Indonesian Journal of Electrical Engineering and Computer Science
Vol. 29, No. 2, February 2023, pp. 1113~1121
ISSN: 2502-4752, DOI: 10.11591/ijeecs.v29.i2.pp1113-1121

Modeling and classification of Departmental Business Processes of a Bangladeshi University

Tahmina Akter Tisha[1], Mir Moynuddin Ahmed Shibly[2], Rashedul Amin Tuhin[1], Ahmed Wasif Reza[1]
[1]Department of Computer Science and Engineering, East West University, Dhaka, Bangladesh
[2]Department of Computer Science and Engineering, United International University, Dhaka, Bangladesh

Article Info

Article history:

Received May 26, 2022
Revised Oct 17, 2022
Accepted Nov 4, 2022

Keywords:

As-is model
BPMN2.0
Business process model
Business process optimization
Workflow pattern

ABSTRACT

Business process modeling (BPM) is a field of computer science that can be used by every organization to maintain its workflow pattern. Adopting this can significantly improve the workflow and can identify problems with the workflow in terms of resource optimization. In this article, the idea of representing the business processes of a Bangladeshi Educational Institute using the business process model and Notation 2.0 has been presented. In this case study, a business process model for the information system at the departmental level of East West University (EWU) has been designed after analyzing 15 key business processes by interviewing stakeholders. After classifying the created as-is business process models based on two criteria-order of actor participation and participation of external entities/departments, two areas of optimization in the workflow pattern have been proposed, load optimization and online automation. This documented model of the business processes has multi-purpose uses. It can be used for resource management, as a guide for stakeholders to better understand a business process, and as a guideline for new employees. This study has shown that by adopting business process modeling, an educational institution could march toward a better and enhanced workflow pattern by identifying problems in it.

Corresponding Author:

Mir Moynuddin Ahmed Shibly
Department of Computer Science and Engineering
United International University
United City, Madani Avenue, Badda, Dhaka 1212, Bangladesh
Email: moynuddin@cse.uiu.ac.bd

1. INTRODUCTION

Business process model and notation (BPMN), a field of computer science and an information system, allows organizations to understand their internal business processes in a graphical notation and also to communicate these processes in a standard way [1]. BPMN is required to document processes to minimize costs and time in terms of resources through process improvements. A growing organization will eventually design and develop its internal information system for smooth management and navigation of processes to provide meaningful insights to its participants through an easy-to-understand visual representation of procedural steps. BPMN is aimed at the people who will implement the process at the appropriate level and provides sufficient information to ensure effective implementation. It offers a common and standard language for both technical and non-technical stakeholders such as market analysts, managers, technical developers, as well as consultants, and external teams. Providing sufficient detail and consistency in the sequence of business activities in a model bridges the gap between the purpose of the process and execution.

The business processes of an organization can be modeled using various methods and techniques [2] such as flowcharting [3], Petri-nets [4], definition language (IDEF) techniques, and BPMN [5]. However,

studies have been conducted on the acceptance of the BPMN as one of the most notable tools for modeling business processes. BPMN has been shown to still be considered the de facto standard to model a business process [6]. Many organizations have designed their processes using BPMN for better management and better workflow. Several studies have been conducted from time to time to model a business process using this notation. For example, a study has been carried out to develop a model for the production of medical instruments using BPMN. The model has been created to demonstrate the complex processes of designing medical devices more easily and conveniently [7]. BPMN can also be used in modeling software processes [8]. An extension has been integrated along with the activities elements of the BPMN to analyze whether there was a physical risk or not in a process performed by workers in manufacturing companies [9]. Another study has been carried out to design enterprise modeling using BPMN [10]. A case study [11] has been conducted to re-engineer the business processes of a construction company. The concepts of business process modeling (BPM) have also been followed by small-to-medium enterprises [12]. Using BPM, the gap between different processes has been analyzed in another work [13]. BPM has been widely used in healthcare systems [14]-[18].

