

# THE SUCCESS FACTORS OF THE DIGITAL TRANSFORMATION OF HIGHER EDUCATION INSTITUTIONS: THE EXPERIENCE OF HASSAN 2 UNIVERSITY OF CASABLANCA (UH2C) IN MOROCCO

Birahim Babou<sup>1</sup>, Khalifa Sylla<sup>2</sup> and Samuel Ouy<sup>1</sup>

<sup>1</sup>*Polytechnic High School of Dakar, Computer Science Department, Senegal*

<sup>2</sup>*Department of Applied Mathematics and Computer Science, Virtual University of Senegal (UVS), Senegal*

## ABSTRACT

This paper reviews the success factors of the digital transformation of higher education institutions based on the experience of Hassan 2 University of Casablanca (UH2C) in Morocco, which is the second largest university in the country. This work is based on the good practices implemented in the university's digitalization strategy during the covid-19 pandemic. In order to run all the courses online and allow students to properly follow their lessons, the implementation of a robust and secure system is essential. This paper will take stock of the technical infrastructure of the university which has enabled it to support approximately 130,000 users, then the identification of all the services whose university needed to do its distance learning courses well and a proposal for the new system with the minimum of services that users will need to deliver and follow quality lessons.

## KEYWORDS

E-learning, Digitalization, Learning Management System (LMS), Videoconferencing, Digital transformation, Distance education in Morocco

## 1. INTRODUCTION

According to the Survey on the impact of the coronavirus on the economic, social and psychological situation of households in Morocco carried out by the High Commission for Planning from April 14 to 23, 2020, nationally, 8% of households have children in higher education. The latter, following the suspension of courses in face-to-face mode, found themselves forced to adapt to the requirements of distance education.

After the State's decision on the closure of all higher education establishments for health reasons, a series of measures were taken in this direction by the UH2C. Among these measures, we have the implementation of online courses in a new i-UH2C platform. The UH2C, the second largest in Morocco in terms of enrollment with 125,377 students or 12.66% of the kingdom's students, has started an innovative digitalization project which consists of setting up a scalable distance education system. for the entire university in order to continue the course.

We realize that there are, more and more, higher education establishments that are struggling to offer synchronous distance learning sessions. This problem is becoming frequent because of several factors, including: lack of financial means, isolation perceived by some actors with distance learning, lack of training, resistance to change, data security, lack of work tools and digital services to meet the needs of training, etc. We are also witnessing strong growth in the number of students, in a context of extension and diversification of training offers.

Distance learning is becoming indispensable in higher education institutions. The covid-19 period has only confirmed the need to put in place support solutions for these establishments for the digitization of their profession, which will make it possible to manage UH2C.

In order to run all the courses online and allow all students to properly follow their lessons, the implementation of a robust and secure system is essential. In this article, we will take stock of the university's technical infrastructure, then identify all the services it will need to do its distance learning courses well and a proposal for the new system with the minimum of services that users will need to deliver and follow quality lessons and end up with a conclusion and recommendations.

## 2. STATE OF THE ART

Distance education is becoming more and more necessary for the transmission of knowledge in higher education institutions and more particularly in Africa. With the lack of means for the creation of physical establishments able to take care of all the demand for training, the integration of distance education in training courses becomes essential and fundamental for the achievement of the objectives within the establishments of higher education.

With information and communication technologies, all the conditions are met to carry out distance learning courses at all levels (primary, secondary and university). One of the major concerns during distance courses is the isolation perceived by the actors (learners, teachers, tutors, administrators, decision-makers, etc.) during synchronous sessions. This training method offers several advantages, including: increased intake capacity, better management of continuing education, improved performance of the establishment and continuity of teaching.

In order to integrate this method in traditional (physical) universities whose courses are face-to-face, a digital transformation is necessary. This transformation must take place in all sectors of activity of the establishment, including educational and research management, administrative management, governance and decision-making as illustrated in the following table.

Table 1. Architecture of the i-UH2C digital system

Smart University: Academic Resource Management (ARM)								
ARM	Digital Governance Steering, Dashboard, Quality, Audit, Communication...							
1. You Cannot Manage Unless You Measure	Ecosystem: partners	Process Domains	Education		Research		Administration	Campus: Students, Staff...
2. But the measures must be meaningful		Digital Overlay	Middleware	Data store & BA	Platforms	Apps	User experience	
3. And they lead to action		Physical infrastructure	Physical infrastructure					
Smart University Architecture								

## 3. DESIGN OF THE I-UH2C SOLUTION

After several working sessions carried out with the various players in the UH2C system, it emerged that a complete digital transformation of the university's pedagogy would be needed. This transformation will be done through Learning Management System (LMS) solutions, single sign-on systems, videoconferencing systems, automatic backup systems, secure online exam solutions, tracking systems and performance evaluation, teleworking spaces, etc.

