

# Model for the Generation of Digital Academic Certificates

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## Abstract

The generation of academic certificates is a complex task due to the process of document verification and the way it must be requested, that is why a model is presented where all the procedures and documents are analyzed and selected for their request and subsequent digitization and issuance of certificates. It is also presented the commissioning of the platform where it is possible to demonstrate increases in requests of more than 166% when comparing the semesters affected by the pandemic, as well as the expedition becomes more agile, which achieves internal and external satisfaction. It is noteworthy that due to Covid-19 the number of applications has increased in the systems engineering career due to its high labor demand.

**Keywords:** Digital certificates, academic procedures, higher education, online procedures.

## 1. INTRODUCTION

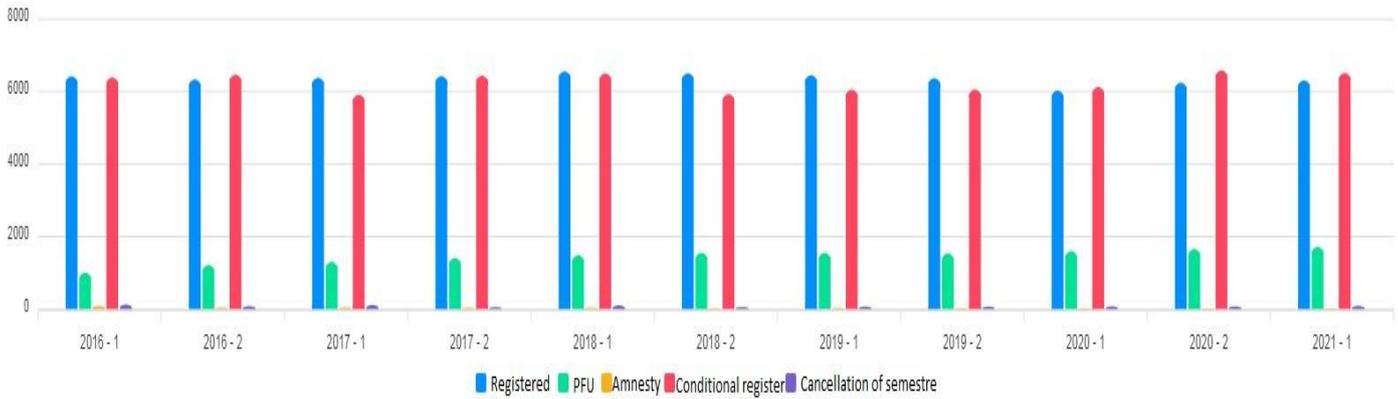
The generation of academic certificates is one of the most requested processes in universities, which become complex due to the variety and consultation of the information in the files or the way it is requested. Generally, the request for a certificate is made in person, attaching the necessary documents in physical form for its issuance. The usual problems can range from the transfer to the institution or the falsification of the documents due to the lack of a virtual registry [1]. With Covid-19, the possibility of going to the institution to request a certificate was limited to the extreme, this brought countless problems such as the form of payment and the presentation of the requested documents to successfully obtain the certificate [2], [3]. That is why higher education institutions had to migrate their system to make it accessible, comfortable and agile for the user, who could make requests without having to move physically. In order to do this, it is necessary to keep in mind the type of procedures that are most commonly performed and the number of documents required for their issuance. Each certificate is different due to the number of documents, if they are internal or external and if they must pay tax fees. For this it is necessary to create a model that would allow to know all the requirements and requests, evaluating in the best way the efficiency of the system.

The model is necessary to take into account the number of students enrolled and the procedures that each of them can request, based on whether they are in good standing with the university. The model should be functional for undergraduate and graduate students, regardless of the number of programs or

graduate programs offered. It also allows the user to upload each of the requested documents with PDF extension, to be reviewed by the Admissions, Registration and Control Office. Any incomplete application can be modified in an agile way, reducing the delivery time of the certificates.

The advantage in issuing certificates online, allows the user to protect themselves from Covid-19 variants, and that is why different solutions have been presented to solve different problems in education [4]-[7], as well as to continue with their paperwork, being in any location. Certificates that must pay taxes can use payment gateways or a bank office, attaching the cancellation receipt. Another of the most common drawbacks is the signature that each certificate must bear by the head of the unit, when a certificate is done it is not necessarily approved for issuance, due to the inconvenience of the respective signature, that is why it must be taken into account how to verify the certificate with the digital signature of the Head of Admissions [8]-[10], this instrument widely used and implemented in banks, notaries or other institutions is basic for the model to be functional. Online certificates are widely used in government institutions such as the Ministry of Education [11], certificates of vaccination against Covid-19 in Spain [12], the Chambers of Commerce of each department [13], electronic invoices before the National Tax Directorate in Colombia or certificates of residence among others [11]-[14], using massively the information and communication systems, This not only expedites the issuance of these documents, but also controls the waste generated by paper, mitigating the environment by not reusing them [15]. It is estimated that the amount of paper is too large and even if it is recycled it continues to generate pollution, which is why digitization and online services offer great benefits [16], [17].