On the other hand, business process modeling can be used in educational institutions to detect bottlenecks in the system's working pattern. The business process analysis tool (BPA) has been used to identify the weak points in the work process of the University of Split School of Medicine and 80 weak points have been found [19]. Although BPMN has not been used to model the processes of that school, the study clearly showed the importance of process management and modeling. In another study, using business process modeling, a framework for higher education has been proposed. The satisfaction of the students has been measured on some competence levels. On the basis of the results, suggestions for improving the courses have been sent to the professors [20]. However, there is limited research on the topic of minimizing costs and optimizing the process in terms of limited resources in the educational institutions of a developing country such as Bangladesh. Such models would be useful for a particular university to provide software requirements specifications and to implement the blockchain for creating a trusted network (i.e. web 3.0) as well as collaborating with other universities. Another important aspect is that entities of similar types can get help modeling their processes leading to interoperable information systems [21] toward digital governance through the knowledge of this study. New processes can be discovered and established eventually (e.g., online courses taught by a prominent professor, social media presence, dissemination of research findings) as well. Moreover, persons are transferred, but the process remains unchanged. Therefore, a model can act as a guide for a newcomer in that case. To our knowledge, there has not been made to represent the business processes of educational institutions in Bangladesh using standard business process modeling and analyzing the efficiency of their workflow patterns.

This study is an attempt to represent the business processes using BPMN for identifying the workflow patterns of East West University (EWU) at the department level and to identify the optimization scopes in it. The major contributions of this study are as follows:

a) Identifying the key processes of EWU at the department level and the related stakeholders of these processes.
b) Developing an as-is business process model for the EWU information systems.
c) Identifying the scopes of optimization in the workflow pattern of EWU at the department level using the created as-is model.

In the following sections of this article, first, the methods of this case study are described. In the subsequent section, the results obtained from designing department-level as-is business process models are presented with proper discussion. Finally, the limitation of this study with future directions and concluding remarks are presented.

2. METHOD

The objective of this study is to design an as-is business process model so that the optimization scopes of the processes could be identified. In this section, the study working procedure is explained with proper justification. The first step was to collect qualitative data for identifying the key business processes at the department level and gain further insight with multiple interviews the associated stakeholders. Analyzing the collected data, process models were developed, validated, and further refined based on the feedback from the stakeholders towards the scopes of optimization of the workflows.

2.1. Data collection

To gain a clear understanding of existing business processes, a Department-Level Information System needs to be developed for EWU, which has been done by following the case study strategy. For similar studies as this, the majority of other researchers have also used case studies as a research strategy [19], [17], [22]. Surveys are not appropriate for this type of study because they are random and for covering a larger area. The developed as-is model is only specific to the computer science and engineering (CSE) department of EWU.

Collecting data about all department-level business processes and modeling them has not been feasible. Therefore, some key processes have been identified as representatives of other processes to generalize the outcome of this study. Since qualitative data would be generated from the identification of key business processes, a qualitative data collection method has been followed, such as interviews with various stakeholders who are directly involved in the process. Their insights, thoughts, and opinions have been essential for the proper modeling of these processes. As this study's focus has only been on EWU, the interviewees have been possible to be reached, and the interviews have been time- and cost-effective. Semi-structured and in some cases unstructured interviews have been conducted. Following these methods, the interviewers could immediately resolve the ambiguous responses of the respondents. However, some processes have been difficult to model due to poorly taken interviews. The questionnaire method could perform poorly in gathering information from the business process. Taking all these into account, semi-structured and unstructured one-to-one interviews have been conducted to avoid fixed control of the question-and-answer format. Moreover, there has been a need for document studies to carry out this work. Many processes have documents associated with them. These documents have been collected from various sources such as department offices, faculty members, and students. Reading these documents corresponding to a process has helped to grasp the exact workflow of it. Components of a particular process have also been extracted efficiently from the posted notices of that process. The sampling frame of this study includes the chairperson, faculty members, students, laboratory officers, messengers, and the CSE department officers. Data have been collected from stakeholders in their natural settings. For example, information from a faculty member has been collected from his/her office during office hours. Since the problems with the EWU workflow and the extent of optimization were to be identified in this study, the selected processes have been exploratory. In addition, the processes have been deliberately chosen based on their distinctive attributes. Moreover, purposive sampling has been used, as we have chosen the respondents based on the thought that they would provide easy-to-understand knowledge about the processes. There were 10 faculty members, 60 students, 3 lab officers, and 2 messengers, who are chosen for interviews, and 15 business processes were identified and modeled.

