

Digital Transformation Model in the State Universities in Cameroon Based on Actor Network Theory

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Abstract: The number of students increases every year in all universities in Cameroon. The facilities in each university do not allow efficient teaching and training of students. For a given course, instead of delivering one class per week in a normal situation, the same class is delivered many times per week to allow students to try the course. For some classes that can't be scheduled multiple times a week, students attempt the class by standing outside the amphitheater when it is already full. In this chaotic situation, it becomes extremely difficult to schedule an internship that would allow students to gain experience. As a result, the failure rate is very high, students who managed to graduate did not have the necessary skills to scope with real world problems related to the environment or applied area of study. Now, the main question is how to scope with a larger number of students in the case of insufficient teaching and training facilities. More specifically, how to facilitate digital transformation in state universities in Cameroon? This is the objective of this thesis. To address this issue, the Actor Network Theory is used. The result is the definition of the digital transformation model and its implementation to facilitate the adoption of technologies in the teaching and learning process in state universities in Cameroon.

Keywords: Actor network theory, Business process modeling, Digital transformation, M-learning, Quality of service.

I. INTRODUCTION

The government of Cameroon had launched the E-National Higher Education Network project for the

digital transformation of the higher education system to scope with the problem of overcrowded students on campus. This project is designed to assist state universities in scoping with the issue of overcrowded students on campus in universities. From the project, IT infrastructures have been updated to provide students with free Internet access and online access to course materials [12]. Digital development centers were built to facilitate the digitization of teaching, and a large number of portable computers were offered to students in general. Cameroonian universities are no longer last in the search for academic excellence and competitiveness. These students must use these computers to facilitate their learning practice and acquire new knowledge anytime and anywhere. With this act, the state has laid the solid foundation of the digital campus. Reason why the mobile learning project is in gestation in the state universities in Cameroon to find out how it is possible to perform their learning and teaching systems, to increase the rate of success of the students and to achieve the goals of digital governance depicted in the manual of academic norm. So, before building this kind of important project, it is necessary to assess the readiness of the universities to effectively prime mobile technology in their educational system and to bring to light the actors (human and non-human) who can positively influence this initiative. This type of initiative is called mobile learning (m-learning) [1, 16]. Many authors have defined the concept of m-learning [1, 15, 18]. M-learning is defined as learning practices that take place when learners or educators are either in a permanent, prearranged or not

in a permanent or prearranged learning environment and where mobile technologies are used as a tool to facilitate learning [2, 15, 16, 17]. In this definition, we can note that we have many different actors, learners and educators who deal with the m-learning process.

Thus, the aim of this paper is to show how to facilitate digital transformation in state universities in Cameroon to help them in scoping with the overcrowded students on campus in universities. To solve similar problem, many theories or approaches have been used and we can notice, activity theory where activity is the core concept and is defined as dialectical relationship between subject and object. This theory has been used to understand the great opportunities that mobile technologies can offer to mobile learners [1, 6]. The Unified Theory of Acceptance and Use of Technology (UTAUT) was developed by Paledi *et al.* [15]. This theory has been used by Liu [13] to emphasize and indicate that the functionality of learners' devices and the perception of support from learning material providers affect learners' satisfaction and decisions to adopt mobile learning. Many other theories have been used by information systems researchers in the specific area of mobile learning, such as Structuration Theory and Actor Network Theory, which will be the theory used in this study. In this paper, Actor Network Theory will be used. The result is the definition of the digital transformation model and its implementation to facilitate the adoption of technologies in the teaching and learning process in state universities in Cameroon.

The rest of the paper is organized as follows: in Section II, we present the existing solutions that address the highlighted problem and their limitations; Section III presents some preliminary concepts that are useful for understanding our proposal; Section IV presents our proposal; Section V presents the case study; Section VI presents the results and discussions; and Section VII concludes the paper and gives some research perspectives.

II. RELATED WORKS

Information system researchers use many theories or approaches to underpin the issues related to information and communication technology (ICT)

such as theoretical aspects in information system, cultural issues, social issues, digital transformation, ICT projects and education. In the specific case of education, this section provides literature review of theories or approaches used in m-learning such as Activity Theory, Unified Theory of Acceptance and Use of Technology (UTAUT).

A. Activity Theory

The Russian psychologist Vygotsky and his disciples had introduced Activity Theory in the 1920s to provide a lens that can help researchers better understand human activity. Activity theory is based on social-cultural theory. Social-cultural theory is based on the notion that an individual cannot be viewed as separate from his or her social and cultural environment [8]. In this social-cultural environment, relationships can be formed between subject (human doer) and object (the things being done). These relations form the core of an activity.

