STREAMLINING WORKFLOW PROCESSES IN PUBLIC SECTOR UNIVERSITIES: A MODELING AND SIMULATION-BASED AUTOMATION SOLUTION

R. Choudhary[1], H. Tariq[1], N. R. Chaudhry[2], Maneha[1] and R. Awan[1]

[1]Department of Software Engineering, University of Gujrat
[2]Department of Computer Science, University of Gujrat

Corresponding Author's Email: nauman.riaz@uog.edu.pk

ABSTRACT: Business process engineering is used to make business process more efficient, to increase the quality of product and reduce cost and time as well of current business process. The aim of this work is to find the problem associated with the administrative workflow in public sector university of Pakistan. The problem is when we do things manually, it consumes a great amount of time to complete work. In manual work the chances of human error are also more than any automated system used for administrative workflow. Students cover a lot of distance for administrative work and wait a lot in queues for their turn that also wastes a lot of time of students. University administrative staff have to spend too much time in dealing with current manual processes like paperwork, emails, and spread sheets. It takes a lot of time for one activity to be done in current process. In current business process there is a long queue in front of administrative officewhenever there is some important deadline. The use of an automated systems improves efficiency and effectiveness of an organization. An automated system is proposed by using business process engineering with modeling and simulation that will help the students as well as administrative staff in improving efficiency and will also reduce time and cost. The major outcome of this study is to propose a solution using modeling and simulation that will be accurate in performance, reduce human error, efficient work, save time as well. The results show that the automated system will reduce the burden of workload as well as the students waiting time outside the offices.

INTRODUCTION

Business Process Reengineering is an approach which is used to increase efficiency and time management of any organization. Business process reengineering is used to reduce cost of an organization and make quality products for an organization. It is used to increase quality of an organization like speed, cost, time and productivity as well. Current business process in universities is low efficient and less effective due to manual work in administration of university[1; 25]. A manual process consumes more human power and can have more errors as compared to an automated system[2]. In Public Sector University, there is a need to automate the workflow in order to manage workflow, accuracy, and to increase user experience. The reengineering is to reduce student queues in front of admin offices and to provide ease to student and admin staff in the university by automating their roles.

When students have to add or drop courses their courses, or do another admin work they have to go from series of activities. Students cover a lot of distance for admin work and wait a lot in queues for their turns that also wastes a lot of time of students [3], [4], [5]. This manual work can also take a lot of human energy. In manual process, increases in number of employee's causes an increase in cost. In manual work with increase in human error process of activities for students and admin staff also increases which cause an increase in cost also. Currently the public sector University equipment and tools and methods can be greatly flexible and customized if want to satisfy educational services and administrative services also [6],[7]. University admin staff have to spend too much time in dealing with manual processes like paperwork, emails, and spread sheets. Today electronic workflow is introduced for electronic workflow [8]. To automate the workflow today it is big challenge for organization.

In this research paper we are going to automate all the workflow of university administrative process. Our system will be an online platform that will integrate various systems providing access to academics, students and administrators [9], [10]. The automated system in universities provides an online portal to students and admin staff to submit applications and to make approvals without wasting time in queues. The automated system

also reduce process of activities in add/drop courses and in challan form error and in update students' information as well. The system also reduces the paper based work for students and admin staff as well. This system also uses the time of admin staff and students in an efficient manner. In this research paper we will provide our solution with the help of getting data through Questionnaire filled by students and by making Business process modeling notation with Draw.io of problem and solution as well and Simulation with anylogic of problem and solution.

Background: While delivering a quality product to a customer, company are under pressure to reduce cost and improving efficiency. Business Process Reengineering is an approach to increase improvement in cost and performance in short time, response time if we are effecting the company's policy and techniques. "Why" a specific series of process and activities should they take is the focus of Business processes re-engineering (BPR)[11]. Business processes re-engineering (BPR) is a main management of linked activities in a business process. Its effectiveness has been proven by helping organizations to boost and establish performance [12]. Business processes Reengineering(BPR) is a redesigning of a current manual business process. It can give improvement in many aspects of business. Business process can be improved by making changes in business process. Experiments and mistakes help a lot in the re-engineering processes [13].In every business even it is a large or small business, all follows a business process that is a collection of interrelated tasks. Sometimes these tasks are time and money consuming. The major aim of BPR is to analyze workflows of business functions to make business to run smoothly. Eliminating unnecessary functionalities and providing better functionalities and implementing more to it. Automation can integrate the workflow used in any organization at a single platform. It can also provide better result and save time [14]. Some of the advantages of Business process reengineering are discussed: Eliminates delay in operations and provide improved viability. Focuses to determine solution that how business process can be made more effective and efficient. Business process reengineering integrates many functions immediately. It reduces consumption of time and cost [15].

