Requirements for an Online Automated Project Allocation System in Higher Education Institutions – A Case Study

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Article Info	ABSTRACT
	This paper presents the requirements gathered for an online automated project allocation system that can be used to assign final year projects to students registered in Higher Education Institutions (HEIs). The requirements are gathered for a well-known University in Mauritius. This research is motivated by several issues encountered with the current manual system in place at the studied institution and the need for adopting online systems following the COVID-19 outbreak. Following document analysis and a survey, important functional and non-functional requirements for an online automated project allocation system were uncovered. Gathered requirements also helped in determining a recommended workflow that can be adopted as best practice for final year project allocation. We posit that requirements presented in this paper can help develop a system that can be very useful and ultimately streamline the process for allocating projects typically important for Higher Education Institutions and other similar training institutions.

I. INTRODUCTION

The requirement to complete a dissertation is part of many degrees offered by Higher Education Institutions around the world [1]. At the start of each academic semester or year, academics will usually suggest a list of project titles, which final year students may choose to work on as their final year projects. The final year project is a module or course that gives students the opportunity to conduct research work in an area linked to their Programme of Studies under the supervision of an academic. Completing a final year project, not only, helps a student apply accumulated skills over the course of his/her studies, but it also allows the development of new skills such as independent work and writing/communication skills, both essential for transitioning to the workplace [2].

Final year projects are therefore associated with a written dissertation, which is assessed by one or more examiners at the end of the duration allowed to work on a project. Final year projects carry credits and those credits are counted as part of the final grade of the student, such that a bad choice or allocation of a project title may lead to a low grade. A final year project usually lasts for a few months and during that time the student may face difficulties, which ultimately may have a negative impact on the student performance [3].

It is therefore important to ensure that students are allocated a project of their choice for which they are highly motivated and not discouraged easily. For the purpose, an internal, organization specific, mechanism is normally used to assign project titles to different students while ensuring a fair distribution of projects to be supervised by academics [4]. This process of project suggestion and allocation system is generally manual and can be very time consuming and accompanied by several issues such as mismatch between students and project preferences, dissatisfied students, and selection of same project titles by several students [5]. Sometimes, many students bid for the same project title while a project title may not receive any interest at all. Eventually, it is often the case that allocating projects to students may take a few rounds before all students in a batch are assigned a project title and a supervisor [6].

Recently, due to an increasing number of students undertaking degrees in the current education system, it is desired that project title suggestion and allocation be conducted online and as far as possible automated to reduce

manual effort [7]. At the same time, the need for an appropriate algorithm for fair distribution of workload among academic supervisors while ensuring a fair allocation of project titles to deserving students is also essential [5].

The aim of this paper therefore is to determine the requirements of an online system that can be used for assigning final year projects to students so as to ensure a fair distribution of project titles while maintaining satisfaction of the students. Such as step, referred to as requirements gathering, is common in early phases of system development where the system analyst adopts a strategy to gather the needs for a desired system [8]. More specifically, we intend to obtain the functional and non-functional requirements for an online project allocation system. A computer programmer can then easily convert those requirements into a working system. The need for an online project allocation system has in fact become even more desired so as to minimize human contact and prevent propagation of highly contagious diseases as observed for the recent COVID-19 virus outbreak.

The rest of the paper is organized as follows: section II gives an overview of related works concerning project allocation in our case study; Section III describes the methodology used to gather requirements for an automated project allocation system; Section IV lists the different functional and nonfunctional requirements gathered; A brief discussion follows in Section V and we conclude the paper with some future directions in Section VI.

II. RELATED WORKS

Pan [9] conducted a study for project allocation at the University of Hong Kong. The aim of the study was to distribute projects fairly to the students of "Directed studies of Mathematics" using the "Goal Programming Algorithm". The algorithm was used to allocate projects so as to optimize students' satisfaction based on their preference list. It is found that the algorithm implemented can process a large amount of request and assign projects according to student with a high level of satisfaction. The system, however, does not cater for an interface for supervisors or students.

