Process design and implementation of an automated document issuance system for academic purposes

1 author:

Amr Mousa
AVL LIST GMBH
7 PUBLICATIONS **6** CITATIONS

SEE PROFILE

Arizona State University

MASTER'S DEGREE PROGRAM

ENGINEERING MANAGEMENT

ALUMNI AFFAIRS OFFICE

SUBMITTED AS A CAPSTONE PROJECT

to obtain the academic degree of

Master of Engineering (MEng)

by

Amr Mousa Mohamed Mousa

May 2022

Project supervisor

Prof. Daniel R. McCarville

CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

Zewail City Alumni Association (ZCAA) is a non-profit organization that seeks supporting Zewail City (ZC) in its pursuit of excellence and building a place for the Alumni to keep ties with their alma mater [1]. This is achieved by supporting their needs, elevating their connections, and assisting their career's development. ZCAA's vision follows the eagerness of Dr. Ahmed Zewail (the Nobel laureate and the father of femtochemistry [2]) to contribute to the Egyptian community through propagation of knowledge and building the necessary scientific reconnaissance that Egypt truly needs.

This motivation was reflected in substantial achievements by ZC community as many Alumni of the University of Science and Technology at Zewail City (UST-ZC) joined reputable institutions all over the world, started or joined businesses in the Egyptian/international market. Such positivism shall be sustained through a strong network that motivates, helps and guides students directly to achieve their goals, connecting and conveying expertise members possess to the Egyptian market and industry. This cooperation among talented and enthusiastic ZC alumni will be utilized to boost their potential, and hence ZC, nationally and globally.

1.2 PROBLEM STATEMENT

ZC was inaugurated in 2013 as Egypt's national project for scientific renaissance [3]. In early 2020, a team of nine first-batch-graduates established ZCAA and the founding process is still ongoing. Being the first batch graduated from the university, we are carrying the trusteeship of founding the pivotal milestones in the university and the academic life pillars.

Currently, there are five batches graduated and the communication channel between them and the university is not yet properly established. Moreover, the alumni affairs and services are not provided professionally and efficiently by the university due to having several internal problems which expels such issues from the executive's priorities.

This project is tackling several problems related to the process of issuing the academic documents needed by the alumni such as graduation certificates, transcripts, language proficiency certificates, syndicate certifications, etc. The provided service currently has the following problems:

- The process is not flexible in terms of providing various options in requesting the service or delivering the document.
- Lack of ability to follow-up the process and resolve the bottlenecks.
- The process is not realistically time-bounded.

There is no clear procedure to be followed in case of requesting a correction/change to a certain field in the document, however currently the problem is handled case by case.

1.3 PROJECT OBJECTIVES

This project aims to propose and prototype a digital solution to provide the service with the following characteristics:

- Interact with the user through an effective and user-friendly online/hybrid portal.

- The documents are to be issued in two ways:

  1. Softcopy, where the document is automatically generated from and verified by the system. This way is completely online with no human intervention from the university registrar office.

  2. Hardcopy, where applying for the document issuance is made online, created automatically by the system, finalized in a printed authentic copy that is delivered by post or picked up from the office.

- The issuance requests can be followed-up online and the user is regularly notified regarding the document status.

- The service fees are to be payed online.

2 PROBLEM STUDY AND LITERATURE REVIEW

This chapter illustrates the results of an alumni survey conducted to get the alumni's reflection on the services provided by the registrar office. Following the survey, a research is done to evaluate the other universities' solutions to such a problem. Lastly, a further problem statement is formulated to precisely define the scope of the project and support the project planning.

2.1 ALUMNI SURVEY

The alumni survey has been motivated by repeated complaints from some of the alumni regarding the level of efficiency and convenience of the document issuance process. This section summarizes the main results of the survey, including the number of participants and an estimate of their needs, what they think about the process, the problems they have faced and their suggestions for improvement.

2.1.1 PARTICIPANTS SAMPLE

Our team received 68 responses, with an approximately even representation of the classes that have graduated so far from 2017 to 2021, and distribution of science/engineering-based programs. Around half of the sample are currently pursuing their post-graduate studies abroad, while the remaining half are mostly employees, post-graduate students, looking for jobs/study programs, start-up owners, and finally doing their military service.