The fundamental advantage of using business process reengineering is to improve user experience, reduce cost, update technology, change organization's working structure, rebuild working structure and make implementable to use [16]. By use of which an organization improve performance matrices like speed, service, quality and cost [17]. Companies and organizations that exercise BPR can improve their working performance as compared to the current operations [18].. The need of business re-engineering

increases when there is a huge increase in the number of complains and rise in refund request. Within an organization workload on staff has been increased to much that causes stress to them and could not perform well. That thing results in many complaints and to resolve the issue re-engineering practice is used [19]. So, companies are also enhancing their technologies in their businesses in order to provide a market edge to other competitive organizations. That thing also needs the change in the business current state to update technology to meet market edge. Less finance can also force to adopt process re-engineering to reduce some unnecessary activities and focus on automation of some activities. These things triggers the need for the changing in business processes and to transform the process [20] .Business process reengineering is not an easy process as it a risky process. There have been many challenges during the process. Its disadvantages include: It can be threat to job due to automation of some manual workflow, Sometimes the improvement in our department consumes cost of the entire process, a lot of finance has to be used during this process. Change is always a risky procedure. So there is not any surety of success [21].

BPR is a comprehensive and strategic approach that seeks to increases the performance of business process by re-thinking and again redesign them from the ground up. This approach is particularly useful for universities looking to streamline them add/drop process, reduce wait times, improve accuracy, and enhance security. Then understand process with many actors which includes organizations' employees, customers, non-competitor, competitor and new technologies used in it. The main problem is to determine which approach is the bet to use [22].Business Process Re-engineering application and websites equipment and tools enable a user to build a model of a process, simulate and then check the best performances of the business processes model. This activities of modelling, simulating and checking the processes will iteratively take until target process is achieved. BP tools allow difficult processes model to be generate and their performance should be checked in a short period time [23].

METHODOLOGY

The main problem in our system is the waiting time in the system in front of admin office or in the admin office at every weekday. Whenever, a university student has to add/ drop a course, update information, challan form error correction, he/she has to go through a series of many activities and then he'll be able to do that any particular task. In this process, he/she has to waste a lot of time and energy in front of office or on the way to office. Firstly, he /she have to visit admin office, get the application form, then fill out the application form for the

particular problem, then submit the form. After submitting the form, wait for the response. Moreover, students have to wait a lot in queue for their turn to visit the office. then request for form. Approval process is also time consuming. We will provide an Automated system both for students and admin staff to do their work online on that system. It will increase efficiency and productivity in the current workflow. This can replace the slow procedure and consumes less time in the working activities The automated system will also reduce the burden of workload which will minimized the decrease the cost that goes to the employees in the admin staff and also number of employees in admin offices. The process is mainly to check and accept the applications is a mixture of series and parallel actions that performed in the process; the users (student or admin staff) receives information from the student or it can be from the admin staff, related to the process and the activities are run in the process, by using the e-mail or through online portal. After a certain time passed, e-mails should be created to allow the user of a delaying in the executing of an activity of a series of processes. This could ensure a technical arrangement, of the technology in the public sector university, allowing a common development of all types of forms for enrollment in public sector university,

add drop courses, centralized reporting and processes related to the graduation in the public sector university[3].
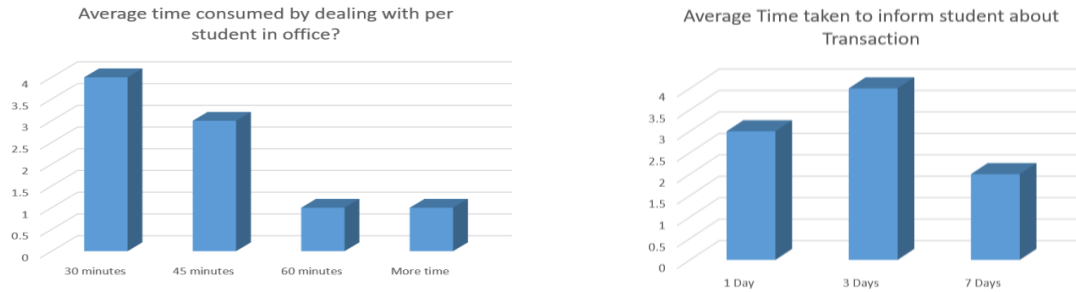
In the first step of this research paper, our objective was to conduct an accurate data to find the time wasted during manual process of administrative system workflow and how inefficient the current process is. Data related to arrival time of the students and the time spent of students in queues for waiting for their turn and time taken by admin staff to perform per student process were collected in 3 working days. The data was collected with the help of questionnaire from admin staff and student as well. The students' arrival in the admin office is a basic attribute of a queuing system in front of admin office. The questionnaire was divided into two sections. Out of 100 questionnaires from almost 25 plus admin offices only 9 admin offices responded us and the percentage of respond rate of admin office were almost 27%. Out of 100 questionnaires from university students 100 students respond us and the result was 100% from the students. Following table represents the detail of the question that we asked from admin staff for this research paper and these question are main part of our analysis in research paper:

Table 1: The table analysis of data collected from admin staff and students of few departments.