2.2. Data analysis

While data were collected, the interviews were recorded by an audio recorder with appropriate notes. The audio recordings have been transcribed and annotated, identifying the key components and all stakeholders in the process. In this case, qualitative data analysis has been carried out since the collected data were qualitative. Furthermore, content analysis was also performed to analyze different documents to identify processes as the hidden aspects of business processes could be found through this type of analysis. Each process has been modeled using the Business Process Model and Notation 2.0 (BPMN2.0). BPMN [23] is a graphical representation for specifying business processes in a business process model. This is maintained by the object management group (OMG). There are four major categories of elements in BPMN: flow objects, connecting objects, swim lanes, and artifacts, and with those elements, a business process can be modeled. Process modeling using BPMN2.0 has been possible with several online tools. In this study, all key processes were designed by an online tool called 'Signavio- the academic Explorer Version 13.14.0' [24] for its advanced process mining capabilities. It provides a 'QuickModel' feature where users can include their colleagues in collaboration design throughout modeling, analyzing, optimizing, and executing processes. Cawemo, bpmn-js, and visual paradigm online. are well-known alternative tools for business process modeling. But some of them are used only as an editor without business process automation and simulation features. But these are available in 'Signavio' which is easy to use and provides automatic positioning assistance. Risks and controls can be attached to any step of the process to remove relevant risks with the help of an internal control system of this tool.

3. RESULTS

In the data collection phase, the interviewees were asked how exactly a process runs. They have been cooperative and were clear about explaining the workflow of a process. Some subsequent questions have been asked to get a deeper understanding of the business process. Some of the participants have not been completely satisfied with the way the process runs. A participant has complained about the workload saying: "The courses should be assigned to a teacher moderately and the workload should be optimized". There has been any specific document for some processes. In that case, the stakeholders of a process have been identified based on their knowledge about them. After that, a BPMN diagram has been drawn for each process considering every step of a process that has been extracted through document studies and interviews.

3.1. Correctness and soundness

During the modeling phase, a set of semantic rules has been followed to detect errors. To do this, the SIGNAVIO tool has been used which can detect the error while designing the model following those rules. Syntactic correctness has been ensured by organizing the elements of the model that match the syntax of the

modeling language. Using the tool, semantic correctness has been checked that the process behaves correctly and properly terminates. No behavioral anomalies have been found in these models. For the process model, a generic correctness criterion is known as soundness. Soundness follows from the assumption that a process is structurally sound. In this study, the soundness has been transferred to the level of BPMN. The soundness of each model has been ensured by maintaining the three properties of the structural soundness-each process has exactly one start event and one end event, and each node in the process model is on the path from the input to the output. Even all the possible violations such as *Deadlocks,* which means the process gets stuck before reaching the final event, *Livelocks,* which means the process continues infinitely even reaching the end event, and *Remaining activities* that mean activities in a process that can never be executed have been detected with the advanced process mining capabilities of the tool in the as-is model. Considering the provided soundness checks and feedback messages, the as-is model has been fixed without any violations.

3.2. As-is business process model

To identify any scope of optimization in the workflow of any organization, the first step is to design the current processes as-is. Based on that as-is model, optimization scopes can be found. In this study, the most frequent processes that run in the CSE department of EWU have been modeled exactly the way the stakeholders have described them. After analyzing business processes, their stakeholders, and how the processes are executed, they have been modeled with the presumption that if any tasks are interrupted or dismissed in any lane's workflow, the entire process will be stopped as a failed process. All the process models have been easy to comprehend and suitable to act as a guide to newcomers. They also provide important insights into how stakeholders interact with the processes and which stakeholders are involved in which processes in what capacity.

3.3. Classification

After creating the as-is business process model, the behavior of the processes has been observed. Different processes behave differently depending on different circumstances. There have been so many variables based on which the process behavior might change. For example, what would happen to a process if a dependent stakeholder were not present at the department? Will the process go down? Will the process be continued with the executive administration of some other stakeholders? Observing individual process behavior and finding optimization scopes in a particular process may not be feasible, as there are so many running processes in an organization. Moreover, predicting the behavior of a new process is not possible if there is no logical categorization of the processes available. Therefore, the classification of the processes into some groups is necessary. In this case study, department-level business processes are categorized into some classes based on two criteria, participation of external entities and order of participation. Table 1 shows all the 15 processes that are classified into described categories. Business processes are categorized in such a way that a process can fall into one category from each group. A process can be sequential or back-and-forth. On the other hand, that same process can be intradepartmental or collaborative. In this regard, the business processes can be classified under four general classes–intradepartmental sequential, collaborative sequential, intradepartmental back-and-forth, and collaborative back-and-forth business processes with the view that other processes that are not modeled can be classified in the same way. The benefit of classifying the processes in this manner is to realize the complexity of a certain process. A collaborative back-and-forth business process where more than one departmental entity is involved repeatedly surely has more complexity than a sequential intradepartmental business process where only departmental entities are involved only once. Paying more attention to more complex processes can improve workflow in terms of resource management.

