Scientific Research Publishing

**Engineering, 2023, 15, 275-290**
https://www.scirp.org/journal/eng
ISSN Online: 1947-394X
ISSN Print: 1947-3931

# Requirement Engineering for E-Coaching in Higher Education

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**How to cite this paper:** Almuhsin, E., Soh, B., Li, A. and Ullah, A. (2023) Requirement Engineering for E-Coaching in Higher Education. *Engineering*, **15**, 275-290.
https://doi.org/10.4236/eng.2023.155022

**Received:** April 14, 2023
**Accepted:** May 13, 2023
**Published:** May 16, 2023



## Abstract

This paper presents a requirement engineering for developing an e-coaching environment in the higher education sector. This research demonstrates that IT experts encounter challenges in establishing a system that matches a university's expectations, as they are usually uncertain about its goals and system requirements. The paper illustrates a business goal-focused requirement induction technique, which encompasses demonstrating the business procedures through Business Process Modelling Notation (BPMN), assessing the university goals via the tree diagram, and drawing out the system requirements from the university objectives through UML state diagrams. A case study of supporting the development of a new IT course is used as a case study and applied using BPMN.

## Keywords

E-Coaching, System Requirements, Requirement Engineering, E-Coaching Process, Business Goals

## 1. Introduction

Studies show that there is continuing progression in the areas of personal and universal computing, both in the business and academic worlds, towards the digitalization and mechanization of coaching practices. Digitalization and mechanization are applied not only in encouraging physical activity and regulating dietary consumption, but also in fields that are conventionally considered to be within clinical scopes, such as the treatment of depressive disorder and sleeplessness [1] [2].

Generally, progressions in planning and manufacturing independently operating electronic coaching systems are targeted at bracing people in their

self-regulation and goal-achieving efforts. For example, in the health domain, the objective is usually to support people in self-care and self-management, with the intention of boosting their self-sufficiency. This confidence, coupled with the ability of digitalization and mechanization to support timely and round-the-clock coaching to a wider audience, which is not possible in face-to-face coaching, forms a major part of the appeal of such technologies [3] [4].

In other words, the problem is that a highly comprehensive definition supports the accuracy of negligible technical specifications for planning and structuring systems that can be rationally used in coaching. Having a tapered definition will be valuable in regard to introducing features that are vital for the systems, as they will offer an understanding of the technical proficiency that designers and engineers must have or attain to manufacture systems that match these demands. Having nominal requirements is also vital for classifying particular technical aspects that would benefit from further progression.

Coaching is all about intended communication between the teacher and the individual being taught. E-coaching is carried out virtually and boosts such opportunities. Some electronic coaches refer to it as "remote coaching", "remote mentoring", or even "telementoring". One interesting fact about e-coaching is that virtual engagements and tools are fundamental to support the coaching association. Electronic coaching can be described as the practice of coaching via technology. For instance, a human teacher uses technology as a means of communication to acquire information regarding students' attitude and to offer feedback [5]. Ribbers and Waringa (2015) describe electronic coaching as a non-hierarchical progressive partnership between two parties separated geographically, in which the learning and reflection procedure is carried out both online and in person [6].

Developing a suitable information system for the e-coaching environment requires a detailed evaluation of the system, requirements gathering, and analysis of the requirement. For this, it is important to derive the requirement from the organizational process. If developers are able to develop e-coaching systems based on organizational processes for any process in higher education, e-coaching programs could be aligned with university degrees [7] [8] [9]. The aim of this paper is to present a requirement engineering for developing an e-coaching environment in the higher education sector. The outcome of this research will enable the establishment of a strong alignment between technology and higher education.

## 2. Literature Background and Characteristics of E-Coaching

In November 2014, the Dutch Rathenau Institute issued an advice-giving report on the existing progressions in the field of electronic coaching systems. Illustrated for a wider audience, this report deliberates students' and teachers' perceptions of the gradual shift of coaching practices towards digitalization and provides an evaluation of the societal influence of these progressions. The report speaks about electronic coaching systems in a comprehensive manner, encom-

passing a huge variety of systems. The authors explain that designing electronic coaching systems involves three procedures: gathering data, evaluating the data and determining the coaching strategy, and providing influential and encouraging feedback. Although these settings might seem not easy to follow at first, they are actually quite humane. In fact, the class of systems that these settings encompass does not evidently show in what sense they are adopting the role of a teacher [10] [11] [12].

