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Role of the University Management System in the digitalization of Technical University of Moldova

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Abstract—Digital transformation has radically transformed societies and economies, having an ever-increasing impact on everyday life. The COVID-19 pandemic has revealed certain challenges for education systems related to digital skills of the higher education institutions, the use of digital tools and general level of digital competences and digital literacy. Ideally, a University Management System should have several functionalities, such as: management of the professional guidance of students (prospective students), management of the admission process, student management, employee management, finance management, research management, graduate management, management of the university documents and processes, but also academic management. A successful university management system will ultimately ensure the quality of education, will maintain a high level of institution's image and academic integrity.

Keywords—university management system, digital transformation, digital literacy, quality of education.

I. INTRODUCTION

Digital technologies have already markedly transformed the media, commerce, entertainment sectors, and education, the higher education sector being the next on the list. In the future, university campuses will be kept as spaces for teaching, learning, research and innovation, but digital transformation will radically change the way knowledge is delivered, will enable real-time feedback from students, will boost distance learning and will enhance market diversification of the educational service providers.

According to the study on the economic and social impact of the COVID-19 pandemic, developed by UNDP (United Nations Development Programme) Moldova [1], about 150 thousand pupils and students did not have access to studies during the restrictions, due to the lack of the necessary equipment, knowledge or Internet connection of pupils/students or teaching staff; several

small and medium enterprises, not being prepared for online commerce, stopped their activity, causing an economic decline of -7% of GDP in 2020; most of the employees of the local and central public authorities had to be physically present at work, exposing themselves to the risk of infection, due to the malfunctioning of some digital systems, etc.

Moldovan legal system in terms of public sector and its digital transformation has developed a lot lately. A series of recently published normative acts obliged public institutions to provide e-mail communication with citizens, but also to accept from them documents in electronic format. However, the public system still seems to be caught in the inertia of bureaucracy, and recent approaches to the subject by the mass media reiterate this inertia. The educational information systems are also fragmented, seized between the online and offline environments, also due to the lack of a unitary legal framework that would constitute the foundation for the architecture of digital public services. Some higher education institutions benefit from minimal or average functionalities of the University Management System (UMS), while others - of the same level, do not have sufficient resources to introduce such innovations in the service portfolio. One of the causes of this fragmentation lies in the lack of a previous prioritization of the digital transformation, an imperative of the institutional management too. This situation determined the emergence of an environment where some universities operate only on paper in the same inertia of bureaucracy.

Even though the Republic of Moldova has 98% of its territory under 4G coverage, several functional e-Gov services, an ICT (information and communication technology) sector with an accelerated development of about 7% contribution to the gross domestic product - GDP, the COVID-19 pandemic highlighted the lack not

only of a university digitization strategy, but also of a national governance framework for digital public services.

II. DIGITALIZATION STRATEGY OF THE TECHNICAL UNIVERSITY OF MOLDOVA

Digital transformation strategy of the Technical University of Moldova (UTM) focuses on several documents that reveal the trends regarding the digitalization of the Republic of Moldova:

- 2030 Digital Compass: the European model for the digital decade proposed by the European Commission [2], which mentions the vision for the year 2030 regarding digital transformation at the European level. Four cardinal points are established and they should be considered by all national structures, and since Moldova was granted the status of a candidate country for accession to the European Union, these goals became national recommendations:

- a. A digitally skilled population and highly skilled digital professionals;

- b. Secure, high-performing and sustainable digital infrastructures;

- c. Digital transformation of businesses;

- d. Digitization of public services - providing all key public services in the online environment in proportion to 100%.

- The concept of the digital transformation strategy of the Republic of Moldova for the years 2023–2030 (STDM 2030) [3]. In this context, the document provides that the implementation of STDM 2030 will ensure the transformation of the Republic of Moldova into a country with an innovative and inclusive digital society, based on a modern infrastructure with digitally educated people, pro-digital governance, a business community that fully implements digital opportunities as well as a collaborative environment for stakeholders, which encourages the innovative work of all people and ensures sustainable human development.

- The digital education action plan of the European Union for the period 2020-2027 [4], which is grounded in two strategic priorities: Fostering the development of a high-performing digital educational ecosystem and Enhancing digital skills and competences for the digital transformation.