2.1.2 QUESTIONS ABOUT THE NEEDED SERVICES

We asked them which documents they needed previously to issue and how frequently they expect to need them in the future, the answers are shown in Figure 1.
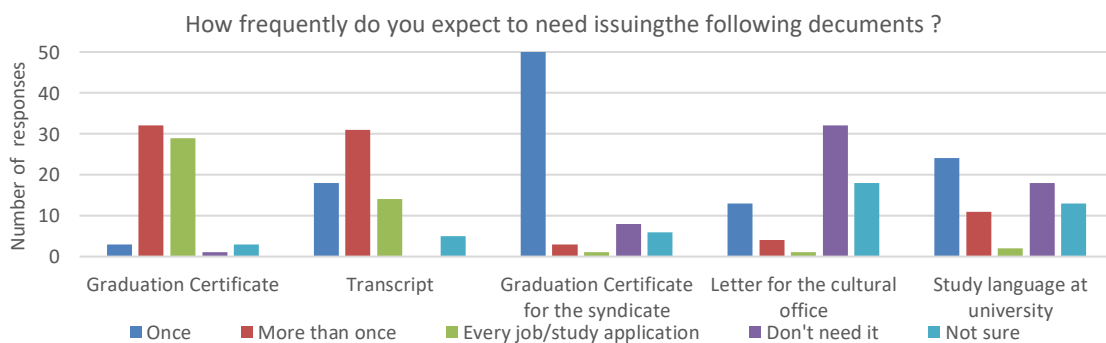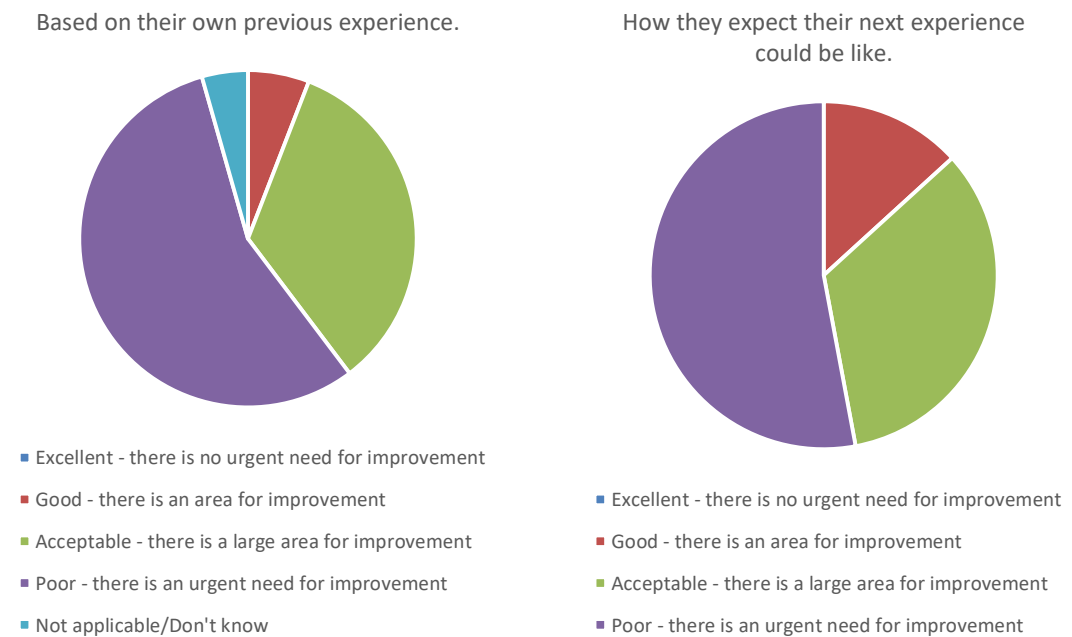

Figure 1 - Document types needed question

Moreover, they were asked what other documents/services they need from the registrar office. The answers were summarized as follows:

−   A letter stating that UST-ZC is a governmental university.

−   A letter stating that the UST-ZC's bachelor programs qualify for master studies.

−   Direct communication between the registrar office and the institution the graduate is applying for (to send graduation certificate and/or transcript as a way to authenticate these documents).

2.1.3   QUESTIONS ABOUT CURRENT SERVICE EVALUATION

The participants were asked how they evaluate the services provided by the registrar office, and the answers are shown in Figure 2.

Based on their own previous experience.

How they expect their next experience could be like.

■ Excellent - there is no urgent need for improvement

■ Good - there is an area for improvement

■ Acceptable - there is a large area for improvement

■ Poor - there is an urgent need for improvement

■ Not applicable/Don't know

■ Excellent - there is no urgent need for improvement

■ Good - there is an area for improvement

■ Acceptable - there is a large area for improvement

■ Poor - there is an urgent need for improvement

Figure 2 - Current service evaluation questions

The participants shared their experiences (positive or negative) in an open question that has answers summarized in Figure 3.
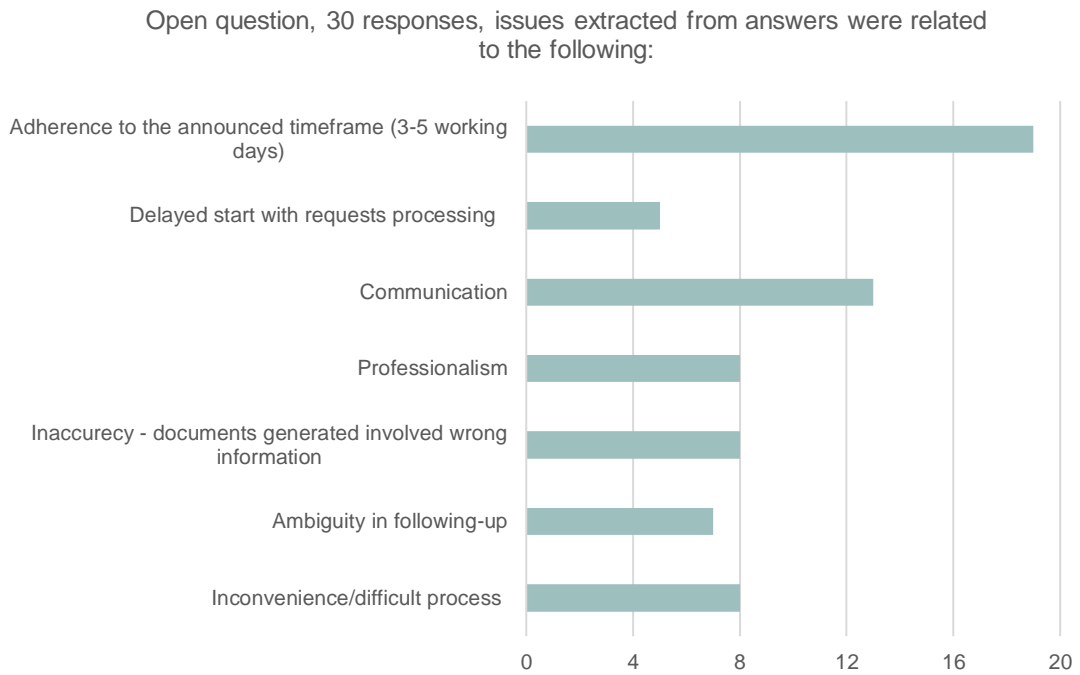
4