Warner describes electronic coaching systems as educational agents that offer questions to students and answers based on students' entries for choices [13]. The optimistic side of this description is that it seems too comprehensive and too tapered. It can be regarded as tapered because educational agents are generally described as having life-like vibrant interfaces, whereas with electronic coaching, it is ideally possible to be taught only through voice, message, or other interfaces. Van Wissen describes e-coaching systems as Behavioural Transformation Support Systems (BCSSs) [10] [11] [12] [14]. This term was originally devised by Oinas-Kukkonen in 2010, and described as an informative system structured to develop, modify, or strengthen approaches, behaviors, or acts of a fulfilling nature. In this design, BCSSs are presented on par with influential systems: "interactive computing systems planned to transform people's attitudes and behaviors" [14].

In order to decide on the characteristics that an e-coaching system must possess, one must have a rough idea of what coaching is. Although there are several definitions of coaching, they have very less validation. Ellis (1994) differentiated nine different methods of coaching, including humanist methods (focused on personal development), behavioral methods (focused on behavioral transformation), cognitive methods (focused on establishing adaptive contemplations), and goal-oriented methods. In the final approach, coaching is mainly concerned with supporting people to regulate and direct their interpersonal and intrapersonal resources to better achieve their targets [12] [13] [15].

With electronic coaching systems, the goal-oriented method seems to be the most prevalent strategy. However, engineers and inventors adopt diverse methods to offer support; some places focus more on transforming people's attitudes while others emphasize more on the behavioral consequences—the support they offer is generally targeted at goal achieving. Hayes and Kalmakis interpret, affirming that "coaching is deemed as a tailored, collaborative association that prompts the customer's prospective for self-awareness, to know the meaning of his or her distinct situation, for analyzing transformation, and for making selections and plans to attain the goal" [12] [13].

## 3. Relationship between Business Goals and System Requirements Derivation

Business goals and objectives are used to signify the organizational targets that need to be accomplished. For the application of business goals, a business process demonstration is required. Process modeling is a language that is used to

identify an initiative's goal and is imitated from a modeling language called Extended Enterprise Modelling Language (EEML). Process modeling is a beneficial approach to capture and explain the business procedures and related business goals of an initiative [16] [17].

Developing business goals is a complicated approach, as one business procedure can be linked to many minor business goals and every task can be related to each other. Hence, these goals must be explored for better explanation. For instance, **Figure 1** illustrates a business goal featuring the minor goals of a business, wherein every task is linked to each other and the flow and priority of the business goals in relation to the major business goals is clearly visible.

With respect to requirements engineering, it is broadly accepted that the university goal can play a key role in capturing the specifics of business and system requirements engineering [16] [17] [18]. The specifics of system requirements engineering encompass:

- requirements induction, which is used to clarify the organizational procedure and the related university goals that the system under consideration is hoping to attain, and the targets that define the needs and limitations of the system under consideration;
- attain and the goals that illustrate the needs and limitations of the system under consideration;
- requirement arbitration, which is used to discover the university goals related to shareholders and helps to describe the agreement among shareholders on system requirements;
- requirement specifics, which is used to offer a broad portrayal of the system behavior that needs to be applied and described in the context of the organization which uses that system; and
- requirement validation, which validates whether the final requirements match the shareholders' needs regarding authentication and final endorsement.

In this section, we mine information from the business goals to complete the

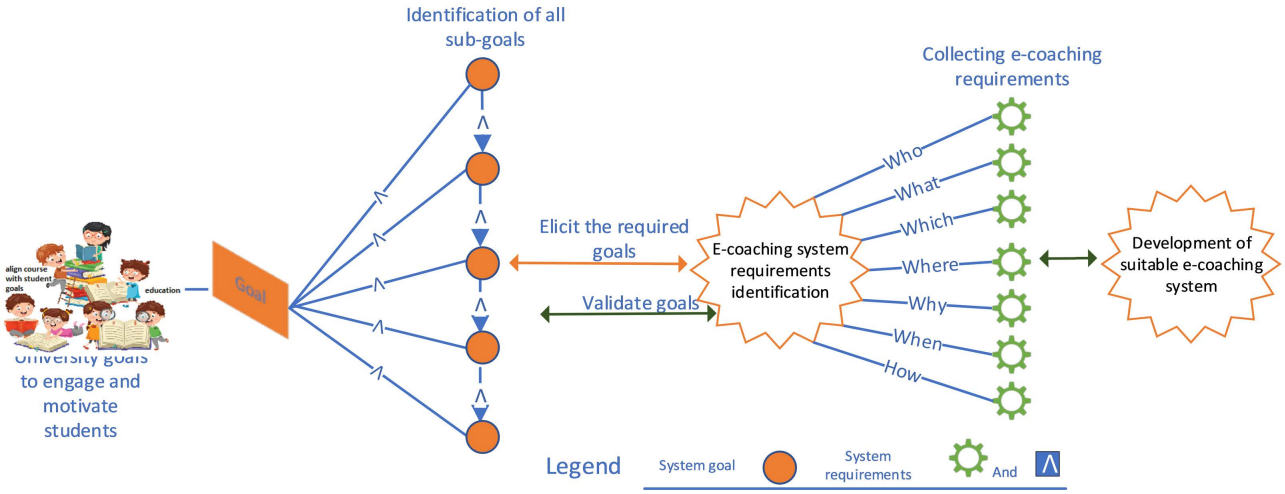


**Figure 1.** Example of sub-goals.

system requirements engineering induction phase as illustrated in **Figure 1**. The procedure suggests that the requirements induction phase should gather information about four characteristics, to help understand the industry:

