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DESIGNING AND MANAGING BUSINESSES IN THE DIGITAL AGE

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Abstract

The environment in which businesses nowadays operate is changing very fast. The Information and Communication Technologies (ICT) are one of the fastest changing technologies we have ever seen. Technologies such as mobile smartphones, high-speed Wi-Fi networks, and wireless laptop computers are some of the new technologies that are changing the enterprise environment. ICT is an undeniable part of the enterprise landscape. Thus, the way new businesses are designed and managed has changed. In this paper we present a summary of different technologies that could be seen as part of the design and management process of businesses in the digital age.

At the center of this effort is the System Approach, that considers a system as a collection of interrelated and interdependent subsystems which collectively accomplish certain objectives using interfaces. We start with the process of engineering requirements for conceiving a new business borrowing from the domain of the software engineering the concept of the use case model that represents the set of functions the new business should provide. Later, we use concepts from the Business Process Modeling approach to present processes and their order of execution. To each process an execution time could be assigned that will be used to simulate the total production time for the production chain. At the end we provide some conclusions and future problems to be addressed in the future.

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Keywords: Systems approach, enterprise engineering, business process modelling notation.



1. Introduction

The environment in which businesses nowadays operate is changing very fast. The Information and Communication Technologies (ICT) are one of the fastest changing technologies we have ever assisted before. Almost every 5-7 years there is a new technology coming around and has important effects in the way businesses are running. New technologies such as Internet, GPS, mobile, power grid etc, are reshaping the way businesses are being designed and managed. We see a fast increasing of communications among businesses around the world. Changes occurring in one nation in one sector will have strong effects in other nations and other sectors linked to the first one through an array of links (Arnold & Wade, 2015). As interconnections among different sectors of economy and different countries are stronger than ever, it is of paramount relevance to have an approach to help us understand the complex world of modern enterprises.

We use concepts borrowed from the software engineering domain and use them in the design and management of enterprises. Thus, we use the use case model to depict the future users of the system and assign to each of them the functionalities they will perform. This is the first attempt to link an employee with the execution of some functionalities that later could be expressed in terms of processes. Later, we present all functionalities in terms of processes by designing process diagrams using the BPMN and simulate these processes. This allows for a precise calculation of the number of people needed for the execution of the process and the time needed for it. We offer a framework for designing and managing rigorously the enterprise functions. We find that using an engineering approach to design and manage an enterprise creates an environment that allows for better use of all kinds of enterprise resources.

2. Literature Review and Theoretical Framework

The issue of using an engineering approach to enterprise design and management has been subject of scientific work for some time. There are authors, such as (Alter & Brown, 2005, Mendez, 2010; Pyster & Olwell et al., 2015), to name a few, that consider that the Systems Analysis (SA) approach could be successfully used not only in the process of software development but to design and implement a broad range of other disciplines. As a result of the use of several engineering principles and techniques to enterprise design and management, a new term has appeared in the literature known as Enterprise Systems Engineering. Enterprise Systems Engineering is that body of knowledge, principles, and practices having to do with the analysis, design, implementation and operation of an enterprise, where 'enterprise' is defined as an intentionally created cooperative of human beings with a certain societal purpose (Mason, 2015). The emerging discipline of Enterprise Engineering is considered to be a suitable vehicle for achieving these goals. It does so by providing new, powerful theories and effective methodologies (Dietz, Hoogervorst, Albani, & Winter, 2013; Magalhães & Proper, 2017).

As the role of IT is becoming central to enterprise activities, there is a need to better align the business strategies and ICT strategies. A better coordination of both business and ICT strategies will help having the ICT strategies determining and driving the business strategy (Cuenca & Ortiz, 2011). A number of authors make the case that this approach should be more present in the university classrooms (Guidry, 2014). An analysis of system's approach taught in universities is provided by (Gray, 1989). Although system's thinking is widely believed to be critical in handling the complexity facing the world in the coming decades; however, it still resides in the educational margins (Arnold & Wade, 2015).

System's approach must be considered to be used as a way of designing and managing businesses in the digital age. System's approach is nothing else but the application of the old Roman mantra "Divide and Conquer" that is successfully used in the domain of software engineering. According to this philosophy, a complex problem should be divided into smaller parts that could stand by themselves and intercommunicate via interfaces (Papajorgji, 2005). Thus, a business could be considered as a system divided in smaller subsystems that can stand by themselves and are interrelated via interfaces. An interface is defined in (Fosse & Delp, 2013) as "to provide the specifications of the relevant properties of a system or component that can be connected to other systems or components while instances of interaction are identified in order to specify the actual integration to other systems or components."