Table 1. Business processes and their category

Business process	Participation of external entities/departments		Participation of external entities/departments	
	Intra-departmental	Collaborative	Sequential	Back-and-forth
Section change	YES	YES	YES	NO
Course registration (online)	NO	NO	NO	YES
Course registration (offline)	NO	NO	NO	YES
Make-up exam	YES	YES	NO	NO
Hiring a teaching assistant	NO	NO	NO	YES
Advising	YES	YES	NO	NO
Semester Withdrawal	NO	NO	NO	YES
Conducting workshop	NO	NO	NO	YES
Class scheduling	NO	NO	YES	YES
Assigning course	YES	YES	YES	NO
Examination	YES	YES	NO	NO
Teaching-learning	YES	YES	NO	NO
Applying for leave	YES	YES	YES	NO
Course add-drop	NO	NO	NO	YES
Changing department	NO	NO	NO	YES

3.3.1. Participation of external entities/departments

The first criterion to categorize the processes that are carried out at the department level is to analyze the participation of external entities or departments. Some of the processes are executed within the department having participants-a student, a faculty member, the chairperson, and many others where no outside participant is involved. These processes are labeled as intradepartmental business processes while the processes are executed with the participation of departmental participants, as well as participants from external entities/departments like the vice-chancellor, human resource office, and the pro-vice-chancellor, are labeled as collaborative business processes. Figure 1 describes the workflow pattern of a complex collaborative business process-'hiring a teaching assistant'. In this process, departmental participants are involved, candidate student, chairperson of the department, recommender faculty member, as well as the pro-vice-chancellor and human resource management office, who are from outside of the CSE department. The process gets executed with the collaboration of all parties seen in the BPMN diagram using more than one pool. However, the process presented in Figure 2 is an intradepartmental process as the participants are within a single department represented by a single lane.