- who: describes the shareholders or system representatives;
- where: refers to the site of the system to be used;
- when: summarizes the time span for which shareholders require the system;
- why: explains what should be incorporated in the system and the motives for which shareholders need the system.

## 4. Related Work

After conducting thorough research on orientation, it was concluded that the idea of system requirement induction in the context of alignment between business and IT has not been formerly studied in detail. Only a handful of scholars have studied this subject, producing a great deal of work such as I*, GOMS, Goal-based Workflow, KAOS, and EKD [19] [20] [21] [22] [23].

The I* structure is developed according to a business procedure and goal demonstrating conception that supports IT experts in analyzing business needs at the preliminary stage of system development. This structure requires the organizational actors to explain the business procedures and strategies. As per the agenda of this structure, organizational actors have distinct goals and theories for business procedures, and each actor is linked to one another. The GOMS and Goal-based Workflow techniques suggest a business goal modeling structure for requirements inductions with regards to explaining the organizational goals and comprehending the existing organizational setting. KAOS is a business procedure and business goal-based technique for system requirements engineering that addresses many requirements engineering facets such as induction, requirement assessment, and requirement administration. This technique also supports the effective accomplishments of business requirements and helps in forecasting clashes between the IT and commercial sectors.

Enterprise Knowledge Development (EKD) is the language used in the requirement engineering examination phase to model the business; for instance, what requires to be incorporated in the projected system and how to apply it. All these techniques have many disadvantages. Firstly, the techniques are complicated for IT experts and developers to comprehend. Secondly, they do not have sufficient information on business procedures or goals, as one procedure is a combination of the minor goals of various businesses that need to be revealed to fully evaluate the business procedures. Thirdly, the techniques involve a lot of time. In the last part of the 20th century, with the swift rise in globalization, businesses need to pace faster and require swifter IT system applications, and have a firm association involving perfect communication with IT.

## 5. Framework for Requirements Derivation for E-Coaching

It is broadly accepted that procedures in business operations are balanced key

features that need to be well accomplished and fit desirably with the planned business strategy to allow seamless employment of the strategy and successful accomplishment of business goals and objectives [24]. However, institutions continually encounter issues in managing business procedures, specifically with respect to exhibiting and assessing them. The target of the requirements derivation approach is to enable IT designers to comprehend the business expectations of the necessary IT system in a better manner [25]. This encompasses knowing the answers to questions such as: Who is the shareholder? What should be incorporated in the projected system? Why is the system required? And what is the use of the system?

This could help achieve the e-coaching process, which involves: 1) evaluating the current condition, which could be done by identifying what needs to be addressed and performing goal analysis; 2) defining the goal matrix, which would allow the definition of the vision and milestones of the e-coaching system; 3) laying out the plan of action, which provides a step-by-step procedure to tackle enroute e-coaching challenges; 4) devising a strategy to execute the plan, which indicates the team member who will implement the guidelines to develop the e-coaching system; 5) achieving the goals, which would lead to analyzing the desired outcome of the e-coaching system and its alignment with the university degrees.

The projected method agenda is planned in two parts, as illustrated in **Figure 2**. Part 1 is further divided into three stages: stage 1 focuses on the organization's shareholders, aims, objectives, and existing resources; stage 2 highlights the business strategy in the form of the organization's mission statement, strategic goals, and the method to assess the strategy; stage 3 frames the business procedures, administration, and all university activities (regarded as activity model). Part 2 defines the approach to mine the system requirements from the business targets, which is regarded as requirement induction. Here, two UML diagrams are used: first, the goal tree, which is used to evaluate the business procedures and the related business goals that are regarded as procedure and goal modelling; and second, the UML state chart, which is used to provide a real depiction of the system requirements and focus on what needs to be incorporated in the system and how to achieve it.