- The institutional strategic development plan of the Technical University of Moldova, 2021-2026 [5], which includes digital transformation activities in all university areas.

UTM identified during its existence the same issues highlighted by the previously mentioned documents, and on the other hand, during the period 2016-2022, it implemented several courageous digital transformation initiatives at the internal level.

Thus, throughout its existence, there were recorded a lot of achievements, facts and challenges at the university

level:

- fragmentation of the infrastructure acquisition in some areas (accounting software, library resources, statistical analysis and planning software, etc.);

- digital transformation of the university components, such as teaching, research, the relationship with the business environment and the administration, was carried out fragmentedly, recording more dynamic and consistent steps only in the last 4 years, thus we can discuss about an average digitization of the university processes;

- taking into account that in the summer of 2022, Technical University of Moldova was reorganized as a result of the mergence (absorption) of the following public institutions: 1) Public Institution State Agrarian University of Moldova; 2) Public Institution Institute of Electronic Engineering and Nanotechnologies “D. Ghitu” 3) Public Institution the Institute of Power Engineering 4) Public Institution the Institute of Microbiology and Biotechnology, it is impossible to discuss the use and deep implementation of IT solutions in all fields of activity of the university. In some areas of the absorbed institutions, the institutional processes are not digitalized at all, and this causes the risk of slowing down the initiatives with an emphasis on digital transformation at the UTM level;

- students / didactic-scientific staff / researchers / administrative staff have benefited from training on digital solutions over time, but a human resource training strategy is now required, covering areas of skills related to digital literacy in order to better capitalize on the opportunities associated with the secure use at large-scale of the digital solutions within UTM;

- a major challenge for the university is associated with the process that involves stop using printed documents, holographic signatures and the full use of electronic documents, but also the certificate of the public key for the qualified advanced electronic signature [6]. University documents and information must be able to be created and exist originally in electronic format, being able to be archived by category, in order to be accessible, transparent and possible to be tracked. This challenge causes some important problems related to financing, but also to the identification of IT solutions, so that all documents created in the UTM have a visible digital history and can be archived / transmitted digitally to all interested users, but also comply with national legislation regarding archiving.

The following diagram was made according to the situation at the university level and presented in Table I, which describes the current organizational status based on the Strengths and Weaknesses, and respectively what we estimate will happen in the future in the external environment regarding digital transformation through the prism of Opportunities and Threats:

TABLE I. SWOT ANALYSIS OF UTM DIGITAL TRANSFORMATION

SWOT analysis	Positive	Negative
Current internal analysis	Strenghts 1. Previous investments in modern computer hardware and software at UTM; 2. Most of the university staff has a high level of technology acceptance; 3. UTM administration is willing to support a large-scale digital transformation process; 4. UTM's thourough understanding of the needs of external stakeholders regarding the university's services.	Weaknesses 1. Existence of fragmented information infrastructure within the UTM; 2. Various levels of digital skills among university's employees; 3. Insufficient financial resources the university can allocate them to digital transformation; 4. Insufficient human resources in order to achieve digital transformation at internal level.
Estimated evolution of the external environment	Opportunities 1. Existence of opportunities for digital transformation funding through external partners; 2. Establishing more valuable partnerships with companies interested in contributing to the digital transformation of UTM; 3. National and international legislation, along with various level strategies foster the digital transformation at UTM; 4. More and more national institutions are able to provide information in digital format.	Threats 1. Rapid change of digital solutions and requirements related to this transformation for various reasons; 2. Major and unpredictable variations in equipment prices as well as supply chain issues related to digital physical infrastructure; 3. Legislative inconsistency at the national level regarding digital transformation and the lack of funding for digital transformation processes.

Digital transformation should take place in a context defined by the university's peculiarities and also by the readiness level of processes. This type of context is determined by the indicators of the SWOT analysis presented above: strengths, weaknesses, opportunities and threats that modulate both the university environment and its evolution in the cultural, economic, political and social development paradigm of the region.