The following table illustrates the different digitization axes at the UH2C level. These axes could be used in other educational establishments.

Table 2. Architecture of the i-UH2C digital system

EDUCATION	RESEARCH	ADMINISTRATION
i-UH2C: E-learning platform Online exam platform i-Mahara: professional integration UH2C@Loghate: Language learning UH2C@Coursea: Online Certification	- i-Research - Digital research management platform - Digital Resources - Open Archives: institutional repository	- UNIV-HR - E-Competition - Digital order desk - electronic signing - Tele-reception
i-Doctorant: Management of the doctoral student's career E-labs: Matlab		
Digital Work Environment (ENT) Apogee Pre-registration Telework decision support system		

UH2C is the second largest university in Morocco with 125,000 students, 399 accredited courses, 123 research laboratories, 10 research centers, 2,472 indexed publications, 143 research projects, 2,500 teachers, more than 1,000 administrative staff distributed in 18 establishments.

### 3.1 State of Play

The architecture of the University is spread over three sites including one main, one secondary and a replication.

A virtualization platform with a more resource-efficient hyperconverged architecture is used. It is made up of a production site with 2 TB of RAM memory and 30 TB of SSD disk, a backup site with 2 TB of RAM memory and 30 TB of SSD disk where more than 25 of the most critical virtual machines have been replicated since the production site and finally a backup site with degraded service of 512 GB RAM with the possibility of replicating 25 other virtual machines from the production site. The image below illustrates the architecture of the University's technology infrastructure.

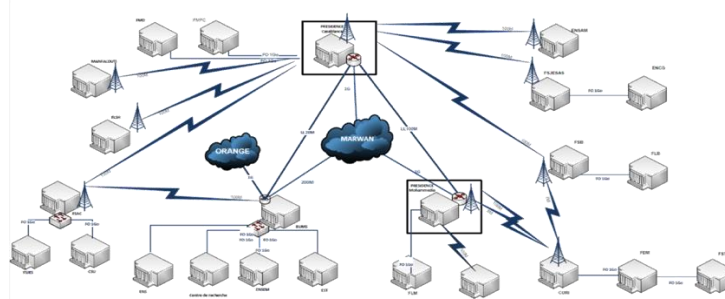


Figure 1. UH2C technology infrastructure

The production site and the backup site come out with a 1 Gbit/s link to the Internet. The backup site comes out with a 200 Mbit/s link to the Internet. The emergency and backup site are linked to the production site with dedicated 100 Mbit/s operator links.

### 3.2 Identification of the Different Needs and Services to be Implemented

In this article, we will come back to the methodology for implementing a few critical applications such as the LMS Moodle platforms, the videoconferencing system, the digital work environment (ENT), the central authentication system (CAS) as well as the technical architecture that will host this entire system.

### 3.3 Sizing of the i-UH2C Solution

The study and dimensioning of an adequate architecture for the implementation of an evolutionary and stable "E-learning" online teaching system are made to ensure high availability and a permanent and continuous service for the whole actors from the university (see figure 5). This study made it possible to define: the number of virtual machines (VM) to be created to manage all the actors of the university; the operating system to put on each server; the capacity (Disk Space, RAM, processor) of each VM; IP addressing; the services to be set up on each System (see figure 6).