### 5.1. Modelling Strategy for E-Coaching Systems

The term "strategy" refers to the extended and short-term strategies of any business setup, wherein the plans specify the business procedures and the associated goals and targets [23]. A more comprehensive strategy can include the following information:

- University long-term plan
- Long-term university accomplishments and future opportunities
- Organizational resources such as workers, funding, and skill-set
- Internal and external university situation

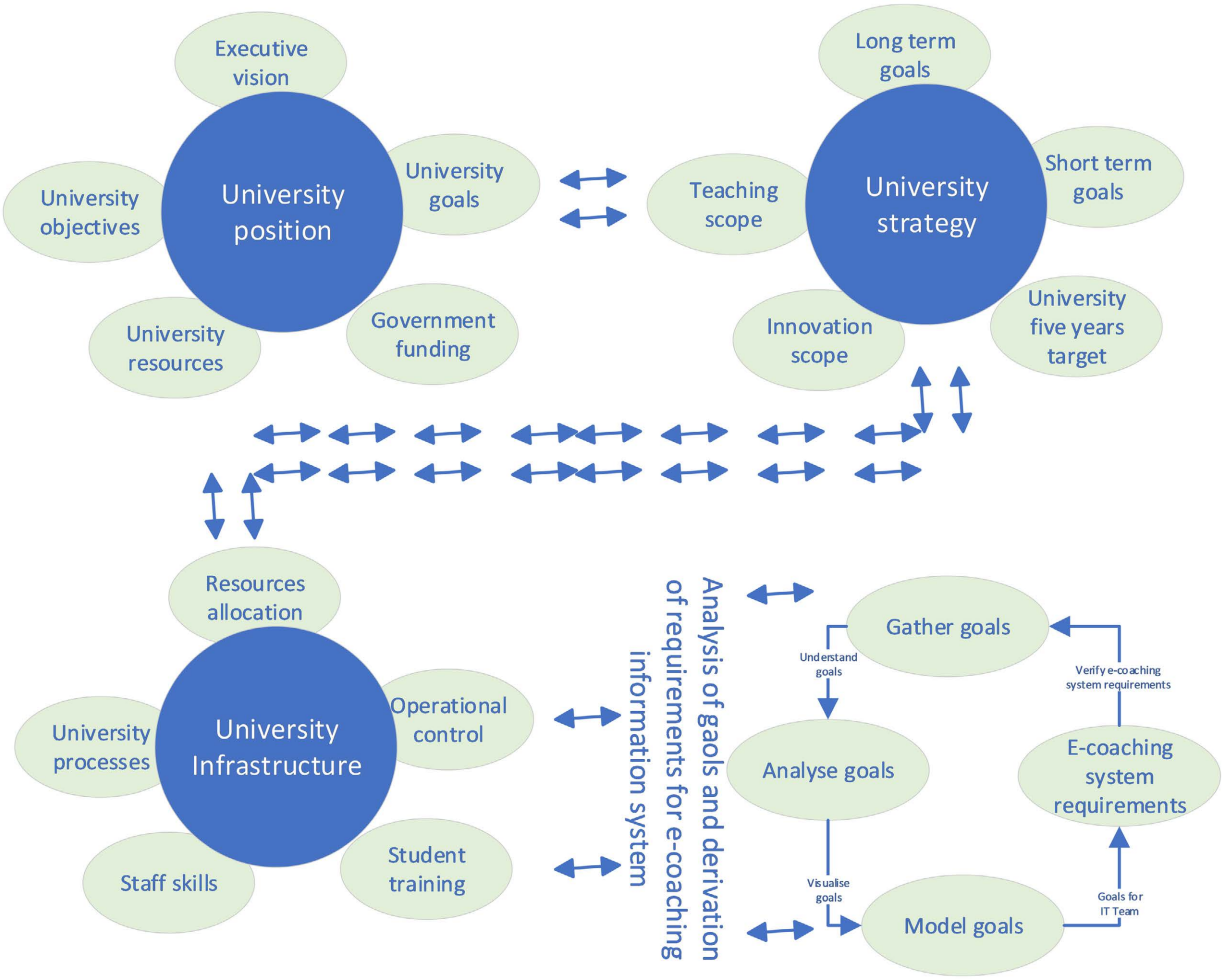


**Figure 2.** Framework of e-coaching system requirements.

- Organizational shareholders

A business strategy has three major constituents:

- University Strategy
- Business Strategy
- Operational Strategy

The university strategy describes the overall ideologies and university opportunity to match the shareholder prospects. The business strategy describes how the organization can contest with companion organizations. The operational strategy describes how all the business features are managed to offer the university strategy. Many significant approaches have been illustrated in the research to describe and exhibit business strategy. Planned agenda demonstrates the strategy through the university's mission statement and via the strategic targets.

The university's mission statement provides an overview of the business, the reason for existence, and the university targets and goals. It also encompasses the strategic goals of the business to signify why business procedures exist and what path to adopt for fulfilling the business mission. An assessment of the organization's strategic goals focuses on how the feat of a business is gauged. The general

idea of exhibiting a business strategy and its substructure is based on our already established technique that is regarded as the requirement engineering for alignment, as illustrated in **Figure 3**.