Activity is the core concept in this theory. Activity is defined by the dialectical relationship between subject and object [14, 19]. Later, in the 1981s, Leontiev presents activity as a holistic [1, 9], high-level, usually collaborative construct, such as undertaking a work project, teaching a course, or doing a PhD, and proposes a representation of the collective activity system (Fig. 1). This representation is used by researchers as the basic model of Activity Theory [2, 4, 16].

Activity Theory is applied in research that studied the complexity of problems in the real world such as community group, places of learning, etc. The Activity Theory provides a language and a set of frameworks for making sense of what is discovered about the situation through observation, interviews, and other methods [4, 17]. To use Activity Theory in research problem, it is recommended to researchers to follow the steps below:

Step 1: Identify the significant activities of the system to be examined, along with the subject(s), object, and purpose of each activity.

Step 2: Identify the actions and mediating tools of the activity(ies), where tools may be primary, secondary, or tertiary.

Step 3: Identify the dynamics and tensions within and between the identified activities (Hasan and Kazlauskas, 2014).

These main steps have been followed by Eltyad *et al.* [8] to build the task model for mobile learning and to understand the great opportunities that mobile technologies can offer to mobile learners. In their work, learning is considered as an activity that can be performed in different contexts: independent context, formalizing context, physical context and socializing context. Fig. 1 shows a representation of a collective activity system.

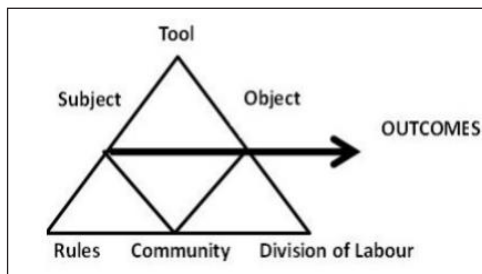


Fig. 1: The Engeström Representation of a Collective Activity System [18]

B. Unified Theory of Technology Adoption and Use

Fezil [11] developed a unified model that brings together alternative views of user and innovation acceptance. The Unified Theory of Acceptance and Use of Technology (UTAUT), which suggests that four core constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) are direct determinants of behavioral intention and ultimately behavior, and that these constructs are in turn moderated by gender, age, experience, and voluntariness of use [3, 14, 16]. The UTAUT was constructed by reviewing and integrating eight major models and theories which are: The PC Utilization Model, the Motivation Model, the Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), a combined TBP/TAM, the Social Cognitive Theory (SCT), the Theory of Reasoned Action (TRA), and the Innovation Diffusion Theory (IDT). Fig. 2 shows the unified theory of technology acceptance and use [4, 17].

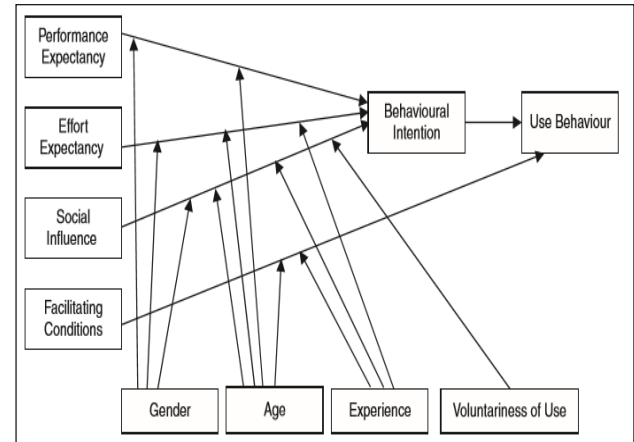


Fig. 2: Unified Theory of Technology Adoption and Use

This unified model has been used in m-learning by several authors, such as Liu [13] to develop an adoption model for mobile learning. In his research, Liu [13] indicates that the functionality of learners' devices and the perception of support from learning material providers influence learners' satisfaction and decisions to adopt mobile learning.

III. GENERALITIES OF ACTOR NETWORK THEORY (ANT)

Basic Concepts of ANT

A network in ANT is an abstract representation of actors (human and non-human) that interact through translation between them, have their own interests and the same goals. An actor is any entity that interacts with other entities or serves as an intermediary between them. An actor can be seen as a node in a network. A theory is a set of organized ideas, abstract concepts applied to a specific domain.

Actor Network Theory (ANT) is based on three principles: agnosticism, generalized symmetry, and free association [15]. Agnosticism means that analytical impartiality is required towards all actors involved in the project under consideration, whether human or non-human [18]. The construction of an actor network is based on "generalized symmetry," i.e., both human and non-human actors are treated equally and described with the same language [16]. The principle of free association requires the elimination and abandonment of all a priori

distinctions between the technological or natural and the social [11].