Questions	(a) : Number of answers	(b) : Number of answers	(c) : Number of answers
How many students add and drop course?	30% : 5	20% : 3	50% : 1
How much time is consumed by dealing with add/drop procedure per student?	20 minutes : 4	45 minutes : 3	50 minutes : 1
How many students get issue in Regeneration of challan per semester?	10% : 3	5% : 3	3% : 3
Is there any cost in resolving challan form error?	No : 7	Yes : 2	
Do you face issue of late request for add/drop a course by students?	Yes : 8	No : 1	
How many students do late request?	15 students : 3	25 students : 2	45 students : 4
How much time is consumed in informing you that particular student have submit fee?	1 day : 3	3 days : 4	7 days : 2
How a student can update his information?	Take form & fill that : 7	Update it online : 2	
How many students update their data within 1 semester?	3% : 5	1% : 3	5% : 1
Do you allow online request approvals?	Do not allow online approvals : 6	All online request approvals : 3	
How much time is consumed in challan correction?	3 Days : 26	7 Days : 7	Don't know : 67
Do you feel ease with present manual system?	No : 69	Yes : 31	

In Figure 1 below we can clearly see that the average time consumed to deal per student for a procedure of manual work is 30 minutes, which is a lot wastage of time the wastage of time in also is in informing student about anything in manual

work. It can be done in seconds by any automated system. There were also more factors involved in manual work that we moved towards automated system.
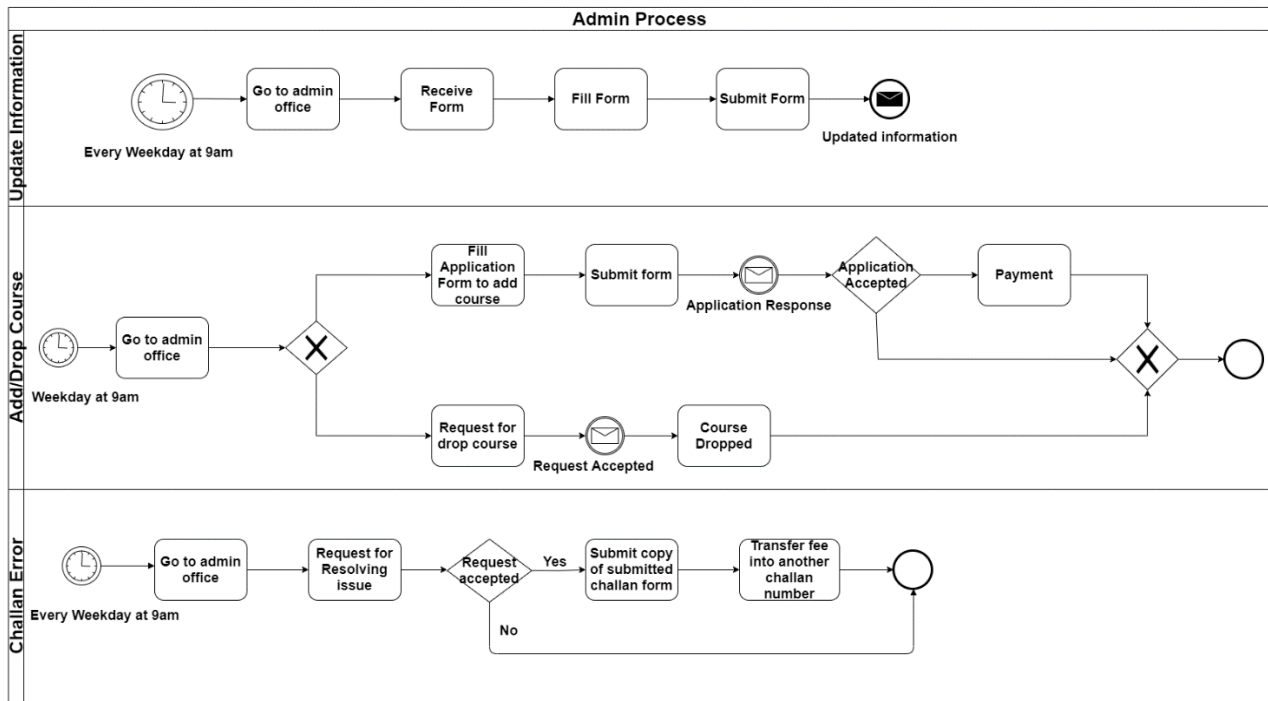

Figure 1: Graphs of analysis from data collected through questionnaire.

There are several tools to analyze the data and for modeling BPMN as well for simulation. In this research paper we are designing model from BPMN.But for our project we decided to take three main and famous tools include Drwa.io that we used to make BPMN, MS EXCEL that we used to analyze our all the data and Anylogic for our simulation modeling. These are great tools for all these purposes. There were many functionalities available in these that reduce your burden and make work easy that's why we selected them.