### 5.2. Modeling E-Coaching Infrastructure

After describing and establishing the business strategy, the business procedures must be exhibited and assessed in terms of the organization's substructure. This must be done by highlighting the links and basic features that altogether brace the business procedures and related goals and targets of the organization. These features can be the setup, procedures, strategies, systems and public, etc.

The recommended approach splits the business substructure into four minor models: first, the management is the key influence in a university; second, the activity demonstration highlights the university actors and their responsibilities; third, the resource demonstration exhibits the university rules and policies; and fourth, the architecture demonstration expresses three structural phases: strategic phase, managerial phase, and operational phase. Business Process Modelling Notation (BPMN) was employed to illustrate the business procedure.

BPMN was formulated by the business procedure management initiative group and is widely acknowledged by business experts and scholars. The main goal of BPMN is to offer standard representation, which is straightforward and easy for creators and other business shareholders to comprehend. Hence, it uses a standard modelling language to channel the gap amid the business exhibition and application [26].

As illustrated in **Figure 3**, a process of supporting the development of a new IT course that is aligned with the e-coaching services of a university in Saudi Arabia, has been used as a case study, and applied using BPMN. The main goal of this university process is to ensure that when developing a new IT course, all related facilities, particularly the e-coaching system, is active and ready to support new students.

The development of the university's new IT course process has been classified into three diverse stages. In the initial stage, the system approves the new course demand and shares it with the faculty office, which reviews the client specifications. In the second stage, the system reviews the staff availability for this new course and funding for the course development. If existing staff is not available, the head of the department will hold the job and publish a new job. In the third stage, the discipline leader will review the course content and activate the e-coaching support for new students.

### 5.3. Linking the IT Environment with Higher Education

Connecting the IT setup with the university and vice versa is always a serious task for the university officials and business IT configuration scholars, due to the intricacy of the university planning. Generally, there are at least three major support systems in an organization: the business setup, the organizational strategy,