The rest of the paper continues as follows: the next section presents the process of requirements engineering, showing how the process of defining the functionalities of the new system. The section **Process Analysis** presents how the analysis of processes in enterprise could be designed and modelled using techniques borrowed from the software engineering domain. The section **Business Process Execution** provides examples of how the execution of tasks could be performed and at the end, section **Conclusions** will make the summary of the paper.

3. Requirements Engineering

A business could be seen as being composed of the following subsystems: Finance and accounting, Sales and marketing, Manufacturing and production, Human resources. The interaction of these subsystems is needed to achieve business goals defined in the company's business model. Each of the subsystems could be designed and implemented separately and as their interfaces are well-defined at the beginning, assembling them into one system could be done at the very end of implementation. This way of conceiving a business as a set of subsystems with their defined interfaces, facilitates the process of designing and implementing information systems. For each of the subsystems several polymorphic implementations could be provided so the user could seamlessly switch to use another subsystem that implements the same interface. This approach will pave the way to the plug and play technology (Papajorgji, 2005). As an example, we could use another human resources subsystem provided that it implements the same interface.

The life cycle of a system is similar to building a house; it includes the phases of planning, analysis, design and implementation (Dennis & Wixom, 2012). The systems approach facilitates using well-defined software engineering techniques to collect requirements when designing the system such as the use case model as shown in Fig.1. The process of collecting the requirements for a system can be addressed with an engineering method such as the use case models (Forrester Consulting, 2014).

Figure 1 shows that the users of this simple university system are students, professors, administrator, admission and finance office. Each user has to login as the system is private. Each of users could launch specific tasks or functionalities that after execution will provide to user some beneficial result. Thus, the student could manage course selection while the human resources department would manage personal data for students and faculty members.

A use case model allows to visually presenting the dialog between users of a system and the information system to be designed. A use case model represents the functionalities the system should

provide to its users without showing how their implementation is to be performed. In addition, a use case model shows the users of the future system and what functionalities each user would launch. Furthermore, identifying specific actors and their roles and responsibilities are integral to the system design (Peffer, 2007).

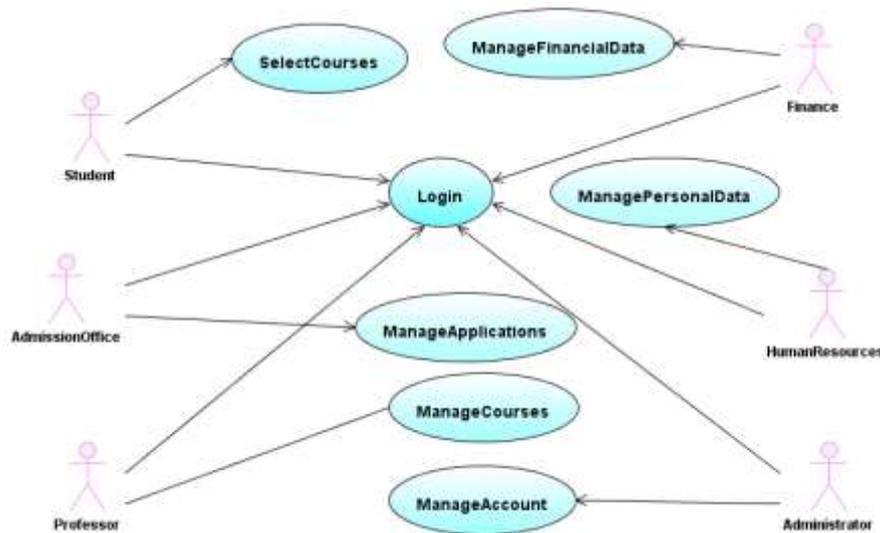


Figure 01. The Use Case model for a University system.

4. Process Analysis

After the definition of the functionalities of a business and the users that will be launching these functionalities is finished, then a serious look must be given to modeling the processes to be performed and their order of execution. Models of business processes aim to capture high level operational activities and decision points of an organization, describing processes ranging from product lifecycle to government operations (Auguston, et.al., 2015).

Business (or operational) processes are "the logical organization of people, materials, energy, equipment, and procedures into work activities designed to produce a specified end result (work product)" (Pall, 1987). This is an important step of analysis as they target capturing operational activities and decision points of a business.