III. DIGITAL TRANSFORMATION OF TECHNICAL UNIVERSITY OF MOLDOVA IN 2018-2022 USING THE UNIVERSITY MANAGEMENT SYSTEM

One of the major objectives of the digital transformation strategy focuses on the development of the university management system, which enables: instant access of the administration to any university information; debureaucratization of the educational and administrative processes; increasing the satisfaction degree of the university environment; implementing modern methods of internal communication; enhanced UTM visibility at national and international level, but also a high level of university credibility, as a result of increasing transparency and access to information [7].

In March 2020, when the Parliament approved the Decision on declaring a state of emergency on the entire territory of the Republic of Moldova, caused by the COVID-19 pandemic, UTM, like other universities, faced a series of challenges. The litmus test was to provide exclusively online learning. A lot was done, various software applications were tested, a period of teachers' training followed. In this context, university's partnerships with various companies in the field greatly facilitated the process of transition to online education. Being one of the first universities in the Republic of Moldova to successfully implement Office 365 for Education, which has an impressive package of tools, which we used in the digitalization of courses, the creation of electronic registers and applications related to class attendance, but also the use modules of the university management system – all these tools represented a special opportunity during the period in which the study process was stopped. UTM was one of the few universities that went online not only for the examination session, but also for the defense of the final year projects, bachelor's and master's theses [8]-[9].

The evolution and modernization of UTM's information systems during the period 2018-2022 played a crucial role in institution's activity and increased its visibility in the online environment. The ICT services of UTM have been developed continuously, a wide range of tools being designed and implemented with the aim of facilitating the activity of the entire academic community:

1. The modules of the university management system of UTM, primarily the "Admitere" (Admission) module, were developed and adapted to the requirements imposed during the pandemic period, ensuring the continuity of university activities. Online registration and pre-admission were developed by the ICT department of UTM and later adapted to the requirements to register candidates for online education during the pandemic period. Therefore, these tools, shown in fig.1, allow the prior registration of candidates for both the first Bachelor's degree cycle and the second Master's degree cycle within the university admission committee. The

functionality of the developed tools enables the candidates to manage data, upload files and pay online all the required fees. The module also provides notifications to the registered candidates by e-mail concerning details about the stage of information verification of their files, as well as SMS notifications at any verification stage.



Figure 1. The interface of the module "Admitere online" (Online admission).

After creating the account, the candidate for studies can access the personal cabinet, presented in fig.2, which is intended to automate the process of making the admission within the UTM. This allows the candidate to complete the form, upload personal files, study documents and complete the corresponding fields corresponding of application form.

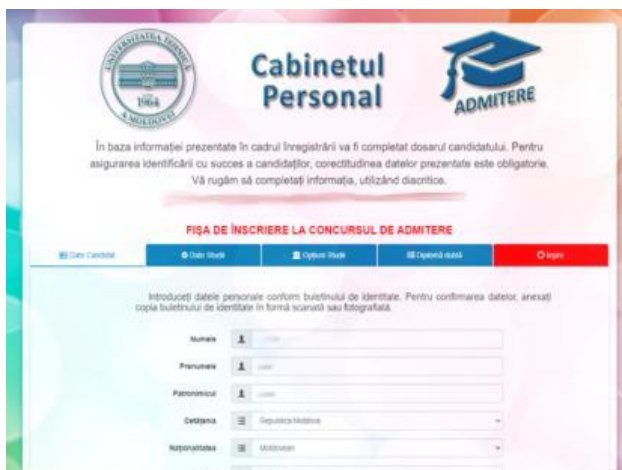


Figure 2. The personal cabinet of the candidate who uses the module "Admitere online" (Online admission)..

2. In order to fully digitalize the admission processes, the first „Achitare on-line” (Online payment) module was developed and implemented (see fig. 3), being initially applied for the payment of the admission

fee, later being applied to other services provided by UTM.



Figure 3. The module „Achitare on-line” (Online payment) processes the admission fees paid by the applicants.