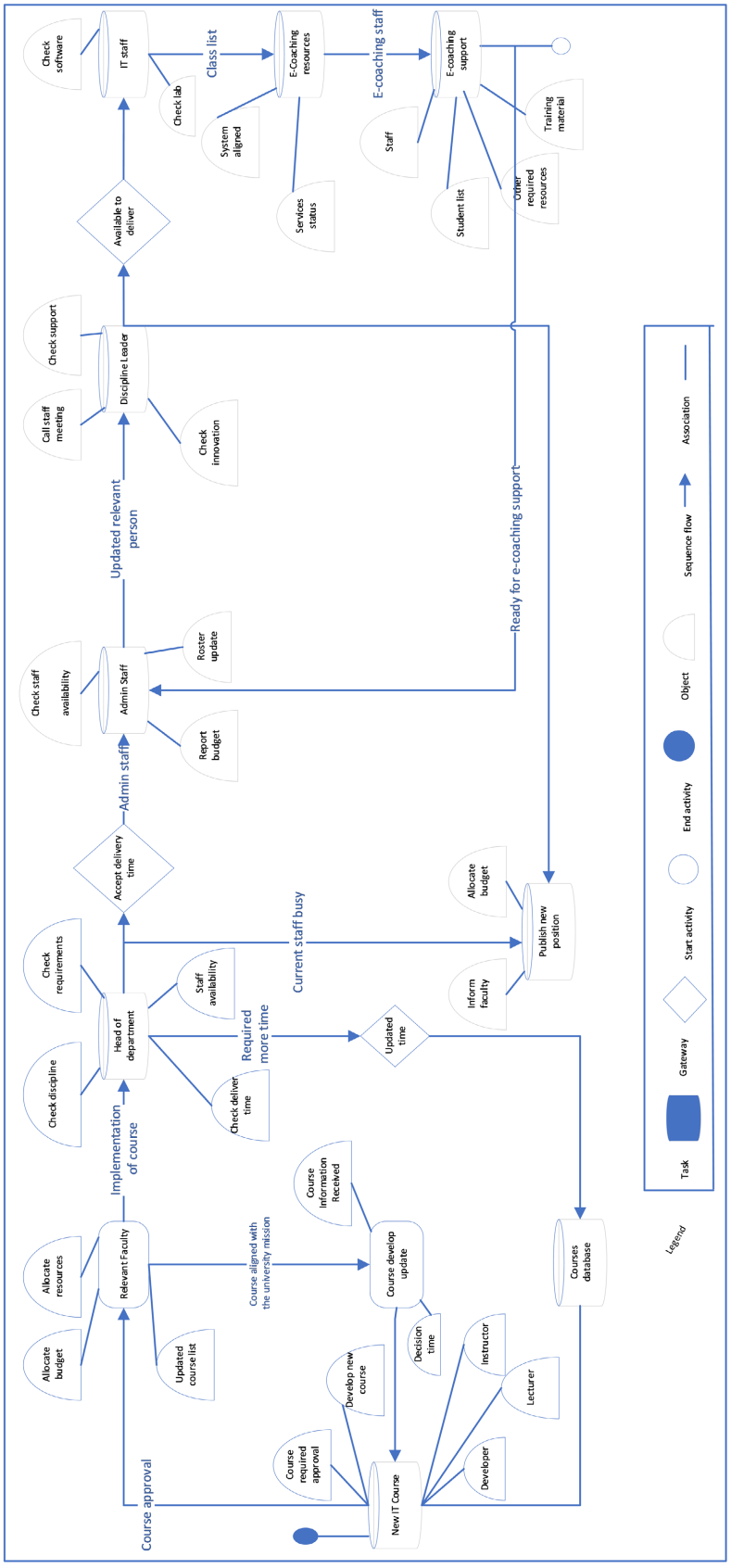


**Figure 3.** Process of developing a new IT course at a university.

and the operations. For the feat of the business, it is vital that these support systems are related to one another and coordinate their operations.

After exhibiting the organizational substructure, the recommended method links the organizational substructure and settings with IT, to withhold apt specifications among these two parties. This connection supports IT experts in formulating a system that imitates the business attitude and matches the demands of the organization. Thus, strong business and IT orientation can be attained. **Figure 2** demonstrates that IT and business connection is feasible with the support of BPMN.

### 5.4. Modeling IT Infrastructure for E-Coaching

The term "IT substructure" denotes a set of mutual IT assets that function together to accomplish shared goals. The idea of IT substructure became prevalent in the mid-1990s. The IT substructure comprises mechanical and human modules. On the technical side, it encompasses linkages, operating system, equipment, and information technology, while on the human mechanisms side, it encompasses human technical abilities and aptitude, and understanding of IT assets to boost business performance [27]. To support IT with the university, the procedure gradually becomes more and more complicated each day and the university rapidly transforms its goals.

In this condition, the IT substructure needs to be flexible so that swift variations in the university procedures and the university goals can be accomplished. Hence, the system requirement induction procedure is vital for the feat of IT substructure. The progression of an appropriate IT setup is a vital component of the IT substructure and happens in different stages: requirement engineering, planning, application, testing, and assessment. The application of each stage is based on the requirement induction stage.

The business procedures and the linked university goals signify the organization's aims and objectives (to be matched). In the IT setup, university goals can play a key role in supporting all areas of requirements engineering: requirements induction, requirement arbitration, requirement specification, and requirements authentication. Also, one university procedure can feature more than one university sub-goal that must be discovered for successful application. This method employs ideas from university goals to exhibit the business procedures, formulate goals from them, as well as evaluate the business procedures and related university goals. **Figure 4** illustrates the business goal tree diagram for the projected business procedures, using rectangles to denote university goals and loops to denote tasks (that need to be performed to attain the goals). After the goal tree of the anticipated business procedure has been created, the procedure and related targets are then evaluated to acquire the formal system requirements, which provide answers to the following questions:

- Who is the shareholder?
- Why is the system required?