A model is presented that analyzes all the procedures that a student or graduate of a higher education institution can request, focusing on the Universidad Francisco de Paula Santander Ocaña in Colombia, analyzing the number of active students. The second semester of 2020 and the first semester of 2021 are analyzed, due to the implementation of the platform, after extracting the certificate generation model. The institution has carried out a migration of its processes in Admissions and other departments such as Faculties, academic programs, and university welfare services, requests for complaints, suggestions and claims, as well as implementing platforms for teaching in each of the undergraduate and graduate programs. The personnel office is one of the most active, having a platform for the convenience of all the workers that make up the university, which has achieved the satisfaction of the administrative staff, teachers, students and graduates.



**Fig. 1.** Monitoring of student population.

## 2. METHOD

The generation of academic certificates is done through the request of different procedures in person, divided into 3 categories: internal procedures, external procedures or peace of mind. The process takes a minimum of 3 to 5 days, and different documents must be submitted physically in order to start the process. The student population is over 6 thousand students, in addition to 12740 graduates, so the number of requests for certificates can be very high (Figure 1). With the inconvenience of Covid-19, the issuance had to be modified in such a way that it would have an impact on the reduction of the issuance time and security of the certificates. That is why the digital and online model was a priority.

For each procedure, a model is prepared to determine the document needs requested and the documents that can be delivered within a maximum of two days. The category of internal and external procedures includes the issuance of 23 documents, as shown in Table 1.

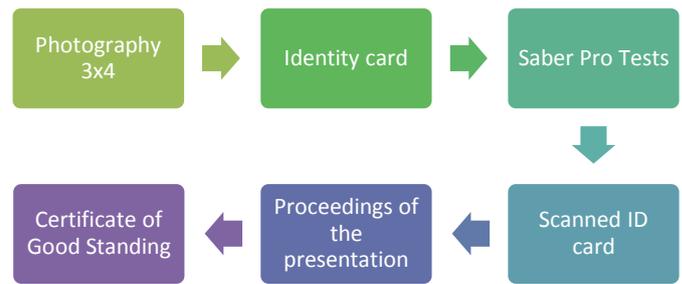
**Table 1.** Number of procedures

|                |    |
|----------------|----|
| Record         | 12 |
| Photocopy      | 5  |
| Certificate    | 3  |
| Qualifications | 1  |
| Reports        | 1  |
| Preparatory    | 1  |

Figure 2 shows the documents required to process the certificate of good standing.

The procedures that the student or graduate can carry out are divided into Cancellation of subjects, qualification and optional exam, Supplementary, Certificates and other procedures.

After a review, it was determined that the certificates to be issued for internal and external procedures should be divided into 6 categories as shown below for each certificate.



**Fig. 2.** Documents to be attached to the request for payment.

Record:

- Completion of undergraduate courses.
- From Technology Study.
- Technical Study.
- Good conduct-pre-graduation.
- Graduate studies.
- Undergraduate Good Conduct.
- Undergraduate assistance.
- Completion of undergraduate courses.
- Undergraduate Study.
- Completion of technology materials.
- Completion of technical subjects.
- Technical fine arts completion.

Photocopy:

- Postgraduate qualifications.
- Academic resume technology.
- Technical academic resume.
- Undergraduate academic resume.
- Postgraduate academic resume.

Certificate:

- Undergraduate notes.
- From technical notes.
- Grades per semester postgraduate.

**Qualifications:**

- Undergraduate security paper.

**Reports:**

- Undergraduate academic enrollment.

**Preparatory:**

- Undergraduate law.

**3. RESULT**

Table 2 shows the number of internal certificate procedures for the second semester of 2020 and the first semester of 2021, showing that although the system was already in operation, the requests had a constant increase, thus adapting to online requests. It can be seen that the highest increase was recorded in requests for completion of subjects with an increase of 166.66%, while in undergraduate transcripts the increase was 53.45%. The total number of requests for the second semester of 2020 was 450, increasing to 843 for the first semester of 2021. With these results it can be demonstrated that the delivery time was faster and more convenient for people who make the request from the comfort of their home, and the statistical records are more effective for the university when making continuous improvement and quality plans.