Open question, 30 responses, issues extracted from answers were related to the following:

Figure 3 -Alumni experiences with the current service.

2.1.4 QUESTIONS FOR POSSIBLE IMPROVEMENT SOLUTIONS

 − 84% said that it would be beneficial if they can apply for the needed document online. About 81% would like to receive the documents by post (and pay for the delivery fees), while 64% of which are willing to use this service regardless of their location (Egypt/abroad).
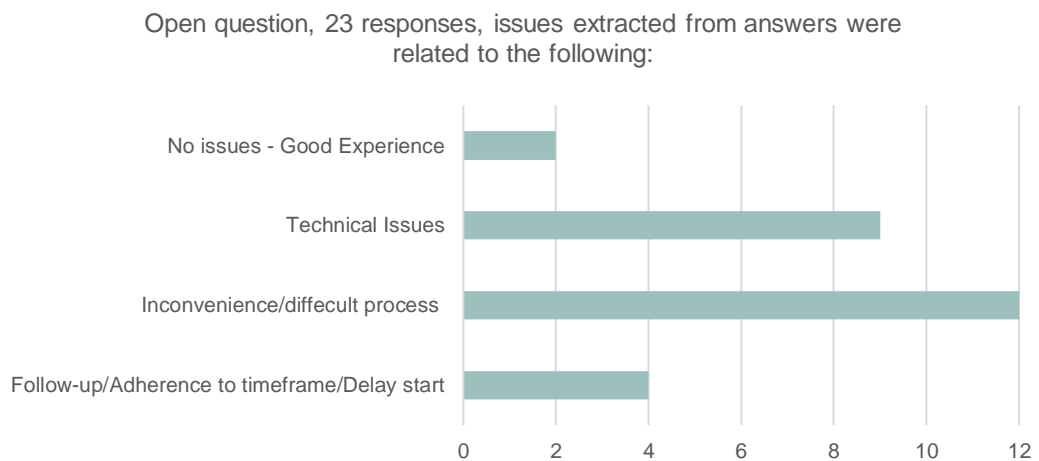
Open question, 23 responses, issues extracted from answers were related to the following:

Figure 4 – Participants' experiences with current application form

- One-third of the participants used the current beta online platform the university provided recently only to apply for documents. 58% of which found the service to be poor, while 27% found it acceptable, 11% and 4% found it good and excellent, respectively. More experience was shared by the participants regarding the current online application form as shown in Figure 4.

- The main note to take from the Figure 4's question is that, while applying online seemed easier and more efficient, the process was still not convenient. This is because (for graduation certificates) the graduates still need to visit the registrar office to submit a passport photo. In addition, introducing this platform did not address many of the issues faced by alumni (highlighted in Figure 3). This is besides the technical problems faced by some (and the lack of appropriate support to solve these problems) which led to their inability to benefit from the service.

- Moreover, they were asked what they think is the step that takes the most time to generate the document. While the answers did not help get a confirmed conclusion as the results were convergent, this highlights the ambiguity in tracking the process and solving the bottlenecks.

2.2 SIMILAR UNIVERSITIES' SOLUTIONS

Madonna University in Michigan established alumni office that provides several services to the alumni such as organizing events, support in publications, career services, networking, and most importantly their in-house online ordering system [4]. Through the online ordering system, official electronic copies of several documents with card payment option are available. Picture ID is required for all hard-copy requests. This university and others such as Dartmouth University in Hannover, USA, follows the same approach of building their in-house system to manage the documents issuance and online orders [5].

On the other hand, some out-of-the-box systems are available and used by several universities, such as Parchment company which provides their university partners with academic credential management platform as an advanced digital credentials service. This platform helps requesting, verifying and sharing transcripts, diplomas, and other credentials in simple and secure ways. Their system is being used by over 13,000 districts,

university registrar offices, state education agencies, and other parties, processing over 100 million records since 2003 [6].

2.3   ACTION PLAN

Based on the findings of sections 2.1 and 2.2, the following steps are suggested towards realizing the solution:

- Automate the process of document generation to avoid mistakes/wrong information and minimize the human intervention.

- Create a time-bounded system for document issuance process with clear steps.

- Allocate enough resources such as employees, development costs and physical resources such as invest in the online platform, providing online tracking, more payment options, and getting a photo printer.

