

# MODELING BUSINESS GOAL FOR BUSINESS/IT ALIGNMENT USING REQUIREMENTS ENGINEERING

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## ABSTRACT

It is widely accepted that sustaining Business and Information Technology (IT) alignment is a complex task, due to the lack of appropriate alignment methodologies, rapid changes in running business processes and insufficient IT techniques to cope with such changes. One way of achieving successful alignment is the development of an IT system which meets business expectations. This is only possible if IT analysts take the organizational environment into account prior to implementing the system. This paper presents an organizational goal-oriented requirements elicitation approach which will allow the IT department to better understand the business goals of the organization to enable them to develop an IT system which will meet business expectations. It also describes what kind of goal modelling and human input is required in order to implement the “automatic modelling IT infrastructure” methodology. A process of order management in an automobile company has been used as a case study to validate the approach.

**Keywords:** Business goal; goal modelling; requirements elicitation; alignment; system development; case study.

## 1. INTRODUCTION

Over the past several years, the issue of information technology (IT) alignment with business has surfaced as a top level concern for business executives and IT practitioners. The term *IT-Business alignment* refers to the degree of fit between business and IT activities such as business strategy, business infrastructure, IT strategy and IT infrastructure etc. Moreover, alignment is the process by which both business and IT become interrelated, where IT aims to provide services at all levels of a business organization to achieve their goals and objectives effectively [3, 31]. However, achieving strong alignment remains a difficult process for several firms due to a lack of IT support and rapid changes in the business environment, particularly in relation to changes in consumer services, technologies and product lifecycles. Therefore, in this rapidly changing and highly competitive environment, firms demand a system that supplies effective and efficient IT services at all levels of an organization.

The development of an IT system which is in line with business expectations firstly needs an appropriate requirements engineering (RE) process, where four common RE tasks must be performed prior to implementing the system: requirements elicitation, requirements negotiation, requirements specification, and requirements validation. Requirements elicitation helps IT developers better understand the organizational goals that

the system under consideration aims to develop and the goals that describe the needs and constraints regarding the system under implementation. Requirements negotiation helps to identify business goals and establishes an agreement between business and IT as to the system requirements. Requirements specification is used to describe the system behavior that needs to be implemented and describes the context of the organization which uses the system. This is also known as system functional specifications. Finally, requirements validation aims to ensure the final system requirements meet the stakeholders' needs and that these requirements fulfill the internal and external constraints set by the organization [2, 4, 37]. Second, the development of a successful IT system not only needs an understanding of business requirements or the completion of common requirements engineering tasks, the business activities must also be taken into account before commencing the development phase of the system. Therefore, goal modeling is required before performing requirements elicitation for the system.

Business goal modeling is an enterprise language which is used to identify the business goals and the hierarchy among goals. Whereas the “goal” represents the number of stakeholders and their objectives, “model” is used to analyze the goals. The language is well accepted among business analysts in order to maintain an organizational structure which is easy to understand within organizational-related activities. A number of modeling techniques are described in the literature, and a few of these consider business goals in context with the clarification of system requirements [6, 10, 14, 17, 19]. However, these contain several weaknesses: 1) the techniques are complex to understand and provide little information on business goals, as IT people tend to lack business knowledge and setting business goals is a complex process; and 2) they are unable to support business analysts in this rapidly changing business environment, as the techniques require a huge amount of time to implement.

This paper presents the business goal-driven requirements elicitation approach in the context of information technology (IT) alignment with business and answers the following two questions: 1) does having a business goal positively influence the requirement engineering process in the context of IT-Business alignment?; and 2) what kind of goal modeling and requirements elicitation is required for the implementation of the “automatic modeling IT infrastructure approach” proposed by A. Ullah and R. Lai [34]? A process of order management in an automobile company has been used as a case study to validate the approach and to ensure the development of an IT system that successfully fulfils the needs of the business and that positively influences the successful process of IT-Business alignment.

Received: August 3, 2010

Revised: October 12, 2010

Accepted: November 3, 2010

Spring 2011

Journal of Computer Information Systems

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## 2. THEORETICAL CONCEPTS OF ALIGNMENT

From the early days of organization management, researchers have drawn a great deal of attention to the importance of alignment between IT and business, yet still, in this advanced technological age, the problem is still one of the top concerns of business executives and managers. The concept of alignment emerged early in the 1970s [27, 28]. Since this time, alignment scholars have struggled to tackle the issue through linking the business plan with the IT plan. But the early approaches were ad hoc, given the level of dissatisfaction in organizations regarding their respective information technology (IT) departments. These theories have expanded over time and nowadays, researchers point out many issues and challenges, and have developed different suitable alignment techniques and models.