Experiment: This section shows the experimentation done for both problem and the solution. The first part is about IS-A process and then TO-BE process follows. In Challan Error student goes to admin office, wait for his/her turn and in this process the time students waste a lot in queues in front of admin office. Then students enter in admin office and request for his/her issue, admin staff accepts the request of the student then they submit the copy of their chal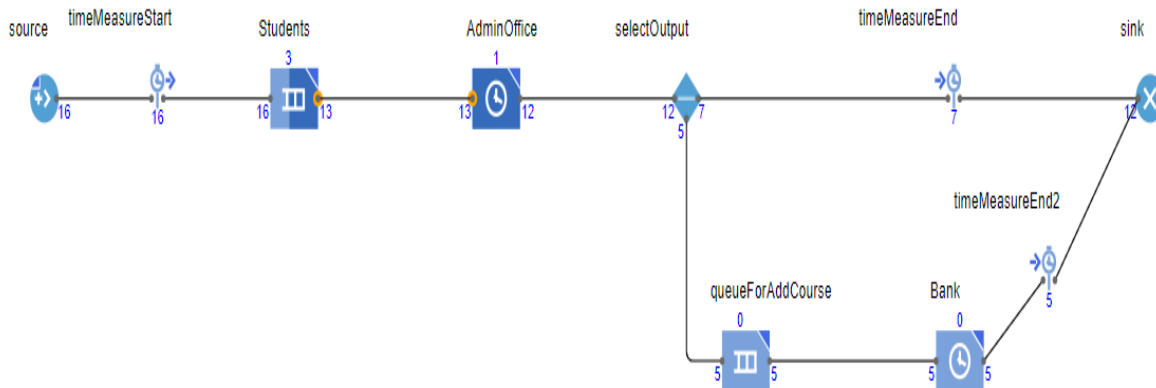lan form and then admin staff send fee in their new challan number. In Updating of information student goes to admin office, wait for his/her turn and in this process the time students waste a lot in queues in front of admin office. Then students enter in admin office and receive form to fill their information on that, and then they fill their form and then submit their form to the admin staff. In Add/Drop Course student goes to admin office, wait for his/her turn and in this process the time students waste a lot in queues in front of admin office. Then students enter in admin office and request for his/her issue, if student has to add course then they will application form and then submit it in admin office, and then they will wait for the response to acceptation of their request, it will also waste their time, if their request accepted then they will go to bank for their payments and there also their time will be wasted and energy as well. The following BPMN represents the is a process in which there are three modules including challan error, Update information, Add/Drop Course.

Figure 2: BPMN of IS-A process in which three modules.

In IS A process of simulation first student comes from source and their time is being started recording, after this they wait in a queue named students, where they wait for several minutes for their turn in the admin office so they can do their processes after that by FIFO method they go in the admin office to submit their, in admin office their time is also wasted just in the process of accepting their request and arguments between them and admin staff. After that we applied the choice of output that if they are the students of add/drop course they will go to the bank office and again wait for their turn in queue and their also their time wastes, after that they go for delay in the process of submitting fees where 5 minutes per student wastes and then time measurement ends for their all the process and we have computed the first 10 values of their time in the Table 3 below. If they are the students of the challan form error or their students of the updating information their end time will be just measure and in the sink process the simulation process will be end. The following simulation represents the problem of time wastage in queues and delays in current manual work.

Figure 3: Simulation of IS-A process in which queuing system is represented.