- Reduce the number of signatures/approvals required for each document (if possible) or make them more time-bounded. As an alternative, online document verification method can be used to replace the need for physical signatures with entities that don't have it as a mandatory requirement.

2.4   REVISED PROJECT SCOPE

The project scope was revised again after the literature review is done and was focused only on the followings:

- Design a suitable document issuance process taking into consideration the available university resources and limited budget.
- Prototype the whole process on the digital aspect to prove the designed process through a Minimal Viable Product (MVP).
- Propose the project to Zewail City executives for revision and approval.
- Suggest and plan the follow-up project in cooperation with the reasonable departments such as registrar office and IT to realize the final developed product.

Other steps that are out of this capstone project's scope, however, are being conducted to fully realize this solution in reality are executing the follow-up project, monitoring and controlling the whole process for future improvements following the project management principals and models.

3 METHODOLOGY AND RESULTS

3.1 PROJECT PLANNING

3.1.1 RESOURCES AND CONSTRAINTS

The project is completed by a team of three members, Amr Mousa (as a team leader), Yasmin Mehannah and Ahmed Elghannam [1]. The project is a strategic, voluntarily-based project which means there is no allocated budget neither for physical equipment needed nor payment to be released to the team members. The project is bounded by the start date of January 6, 2022 and the end date of May1st, 2022.

3.1.2 WBS AND GANTT CHART

The Work Breakdown Structure (WBS) and the Gantt chart are shown in Figure 5. Some tasks were run in parallel in stage 1 while mostly stage 2 and 3 ran sequentially.
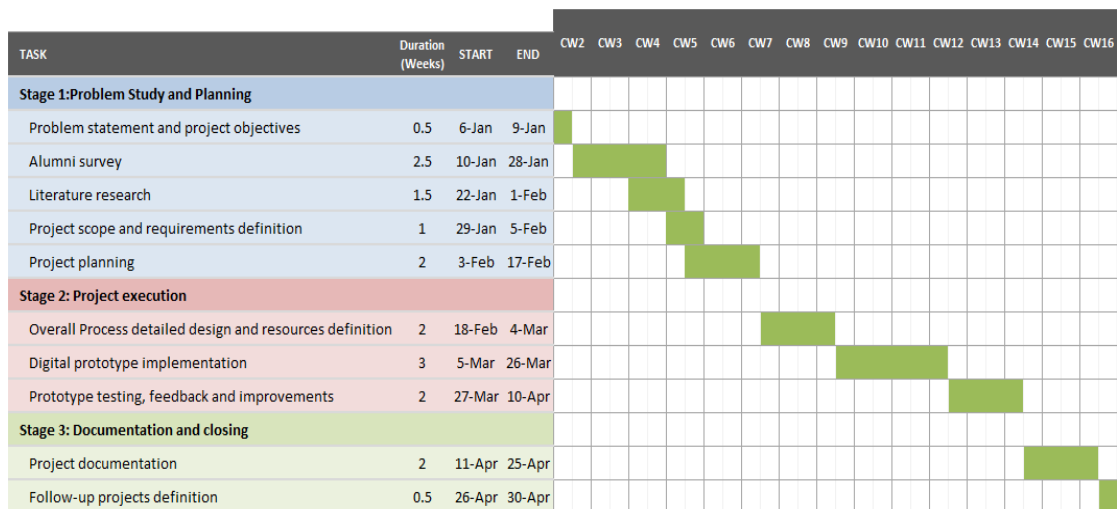
TASK	Duration (Weeks)	START	END
Stage 1:Problem Study and Planning			
Problem statement and project objectives	0.5	6-Jan	9-Jan
Alumni survey	2.5	10-Jan	28-Jan
Literature research	1.5	22-Jan	1-Feb
Project scope and requirements definition	1	29-Jan	5-Feb
Project planning	2	3-Feb	17-Feb
Stage 2: Project execution			
Overall Process detailed design and resources definition	2	18-Feb	4-Mar
Digital prototype implementation	3	5-Mar	26-Mar
Prototype testing, feedback and improvements	2	27-Mar	10-Apr
Stage 3: Documentation and closing			
Project documentation	2	11-Apr	25-Apr
Follow-up projects definition	0.5	26-Apr	30-Apr

Figure 5 - Project WBS and Gantt Chart.

---

[1] Special acknowledgement with all my heartfelt appreciation for the support given by:

Yasmin Mehannah in conducting the survey and putting it into that level of detail.

Ahmed Elghannam for integrating the request module into the website with the user verified access.

Ahmed Hashem, the president of ZCAA and my lifelong friend, for supporting me in handling the project issues and being my motive behind considering this project for the capstone project course.

3.1.3   EXPECTED DELIVERABLES

Table 1 - Project expected deliverables

Phase	Deliverables
Problem Study	Alumni Survey and literature research
	Project complete plan
Build and Deploy	Complete designed process
	Resources definition
	Digital functional prototype as an MVP
Closing	Documentation
	Follow-up project definition

3.2   PROCESS OVERVIEW

The objective of the project, as explained in Chapter 1, is to provide the required service which satisfies the user and create a value for. Process design is where the service is broken down into parts, which further can be helpful in the actual execution process and the process quality control.