### 3.4 Architecture of the i-UH2C Platform

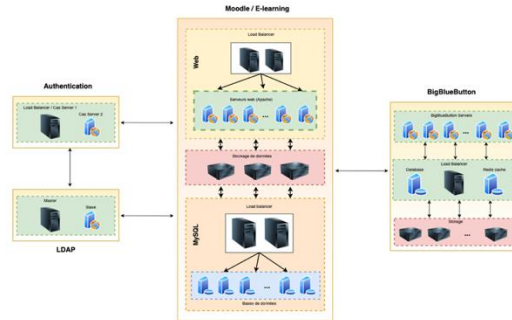


Figure 2. Technical architecture of the i-UH2C platform

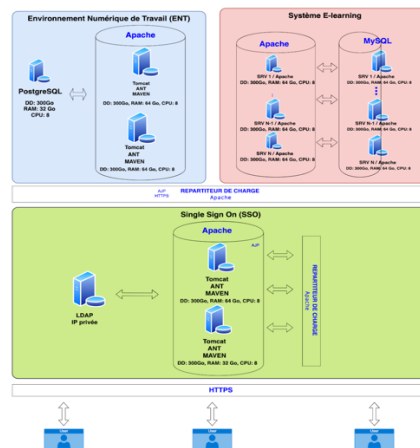


Figure 3. Architecture of the "E-learning" distance education system

### 3.5 Some Components of the i-UH2C System

#### 3.5.1 The Learning Management System (LMS)

After several studies and working sessions, the Moodle platform remains the most suitable for our context. The no longer proven Moodle LMS allowed us to manage all distance learning, teacher training, telecommuting, etc. This platform dedicated to course learning with an interactive dimension simultaneously integrates:

- a course schedule;
- videoconferencing, chat and forum tools;
- virtual classroom creation;
- a student management module;
- management of course usage statistics, user logins, etc.;
- a complete dashboard.

To allow all users to access the system, we have set up a centralized system for managing access to training platforms (Figure 7). A user, depending on his attachment to an entity (teacher of a faculty, student of a school, etc.) only accesses the courses to which he must have access. Access management and administration of the various LMS platforms is done through this system.

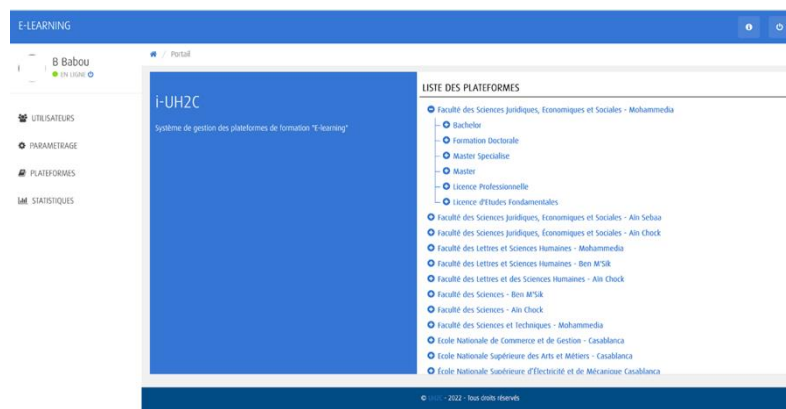


Figure 4. System for centralizing access to training platforms

The teleworking platform, based on Moodle, is accessible on <https://teletravail.univh2c.ma> as shown in the following figure.

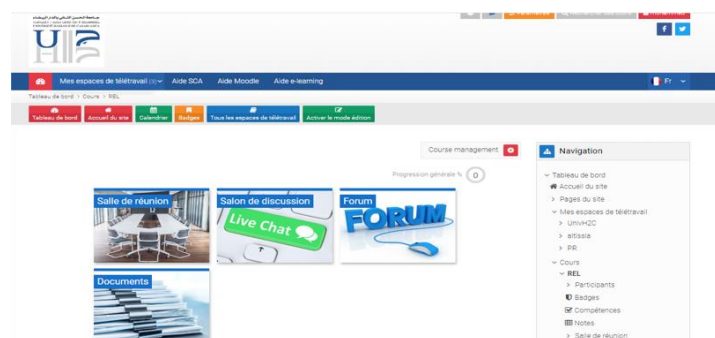


Figure 5. UH2C Teleworking Platform

### 3.5.2 Videoconferencing

In order to allow system users connected to the Moroccan network Academic and Research Wide Area Network (MARWAN) to access video conferencing and other applications for free, BigBlueButton (BBB) was chosen as the video conferencing system. Around ten instances have been installed to allow for around 1,500 simultaneous connections.



Figure 6. UH2C BBB videoconferencing system

### 3.5.3 The Centralized Authentication System

The Central Authentication System (SCA) based on the highly available Central Authentication Service (CAS) is installed in compliance with the university's graphic charter. This system is directly connected to the university's (production) LDAP directory. It should be noted that user registration for courses is done automatically. The CAS is installed on 2 servers with a load balancer to ensure the high availability of the system (see figure 10).