Moussa et al. [10] developed a project allocation model SPA-(s,p) where supervisors have preference over pairs of students and students have preferences over certain projects. The proposed SPA model is very useful to match students with projects and supervisors. The model presents many ways to create the lecturer's preference list that increases efficiency and accuracy of results. In general, their study presented a new data structure, which reduced the space to present an instance of SPA- (s, p). Furthermore, Moussa et al.'s study presented a visualization of SPA- (s, p) model for easy visualization of project allocation process. Here also, the system proposed does not provide any interface for students and lecturers to interact with and students were not allowed to propose their own projects.

In another study [11], the authors proposed a web based system for automatic allocation of projects to students in Universities. The web application also included a feature for monitoring the status of the students' progress once projects are assigned to one or more students. Project allocation is based on students' preferences and aggregate performance score. The proposed system makes use of a database for data storage purposes. However, there is little information on the implementation and evaluation of the proposal given.

There are in fact different approaches adopted by various institutions across the globe for student project allocation as described in [12][13][14][15][6]. Some institutions adopt a first serve first come basis; others adopt one or more specific criteria to deal with contention; some institutions will allow students to submit their own list of projects, while others will limit student choice to supervisors' list only. For a detailed review of different project allocation approaches, readers are directed to the systematic review in [7]. In this paper, we focus on identifying the system requirements for an online project allocation system that will cater for student project proposals as well as supervisor project proposals.

III. METHODOLOGY

Our case study is a well-known University X located in the island of Mauritius. The University name has been kept anonymous for privacy purpose. University X population consist of around 7000 students enrolled in various programmes (undergraduates and postgraduates) offered in disciplines such as Science, Technology, Finance, Management, and Agriculture. All students are expected to complete a final year project as part of their degree requirement. The final year project also carries credits that are counted towards the final grades of the students. Although, every department of University X is responsible for handling project allocation to students, each department basically follows the same approach.

While past studies make mention of the implementation of student project allocation (SPA) in various settings, we could not find essential information that would help us develop our own system for allocating projects to final year students. The current approach used at University X, is basically a manual system with some communications that take place via emails. To gather information about the as-is system and the to-be system, we first proceeded in conducting a document analysis of the policies pertaining to project allocation at the university X. We also conducted a survey and several interviews to have a clearer understanding of the as-is system and requirements for the to-be system.

The policies pertaining to project allocation was obtained through the website of University X, while convenience sampling was adopted to select participants to take part in the survey and the interview. A total of 50 participants were selected for the survey while 10 participants were interviewed. All participants were academics, who have already served as supervisors, PCs or HoDs. Participants were also chosen from different departments across University X to ensure that the requirements gathered for the to be system would be relevant and useful to several departments.

Survey questionnaires were sent by email and processed while interviews helped in probing for details regarding the needs and requirements for an automated project allocation system. We present our findings further.

IV. FINDINGS

Out of the 50 questionnaires sent, 20 participants responded to the survey. Ten academics agreed to participate in the interview, which provided us with useful information regarding the requirements for a project allocation system. We begin by outlining the as is system for project allocation and the associated pros and cons at University X, and then list the functional and non-functional requirements gathered for the to be system.

A. Final Year Project Allocation at University X

At the beginning of a semester or year, the head of department (HoD) must ensure that all academics are allocated a fair share of projects to supervise and that all students are treated fairly when being assigned a final year project. In that respect, the HoD will assign an academic as Project Coordinator (PC), whose role is to oversee the process of project allocation within the department. We outline the as-is method for allocating final year projects in University X.