The document issuance process is designed based on the requirements derived from the problem study in Chapter 2. The process consists of three main stages/modules; Request, Process and Distribution module. The overall process is illustrated in Figure 6.
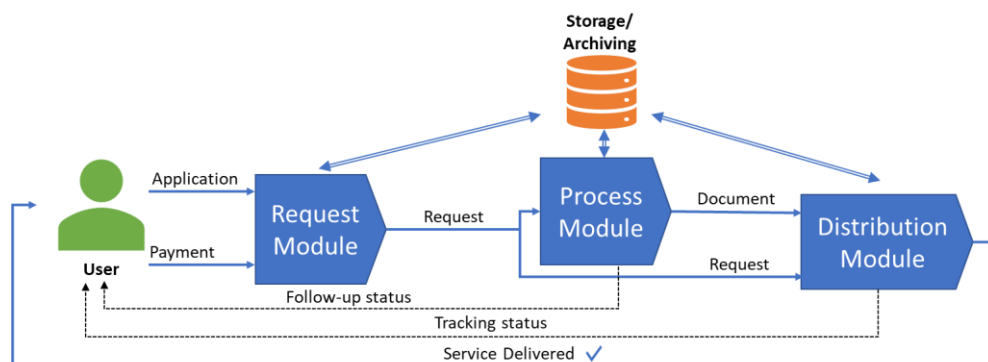

Figure 6 - Document issuance process overview

The user submits the application and payment if needed which will be handled by the request module and handed over to the process module. The process module creates the requested document providing follow-up status to the user while the resulting document in addition to the request will be fed into the distribution module to finalize the service by delivering the document and notifying the user. The details for each module are discusses in the following sections and the overall detailed process is shown in Figure 7.
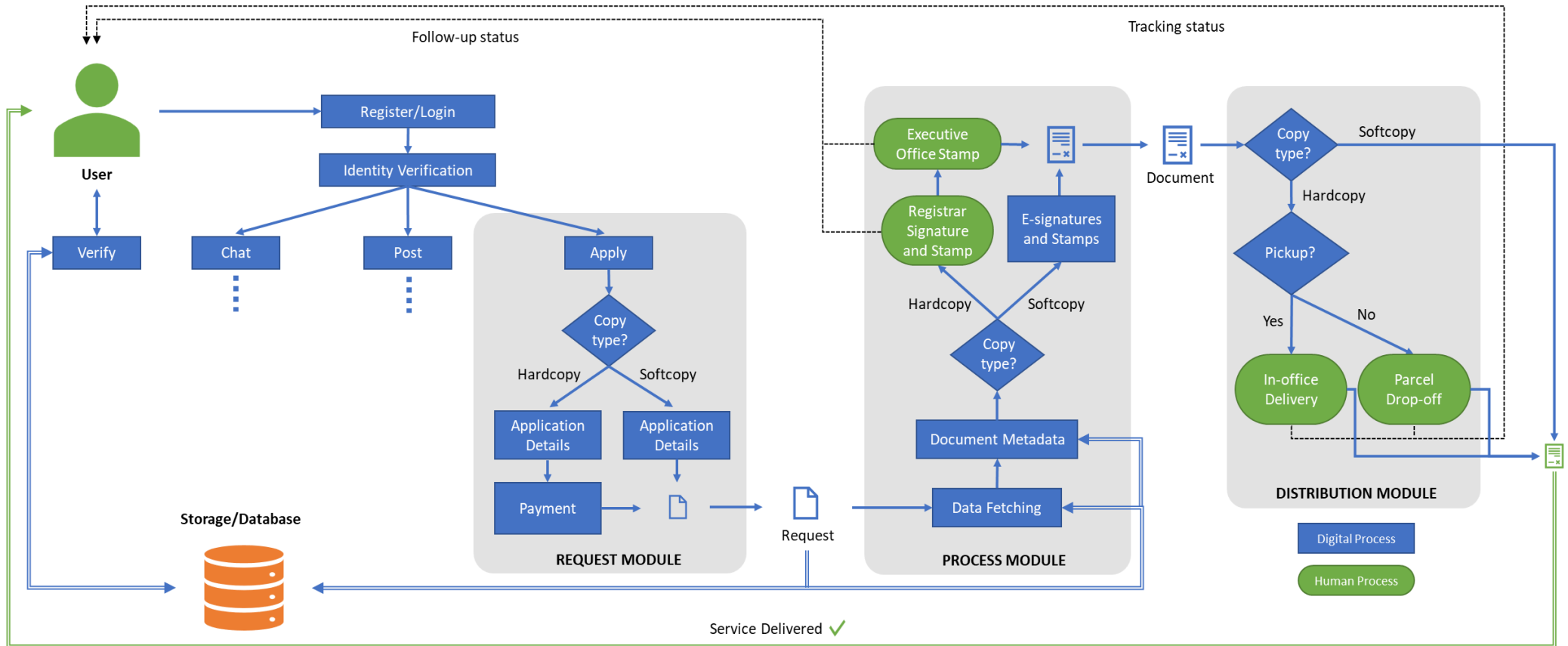
Figure 7 – Overall process detailed view

3.2.1   REQUEST MODULE

There are several steps to be followed to propagate through and complete the digitalization process. These steps are described as follows:

1. The user registers if he/she has an alumni account or logins into the account if it exists.

2. The user identity is verified and login to the portal is permitted where the user can perform several actions such as posting a job to other members in the community, chat with them, or apply online for a document issuance service through the request module (which is the focus of the current project).