The following BPMN in figure 4 represents the processes that we implemented in our automated system to manage all the processes efficiently. In student side students just go to their online portal and check the list of all the modules available in it. The list will include: Updating information, Challan error, Add/Drop Course.
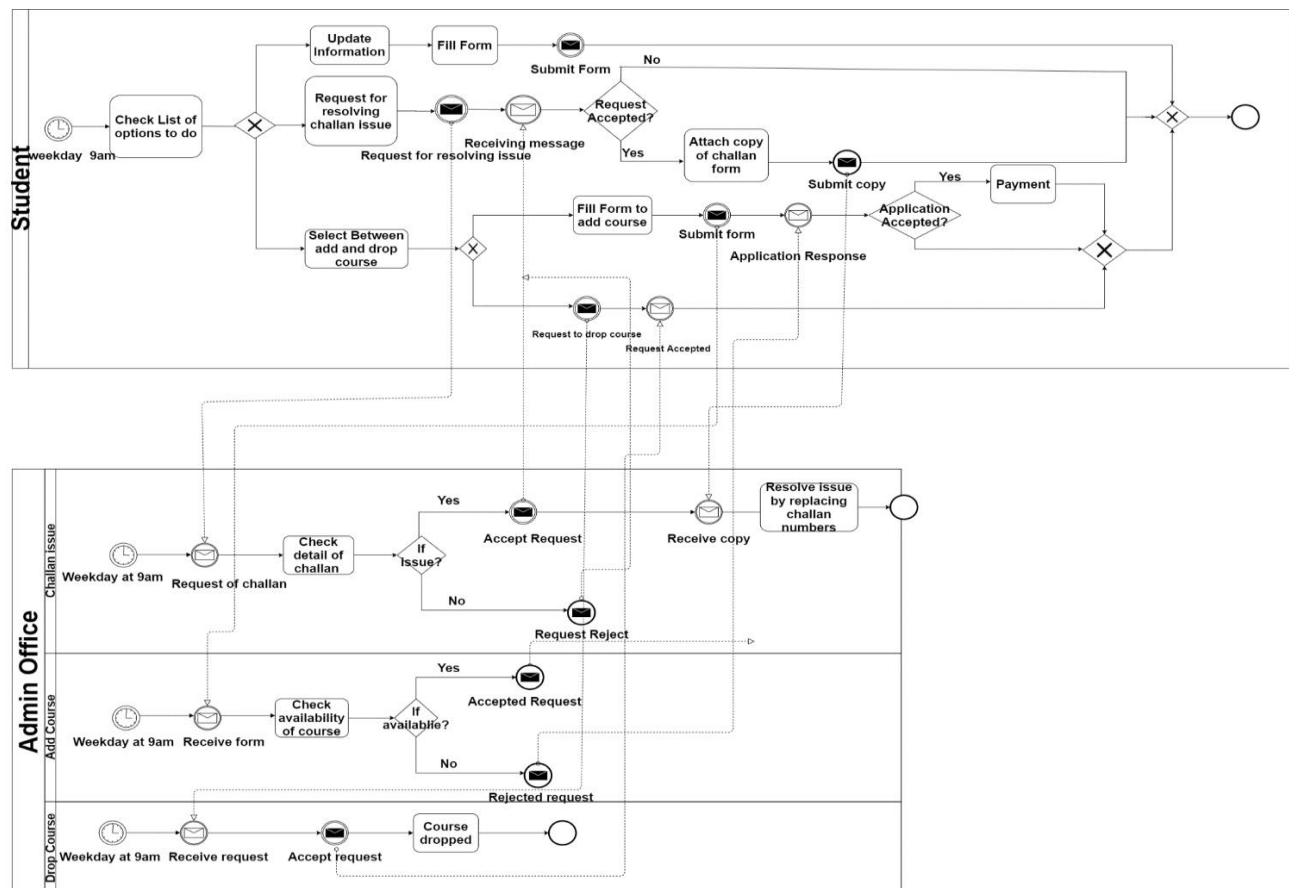
For update information Students will online form and simply submit it, it will save a lot of their time that us wasted in queues in front offices.For request for challan error issue, they will online request for the resolving issue, and then wait for their response from staff if their request accepted they will just attach the copy of challan form and then just will upload it and will easily submitted, it will save a lot of their time that us wasted in queues in front offices. For Add/Drop Course first they will select between add and drop if they select add course they will fill form to add course and then just submit it and wait for their response if it is accepted they will submit fee, it will save a lot of their time that us wasted in queues in front offices. If they select drop course, they will request to drop course if their request accepted their course will be dropped, it will save a lot of their time that us wasted in queues in front offices.
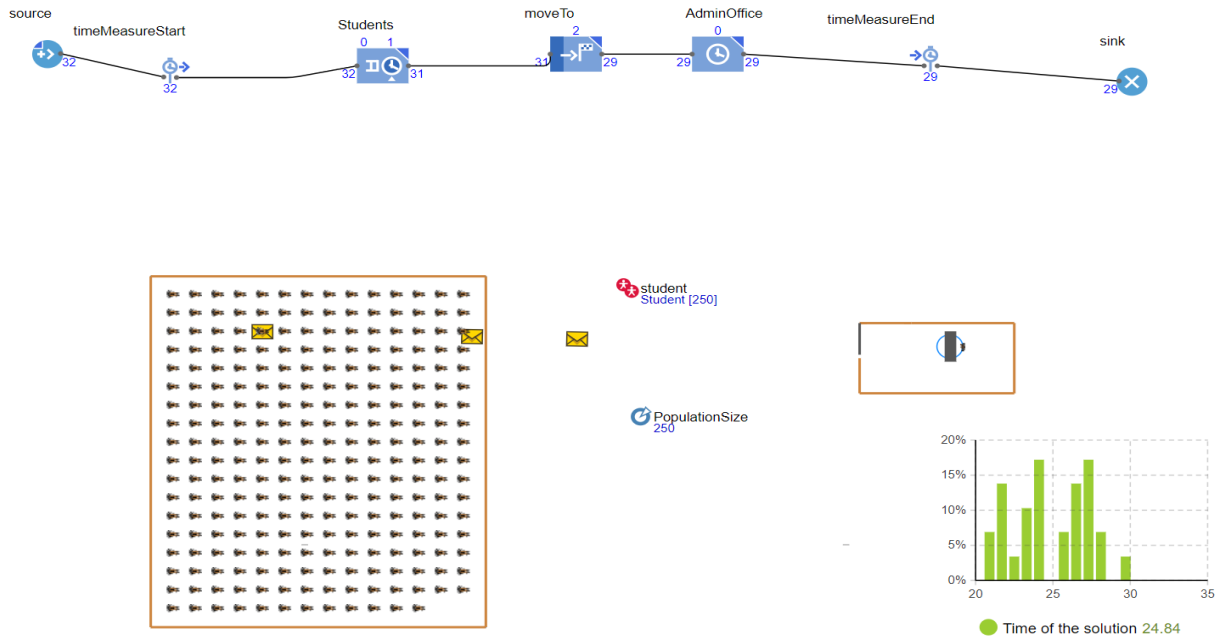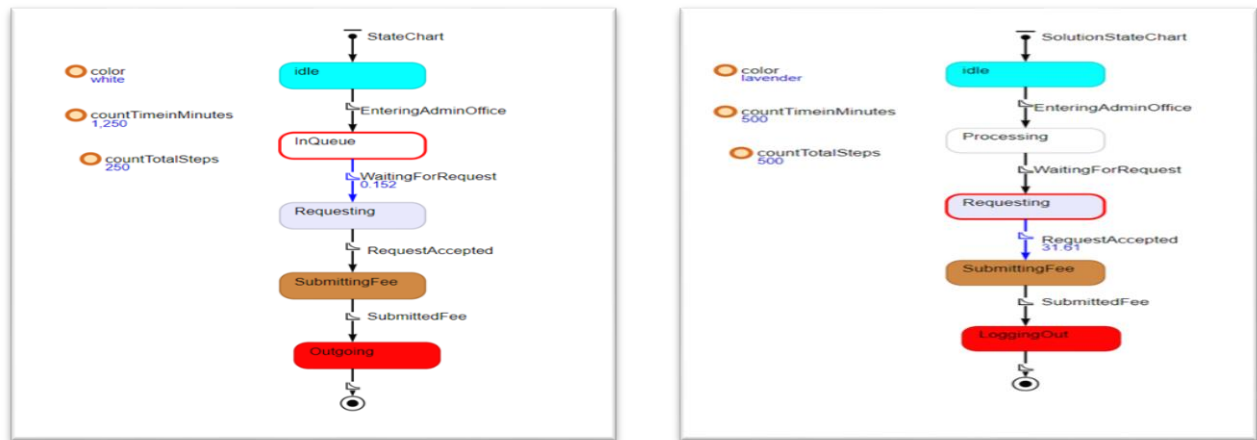
In admin side, there are three modules included Updating information, Challan error, Add/Drop Course. For request for challan error issue, they will first receive request from students and they will check the details of challan if there is issue, then they will accept it, if not they will just reject it. For request for add course, they will first receive request from students and they will check the availability of course if the course is available, then they will accept it, if not they will just reject it.For