The steps involved in allocation projects to students in the departments are:

1) Few weeks prior to start of the semester or academic year, the PC will request lecturers (supervisors) to submit a list of project titles with brief details about the projects.
2) PC compiles the list and shares the list by email with final year students.
3) Students fill in a maximum of five project titles in a manual project request form in an order of choice priority or some students may use the same form to propose their own project (after having contacted a potential supervisor).
4) Students print and leave filled project request form with the PC.
5) PC processes all the returned forms, compare them one by one to manually allocate project to students.
6) During project allocation, students who choose the same project (contention cases) are assigned a project according to choice priority and last performance score indicated by Cumulative Point Average (CPA) in student's transcript.
7) Once all students have been assigned a project according to their choice priority, the list is sent to students by email.
8) Students who have not been able to obtain a project of their choice are requested to fill in the project request form again and choose among projects that have not been allocated to any students or to contact potential supervisors for additional titles.
9) Steps g) and h) are repeated until all students are assigned a project.

B. Pros and Cons of the As-Is System

At the University X, the PC oversees the process of project allocation. The fact that the process is monitored provided several benefits.

- The task of project allocation is well coordinated to meet with deadlines for project allocation.
- The as-is approach ensures that the process of project allocation is transparent.
- The PC ensures that all academics are allocated a fair share of projects to supervise.
- Contention cases are resolved on the basis of student performance, i.e., students with higher CPA are given priority on the choice of projects.
- The PC is the person to contact in case of any issues regarding project allocation.

In parallel, the fact that projects are being processed and assigned manually was also associated with several drawbacks.

- Project allocation process is time consuming and prone to manual errors
- The increasing number of students registering for final year projects implies a higher complexity in handling a larger number of requests from students.
- Paper records can become cumbersome and easily lost with no records regarding how requests have been processed.
- Contention cases lead to overload in processing student request delaying the process of project allocation.
- Difficult to generate report regarding project allocation as the system is manual. Such step will require additional effort from the PC, who is already burdened with manually processing a large number of requests.

Following survey and interview data analysis, it is understood that for an improved project allocation system, the following main tasks should be available via an online system:

- Lecturers must be able to propose previous project titles that were not allocated in previous years
- Lecturers must also be able to propose new project titles
- PCs must be able to set deadlines for submission of student's project choice
- Students must be able to bid on projects proposed by lecturers
- Students must be able to their own project title
- PCs must be able to allocate projects to students
- Any contention (the same project title is chosen by more than one student) must be easily solved through automation by some form of algorithms,
- PCs must be able to notify students about the allocation of projects
- PCs must be able to generate reports any time

Consequently, we formulate the following functional and non-functional requirements for an online automated project allocation system for University X.

C. Functional Requirements of the To-Be System

FR1: The system shall allow for a mechanism to authenticate and identify users (PC, students, supervisors)

FR2: The system shall allow the PC to register users

FR3: The system shall allow the PC to manage users

FR4: The system shall allow supervisors to enter project details

FR5: The system shall allow supervisors to enter details of projects

FR6: The system shall maintain a fair share of the number of projects to be proposed per lecturer

FR7: The system shall allow the PC to view the project list

FR8: The system shall allow the PC to set a deadline for project selection

FR9: The system shall allow students to register to a group

FR10: The system shall check the deadline to display the appropriate project list

FR11: The system shall allow students to view the project list after the group registration

FR12: The system shall allow student to bid on projects

FR13: The system shall allow students to choose a maximum of five projects

FR14: The system shall allow the students to set the choice preferences for selected projects

FR15: The system shall allow students to propose a project title

FR16: The system shall allow students to indicate the supervisors who agreed to supervise their own proposed final year project.

FR17: The system shall allow PCs to manually allocate projects proposed by students

FR18: The system shall automatically allocate supervisor proposed projects to students

FR19: The system shall allocate a project to students having the highest average CPA/CPA in case of contention

FR20: The system shall repeat the process listed in FR18-FR19 until all students are allocated to projects

FR21: The system shall display two tables showing both teams/students that were allocated to a project and those who were not allocated to any projects

FR22: The system shall allow the project coordinator to view the project allocation tables.