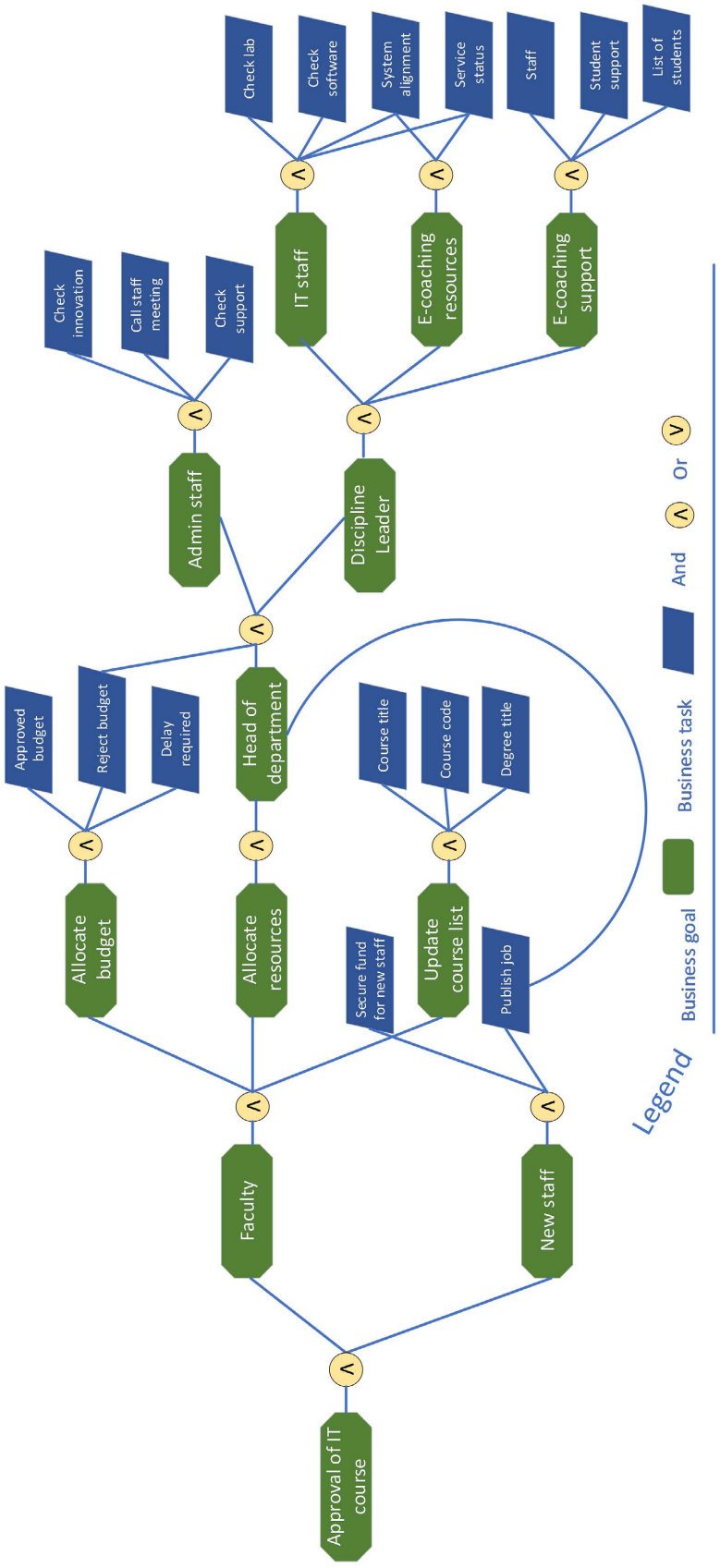


**Figure 4.** Derivation of business goals from a process.

- What should be incorporated in the system?
- When is the system required?

The IT experts first study the business procedures and then tag the leaf components of the procedures that reflect the nature of the business procedures and related goals and tasks. If the IT experts spot a specific goal that cannot be programmed by IT and has to be physically executed, they highlight it with a cross. After executing all the business procedures, the goals that are highlighted with a cross are eliminated from the diagram. The final illustration is then transformed into a UML state diagram that provides a real depiction of the system requirements induction.

### 5.5. System Requirements Derivation Procedure

Structuring an IT system that match business needs is a difficult task as IT experts have access to fewer system requirements induction approaches and business knowledge. Hence, it negatively influences business performance.

Therefore, system requirements induction has to be completed before the evolving stage of the system. After the goal tree of the case study has been determined, UML state charts can be extracted from it. Figure 5 illustrates how an IT expert creates the system requirements with help of a UML state chart.

Almost six forces are used to create the state chart: first, a "university staff" creates a request for course approval; second, university management staff, who are part of the "faculty system", develop the new course; third, the "head of the department system" manages the development of the new course; fourth, the "discipline leader" checks whether there is need to hire new staff; fifth, the "e-coaching team" finalizes the e-coaching resources for the newly developed IT course.

The UML state chart allows the system specialist to alter any requirement packet at any level of the state chart. The system expert gathers all the state charts in a single package and delivers it to the designers for accomplishment.