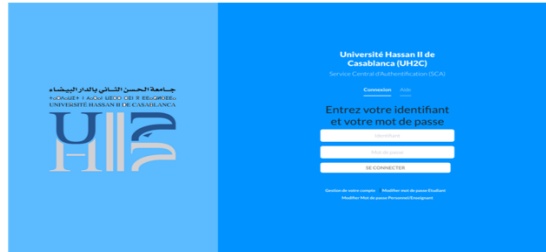


Figure 7. Central Authentication System (CAS)

### 3.5.4 The Digital Work Environment (ENT)

The Digital Work Environment (ENT), based on Esup Portail is distributed over 3 servers in order to allow high availability.

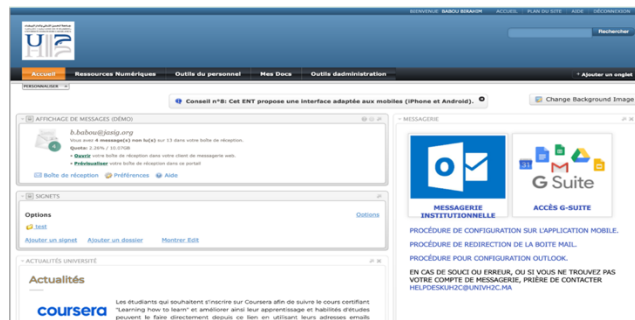


Figure 8. Digital Work Environment (ENT)

## 4. SYSTEM SECURITY AND SCALABILITY

To guarantee security of access to the system, an SSL certificate is installed on all platforms and applications. Each web application is on a different virtual machine from the one where its database is installed. Indeed, security plays a very important role in the information system (IS); therefore, all the applications implemented must only be accessible in https.

The load on the server at a given moment depends on the number of simultaneous users executing a task but not on the total number of user accounts and no longer on the number of connected users. Concurrent users, for Moodle and BBB, are considered to be those performing an action at time T on a given server. The rough general rule for a single server is:

- The maximum number of concurrent users = RAM (GB) \* 50
- In consultation = maximum number of concurrent users \* 5.

The rule applied to our case gives the following results:

- Maximum concurrent users:  $64 * 50 = 3200$
- In consultation:  $3200 * 5 = 16,000$  users connected

In this case, the web server and the database server are separate; this therefore greatly exceeds our needs for simultaneous connections.

Each BigBlueButton (BBB) video conferencing server can take up to 250 concurrent connections which gives  $250 * 10$  (number of instances installed) = 2,500 concurrent connections for BBB.

## **5. TRAINING OF THE VARIOUS ACTORS AND SUPPORT FOR CHANGE**

For a better handling of the distance education system of the University Hassan II of Casablanca (UH2C), practical training sessions for the benefit of teachers and administrators of platforms of the various establishments of the university have been carried out online. more specifically on the platform dedicated to teacher training designed for this purpose (<https://enseignements.univh2c.ma>). This training lasted one month.

The training took place in the form of sessions from 9 a.m. to 6 p.m. with two (2) establishments per training day. Among the modules unfolded, we have: Presentation of the UH2C system, Discovery of the platform, Course management, the videoconferencing system, how to insert resources in a course, Forum, User management and manipulation, Quiz & Assignment, Roles and rights, Registrations, Advanced settings, Report management, Feedback.

The distance learning project requires profound changes in the operating mode of the teaching-learning process for learners, teachers and other stakeholders (tutors, monitors, etc.). This support project has several axes: raising awareness of the actors on distance training and the digital tools used, the definition of the pedagogical model and internal standards for teaching within the UH2C, the training of teachers in pedagogical engineering and the use of the platform; training tutors in online tutoring and using the platform; internal and external communication on the effects and impacts of the paradigm shift; the multi-channel strategic choice to favor the interactivity of the course of the training.

## **6. CONCLUSION, PERSPECTIVES AND RECOMMENDATIONS**

This platform made it possible to deliver courses correctly throughout the crisis period and is still in use. For better integration, it would be very important to set up a federation of digital identity in order to allow member establishments to be able to share important data and information for good learning.

Each higher education establishment must have a digital center which will be responsible for steering the digital transformation of teaching, research and all other activities. This transformation must be accompanied by an adequate budget with clear activity programs and results to be achieved according to well-defined deadlines.