FR23: The system shall allow the PC to send email to students who have not been assigned any projects.

FR24: The system shall store all details in a database for future reporting and monitoring.

D. Non-Functional Requirements of the To-Be System

NFR1: The system should have a good response time.

NFR2: Only authorized personnel should have access to the system

NFR3: The system should be secure with proper usernames and passwords.

NFR4: The system should be user-friendly with an easy to use interface.

NFR5: The system should provide simple and clear descriptions for its users to follow when using the online system.

NFR6: The system should allow for easy navigation from one page to another.

NFR7: The system should maintain data integrity; data kept should not be redundant and inaccurate.

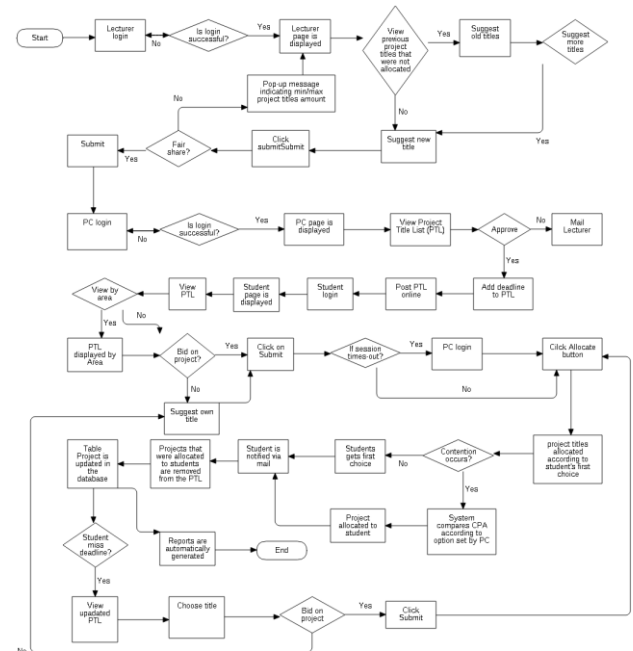The flowchart in figure 1 illustrates the different processes of the proposed system.

Fig. 1. Steps for an automated system to allocate final year projects to students

V. DISCUSSION

Following requirements gathered from participants at University X, it was found that the present manual approach used to allocate projects to students was very time consuming and had several drawbacks that necessitated a review of the way projects were being allocated. A list of functional requirements could be formulated along with some non-functional requirements that would make the proposed system useful and user friendly. As shown in Figure 3., three users should be able to interact with the online system: PC, supervisors and students. The role of PC is primarily administrative in that he/she is responsible for creating user accounts and managing the system. The PC is also responsible for occasionally allocating projects when necessary. In normal case, the system should automatically be able to match students with projects using a pre-defined algorithm, which makes use of highest CPA and project choice as input and generates as output a pair of student and project allocated. Supervisors have for responsibility to upload project lists. An interesting feature in the present proposal is that the system keeps a record of past projects that have been allocated and that have not been allocated. In this way, a supervisor may

decide to propose projects from previous years that were not allocated to any students as well as new projects to be allocated to current academic year. Students have the option of providing their own project list to the system or they can bid for projects that are proposed by supervisors.

The proposed system also has features for sending emails and notifications to users and the setting of deadlines to allow for timely allocation of projects to students. The fact that the system will be online with all data and transactions recorded in a database also makes it easy for reporting purposes and auditing.

By using the online system, it is expected that the process of project allocation will be streamlined, easily monitored, fast and ensure a fair allocation of projects to both students and supervisors.

VI. CONCLUSION

In this paper, we have presented the requirements for an online automated system to allocate project to students enrolled in higher education institutions. In our case study, we found that the present manual system has several drawbacks that delayed the process of project allocation. Although there are several studies, which look at the problem of project allocation, we could not find any that listed the requirements needed to develop such a system. Our study filled this gap and we expect in the future to develop and test our project allocation system for its usefulness and usability.

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