A standardization process has occurred during the years, under hospices of Object Management Group (OMG) to deliver a language, what is referred to as Business Process Management Notation (BPMN), to be used for modeling purposes. The BPMN specifications describe a graphical notation that enable specifying business processes as part of some diagram referred to as Business Process Diagram. The notation used is simple, intuitive and matches the business language used everywhere, no matter what kind of business activities are to be described. This clarity and simplicity enables a fruitful dialog between business people and technical users. BPMN acts as a common language, allowing an organization to interoperate amongst all of its stakeholders (OMG, 2014). BPM and business rules allow collaborating more closely with business stakeholders and quickly validate new requirements and system changes (Forrester Consulting, 2014).

Fig. 2 shows an example of a Business Process Diagram. It shows a simple process for applying, for a student, to be accepted at some university. The example is simple but it is sufficient to show a suite of processes, a number of actors involved in this dialog and who does what and at what time.

The first thing to be noticed in this figure is that there are two different environments: the student and the university environments. Within the university environment, there are two lanes, named admission office and finance office swimlanes. All processes executed by the student are located on student swimlane and this is true for all actors of this simple diagram. The diagram shows that it is the student that starts this process by executing a task referred to as “*Select University*”. This task is well-defined and its execution takes a finite amount of time. This must be true for all tasks of the diagram. The solid lines show the navigability within a swimlane; thus the student after selecting a university may apply to be accepted at this university. Dotted lines show communication among different environments; thus, the student will send his application to the admission office of the university.

Some of the tasks should be executed sequentially and some others could be executed in parallel. Some tasks are exclusive, thus only one possible path will be followed in the case some condition is satisfied.

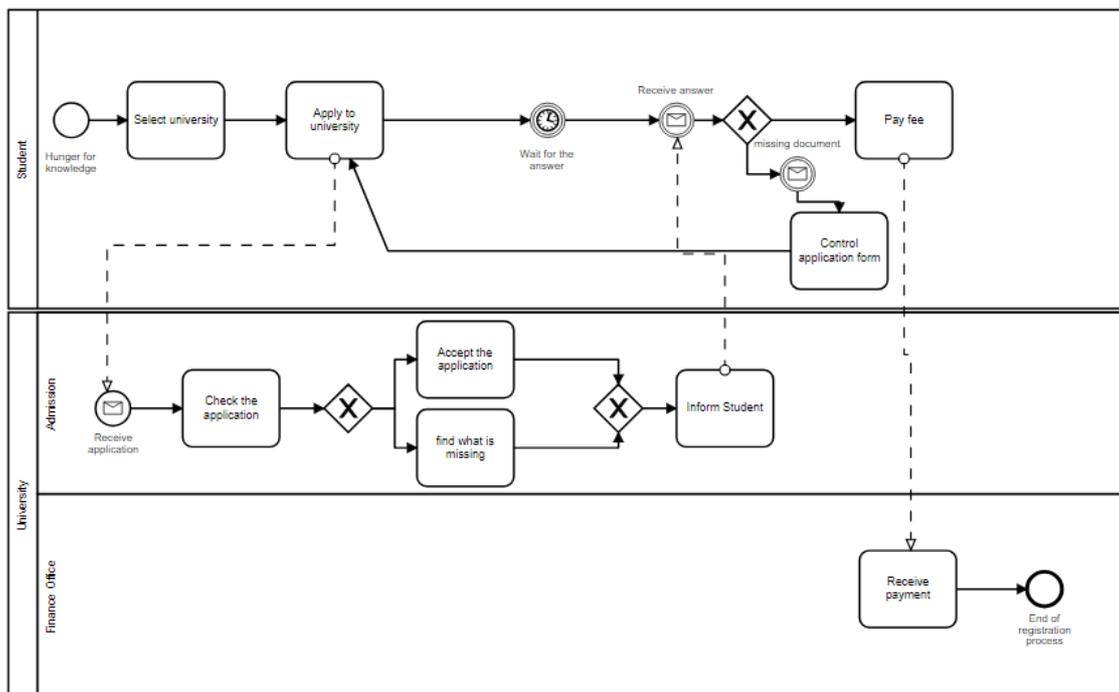


Figure 02. Example of a business process diagram.

To each of the tasks an execution time could be assigned, allowing for an exact estimation of the execution time of the entire process. Using the BPM diagrams forces managers and owners to study at depth the processes that will occur in their business well ahead of building their business. It allows them to have a very detailed picture of who does what in the future business so they can have a well justified view of the number of people they should employ and how long processes will take to be executed and how much the overall cost of the business will be. A more detailed explanation about this concept is provided in the following section.