3. In the period 2018-2022, the University Management System was developed continuously by including new functionalities, as well as improving the existing ones. Annually, it is performed the analysis, redesign / design, implementation, installation and configuration of the functionalities that includes the following modules:

- Information system "Decanat" (Dean's office)
 - Information system "Departament academic ciclul I și ciclul II" (Academic department cycle I and cycle II)
 - Information system "Evidența studenți" (Student record)
 - Information system "Fișa de lichidare" (Liquidation form)
 - Unified System "Managementul resurselor umane" (Human resource management)
 - Information system "Salarizare" (Payroll)
 - Information system "Anti-plagiat UTM" (UTM anti-plagiarism)
 - Information system "Universitatea Mea" (My university)
- All these modules, as well as other digital tools that aim to facilitate university processes, can be selected by the operator, at the time of his/her authentication and authorization in the UMS interface of UTM, as shown in fig.4.



Figure 4. Selection by the operator of the mode required for the subdivision or university processes within the UMS of UTM.

Improving the functionality of the module “Managementul resurselor umane” (Human resource management), which aims to record the academic staff by using a wide range of functionalities. All the possibilities offered by the given system are due to the interconnection of a multitude of submodules: Planning, Orders, Reports, Staff Records, Salary Calculation, Time Attendance, etc. An important module that simplified and digitalized the nondigital or paper documents is “Pontaj” (Timesheet) information module – Timesheet Generation. This module collects the information at the level of orders issued on employees by the human resources records office, and based on them, it automatically generates the timesheets, which will be used later in the salary calculation. The interface of the automated timesheet generation system is shown in fig.5.

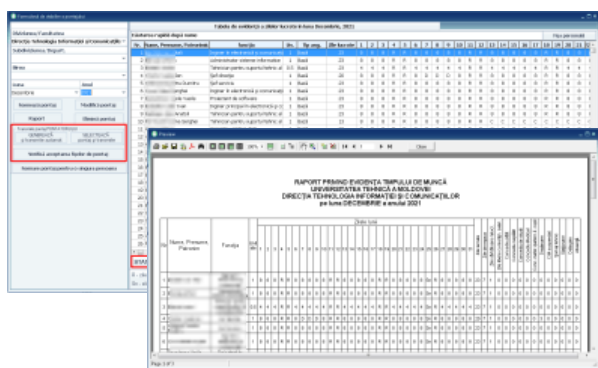


Figure 5. Automated generation of reports regarding the timesheets records of UTM employees.

The most important functionalities of this submodule include:

- setting the persons responsible for timesheets per faculty / subdivision / department, etc.,
- the possibility of automated transmission of the document generated in *.doc format to the timesheet managers for verification and approval,
- the possibility of sending a document with some changes made by the Human Resource Office after its generation to the timesheet managers for verification and approval,

- automatic notification of the timesheet managers via corporate mail about the generation of the timesheet document and the need to access the UMS for verification and approval,

- the possibility to establish a communication between the timesheet managers and the person who generated the timesheet through the online chat within the UMS.

Subsequently, the report on the record of the employees' working time is used within the informational module also fully managed by the UTM - the informational module “Salarizare” (Payroll). It uses a set of regulations and mechanisms related to fixing the salary level, it

differentiation (by branches, professions, positions, seniority, etc.). The interface of this tool is shown in fig.6.

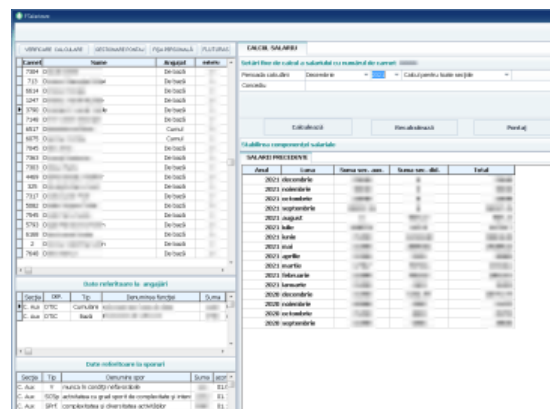


Figure 6. The operator interaction interface that manages the module “Salarizare” (Payroll).

4. Completion of the module „Arhiva ordine” (Order archive) with the module „Notificări” (Notifications), shown in fig.7, which carries out the notification process via the university corporate e-mail of each individual collaborator, with the possibility of direct access to the document in which he/she is being targeted.