request for drop course, they will first receive request from students and they will accept the request and then just simply drop the course.

In TO-BE process of simulation first student comes from source and their time is being started recording, after this we applied service because in service students wait for a while and there is delay in it in which they do their process of work like make request for some module and then the message form students moved from students to the next delay which is admin office in admin staff process their request and then there comes an end of the time which is name time measure end and then sink the process . The following simulation represents the queue managing and reduces delay in the admin office and in front of it by reducing time in processes.

From Figure 6 we can clearly see that automated system is fully successful in this research paper because time in the second state of is a process is greater than time in the third state of to be process, it means that our main objective (reducing time using BPR technologies) is achieved in it and our research paper and our automated system is in the right path. Time count in minutes is basically a variable in our state diagram which is calculating time of total students at every single state and representing it to us. It should be less in to be process which is so we achieved our goal.

Figure 4: BPMN of TO- BE process in which two sides' student and admin are represented in detail.

Figure 5: Simulation of TO-BE process in which automated system is represented.

Figure 6: State chart of IS A process on left and TO BE process on right including three variable.

RESULTS AND DISCUSSION

Table 2: The table of research graphs and variables of comparison of IS-A process and To-BE process:

	Research data of graph and Variables of IS A process			Research data of graph and Variables of TO BE Process	
	Time Add/Drop Course (minutes)	Count Time in Minutes Variable (minutes)	Time Challan and Updating (minutes)	Total time in automated system (minutes)	Count Time in Minutes Variable (minutes)
Number of data	128	5	122	250	5
Minimum Value	641.67	1250	1206.62	0.41	250
Maximum Value	1709.49	5250	2208.43	0.42	1250
Mean	1527.684	3550	1915.14	0.415823	750