3. The document is selected between various options such as graduation certificate, transcript, special letter, language proficiency certificates, etc. Additionally, the type of the document is determined whether it would be hardcopy or softcopy.

4. Further application details are entered by the user, attaching a high-resolution photo for printing (if needed), determining the delivery option, and paying the fees in case a hard copy and/or shipping are required.

5. The request is completed and is proceeded digitally to the subsequent module.

3.2.2   PROCESS MODULE

The process module starts by getting the request and it proceeds as follows:

1. Perform a data fetching process from the database based on the type of the document and the needed data such as user full name, student ID, major, minor, cumulative GPA, course record, etc.

2. Generate the document metadata such as document version number, creation date, issue date, etc. Moreover, the verification data and QR-code are generated and sent to the database for storage purposes. The aforementioned data is collected and added to the document template to proceed to the finalization stage based on the copy type.

3. If the document is requested to be a softcopy, e-signatures are attached, and the document is ready to be passed to the subsequent module.

4. In case of a hardcopy is requested, the document is sent to the registrar office for printing, physical signatures and stamps to be attached. This is a human process that shall be limited to a maximum of two working days. A follow-up status is sent to user via a mail notification and additionally updated to the system portal for tracking using the order number.

5. Furthermore, the document is handed over from the registrar office within the predetermined period to the executive office for getting the official stamp. This process shall be limited to a maximum of two working days as well. Additional follow-up signal is notifying the user and updating the portal with the current status and the estimated processing time. Eventually, the hard-copy document is issued and proceeded to the last module

3.2.3 DISTRIBUTION MODULE

This module advances the issued document and finalizes the whole process by:

1. Proceeding with the in-office delivery option if selected in the request and notifying the user on mail about a specific pick-up appointment. This appointment is selected based on the calendar of the front desk employee and the preferred delivery time pre-selected in the application by the user.

2. If shipment delivery option is selected, a reception employee is notified to pick-up the document, seal it in an envelope with the postage stamp and drop it in the post box. This employee shall enter the tracking number in the system and finalize the step while the user gets a notification with the tracking number of the envelop to be tracked with the post.

3.3 RESOURCES

Based on the process details previously described, the following resources are needed both as human and physical resources.

Table 2 - Process required resources

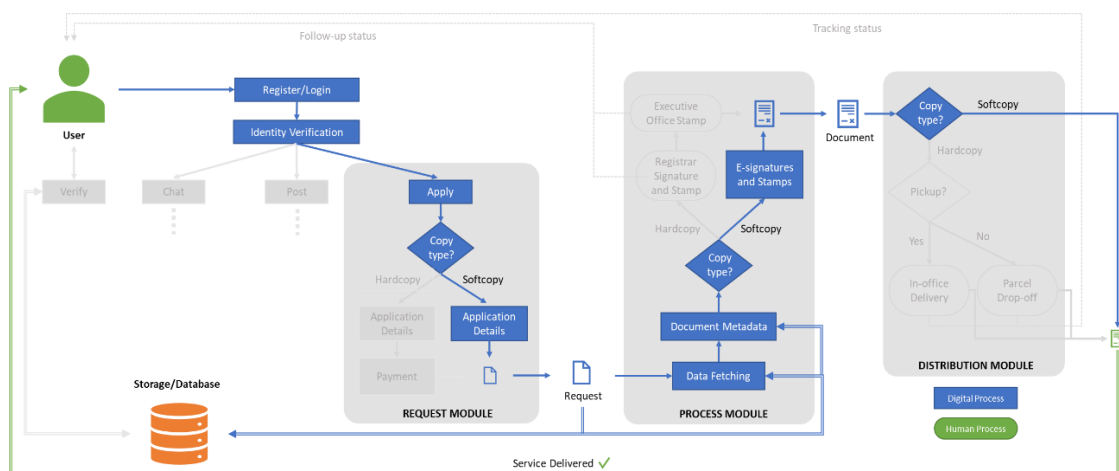|	Item	Description
Human Resources	Registrar office employee	1. Printing the document, picture and attaching it. 2. Handing it over to the head for signature.
	Registrar office head	Signing and stamping the document.
	Registrar office employee	Handing the document over to the executive office and update the system.
	Executive office employee	Stamping the document and update the system.

	Front desk employee	1. Picking up the document from the Executive office.
		 2. Perform:
		   a. Envelop packing and drop off, *or*
		   b. In-office delivery.
		 3. Update the system with the document status and data.

Physical Resources	Documents Printer	High-quality color printer, ex. Ricoh SP C252SF
	Picture printer	Printing glossy pictures, ex. Canon Pixma Pro-200
	A4 Printing Papers	-
	Glossy paper	-
	A4 Envelop	-
	Sealing sticker	-
	Post stamp	Pre-payed stamp for Egyptian post
	Post tracking number	Pre-payed tracking number sticker

3.4 DIGITAL PROTOTYPE

Figure 8 - Simulated digital document issuance process

The issuance process is prototyped using Google Cloud Platform (GCP) and JavaScript (JS) programming language. The illustration in this project report will only focus on the following part of the process shown in Figure 8. This part validates the concept as an MVP while the remaining parts of the process are postponed for the final developed version of the software in the follow-up project.