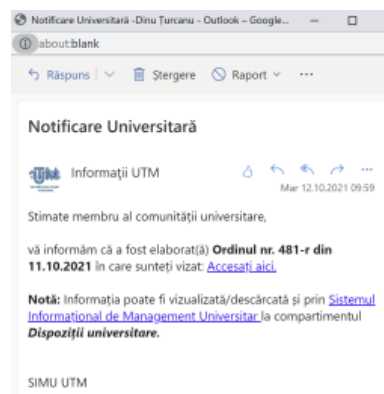


Figure 7. Example of notification received by the university collaborator in the corporate e-mail address.

5. The creation of the module „Omagiat”- (Celebrant), as a component of the university management information system, which performs a complex automated process of interaction of different data processing algorithms for the identification of celebrant university collaborators at an indicated period of time. Tool's functionality focuses on 3 components: the module the module „Omagiat administrație” (Celebrant administration) - informing the rector and vice-rectors about the list of celebrants for a predetermined period via the university corporate e-mail; the module „Omagiat decan” (Celebrant dean) – informs the deans of the faculties about the list of celebrants from the

corresponding faculty; the module „Omagiat felicitare” (Celebrant birthday message) – sends a congratulatory message per celebrant as shown in the image in fig.8.

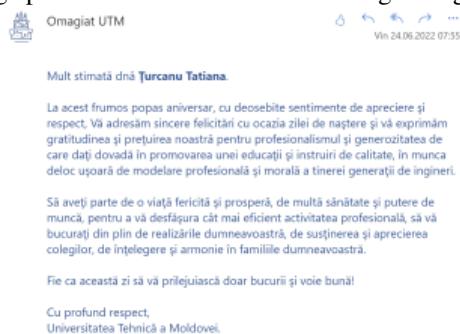


Figure 8. Example of a birthday message sent to the corporate e-mail address of the celebrant university employee.

6. Starting from the projects on process digitalization within UTM, the purpose of which is to facilitate a series of work and/or study activities, in order to simplify the process of data collection at the electricity, drinking water and domestic water meters by the residents of the university dormitories, it was developed an informational management system that digitalizes the meter data and allows the issuance of automatic invoices in the online environment - the „Serviciul on-line de colectare a datelor” (Online data collection service), shown in fig. 9, which is currently being improved, through the establishment of automatic / remote reading and implementation of online payment based on Moldova Agroindbank and/or MPay - Government Electronic Payments Service.



Figure 9. Data collection and issuance of online invoices for the services consumed by the residents of the UTM dormitories based on the "Serviciul on-line de colectare a datelor" (Online data collection service) module available in the university employee's personal cabinet.

7. Another very important digital tool of the university – the Online Platform "Universitatea mea" (My university), allows synchronization and quick access to the modules of the University Management System, which ensures transparency and access to information for any

student or collaborator. The platform can be accessed from any location, from any device in real time, by accessing <https://utm.md/universitatea-mea/>. Based on this tool ("Universitatea mea – student" (My university – student)), UTM students can check online their academic situation and other information of university interest, as shown in fig. 10, and since the fall of 2019, the paper gradebook was excluded and is no longer used within the university. This tool, during 2021, was accessed by students 301,000 times.



Figure 10. The UTM student's digital notebook - the section "Academic Situation" of the module "My University – Student".

Also, through this tool, the annual agreement and the study contract can be accessed and signed. In order to confirm the consent regarding the extension of studies at UTM, the student has the opportunity to sign by pressing the „sign” button, as shown in fig. 11.

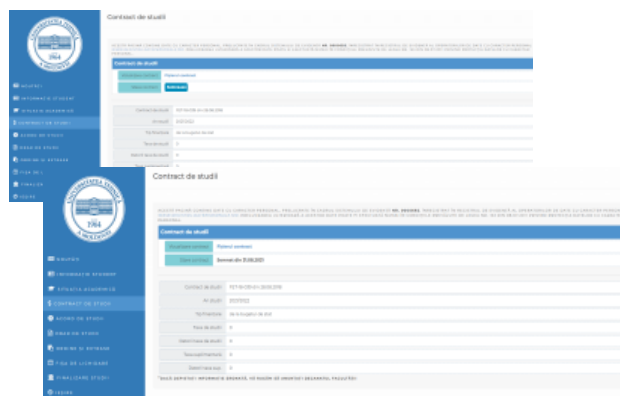


Figure 11. Accessing and signing the study agreement / study contract on the platform "Universitatea mea – student" (My university – student).