Table 2. Number of internal certificate procedures

| CERTIFICATE                          | YEAR - SEMESTER |        |
|--------------------------------------|-----------------|--------|
|                                      | 2020-2          | 2021-1 |
| Completion of Graduate Studies.      | 9               | 13     |
| From Study Technology.               | 13              | 19     |
| Technical Study.                     | 1               | 2      |
| Good undergraduate conduct.          | 0               | 0      |
| Postgraduate studies.                | 3               | 7      |
| Undergraduate Good Conduct.          | 4               | 10     |
| Undergraduate assistance.            | 2               | 3      |
| Completion of undergraduate courses. | 132             | 352    |
| Undergraduate Study.                 | 275             | 422    |
| Completion of technology materials.  | 10              | 14     |
| Completion of technical subjects.    | 1               | 1      |
| Technical fine arts completion.      | 0               | 0      |

Table 3 shows the number of photocopy certificates, where the undergraduate curriculum vitae is the most requested with an increase of 85.71% in requests. Table 4 shows one of the most requested certificates and the program that has requested it the

most. It can be determined that the most benefited program is Law day and night, while programs such as zootechnics and accounting at night request it very little. This indicator can determine the number of students who aspire to receive a degree and have continued studying in the semesters affected by Covid-19.

Table 3. Number of photocopy certificates

| PHOTOCOPY                      | YEAR - SEMESTER |        |
|--------------------------------|-----------------|--------|
|                                | 2020-2          | 2021-1 |
| Postgraduate qualifications.   | 0               | 2      |
| Academic resume technology.    | 0               | 2      |
| Technical academic resume.     | 0               | 0      |
| Undergraduate academic resume. | 7               | 9      |
| Postgraduate academic resume.  | 0               | 0      |

Table 4. Number of proofs of completion of undergraduate courses by program

| ACADEMIC PROGRAM                               | YEAR - SEMESTER |        |
|--|-----------------|--------|
|  | 2020-2          | 2021-1 |
| Environmental engineering                      | 7               | 24     |
| Civil Engineering                              | 4               | 31     |
| Mechanical Engineering                         | 4               | 7      |
| Systems Engineering                            | 4               | 10     |
| Public accounting day                          | 3               | 29     |
| Public accounting at night                     | 0               | 4      |
| Right day                                      | 75              | 136    |
| Right night                                    | 28              | 21     |
| Social communication                           | 1               | 56     |
| Zootechnics                                    | 1               | 9      |
| Commercial and Financial Management Technology | 0               | 0      |
| Business Administration                        | 5               | 24     |

Table 5 shows the number of certificates of undergraduate students, which shows that it is a highly requested certificate for scholarship applications, presentation of resumes when applying for a job or as evidence to determine whether they are active students in a given semester. Where the careers of law continue with a greater request, and is reflected in second place to the systems engineering program, which are being more requested to join jobs related to the entire computer process, as a cause of the coronavirus. The increase in requests is 53.09% for this type of certificates.

The business and financial management technology program does not submit any applications and this is because the

students subsequently continue with the business administration program.

**Table 5.** Number of undergraduate studies by program

| ACADEMIC PROGRAM                               | YEAR - SEMESTER |        |
|--|-----------------|--------|
|  | 2020-2          | 2021-1 |
| Environmental engineering                      | 36              | 40     |
| Civil Engineering                              | 28              | 43     |
| Mechanical Engineering                         | 26              | 30     |
| Systems Engineering                            | 34              | 56     |
| Public accounting day                          | 30              | 44     |
| Public accounting at night                     | 10              | 9      |
| Right day                                      | 39              | 61     |
| Right night                                    | 15              | 33     |
| Social communication                           | 20              | 41     |
| Zootechnics                                    | 17              | 21     |
| Commercial and Financial Management Technology | 0               | 0      |
| Business Administration                        | 20              | 43     |

#### 4. CONCLUSION

The number of students or graduates who can request academic certificates is very large, which caused inconveniences due to the amount of paper used and the transfer to the office to make the request. The model presents a total of 23 procedures that can be carried out virtually, avoiding the possibility of Covid-19 contagion and increasing the response time in the issuance of each certificate. Likewise, usage rates in some procedures have increased up to 156% due to the ease of use and improved response times. One of the most important benefits is for the graduates who are working in their respective companies located in different parts of the country and abroad.