The process modules are explained as follows:

- **Database:** a model database was built to store and fetch the student data such as ID, mail, name, grades, degree, etc. This is to be extended in the follow-up project to include all students' data while maintaining the same structure and APIs communicating with the other application modules.

- **Request Module:** ZCAA has the website which recently included membership and user profile with login feature. In this project, it was further developed to include the request module in the services drop-down menu under 'Issue Document' as shown in Figure 9. Such service is only available for members after logging in and verifying the user identity following the process in Figure 7. Thereafter, the user accesses the document issuance application where he/she is asked to provide the followings:

  > A mail to receive the notifications and/or the softcopy of the document if requested.
  > The type of the requested document.
  > The type of the copy.
  > Further inputs based on the previously selected points such as delivering option if hard-copy is to be selected, photo upload if needed, and further details are to be entered in case of special document is requested.

  The user can receive the document on any mail outside Zewail City domain; however, each user is only allowed to issue a document for him/herself. Hence, neither the ID nor user details, such as full name, are needed. However, all the data is gathered from the database in a completely automated way.
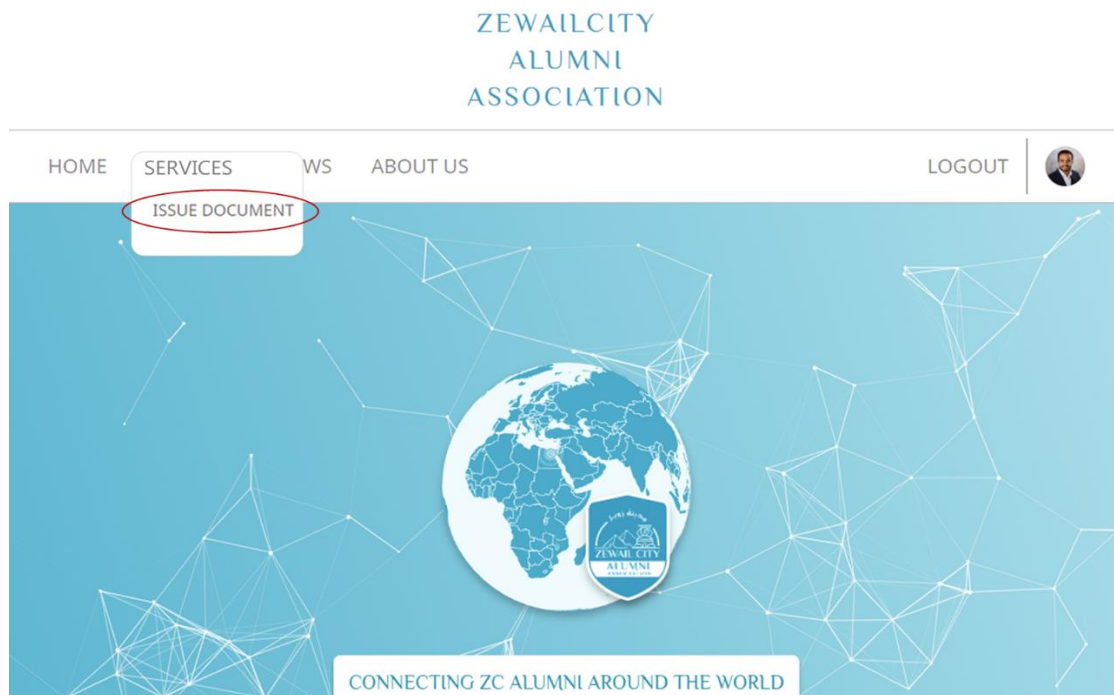
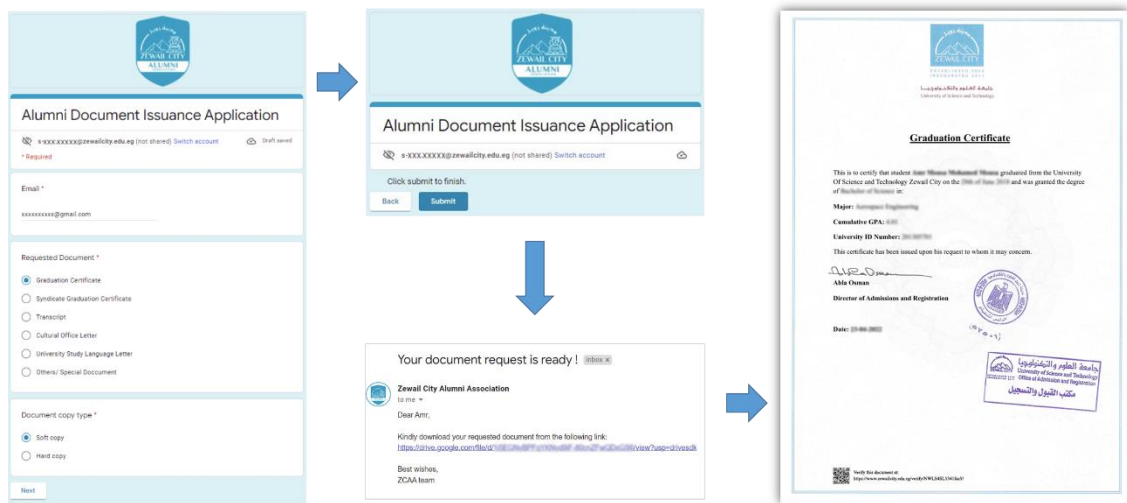*Figure 9 - Request module's access through ZCAA website.*

Figure 10 – Soft-copy graduation certificate issuance steps using the online portal.