Alignment can be defined as the degree of fit and integration between business strategy, information technology strategy, business infrastructure, and information technology infrastructure [23]. Alignment can be measured in various directions [7, 9, 11, 30, 33, 38]. These directions are characterized with respect to an organization's strategy, structure, culture, and social direction. In regard to an organization's strategic directions, researchers normally consider a "formal strategy" and an "informal IT strategy" in order to measure alignment. On the structural side, researchers focus on "structure complexity", and "rapid changes in organizational structure". On the organizational culture side, researchers investigate the "lack of communication between business and IT", "weak relationships between business and IT" and "low IT belief within the organization". Finally, in relation to the social direction of the organization, factors such as a "lack of shared domain knowledge", a "lack of business knowledge of IT" and a "lack of IT knowledge in the business" are considered. Moreover, alignment can be divided into several phases, each phase representing a specific part of the business organization, for example, internal or external phase, department phase, project phase, etc. In the external phase, the business organization is aligned with the business partner or with other similar business organizations including clients, dealers, competitors etc. In the internal phase of alignment, business aligns with the other departments within the organisation. This kind of alignment could be organization phase alignment, department phase alignment, upper and lower phase alignment, project phase alignment, system phase alignment, etc [23].

## 3. BUSINESS GOALS AND REQUIREMENTS ELICITATIONS

Business goals are used to represent organizational objectives/targets that need to be completed and for the implementation of business targets, business goal modelling is required. Goal modelling is a language which is used to specify an enterprise's goal and is derived from a modelling language known as Extended Enterprise Modelling Language (EEML). It is a useful method by which to capture and clarify the business goals of an enterprise. Developing business goals is a complex process, as one business goal can carry more than one sub-goal and every sub-goal is linked to each other, therefore, it is important that these are explored for better clarification. For example, Figure 1 shows a business goal which contains a further four sub-goals, where every sub-goal is linked to each other and it also shows the relationships between each sub-goal that describe the flow and priority of the goal [2].

In relation to requirements engineering, it is widely accepted that business goals can play a pivotal role in capturing the details of business and system requirements engineering. The details of system requirements engineering include: requirements elicitation which is used to clarify the organizational goals that the system under consideration aims to develop and the goals that describe the needs and constraints regarding the system under implementation; requirements negotiation which is used to explore the business goals belonging to stakeholders and helps to define agreement between stakeholders on system requirements; requirements specification which is used to provide a wider description of the system behaviour that needs to be implemented and describes the context of the organization which uses that system; and requirements validation which aims to ensure the final requirements meet the stakeholders' needs in regard to verification and final approval [2, 4, 37].

In this proposed methodology, we extract the information from the business goal to complete the system requirements engineering elicitation phase as shown in Figure 1. The process recommends four attributes of requirements elicitations in regard to understanding business: *who* — defines stakeholders or system agents; *where* — describes the location of the system to be used; *when* — outlines the time frame by which stakeholders need the system; *why* — describes what needs to be included in the system and the reasons stakeholders need the system.