#### REFERENCES

[1] B. Galindo, M. Suárez, y A. Sanchez Martin, «BC-CAD Sistema para la generación y validación de certificados académicos digitales implementando Blockchain», *Encuentros Con Semilleros*, vol. 1, p. 193, nov. 2019, doi: 10.15765/es.v1i1.1665.

[2] «¿En casa por el coronavirus? Así siguen estudiando jóvenes por todo el mundo», *La Juventud Opina*. <https://www.voicesofyouth.org/es/coronavirus-estudiar-desde-casa-escuelas-cerradas-consejos> (accedido ago. 01, 2021).

[3] «La educación superior en tiempos de COVID-19: Aportes de la Segunda Reunión del Diálogo Virtual con Rectores de Universidades Líderes de América Latina | Publications». <https://publications.iadb.org/publications/spanish/document>

/La-educacion-superior-en-tiempos-de-COVID-19-Aportes-de-la-Segunda-Reunion-del-Di%C3%A1logo-Virtual-con-Rectores-de-Universidades-Lideres-de-America-Latina.pdf (accedido ago. 01, 2021).

[4] A. M. S. Suarez, R. Villamarin, S.-A. Suarez, *et al.*, «Education in Times of Covid-19, Challenges and Opportunities», *Int. J. Mech. Prod. Eng. Res. Dev.*, vol. 10, n.º 6, pp. 45-52, 2020, doi: 10.24247/ijmperdec20206.

[5] A. Suarez, I. Rincon, y S. Suarez, «Impacto del programa Generación E en la Educación Superior durante el COVID-19», *Espacios*, vol. 41, nov. 2020, doi: 10.48082/espacios-a20v41n42p26.

[6] I. Rincon, S. Suarez, y A. Suarez, «Incidencia de COVID-19 en la inscripción de estudiantes a los programas de educación superior», *Espacios*, vol. 41, nov. 2020, doi: 10.48082/espacios-a20v41n42p27.

[7] S.-A. Suarez y A. M. Suarez, «Proposal to Reduce Contagion through a Programmable Electronic Vehicle in Times of Covid-19», *Int. J. Mech. Prod. Eng. Res. Dev.*, vol. 10, n.º 5, pp. 781-788, 2020, doi: 10.24247/ijmperdoct202078.

[8] M. D. R. López, D. M. S. Botero, y C. N. M. Durango, «Firma digital: instrumento de transmisión de información a entidades financieras», *Rev. Av. En Sist. E Informática*, vol. 8, n.º 1, pp. 7-14, 2011.

[9] F. Y. H. García, «Análisis de la firma digital con base en la infraestructura de clave pública», *HAMUT'AY*, vol. 5, n.º 2, Art. n.º 2, mar. 2019.

[10] G. Villarreal, «La firma electrónica y los certificados electrónicos: mecanismos de seguridad del mensaje de datos», *Rev. Univ. Zulia*, vol. 4, n.º 10, Art. n.º 10, 2013.

[11] «Solicitud de certificado de programa académico de Instituciones de Educación Superior. - Ministerio de Educación Nacional de Colombia». [https://www.mineducacion.gov.co/1759/w3-article-236657.html?\\_noredirect=1](https://www.mineducacion.gov.co/1759/w3-article-236657.html?_noredirect=1) (accedido ago. 01, 2021).

[12] «Ministerio de Sanidad, Consumo y Bienestar Social - Profesionales - Mapa del estado de la expedición del Certificado COVID Digital de la UE en Comunidades Autónomas». <https://www.msbs.gob.es/profesionales/saludPublica/ccay/es/alertasActual/nCov/ccd/ccaa.htm> (accedido ago. 01, 2021).

[13] C. de C. de Bogotá, «Descargue certificados de la CCB aquí». <http://www.ccb.org.co/Inscripciones-y-renovaciones/TODO-sobre-renovaciones/Adquiera-certificados-aqui> (accedido ago. 01, 2021).

[14] «Certificado de residencia», *Guía de Trámites y Servicios*. <https://guiatramitesyservicios.bogota.gov.co/tramite-servicio/certificado-de-residencia/> (accedido ago. 01, 2021).

[15] A. Uzcátegui, «La iniciativa paperless, innovación al servicio de la conservación del medio ambiente», *Luna Azul*, n.º 48, pp. 121-134, 2019.

[16] A. M. M. Lezcano y D. R. Diaz, «Digitalización, colaboración con la sostenibilidad del medio ambiente», p. 14.

[17] A. Tic, «Digitalizar el servicio al ciudadano». <https://www.digitalbizmagazine.com/digitalizar-el-servicio-al-ciudadano/> (accedido ago. 01, 2021).