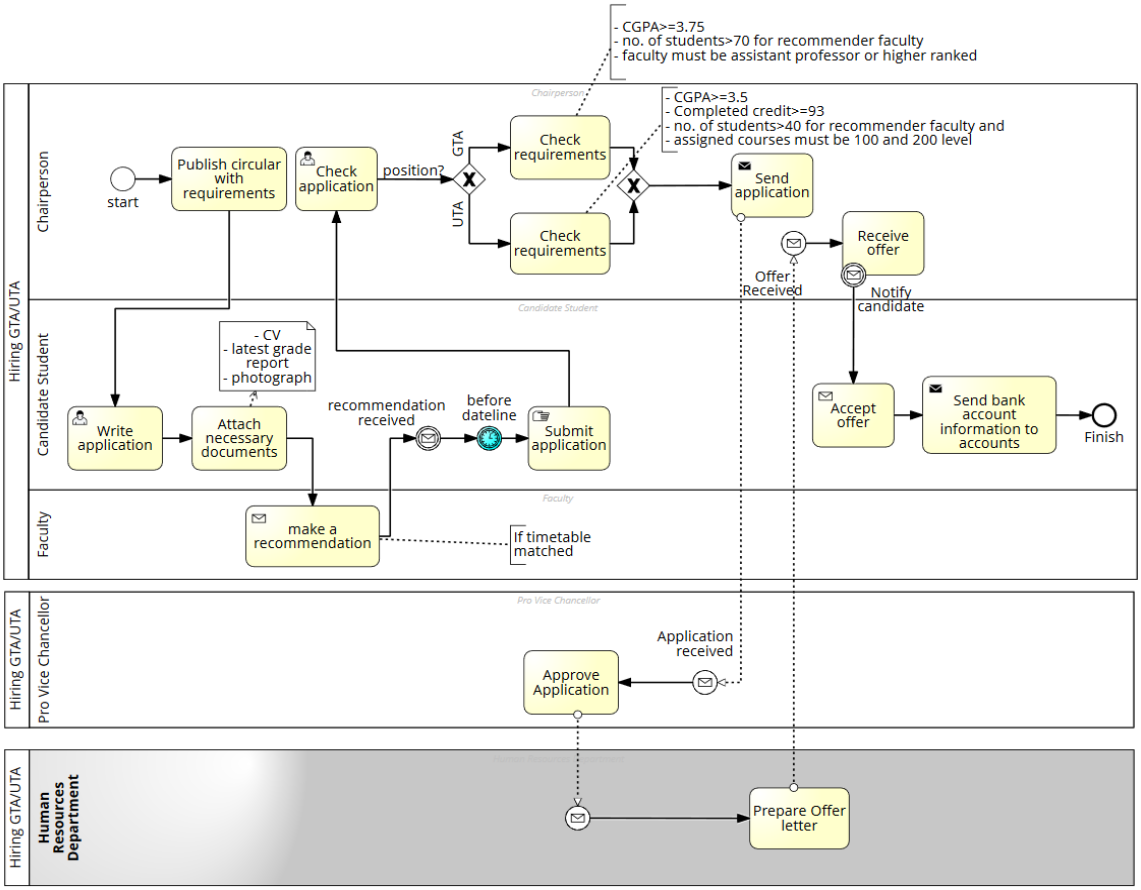

Figure 1. BPMN diagram for 'hiring teaching assistant' business processes (collaborative back-and-forth)

3.3.2. Order of actor participation

Another way to categorize business processes is based on the order in which the business actors participate. Taking this into account, two types of business processes have been found after mining: sequential business processes and back-and-forth business processes. Processes that only have forward propagation fall under the category of sequential business process where a participant interacts with the execution of a process only once. After completing the own share of activity by a participant, the workflow does not involve that participant again in the life cycle. On the other hand, in back-and-forth business processes, at least one stakeholder is involved in the execution multiple times. Most of the processes fall into the second category. Figure 2 shows the workflow of the 'section change' process. If students want to change their assigned section of a course to another section for different reasons such as an overloaded schedule, or preference, then the tasks listed in Figure 2 need to be performed to complete the entire process. Every task in this process is sequential

and depends on the completion of the immediate previous task. To change the section, a student must apply for valid reasons. Once the student is done with it, the faculty member of the current section needs to make a recommendation. Then the faculty member of the desired section gets involved. In this way, the process continues, where the advisor, chairperson, and coordinator get involved one, by one and there is no turning back to previous participants when a task has been completed by them already. Sequential processes can be said to be simple, and back-and-forth processes are comparatively complex. Hiring undergraduate teaching assistant/graduate teaching assistant (UTA/GTA) is an example of a back-and-forth process, which is given in Figure 1 where two participants-a candidate student and the chairperson-get involved numerous times.

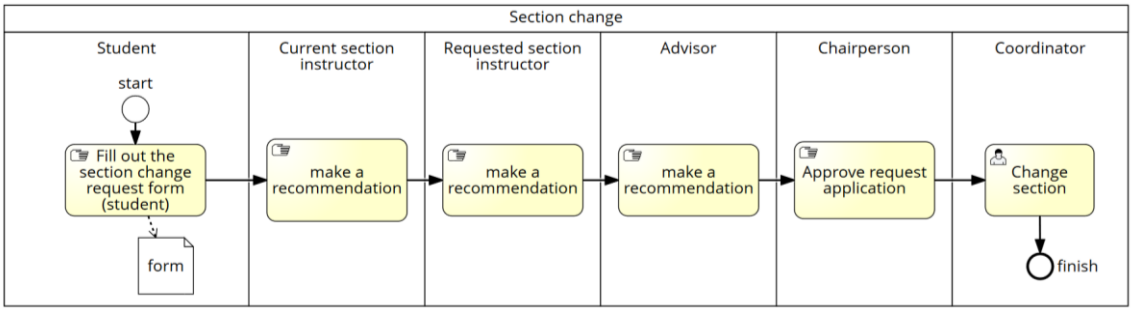

Figure 2. BPMN diagram for the 'section change' business process (intradepartmental sequential)

3.4. Optimization

After classifying the business processes, some scopes of optimization are found. These scopes are specific to a particular process but can be generalized into two broad categories, load optimization, and online automation. From the point of view of and created as-is business process model, it is discovered that many processes run on low resources and some participants have too much workload on them. One example is that almost all processes at the departmental level are eventually completed through the involvement of the chairperson, which is too much work for a single person. The chairperson may have no or very little need to get involved in the processes such as the makeup test, section change, or course add-drop. Thus, the first suggestion is to narrow down the workload of the chairperson. The involvement should be determined by the importance of the process to minimize time and cost. Another scope of optimization is to reduce the credit load of faculty members per semester. According to the university rule, a minimum of 9 credits and a maximum of 12 credits can be assigned to a faculty member per semester. But most faculty members in the CSE department have more than 12 credits load per semester. This matter can be resolved by appointing more faculty members.