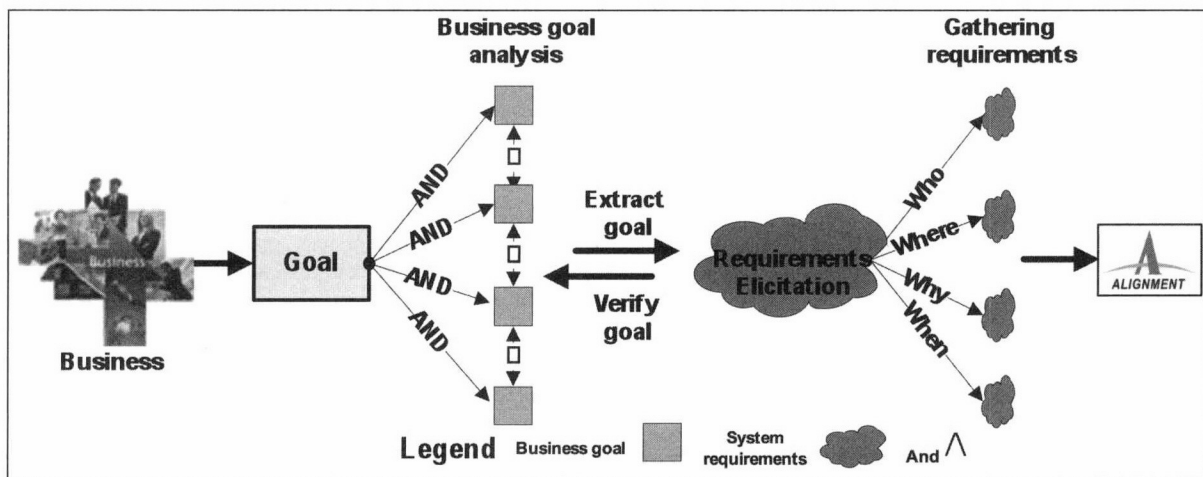


FIGURE 1 — Business goal modeling versus requirements elicitation

#### 4. RELATED WORK

Over the last couple of decades, organizations have faced rapid changes in the business environment that have negatively affected business performance. To compete in this environment, organizations require strong IT-Business alignment. However, the literature shows that sustaining strong alignment between these two departments has long been a crucial issue on which researchers have worked for many years in an attempt to bridge the gap by proposing different alignment techniques and models, but unfortunately, these were business driven rather than IT driven. As IT staffs often have difficulty understanding business goals and objectives, a lack of information on business goals may hinder the system requirements engineering process and the development of IT systems which meet the expectations of the business.

After a comprehensive literature review on alignment, we believe that the concept of system requirements elicitation in the context of alignment between business and IT has not previously been studied in great depth. Only a few researchers have examined this issue, collectively producing a good deal of work such as *I\**, GOMS, Goal-based Workflow, KASO, EKD [6, 10, 14, 17, 19]. The *I\** framework is based on a business goal modelling concept that enables IT analysts to examine the business requirements at an early stage of system development. It requires the organization's actors to clarify the business goals and strategy. According to the framework, the organizational actors have their own goals and beliefs and each actor is connected to one another. The GOMS and Goal-based Workflow methodologies propose a business goal modelling infrastructure for requirements elicitation in regard to clarifying the organizational goals/objectives and to understanding the current organizational situation. KAOS is a business goal-based methodology for system requirements engineering that addresses several requirements engineering aspects which include: elicitation, requirements analysis and requirements management. This methodology also helps in the successful completion of business requirements and helps in detecting conflicts between the IT and business sectors. The Enterprise Knowledge Patterns (EKD) is the language used in the requirements engineering analysis phase to model the business, for example, what needs to be included in the proposed system and how to implement it.

All these methodologies have several drawbacks. First, the methodologies are complex for IT analysts and developers to understand. Secondly, they do not provide enough information on business processes or goals, as one business goal is a combination of different sub-goals that need to be explored in order to analyze the business goal completely. Thirdly, the methodologies are time consuming. In the latter part of the last century, with the rapid increase in globalization, businesses need to move faster and require quicker IT system implementation, and have a strong relationship involving clear communication with IT.

#### 5. THE PROPOSED FRAMEWORK

A typical business organization is a combination of a set of complex management activities which includes a business model, business strategy and operations, where the business model is used to refer to how an organization creates, delivers, and captures value; the strategy is defined and meets the goals of the business model; and the operations implement the business strategy which consists of people, processes, and technological elements. Processes in business operations are the stable key elements which need to be well managed and fit optimally with the proposed business strategy and other related organizational activities. The organization needs an efficient business process to enable the business strategy to be implemented and to achieve business goals and objectives effectively [5]. However, it has long been well known that organizations continuously face problems in organizing the business process.

The aim of the requirements elicitation approach is for IT developers to better understand the business expectations of the required IT system which includes: who is the stakeholder? What needs to be included in the proposed system? Why is the system needed? And where is the system going to be used? The proposed approach is structured in two parts as shown in Figure 2. Part 1 describes the specifications of the business strategy and business infrastructure which is based on the widely accepted strategic alignment model called SAM, proposed by Henderson and Venkatraman [23]. Part 1 is further divided into three levels: level 1 details the organization's stakeholders, aims, objectives and available resources; level 2 describes the business strategy in the form of the business mission statement, strategic goals and targets, and the way to evaluate the strategy;

