process: A position paper". REFSQ'04, 63-68, Riga, Latvia, 2004
2. R.N. Anthony, Planning and Control Systems: A Framework for Analysis, Harvard U., Boston, USA, 1965
3. A. Aurum, E. Martin, "Managing both Individual and Collective Participation in Software Requirements Elicitation Process", 14th Int. Symp. on Computer and Information Sciences, Kusadasi, Turkey, 124-131, 1999
4. A. Aurum, C. Wohlin, "The Fundamental Nature of Requirements Engineering Activities as Decision Making Process". Journal on Information and Software Technology, 45(14): 945-954, 2003
5. A. Aurum, C. Wohlin, "Requirements Engineering: Setting the Context". In Managing and Engineering Software Requirements, A. Aurum, C. Wohlin (Eds.) Springer-Verlag, Germany, 2005, ISBN: 3-540-25043-3
6. B. Boehm, Value-Based Software Engineering. ACM SIGSOFT, Software Eng. Notes, March, 28(2): 1-12, 2003
7. BSC'04, The challenges of complex IT projects". Royal academy of engineering and the British computer society, ISBN 1-903496-15-2. Access on 20th October 2004 http://www.bcs.org/BCS/News/PositionsAndResponses/Positions/complexity.htm
8. R.E.M. Champion, T.T. Moores, "Exploiting an enterprise model during systems' requirements capture and analysis" ICRE, pp. 208, 1996
9. P.P., Chen, "The Entity-Relationship Model – Toward a Unified View of Data". TODS, 1(1), 9-36, 1976
10. CREWS (2003): Cooperative Requirements Engineering with Scenarios, http://www-i5.informatik.rwth-aachen.de/lehrstuhl/projects/crews/ Accessed on 1st March, 2003
11. T.H., Davenport, Process Innovation, Harvard Business School Press, Boston, MA, 1993
12. M. Davson, "Are Software Processes Business Processes Too?" Panel Session of the Proceedings of the 3rd Int. Conference on the Software Process, 177-178, 1994
13. R., Evans, S. Park, H. Alberts, "Decisions not Requirements: Decision-Centered Engineering of Computer-Based Systems", Int. Conference on Eng and Computer-Based Systems, 435-442, 1997
14. S.R. Faulk, R.R. Harmon, D.M. Raffo, "Value-base Software Engineering: A Value-driven Approach to Product-line Engineering", 1st Int. Conf on Software Product-Line Engineering, Colorado, August, 2000
15. T. Gorschek, C. Wohlin, "Requirements Abstraction Model". Under review, 2005
16. C.W. Holsapple, A.B. Whinston, Decision Support Systems: A Knowledge-Based Approach, West Pub. Comp, USA, 1996
17. L. Jiang, A. Eberlein, "Decision Support for Requirements Engineering Process Development". Canadian Conference on Electrical and Computer Engineering, 1359-1362, 2003
18. B.K. Kahn, D.M. Strong, "Information Quality Benchmarks: Product and Service Performance". Communications of the ACM, 45(4): 184-192, 2002
19. M. Lubars, C. Potts, C. Richer, "A Review of the State of the Practice in Requirements Modelling". IEEE RE Conf, San Diego, 1993
20. S. Maurice, G. Ruhe, O. Saliu, A. Ngo-The, R. Brassard, "Decision Support for Value-Based Software Release Planning". In: Value Based Software Engineering, S. Biffl, A. Aurum, H. Erdogmus, B. Boehm, P. Grunbacher (Eds.), Springer 2005 ISBN 3-540-25993-7
21. L. Neumann-Alkier, "Think Globally, Act Locally – Does it Follow the Rule in Multinational Corporations?" 5th European Conf. on Information Systems 541-552, 1997
22. A. Ngo-The, G. Ruhe, "Decision Support in Requirements Engineering. In: Engineering and Managing Software Requirements", Springer Berlin, Heidelberg, New York, ISBN: 3-540-25043-3, 2005 (in press)
23. R. Regnell, B. Paech, A. Aurum, C. Wohlin, A. Dutoit, J. Natt och Dag, "Requirements Mean Decisions! – Research Issues for Understanding and Supporting Decision-Making in Requirements Engineering", 1st Swedish Conference on SE Research and Practice, Ronneby, Sweden, 49-52, 2001
24. C. Rolland, C. Souveyet, M. Moreno, An Approach for Defining Ways-Of-Working, Information Systems, 20(4), 1995, pp. 337-359, 1994
25. D. Rosca, S. GreenSpan, M. Feblowitz, C. Wild, "A Decision Making Methodology in Support of the Business Rules Lifecycle". IEEE RE Conf, 236-246, 1997
26. M. Rosemann, P. Green, "Developing a Meta Model for the Buge-Wandweber Ontological Constructs". Information Systems, 27:75-91, 2002
27. H.A. Simon The New Science of Management Decisions. Prentice Hall, Inc. Englewood Cliffs, NJ, USA, 1960