In addition to this, it would also be necessary to: Reinforce connectivity, set up a high-speed Wi-Fi network in the establishments' e-learning amphitheatres, set up microphones connected to PCs in the classrooms. recording for better recorded sound quality, posting user guides and videos on the creation and scripting of online courses, hosting webinar sessions to support teachers in e- learning; the creation of an educational innovation unit to strengthen support for teachers and students in their establishments.

The current platform occupying more than fifty 50% of the overall capacity of the University's Datacenters, a project to migrate the system to a national Datacenter is under consideration.

The current technological platform will be used as a backup of the one on the cloud. The following figure illustrates the architecture of the new solution that will be deployed.

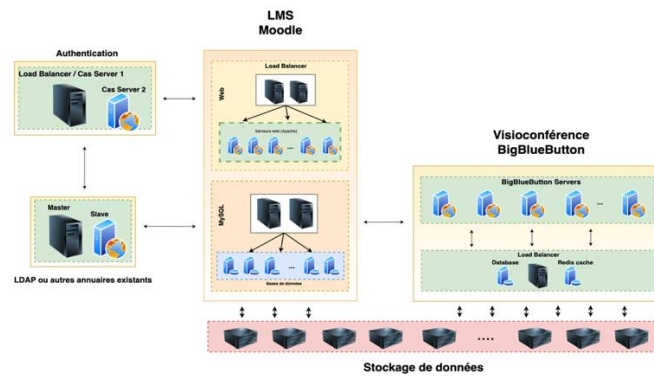


Figure 9. Cloud architecture of the i-UH2C system

## REFERENCES

- Aguti, B., Wills, GB., and Walters, RJ. (2014). "An evaluation of the factors that impact on the effectiveness of blended e-learning within universities," International Conference on Information Society (i-Society 2014), pp. 117-121, doi: 10.1109/i-Society.2014.7009023.
- Al-Ajlan, A., and Zedan, H. (2008). "Why Moodle," 2008 12th IEEE International Workshop on Future Trends of Distributed Computing Systems, pp. 58-64, doi: 10.1109/FTDCS.2008.22.
- BigBlueButton, "Système de Visioconférence Open Source". Available online: <https://bigbluebutton.org/>
- Central Authentication Service (2022). Available Online: <https://www.apereo.org/projects/cas>
- ENSSUP (2021). Available online: <https://www.enssup.gov.ma/storage/statistique/L%E2%80%99enseignement%20sup%C3%A9rieur%20en%20chiffre%202020-2021.pdf>
- ESUP-PORTAIL "Environnement Numérique de Travail (ENT)". Available online: <https://www.esup-portail.org/>
- Hantem, A., and Iscae- Rabat, A. (2020). The conditions of distance education during confinement due to COVID19: Case of higher education in Morocco.
- Hassan II University of Casablanca (2020). Available online: <http://www.univh2c.ma/>
- Hassan II University of Casablanca Report (2020). Available online: <http://report.univh2c.ma/data/opi.php?annee=2020>
- Hernandez, J. C. G., and Chavez, M. A. L. (2008). "Moodle security vulnerabilities," 2008 5th International Conference on Electrical Engineering, Computing Science and Automatic Control, pp. 352-357, doi: 10.1109/ICEEE.2008.4723399
- Makarova, I., Shubenkova, K., Bagateeva, A., and Pashkevich, A. (2018). "Digitalization of Education as a New Destination of E-Learning," 2018 International Symposium ELMAR, pp. 31-34, doi: 10.23919/ELMAR.2018.8534662.
- Modular Object-Oriented Dynamic Learning Environment - Moodle (2022). Available online: <https://moodle.org/>
- Moroccan National Research and Education Network (2018). Available online: <https://www.marwan.ma>
- Ndassimba, N. G., Kossingou, G. M., Ndassimba, E., and Ouya, S. (2021) "Contribution for the continuity of courses at the University of Bangui in the context of COVID-19," 2021 IEEE Global Engineering Education Conference (EDUCON), pp. 792-797, doi: 10.1109/EDUCON46332.2021.9454151
- Ouya, S., Mbacke, A. B., Mendy, G., Diouf, P. W., and Sy, K. (2015). "Social network integration to e-learning environment," 2015 IEEE/ACS 12th International Conference of Computer Systems and Applications (AICCSA), pp. 1-4, doi: 10.1109/AICCSA.2015.7507222.
- Survey on the impact of the coronavirus on the economic, social and psychological situation of households in Morocco carried out by the High Commission for Planning from April 14 to 23, 2020