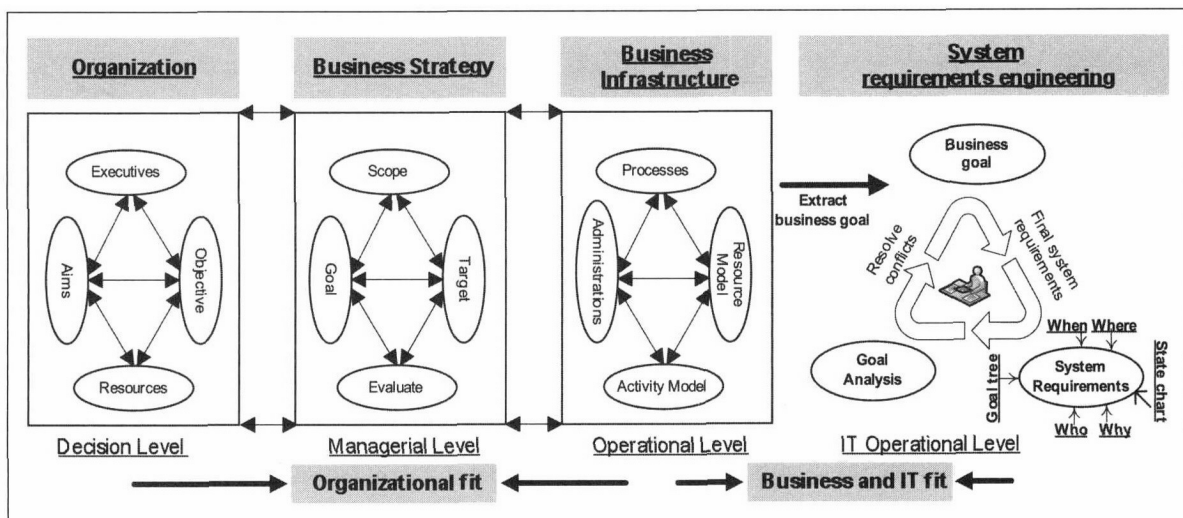


FIGURE 2 — Proposed approach framework



the supply of auto parts in different cities around the country. The company order management process has been divided into four different phases. In the first phase, the company system accepts the order request and forwards it to the company head office, where they check the customer's details. In the second phase, the system checks the customer's chosen payment method after the order has been placed. If the payment method is accepted, the order is forwarded to the operational department or the order is cancelled if the payment method is rejected. In the third phase, the manager checks the stock availability, and orders new items in the case where there is no stock, otherwise the stock is forwarded to the store man to complete the order. In the fourth phase, the store man assembles a package that includes the spare parts, the invoice and the recipient's address and ships the order to the customer.

### 5.3. Connecting the IT environment with business

Linking the IT environment with business and vice versa is always a critical task for business executives and IT-Business alignment researchers, due to the complexity of the business structure, as typically, there are at least three important pillars in an organisation: the business model, the business strategy, and the operations. For the success of the business, it is important that these three pillars are linked with one another due to the interdependency of their functionalities. After the organizational infrastructure has been modelled, the proposed approach connects the business infrastructure or environment with IT in order to maintain appropriate specifications between both these two groups. This linkage enables IT technicians to develop a system that reflects the organization's behaviour and meets the needs of the organization; hence strong IT-Business alignment can be achieved. Figure 2 shows that IT and business linkage is possible with the help of BPMN.

### 5.4. Modelling IT infrastructure and requirements elicitation

The term *IT infrastructure* refers to a set of shared IT resources that work together to achieve common goals. The notion of IT infrastructure became popular in the mid 1990s. It consists of technical and human components. On the technical side, it includes networks, software, hardware and telecommunication,

while on the human components side, it includes human technical skills and capabilities, and knowledge of IT resources to enhance business performance. However, in the context of aligning IT with business, the processes progressively become more and more complex every day and businesses change their goals/objectives rapidly. In a situation such as this, the IT infrastructure needs to be flexible so that rapid changes in business goals and objectives can be managed [8]. Therefore, the system requirements elicitation process is important for the success of IT infrastructure. The development of a suitable IT system is the major component of IT infrastructure and occurs in several phases: requirements engineering, designing, implementation, and testing and evaluation; the implementation of each phase is based on the requirements elicitation phase.