– **Process Module:** after submitting the application as shown in Figure 10, the process module follows the steps illustrated in Figure 7 to prepare the document. The user data is fetched in the database, metadata is prepared, and the document template is filled, the e-signatures are attached, and verification data is attached and updated on Zewail City website cloud server. The whole process takes place in the cloud and the document with no need for physical servers moderating it.

- **Distribution module:** in the present example, the distribution module only takes care of generating the download link to the document from the cloud, gives the appropriate access (viewer permission) for the user and notifying him/her. A mail template is used to attach the document to and send it to the user as shown in Figure 10.

4   CONCLUDING REMARKS

4.1   DISCUSSION

This project discussed proposing a service for ZC alumni to help facilitating the documents issuance and minimizing the human factor errors that could happen. The problem is defined, and the project scope was clearly in-focus after studying the alumni feedback, experience and suggestions. Additionally, the university's internal policies, budget, equipment, employment resources were taken into consideration while designing the proposed process.

An MVP is created to prove that the process digitalization is beneficial, and it shall be integrated to the current organizational eco-system the soonest. This project report is to be presented finally to ZC executive's board in June 2022 for approval and thereafter, the follow-up project discussed in the next section shall be launched.

4.2   FOLLOW-UP PROJECT OBJECTIVES

This project created an MVP which has several limitations and there is a room for further improvement. Accordingly, a follow-up project is to be launched by the team, after this project's report approval, aiming to achieve the following objectives:

- Connecting the process module with the registrar office's database, instead of the model database we have in this project, to fetch and prepare the real students data.
- Support the remaining document types other than the graduation certificate with their templates, input tags, e-signatures and stamps.
- Design a separate process to handle the special documents and requests which are not supported by the system's automatic document generation.

− Connecting the verification webpage to the official ZC website instead of the Alumni portal currently in-use.

4.3 LESSONS LEARNED

The main important takeaways from this project, besides the valuable experience dealing with such type of projects, are as follows:

− Surveying and studying the problem well deserves a big portion of the project planning phase. In such an environment with limited resources, the room for mistakes and exceeding project's budget and resources is very narrow. Therefore, the conducted intense problem study helped our team in designing a practical/beneficial process and achieve substantial results.

− Breaking down complicated projects into smaller projects with multiple versions of the product following the Lean Product Process approach, especially in case of several approvals needed in governmental organizations, can help minimizing wasted efforts and proceed faster towards the final goal.

− The cloud providing services such as GCP made it way easier to implement complex automation projects with less efforts. They are valuable resource to be used in similar future projects.

On the other hand, applying the learned concepts from the EM program in ASU helped as follows:

− **Project and Risk Management courses:** both courses with all their tools helped in structuring the way of handling projects successfully on the organizational level that has several projects running in parallel. I'm leading the committee which has four projects running simultaneously and this is just one of them. Even though, this project ran smoothly achieving the expected outcome that is satisfying for all the project stakeholders and meeting the project defined success criteria.

− **Strategic Enterprise Innovation course:** this course supported the project with the Four Lenses of Innovation and Design Thinking tool by using the different thinking patterns in defining the project idea and scope. Moreover, the Agile Development and Lean Product Process approach were used in a hybrid fashion to iterate several times over the problem definition, requirements and measures

      based on the survey and literature review. Afterwards, the product itself is iterated over through the current and the follow-up project outcomes.

- **Web-enabled Decision Support Systems course:** the tools learned in this course such as web-enabled database applications development and the programming skills were the main essence of the MVP developed.

Therefore, at the end of this EM program journey, …

I'd like to deeply thank my ASU professors, in the aforementioned courses and the others, for their effort in delivering us the information in the best way possible. I can't express my sincere gratitude to my supervisor Prof. Daniel McCarville. Your continuous support during this course and the previous other two courses, your enthusiasm, motivation, and immense knowledge were the perfect guidance all the time.

5 REFERENCES

[1] "(2) Zewail City Alumni Association | LinkedIn." https://www.linkedin.com/in/zcaaalumni/?originalSubdomain=eg (accessed Apr. 17, 2022).

[2] "Ahmed Zewail - Facts." https://www.nobelprize.org/prizes/chemistry/1999/zewail/facts/ (accessed Apr. 17, 2022).

[3] "About Zewail City." https://www.zewailcity.edu.eg/main/content.php?lang=en&alias=about_zewail_city (accessed Apr. 17, 2022).

[4] "Transcript/Diploma or Certificate Replacements | Madonna University." https://www.madonna.edu/resources/registrar/transcript/ (accessed Apr. 22, 2022).

[5] "Office of the Registrar." https://www.dartmouth.edu/reg/ (accessed Apr. 22, 2022).

[6] "Products - Parchment." https://www.parchment.com/products/ (accessed Apr. 29, 2022).

6   LIST OF FIGURES AND TABLES