5. Business Process Execution

During the last decade BPMN has been considered very seriously as the most important modeling approach to business processes. BPMN is a product of Object Management Group (OMG, 2014) with the primary goal of creating a notation that would facilitate the dialog among people involved in designing, developing and implementing enterprise information systems. Thus, BPMN creates a standardized bridge for the gap between the business process design and process implementation. Second goal, is to ensure that XML languages designed for the execution of business processes, such as WSBPEL (Web Services Business Process Execution Language), can be visualized with a business-oriented notation (OMG, 2014).

OMG's first goal to create a BPMN system has been addressed by many; a quick search on Google will provide a number of companies that provide this service such as (Bizagi Modeler; 2018, BOC, 2018; Farrance, 2016 and Modelio, 2018) to name a few. Implementing OMG's second goal is a little harder and difficulties and definition inconsistencies are studied by (Doux, Jouault & Bézivin, 2009).

Many are managers that would like to switch to this new approach to modeling enterprise processes, but the real challenge is in the strong inertia that exists in enterprises. BPMN is becoming very present in the industry and allows for creation of specific extensions in order to provide support for specific branches of industry (Braun & Esswein, 2014). Thus, an effort to address social engineering issues is presented by (Brambilla, Fraternali & Vaca, 2011). There are even efforts to extend BPMN in wireless environments, as authors believe that a set of BPMN extensions that fulfil these requirements and demonstrate that they are better suited for modeling WSN processes than standard BPMN (Sungur, et al., 2013).

Some authors have made considerable efforts to have a holistic approach so that the BPMN models could be executed. An example of these efforts is WebRatio system, a tool that applies Model Driven Engineering techniques to complex, multi-actor business processes, mixing tasks executed by humans and by machines, and produces a Web application running prototype that implements the specified process (Brambilla, Butti & Fraternali, 2010). Another well-established software is (Bizagi Modeler, 2018), that through a guided process allows users to create complex systems without writing a line of code. Other systems are Modelio, 2018, BonitaSoft (Farrance, 2016) and Adonis (BOC, 2018) to name a few.

BPMN systems that allow for execution of the models are very powerful as they speed up enormously the process of design and implementation of complex information systems. They make possible simulation of production processes to make sure that all bottlenecks are discovered (processes that are assigned fewer human resources than is needed) and positions that are not efficiently covered (processes that are assigned more human resources than is needed).

The use of such approach makes the enterprise management process easier and more efficient. Using BPMN systems, forces management to undertake a deep study of processes to be executed and the order in which they are executed. Furthermore, assigning an execution time to each of the processes, it is possible to have a realistic estimation of the production time, thus, creating an environment that allows for rational use of all kind of resources needed in the production chain.

Historically, many projects have failed because of the misunderstanding among business people and software engineers. These two groups of people have different backgrounds and different working

mentalities, and often what could be considered clear from the business perspective, could mean confusion from the software engineering perspective. Thus, having tools that allow business people to design their processes and the system will execute these designs, puts business people in the driving seat of the project. This modeling paradigm reduces chances of failure as it gives more power to business people in designing and implementing complex systems.

6. Conclusion and Discussions

Recent advances in ICT and their applications to enterprises have created a new environment for having better tools in designing and implementing new enterprises. Nowadays, there are available many tools and paradigms that could successfully change the way enterprises processes are designed and implemented.

Techniques borrowed from the software engineering domain could be used to design and implement the architecture of new enterprises. One of these techniques is Systems Analysis that considers an enterprise as a unique system composed of several subsystems communicating among themselves through interfaces. The System Analysis approach reduces the complexity of analysis and implementation of a complex problem. Furthermore, SA facilitates the implementation of software, as the definition of interfaces allows for easy use of plug and play technology, thus creating flexible software systems.

The requirements for the new system could be gathered using the use case model approach, using The Unified Modeling Language (UML). This approach helps to express the functionalities of the system without implementing them. Furthermore, the use case model presents the first attempt to associate employees and the functionalities offered by the enterprise in study. Furthermore, identifying specific actors and their roles and responsibilities are integral to the system design.

The BPMN technologies could be used to express enterprise functions in terms of task that could be executed sequentially or in parallel. BPMN diagrams clearly specify people assigned to processes, the time of execution of each process and the order in which processes are executed; thus allowing for simulation of the production process well ahead of the implementation of these processes. This approach creates a better environment for planning all kind of resources to be used. Simulation can discover bottlenecks and processes that are assigned more human resources than the need is. The enterprise management is enormously facilitated by the use of such technologies as they allow for streamlining of the processes by assigning the necessary amount of people to carry out each of the tasks, thus avoiding delays of the production. The use of this paradigm makes it possible to move towards Enterprise engineering approach.

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