Business goals refer to the organizational goals and objectives that must be met and in context with IT infrastructure. It is widely accepted that business goals can play a pivotal role in sustaining all aspects of requirements engineering [2, 4, 37]: requirements elicitation, requirements negotiation, requirements specification, and requirements validation. Moreover, one business goal can carry more than one sub-goal that needs to be explored in regard to complete implementation. This approach uses goal and task concepts to model the business process and to extract goals from it, as well as to analyze the goal. Figure 4 presents the goal tree diagram for the anticipated business process, where rectangles are used to represent business goals and circles illustrate tasks that need to be performed in relation to the business goal.

After the goal tree of the selected business process has been finalized, the goals are then analyzed in order to obtain valid systems requirements which answer the following: who is the stakeholder? Why is the system needed?; what needs to be included in the system?; and when is the system needed? The IT analysts first examined the goal and then labelled the leaf elements of the goal according to the nature of the business goal and task. If the IT analyst considers a particular goal/task cannot be automated by IT and that it needs to be performed manually, this is marked with a cross. After the completion of the whole business process, the goals/tasks which were marked by a cross are removed from the goal tree diagram. The final goal tree diagram is then converted into a UML state chart that presents a true picture of the system requirements elicitation.

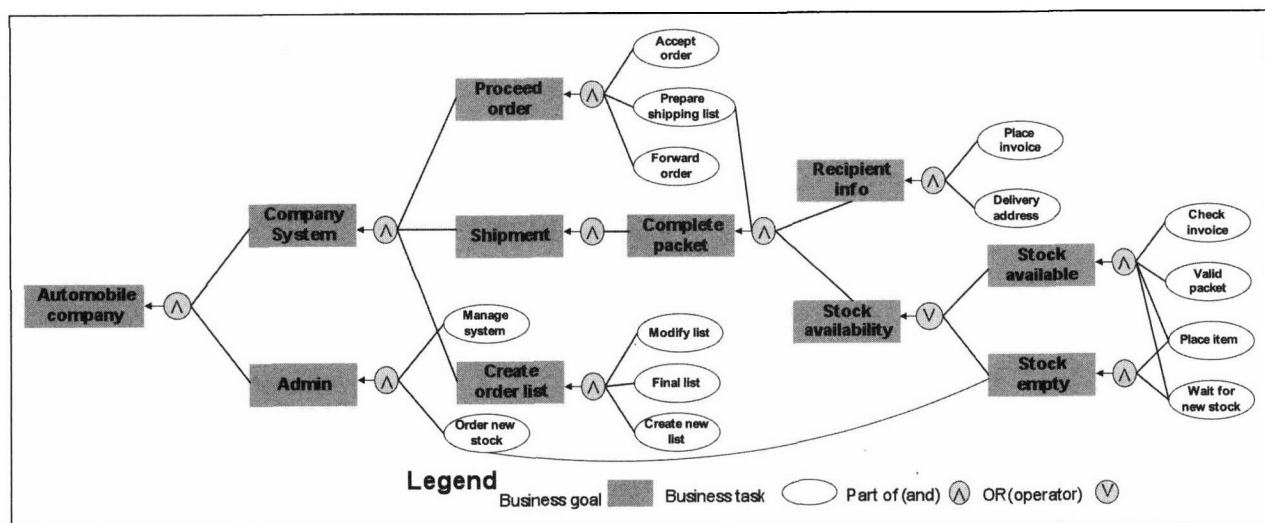


FIGURE 4 — Goal tree for business process

### 5.5. System requirements elicitation

Developing an IT system which is in accordance with business demands is always a challenging task due to a lack of system requirements elicitation techniques and a lack of business knowledge among IT people which causes the business performance to suffer. Therefore, requirements elicitation is important before the developmental phase of the system. After the goal tree of the case study has been finalized, the UML state charts are then generated from the tree. Figure 6 presents how an IT analyst generates the system requirements using a UML state chart. A total of six actors are involved in generating the state chart: first, a “customer” who places the order; second, the “company system” which represents the company administration staff and is responsible for receiving the customer order; third, the “store manager” who is responsible for managing the order; fourth, the “store man” informs the “store manager” in a case where there is no stock; fifth, the “complete packet” is the actor responsible for completing the packet, making sure that the packet contains the correct items and the invoice. After receiving the packet from the “complete packet” actor, the “shipping company” actor organises the shipment of the packet.