The second scope of optimization is to ensure automation for various business processes. After analyzing the as-is business process model, it is realized that most of the tasks in a process are either user tasks or manual tasks. There are very few tasks-like registering courses in the course registration process-that are automated. The course registration process is meant to be an online-based process. However, due to the web portal being at the development stage, several features are still being optimized and improved. Therefore, the online course registration can also be done by going to the course registrar manually. Other processes, such as applying for leave in an emergency, submitting clearance documents, and changing sections, can be performed online. If some of the processes are transferred from offline to online, there will surely be better management of resources.

3.5. Discussion

The result of this study demonstrated that the business processes of an educational institution at the department level can be identified and modeled using BPMN, and these processes can be classified into some categories with the view to optimizing workflow patterns. The result also showed the necessity of giving each process a graphical representation. A well-designed business process model can provide a better understanding of a process to an outsider or newcomer to the scene than written documents associated with a process. Transcribed document knowledge can be achieved by the business process model which is important for analyzing and improving the processes of an organization. Business process modeling can also help an organization optimize its workflow patterns. This study has a result similar to another study conducted [19]. Few other studies have been conducted on representing the business processes of educational institutions graphically and managing resources appropriately. Soares and Setyohady [25], the researchers have proposed a new information system after analyzing the gap in the existing system.

While collecting data on business processes through the interview, stakeholders have also been asked about the time needed to complete a business process. They have been asked about how much time they actively interact with the process and how much time they must wait to complete a process. Their responses have been aggregated to determine the average active time and waiting time corresponding to a business process. In Figure 3, a comparison is illustrated concerning the active time and waiting time of a few processes. From the figure, it is clear that the majority of processes have a higher waiting time than active time. For example, if a student wants to register for his/her courses through the offline course registration process, he/she has to wait in a queue for an average time of 90 minutes. After waiting 90 minutes, the actual registration process can be completed in 5 minutes. This long waiting occurs due to a lack of personnel as course registrars. On the other hand, if a student wants to register through the online platform, the waiting time reduces from 90 to only 15 minutes. This improvement indicates that manual and offline business processes at the department level should be converted to automated and online business processes. With the help of the business process model, an educational institute can explore the prospects of new processes before implementing them. For example, if EWU wants to introduce an online teaching-learning process in time of some emergency (supposing a virus outbreak), the whole online education process can be demonstrated at a general level among the stakeholders by a simple BPMN model so that everyone gets to realize how to interact with that process.

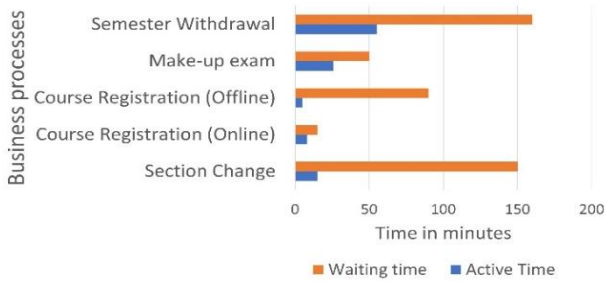

Figure 3. Comparison of active and waiting time of a few business processes

Some processes have been conducted without a specific workflow pattern. For example, as a requirement of a B.Sc. in CSE degree, every student must have to do a 4-credit project/thesis under a supervisor. But there is no specific rule on how a student will be assigned to a supervisor and no protocol to follow in carrying out the project/thesis. Every semester, this process is executed differently. For the variety of practices in the workflow pattern of some processes, the researchers decided to leave them out of scope, at the time of writing this article. Processes such as admission tests, buying instruments for the lab, and faculty recruitment have not been modeled because the scope is more university-level than department-level. In addition, the models are focused on a specific viewpoint which is the CSE department. That means external organizations such as human resources (HR) have not been thoroughly modeled, which has been treated as a black box in the "Hiring UTA/GTA" process.

4. CONCLUSION

In this study, only the as-is business process model is designed and some optimization scopes are identified. Based on the basis of those optimization points, designing a to-be business process model would be interesting and more apparent. A further area worth exploring is the development of a value chain model for department-level processes. In addition to that, Petri-net and colored Petri-net modeling can be done to realize the workflow more precisely. Furthermore, in this study, only the processes at the CSE department level were considered in this study. In the future, the process model at the university level can be derived and the bottleneck/lack can be checked. The inventory item utilization report can also be generated. The feasibility of blockchain implementation in collaboration with other universities and organizations can be effective in the future. Bringing the whole university under business process modeling would surely smoothen the workflow and ensure better management.