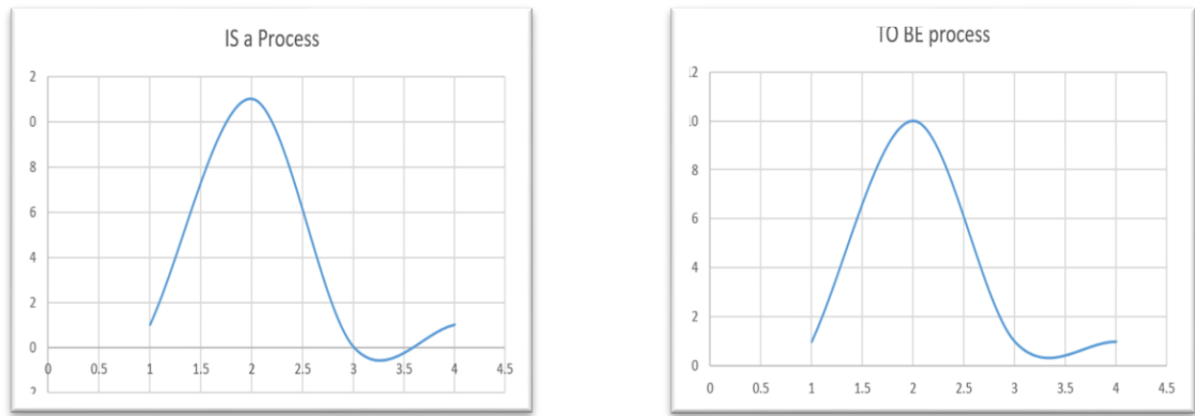|					
Standard Deviation	21265.27	1690.044	157.3242	0.000313	395.2847
Variation	121385.3	2856250	24750.89	2.44E-05	156250
Skewness	-3.68894	-0.46223	-1.66949	-0.3359	0

Figure 7: Frequency of time consumed in simulation model of IS A process and TO BE process.

The simulation result is shown in Table 2 and Figure 7. A comparison between the time of existing business processes and proposed business processes is significant. From Table 2, the result demonstrates that the TO BE process require less time to do the same series of activities that is in our current manual process in public sector university. We can clearly see that the mean value of time in IS A process is 1527.684 minutes but in TO BE process it reduces and comes to 0.4215823 minutes. This is expecting because now the need for students to go in admin office of department is not require which saves the time of students and admin staff as well, and this is our main objective to reduce time of administrative process and to make our TO BE process efficient and error free as much as possible. This highlights the requirement of an automated system in our public sector university, it does not deny the need of admin staff in admin offices, it just reduces their burden of work time and cost of both sides (students and admin staff). From Figure 7, we can clearly see that the frequency in the IS A process is in negative side of graph but in TO BE process it is in positive side.

Conclusion Business process engineering is one of the vital building blocks of automation. The current manual process in the administrative workflow of the Department of Software Engineering in public sector university is facing a lot of difficulties in which major of them is wastage a lot of time of students and administrative staff. In this research paper, we proposed a solution of an automated system to reduce this wastage of time. The advantages of the automated system are they are of low cost, it will increase the positive image of the Software Engineering Department of public sector university, it will reduce the time wasted in queues and processing, it will be very efficient and error free as well. In this

research paper the time of doing request is managed within 1 month and after a month no one can do request online, this is the main benefit for administrative staff to manage and maintain all the processes.The automated system reduces a great percent of time as compared to manual workflow.Inorder to reduce delays and queues we set just 1 delay in our solution which has very minimum time of delay and we removed queues from our system and students now can easily send request without being wasted time in queues.The profits of computerizing these practices is classified as: the automating system will reduce the cost that is spend in the current manual processes and it will build the positive image of public sector university, it will pathway the movement of performance and the incorporation between students and admin staff will be online that through websites or any other source. The automated system in public sector university has some other benefits such as helpingin searching of data, time lessening and cost lessening.

REFERENCES

[1] D. Agushinta R., A. Y. Pratama, and S. Harmanto S, "Business Process Reengineering on Customer Service and Procurement Units in Clinical Laboratory," TELKOMNIKA Telecommun. Comput. Electron. Control, vol. 13, no. 2, p. 644, Jun. 2015, doi: 10.12928/telkomnika.v13i2.509.

[2] "10 Uses Cases for Workflow Automation in Higher Education." https://www.processmaker.com/blog/10-use-cases-for-workflow-automation-in-higher-ed/ (accessed Mar. 02, 2023).

[3] V. Greavu-Șerban, "CASE STUDY OF ADMINISTRATIVE PROCESS

AUTOMATION IN HIGHER EDUCATION INSTITUTIONS FROM ROMANIA," CBU Int. Conf. Proc., vol. 3, pp. 487–493, Sep. 2015, doi: 10.12955/cbup.v3.648.

[4] "Graham_ref3.pdf." Accessed: Feb. 01, 2023. [Online]. Available: https://www.ioea.eu/pdf/textes_2006/Graham_ref3.pdf

[5] V. Greavu Serban and O. Serban, "Social Engineering A General Approach," Inform. Econ., vol. 18, no. 2/2014, pp. 5–14, Jun. 2014, doi: 10.12948/issn14531305/18.2.2014.01.

[6] F. D. Anton, S. Anton, and T. Borangiu, "Educational services in cloud with IBM technology: A new model for open, on demand learning in higher education," in 2012 International Conference on Information Technology Based Higher Education and Training (ITHET), Istanbul, Turkey, Jun. 2012, pp. 1–6. doi: 10.1109/ITHET.2012.6246047.