The UML state chart allows the system analyst to modify any requirement package at any stage of the state chart in regard to ambiguity. System analysts collect all state charts in one packet and send this to the developers for completion. The developers

first check the package to see if there is a goal or a task that has been labelled with a cross or a circle, and if so, the developer sends the package back to the system analyst for further modification. The state chart package will be implemented in cases where there is no error. Moreover, the state chart diagram at this stage clearly depicts the business goals; and exactly what the system has to do and how it should do it, which positively influences the development of a successful IT system and influences the process of implementing a strong IT-Business alignment.

### 6. IMPLICATIONS OF THE WORK

Today, most business executives and managers agree that information technology can play an increasingly major role in the business organization sector. However, over the past several years, organizations have faced rapid changes in the business environment, particularly in relation to changes in consumer services, technologies, product lifecycles, and globalization of the market. Therefore, successful organizations usually employ a structure with many complex components: first, a precise business model is used to create, deliver, and capture the organization’s values; second, an efficient business strategy is required to implement the proposed business model; and third, the operations, which consist of further sub-components such as people, processes, information technology (IT) etc. Developing an IT system which meets the expectations of the business and provides IT services

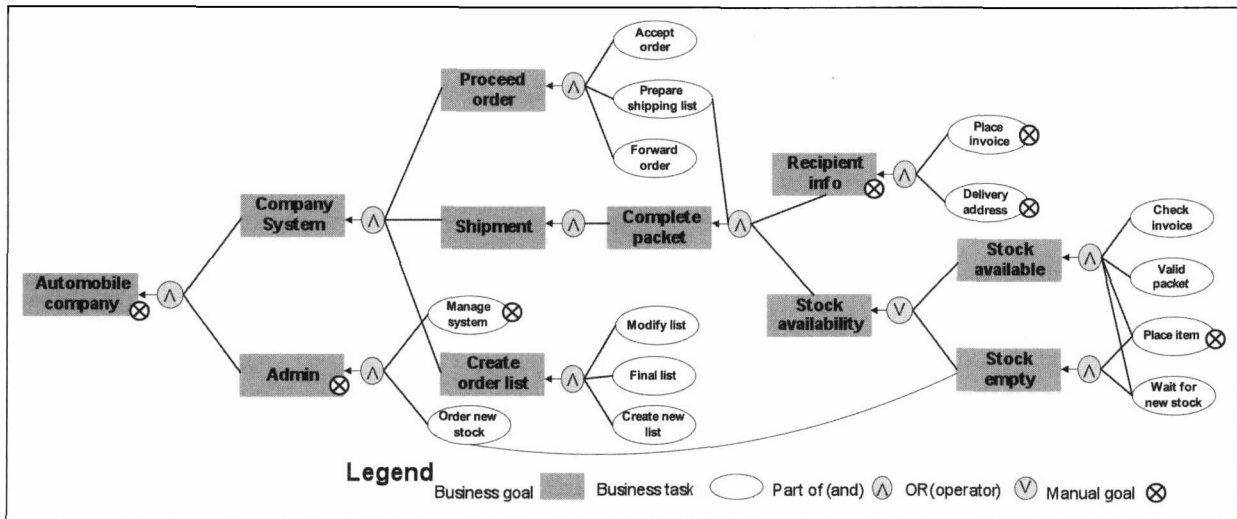


FIGURE 5 — Analysis of business process

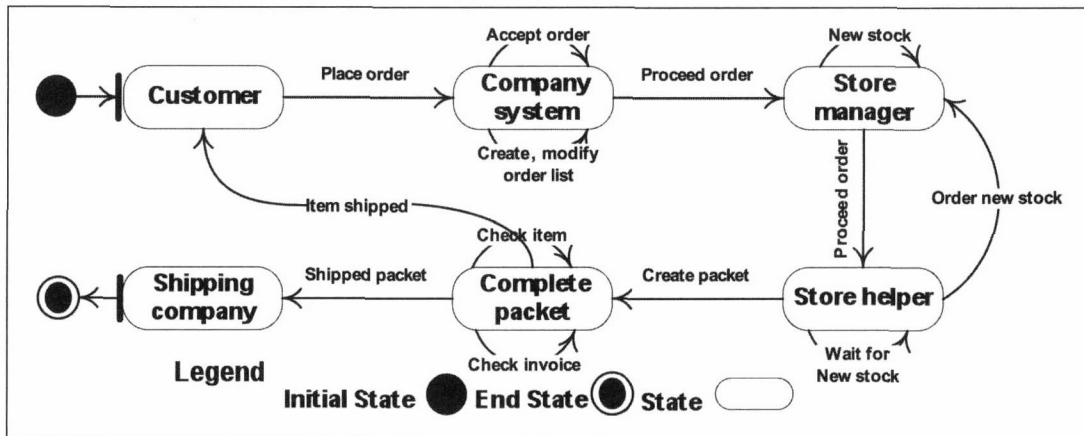


FIGURE 6 — How to extract system requirements from business process

at all levels of the business organization in this rapidly changing business environment is difficult for IT developers. The system and the services should influence the organizational performance [20, 26, 32], promote the sharing of domain knowledge among employees [25], enable an organization's enterprise architecture to align IT with business [21], be flexible to cope with rapid organizational changes [24], help in better business decision making [16, 18], protect organizations from different disasters [1, 13, 35], and maintain organizational security [15, 22] etc.

This paper presents a business goal-based system requirements elicitation approach in the context of alignment between business and information technology. Three major implications can be derived from the study for researchers, IT analysts, and for business analysts. First, for researchers interested in the IT-business alignment research area, this paper presents the requirements elicitation approach for IT to better understand the business goals and system requirements. It draws the researcher's attention from business driven solutions for alignment to IT driven, as almost all existing alignment methodologies are business driven and provide less information on the IT side. This is the reason why, despite the development of all these techniques, models and methodologies, that business executives and managers still consider the alignment issue as unsolved and rank it at the top problem of all organizational issues. The proposed approach is successfully validated by the process of order management in an automobile company that ensures successful IT-Business alignment.

Second, for IT analysts, the requirements elicitation process has a direct effect on the development of a successful IT system. However, performing the requirements elicitation process is always a challenging task for IT in the context of IT-Business alignment. This approach used four different attributes in order to perform the requirements elicitation process as follows: *Who*-defines stakeholders or system agents; *Where*-describes the location of the system to be used; *When*-outlines the time frame by which stakeholders need the system; *Why*-describes what needs to be included in the system and the reasons stakeholders need the system.