Every organization needs to adopt business process modeling to ensure proper management and healthy workflow of its business processes. Educational institutions are not different from that. A business process model can also help stakeholders related to an educational organization to easily understand the essence of a process. Many business organizations around the world are using BPMN modeling to understand internal business procedures easily and clearly. The mutual understanding of the procedures has been improved by using the idea of modeling the processes. In this case study, the idea of using this kind of modeling in the educational sector has

been introduced. The model itself has shown its significance in various ways. The information gathered from the process model can be used to resolve problems in workflow patterns. This case study would also help a departmental entity within a university design its information system. Such an information system would be helpful to understand the essence of the business processes within the department. Furthermore, this type of system would facilitate the integration of newly emerged business processes into the current workflow of an organization.

REFERENCES

[1] E. DIaz, J. I. Panach, S. Rueda, and O. Pastor, "Towards a method to generate GUI prototypes from BPMN," *In 2018 12th International Conference on Research Challenges in Information Science (RCIS)*, 2018, pp. 1-12, doi: 10.1109/RCIS.2018.8406675.

[2] G. M. Giaglis, "A taxonomy of business process modeling and information systems modeling techniques," *Int. J. Flex. Manuf. Syst.*, 2001, doi: 10.1023/A:1011139719773.

[3] T. J. Schriber, *Fundamentals of Flowcharting*. John Wiley & Sons, Inc., 1969.

[4] W. M. P. V. D. Aalst, "Petri Nets," in *Encyclopedia of Database Systems*, Boston, MA: Springer US, 2009, pp. 2103–2108, doi: 10.1007/978-0-387-39940-9_817.

[5] S. White, "Introduction to BPMN," *IBM Coop.*, 2004.

[6] M. Kocbek, G. Jošt, M. Heričko, and G. Polančič, "Business process model and notation: The current state of affairs," *Comput. Sci. Inf. Syst.*, 2015, doi: 10.2298/CSIS140610006K.

[7] H. Tomaskova *et al.*, "The business process model and notation of open innovation: The process of developing medical instrument," *J. Open Innov. Technol. Mark. Complex.*, vol. 5, no. 4, 2019, doi: 10.3390/joitmc5040101.

[8] M. Kuhrmann, J. Münch, I. Richardson, A. Rausch, and H. Zhang, "Managing software process evolution," *Manag. Softw. Process Evol. Tradit. Agil. Beyond - How to Handle Process Chang.*, pp. 1–332, 2016, doi: 10.1007/978-3-319-31545-4.

[9] M. Polderdijk *et al.*, "A visualization of human physical risks in manufacturing processes using BPMN," *In International Conference on Business Process Management*, pp. 732-743. Springer, Cham, 2018, doi: 10.1007/978-3-319-74030-0_58.

[10] H. Krawczyk, "Enterprise activities modeling by bpmn notation," *Inf. Syst. Manag.*, vol. 6, no. 3, pp. 203–212, 2018, doi: 10.22630/isim.2017.6.3.4.

[11] B. Dave, "Business process management - A construction case study," *Constr. Innov.*, 2017, doi: 10.1108/CI-10-2015-0055.

[12] A. S. M. Tam, L. K. Chu, and D. Sculli, "Business process modelling in small- to medium-sized enterprises," *Ind. Manag. Data Syst.*, 2001, doi: 10.1108/02635570110390107.

[13] Y. C. Juan and C. Ou-Yang, "Systematic approach for the gap analysis of business processes," *Int. J. Prod. Res.*, 2004, doi: 10.1080/00207540310001631223.

[14] M. Bertolini, M. Bevilacqua, F. E. Ciarapica, and G. Giacchetta, "Business process re-engineering in healthcare management: A case study," *Bus. Process Manag. J.*, 2011, doi: 10.1108/14637151111105571.

[15] F. Ruiz *et al.*, "Business process modeling in healthcare," *Stud. Health Technol. Inform.*, 2012, doi: 10.3233/978-1-61499-086-4-75.

[16] Á. Rebuge and D. R. Ferreira, "Business process analysis in healthcare environments: A methodology based on process mining," *Inf. Syst.*, 2012, doi: 10.1016/j.is.2011.01.003.