[7] C. ElAmrani, H. Gibet Tani, and L. Eloutouate, "Towards Setting up IBM Cloud Computing VCL at Abdelmalek Essaadi University," Int. J. Comput. Appl., vol. 56, pp. 26–28, Oct. 2012, doi: 10.5120/8976-3184.

[8] K. S. Cheung, "Implementation of Electronic Workflow Systems in Higher Education Institutions: Issues and Challenges," in Advanced Research on Electronic Commerce, Web Application, and Communication, vol. 144, G. Shen and X. Huang, Eds. Berlin, Heidelberg: Springer Berlin Heidelberg, 2011, pp. 306–311. doi: 10.1007/978-3-642-20370-1_50.

[9] A. Telukdarie and M. Munsamy, "Digitization of Higher Education Institutions," in 2019 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), Macao, Macao, Dec. 2019, pp. 716–721. doi: 10.1109/IEEM44572.2019.8978701.

[10] "Utilization of Learning Management Systems (LMSs) in higher education system: A case review for Saudi Arabia | Elsevier Enhanced Reader." https://reader.elsevier.com/reader/sd/pii/S1876610219312767?token=2ED13A30D8E19E05408A072391AE0823E1C52BDB00B0B23864DB9B86E11CAA4F2B57C21231701314C5DC387F762A34E0&originRegion=eu-west-1&originCreation=20230202031658 (accessed Feb. 02, 2023).

[11] "□new□industrialeng00dave.pdf." Accessed: Feb. 10, 2023. [Online]. Available: https://dspace.mit.edu/bitstream/handle/1721.1/48613/%EE%80%80new%EE%80%81industrialeng00dave.pdf?sequence=1

[12] S. Holzmüller-Laue, B. Göde, and K. Thurow, "A BPM-based approach of human task support within life science automation," in 2013 6th International Conference on Human System Interactions (HSI), Jun. 2013, pp. 167–174. doi: 10.1109/HSI.2013.6577818.

[13] H. Bhasin, "Business Process Reengineering: Importance, History, and Examples," Marketing91, Sep. 30, 2019. https://www.marketing91.com/business-process-engineering/ (accessed Feb. 17, 2023).

[14] "Business Process Reengineering - Management Tools | Bain & Company." https://www.bain.com/insights/management-tools-business-process-reengineering/ (accessed Feb. 17, 2023).

[15] "Snapshot." Accessed: Feb. 18, 2023. [Online]. Available: https://wisdomplexus.com/blogs/business-process-reengineering-advantages-disadvantages

[16] A. Herden, P. Muniz Farias, and A. Albuquerque, "An Approach Based on BPMN to Detail Use Cases," vol. 312, 2013, pp. 537–544. doi: 10.1007/978-3-319-06764-3_69.

[17] M. N. Lacheheub, A. Bakhbakh, A. N. Benlabiod, R. Maamri, M. Boutarfa, and S. Sadouni, "A Transformation Approach Combining BPMN and Petri Net to Verify Business Processes Construction in terms of Resource Consumption using Cloud Services," in 2021 International Conference on Theoretical and Applicative Aspects of Computer Science (ICTAACS), Dec. 2021, pp. 1–8. doi: 10.1109/ICTAACS53298.2021.9715190.

[18] D. Kozma, P. Varga, and F. Larrinaga, "Data-driven Workflow Management by utilising BPMN and CPN in IIoT Systems with the Arrowhead Framework," in 2019 24th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), Sep. 2019, pp. 385–392. doi: 10.1109/ETFA.2019.8869501.

[19] "Importance of Business Process Reengineering: Top 5 Benefits." Accessed: Feb. 18, 2023. [Online]. Available: https://www.blueprintsys.com/blog/rpa/business-process-reengineering-more-important-than-ever

[20] "Snapshot." Accessed: Feb. 18, 2023. [Online]. Available: https://creately.com/guides/what-is-business-process-reengineering/

[21] admin, "Advantages and Disadvantages in BPR | EconPosts," Nov. 07, 2019. https://www.econposts.com/business-management/advantages-and-disadvantages-in-bpr/ (accessed Feb. 17, 2023).

[22] "Reengineering and Automation of Business Processes: A Case Study with Universities Travel Request Business Process."

[23] P. Bradley, J. Browne, S. Jackson, and H. Jagdev, "Business process re-engineering (BPR) — A study of the software tools currently available," Comput. Ind., vol. 25, pp. 309–330, Mar. 1995, doi: 10.1016/0166-3615(94)00044-Q.

[24] P. Yotyawilai and T. Suwannasart, "Design of a tool for generating test cases from BPMN," in 2014 International Conference on Data and Software Engineering (ICODSE), Nov. 2014, pp. 1–6. doi: 10.1109/ICODSE.2014.7062692.

[25] Anjum, A. H. G. Abbas and M. Sajid. 2017. Transformational Leadership and Employee Motivation in the Banking Sector of Pakistan. Advances in Economics and Business: 5(9):487-494.