Third, for business analysts, the development of a successful IT system not only needs an understanding of system requirements elicitation, the business activities must also be taken into account before commencing the development phase of the system, therefore goal modelling is required before implementation. Thus, modelling goals is a critical process because one goal can carry more than one sub-goal and every sub-goal is linked with one another, which is hard to explore. The approach successfully models the business goal prior to deriving the system requirements from them, as shown in Figure 3.

## 7. CONCLUSION AND FUTURE WORK

It is widely accepted that information technology plays a pivotal role in boosting business performance which is the reason why IT today has become an essential component of any successful business organization. This reliance on IT is increasing every day, with organizations demanding more IT services and the development of more complex systems in a shorter time frame. However, the literature shows that IT developers experience difficulties in developing a system which meets the organization's expectations as they are often very unclear in relation to the business goals and system requirements. Therefore, it is important

for IT developers to take the business environment into account before system implementation. Business goal modelling in the field of requirements elicitation is an effective way to identify the business goals, analyse the business goals and identify the system requirements.

This paper presents a business goal-driven requirements elicitation approach. The approach is structured in two stages. Stage 1 describes how to model the business environment which includes business strategy and infrastructure. The concept of modelling the business environment was derived from the well accepted strategic alignment model called SAM. Stage 2 describes how to model the IT environment which includes: modelling the business process using BPMN, analysis of the business goals using the goal tree diagram, and extraction of the system requirements from the business goals using the UML state charts. This approach was successfully implemented and tested against the real goal of customer order management of an automobile company, bringing the following benefits to both business and IT environments: first, it helps IT developers to identify the business goals; second, it allows IT developers to develop the system according to the business organization's expectations; third, it describes what kind of goal modelling and human input is required to implement the "automatic modelling IT infrastructure [34]" methodology; and finally, this approach has a positive influence on the IT environment in the context of IT-Business alignment.

However, the approach has several limitations. Firstly, the approach is limited by the validation of only one business process in an automobile company, so there is a need to validate it with different business processes from different organizational sectors, as business processes vary from organizational aim to aim and from organizational sector to sector. Second, the approach does not describe how to extract the complete business process prior to implementing the methodology. For instance, in some cases, business executives and managers are unable to explain their business process completely due to a lack of IT knowledge. Thus, further investigation is needed in both evaluating the methodology with one or more business industry processes in order to enhance the sustainability of the methodology and to extend the methodology in order to cope with the problems that are faced during the business process identification.

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