[17] R. Martinho, R. Rijo, and A. Nunes, "Complexity analysis of a business process automation: case study on a healthcare organization," *Procedia Computer Science*, vol. 64, pp. 1226-1231, 2015, doi: 10.1016/j.procs.2015.08.510.

[18] R. Müller and A. Rogge-Solti, "BPMN for healthcare processes," *In Proceedings of the 3rd Central-European Workshop on Services and their Composition (ZEUS 2011), Karlsruhe, Germany*, vol. 1, 2011.

[19] D. Sapunar, I. Grković, D. Lukšić, and M. Marušić, "The business process management software for successful quality management and organization: A case study from the University of Split School of Medicine," *Acta Med. Acad.*, 2016, doi: 10.5644/ama2006-124.153.

[20] M. Drăgan, D. Ivana, and R. Arba, "Business process modeling in higher education institutions. developing a framework for total quality management at institutional level," *Procedia Econ. Financ.*, 2014, doi: 10.1016/s2212-5671(14)00779-5.

[21] P. Cotofrei and K. Stoffel, "Business process modelling for academic virtual organizations," *In Working Conference on Virtual Enterprises*, pp. 213-220. Springer, Boston, MA, 2008, doi: 10.1007/978-0-387-84837-2_22.

[22] A. Partington, M. Wynn, S. Suriadi, C. Ouyang, and J. Karnon, "Process mining for clinical processes: A comparative analysis of four australian hospitals," *ACM Trans. Manag. Inf. Syst.*, 2015, doi: 10.1145/2629446.

[23] N. Russell, W. M. V. D. Aalst, and A. H. M. T. Hofstede. *Workflow patterns: the definitive guide*. MIT Press, 2016, doi: 10.1007/978-1-4899-7993-3_826-2.

[24] "Signavio," BPM Academic Initiative, 2020, [Online]. Available: https://academic.signavio.com.

[25] S. Soares and D. B. Setyohady, "Enterprise architecture modeling for oriental university in Timor Leste to support the strategic plan of integrated information system," *In 2017 5th International Conference on Cyber and IT Service Management (CITSM)*, pp. 1-6, 2017, doi: 10.1109/CITSM.2017.8089313.

BIOGRAPHIES OF AUTHORS

Tahmina Akter Tisha received her bachelor's degree in Computer Science and Engineering from East West University, Dhaka, Bangladesh. Her research interests include machine learning, data mining, computer vision, software engineering, software development, software quality assurance, and information management system. She can be contacted at email: tahminatish001@gmail.com.

Mir Moynuddin Ahmed Shibly is currently working as a lecturer at the department of Computer Science and Engineering, United International University, Dhaka, Bangladesh. He received his bachelor's and master's degree in CSE from East West University, Dhaka, Bangladesh. His research area includes machine learning, data mining, computer vision, software engineering, and information management system. He can be contacted at email: moynuddin@cse.uiu.ac.bd.

Rashedul Amin Tuhin is a senior lecturer at the Computer Science and Engineering department of East West University, Dhaka. He has obtained his Master's in Network Services and Systems degree from KTH-Royal Institute of Technology, Stockholm, Sweden. His research interests include networked systems security, digital forensics, education technology, and global navigation satellite systems. He can be contacted at email: mcctuhin@ewubd.edu.

Ahmed Wasif Reza obtained a B.Sc (Hons.) in Computer Science and Engineering from Khulna University (Bangladesh), Master of Engineering Science (M.Eng.Sc.) from Multimedia University (Malaysia), and Doctor of Philosophy (Ph.D.) from University of Malaya (Malaysia). Since August 2016, he is working as an Associate Professor at the Department of Computer Science and Engineering (CSE), East West University, Bangladesh. He was also appointed as the Chairperson of the CSE department. Previously, he was attached to the University of Malaya, Department of Electrical Engineering, Faculty of Engineering, Malaysia for almost 8 years. He is serving as a member of the Evaluation Team (ET) for the Accreditation of different engineering programs of various universities, appointed by the Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh. He also has vast experience in supervising Ph.D., Masters, and Undergraduate students. He has been placed in the "World Scientist and University Rankings 2021" ranked by "AD Scientific Index". He has been working in the field of radio frequency identification (RFID), wireless communications, biomedical image processing, bioinformatics, data science, the internet of things, machine learning, and deep learning. He has authored and co-authored several journals and conference papers (about 150 papers; h-index: 22; citations: 1900). He can be contacted at email: wasif@ewubd.edu.