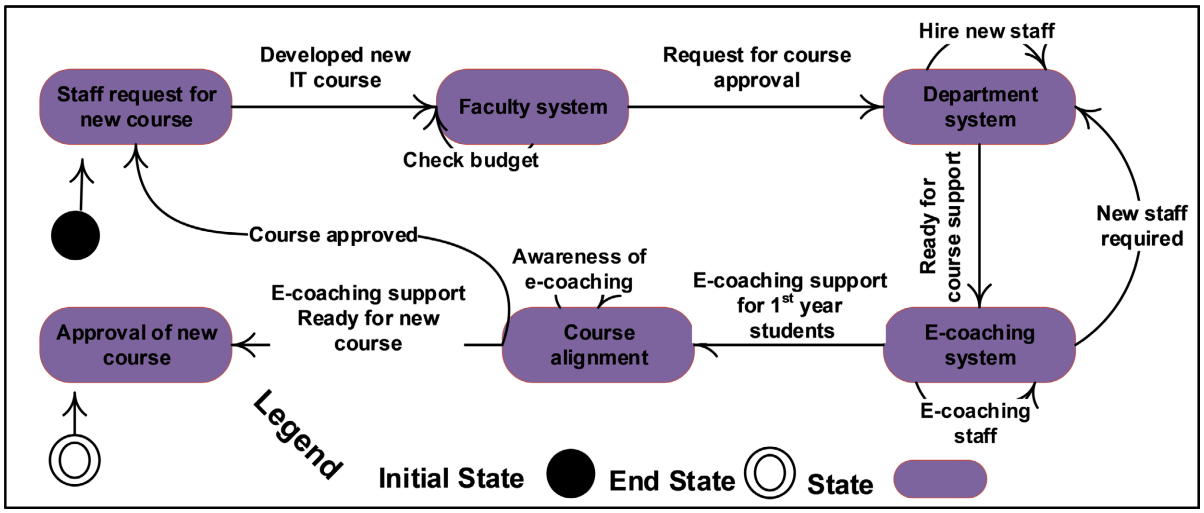


Figure 5. Derivation of system requirements from business goals.

The designers initially review the package to determine if a goal or task has been marked; if it is, the designer delivers the packet back to the system expert for additional modifications. The state chart package will be employed in error-free situations. The state chart illustration at this phase evidently portrays the university target, precisely what the system has to achieve, and the procedure to accomplish it. This clearly impacts the progression of a thriving IT system and also the implementation procedure for business IT orientation.

## 6. Implication of the Work

The implications of this work would be useful for three groups of people: researchers, IT experts, and business forecasters. First, for scholars who are concerned with business IT orientation research, the paper provides the business procedure demonstration and examination approach to develop the system requirements for IT. It offers a comprehensive understanding about the university procedures, related objectives, and system requirements. It redirects the academia's attention from business-focused solutions (concerned with orientation) to IT-focused ones, as almost all existent orientation approaches are business-focused and offer few specifics regarding IT. Regardless of the progress of these approaches, representations, and procedures, business experts and managers still consider the orientation problem as unsettled and list it as a high-priority concern amongst all management problems. Second, for IT experts, the requirement induction procedure has a direct influence on the progression of an effective IT system. However, accomplishing the requirement induction procedure is a difficult task for the IT team in the business-IT orientation setting [28]. The IT team requires information about four diverse factors to accomplish the requirement induction procedure:

WHO—describes the shareholders or system mediators.

WHERE—denotes the system position to be used.

WHEN—sketches the time frame by which shareholders require the system.

WHY—describes what the system should comprise of and why the shareholders need the system.

Third, for business experts, demonstrating and analyzing business procedures is a difficult task, as the procedures are the elements in the organizational structure that often vary. The methods in this section are the most effectively demonstrated and analyzed university procedures and the related university goals prior to deriving the system requisites from them, as illustrated in **Figure 3**.

## 7. Conclusions and Future Directions

It is globally acknowledged that IT plays a key role in improving university performance, which is why it has developed as a vital element of any thriving business setup. This dependency on IT is growing day-by-day, with universities demanding the expansion of IT services into a more complicated system within a brief span of time. However, research demonstrates that IT experts encounter

challenges in establishing an e-coaching system that matches a university's expectations, as they are usually uncertain about its goals and system requirements. Hence, it is vital for IT experts to analyze the business setting before going ahead with the system application.

University goal exhibition in the field of requirement induction is an effective approach to determine the business goals, assess the targets, and ascertain the system requirements. This research illustrates a business goal-focused requirement induction technique, which is formulated in two phases:

Phase 1 illustrates how to exhibit a business setting that encompasses the university strategy and substructure. The idea of demonstrating the business setting was imitated from the widely acknowledged strategic orientation model termed as "SAM".

Phase 2 demonstrates how to exhibit the IT setting which encompasses demonstrating the business procedures through BPMN, assessing the university goals via the tree diagram, and drawing out the system requirements from the university goals through UML state diagrams. This technique can be effectively employed and evaluated against the tangible goal of the course development process. It provides the following advantages:

- Firstly, it supports IT experts to identify the university system goals.
- Secondly, it enables IT experts to formulate the e-coaching system as per the prospects of the business setup.
- Thirdly, it explains what type of goal demonstration and human input is required to apply the "automatic exhibition of IT infrastructure" approach.
- Lastly, it has a positive impact on the IT settings in relation to the IT-business orientation.

However, this technique has many limitations. First, the technique is restricted by the verification of one business process for higher education; so, there is a necessity to endorse it with various business procedures from diverse organizational segments, as business procedures differ from goal to goal and from sector to sector in different organizations. Next, the technique does not illustrate the way to mine a full business procedure before applying the procedure. For example, in a few situations, managers cannot define their business procedures completely due to insufficient IT knowledge. Hence, more research is required to assess the approach in comparison to one or more university procedures to boost the feasibility of the technique and to spread out the technique to manage the issues that are encountered during the business procedure identification.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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