This agreement should also be signed using a holographic signature at the beginning of the academic year at the faculty's dean's office.

The digital tool ("Universitatea mea – angajat" (My university – staff) enables secure access of collaborators to the information related to university activity in real time as well as the automated notification of the persons targeted in some university documents (dispositions,

orders, decisions, requests, etc.), as shown in fig.12. Also, employee's personal cabinet allows to check and request corrections of personal data, to access an aggregator of university news and announcements, etc. This tool, during 2021, was accessed by university employees 85,000 times.



Figure 12. Example of accessing the platform “Universitatea mea – angajat” (My university – staff) by the UTM collaborator.

8. Development of the module “Antiplagiat” (Anti-plagiarism), which is part of the University Management System and allows the academic departments to upload and validate through a friendly interface the final papers per student for the bachelor's and master's degree cycles, as presented in fig.13 and fig.14.



Figure 13. The uploading process of bachelor's theses and master's theses by the university academic departments for the generation of the similarity report.

Nr.	Fileră 1	Fileră 2	Similarity
1	FTP-DWI-142-1-RO-BEZDGA-MIRIANA.DOCX	FTP-DWI-142-1-RO-BEENARU-IONELA.DOCX	22.83
2	FTP-DWI-142-1-RO-COSIARU-SORINA.DOCX	FTP-DWI-142-1-RO-BOGHEANU-CRISTINA.DOCX	22.12
3	FTP-DWI-142-1-RO-ANDRONOVICI-INGA.DOCX	FTP-DWI-142-1-RO-BEENARU-IONELA.DOCX	23.09
4	FTP-DWI-142-1-RO-DOROGAN-MIHAILA.DOCX	FTP-DWI-142-1-RO-TURCAN-ELINA.DOCX	15.43
5	FTP-DWI-142-1-RO-ROTORU-MARIA.DOCX	FTP-DWI-131-1-RO-VISTERNICANU-ALEXANDRA.DOCX	80.61

Figure 14. Generation of the similarity report within the module “Antiplagiat” (Anti-plagiarism) from the UMS of UTM.

9. Supplementing the online module “Universitatea Mea Student” (My university – student) with the tool that allows the graduate student of the first and second cycle to upload individually his/her bachelor's / master's degree thesis in order to check the similarity score, so that if the similarity score approved by the UTM is exceeded, the work can be edited until upon its final verification by the academic department, as shown in fig.15.



Figure 15. The tool enabling graduate students of the first and second cycle to check their bachelor's or master's degree thesis for the allowed similarity score.

10. In order to digitalize and secure access to the university dormitories, the ICT department of UTM implemented in the summer of 2022, an information system that will allow entry only based on a QR code generated by the application from the student personal cabinet on the platform (“Universitatea mea – student” (My university – student)). Thus, the university administration aims to limit the access of foreigners and increase the assurance of public order and safety in the university dormitories. It should be noted that a 24/7 video monitoring system, an access control system and a call system (intercom) with the possibility of opening the doors remotely, all of which can be accessed by the authorized staff (residents of the dormitories corresponding to their residential address) have been implemented. The possibility of generating the access code to open the dormitory door by the student is presented in fig. 16.



Figure 16. Generating the access code from the platform “Universitatea mea – student” (My university – student) by the residents of the UTM dormitories.

In the above-described and analyzed context, we found out that digital transformation refers to the fact that all university processes can be affected by information technologies and to the fact that all these processes can be improved / transformed due to the use of technologies. Digital transformation is not an end in itself, but it can contribute to achieving the university's strategy through an integrated approach that considers all areas of interest of the university and its processes.

IV. CONCLUSIONS

With the support of the university administration, but also due to available and effectively applied financial resources, digital technologies and the continuous development of the university management system will bring added value to education, improving and simplifying all academic and research activities at UTM and will offer a modern student-centered educational offer. Routine components will be automated, hence achieving financial and time efficiency, so that all those people involved in the life of the Technical University of Moldova can focus on really important aspects: knowledge, innovation, research and personal development.

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