Another important concept of ANT is inscription, obligatory passage point (OPP) and translation. Inscription is an act that actors impose on other actors to shape their attitudes and characteristics [6]. OPP is a process by which all actors involved in the network satisfy the interest recognized in them by the main actor in order to make themselves indispensable to the network [17]. Translation is the process by which actors share their interests and construct lasting alliances. According to Pedri [15], this process has four stages: problematization, interessement, enrollment and mobilization. Problematization, which occurs when actors identify a problem and propose a solution [1, 14]. The second stage of

translation is interessement, which can be associated with the notion of influence, where the main actor tries to convince other actors to accept the roles assigned to them during problematization [13]. The third stage, enrollment, is a political process where a high level of persuasion by the principal actor is required to convince actors to accept their roles and maintain stability [9]. The last stage is mobilization, which occurs when the solution is widely accepted [4, 6]. The use of these steps as a theoretical framework will be applied in detail in this study in the section below.

Paledi and Alexander [17], use this graphical syntax to construct the conceptual m-learning readiness assessment actor network (Fig. 3), in which actors have been identified through literature review.

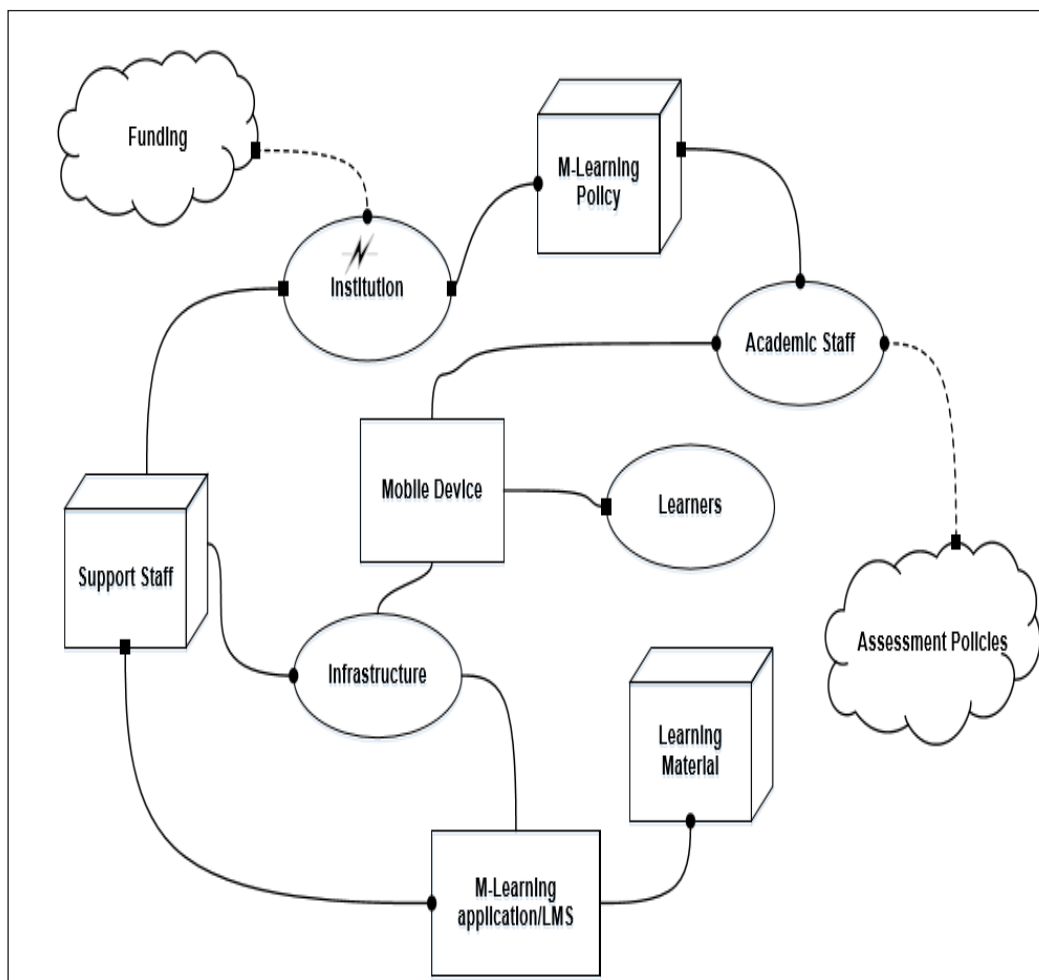


Fig. 3: Conceptual M-Learning Readiness Assessment Actor Network

IV. DIGITAL TRANSFORMATION MODEL

The definition of the digital transformation model is based on four stages: the translation, the obligatory

passage point, the enrollment, and the mobile learning actor network. These stages are shown in Fig. 4 below:

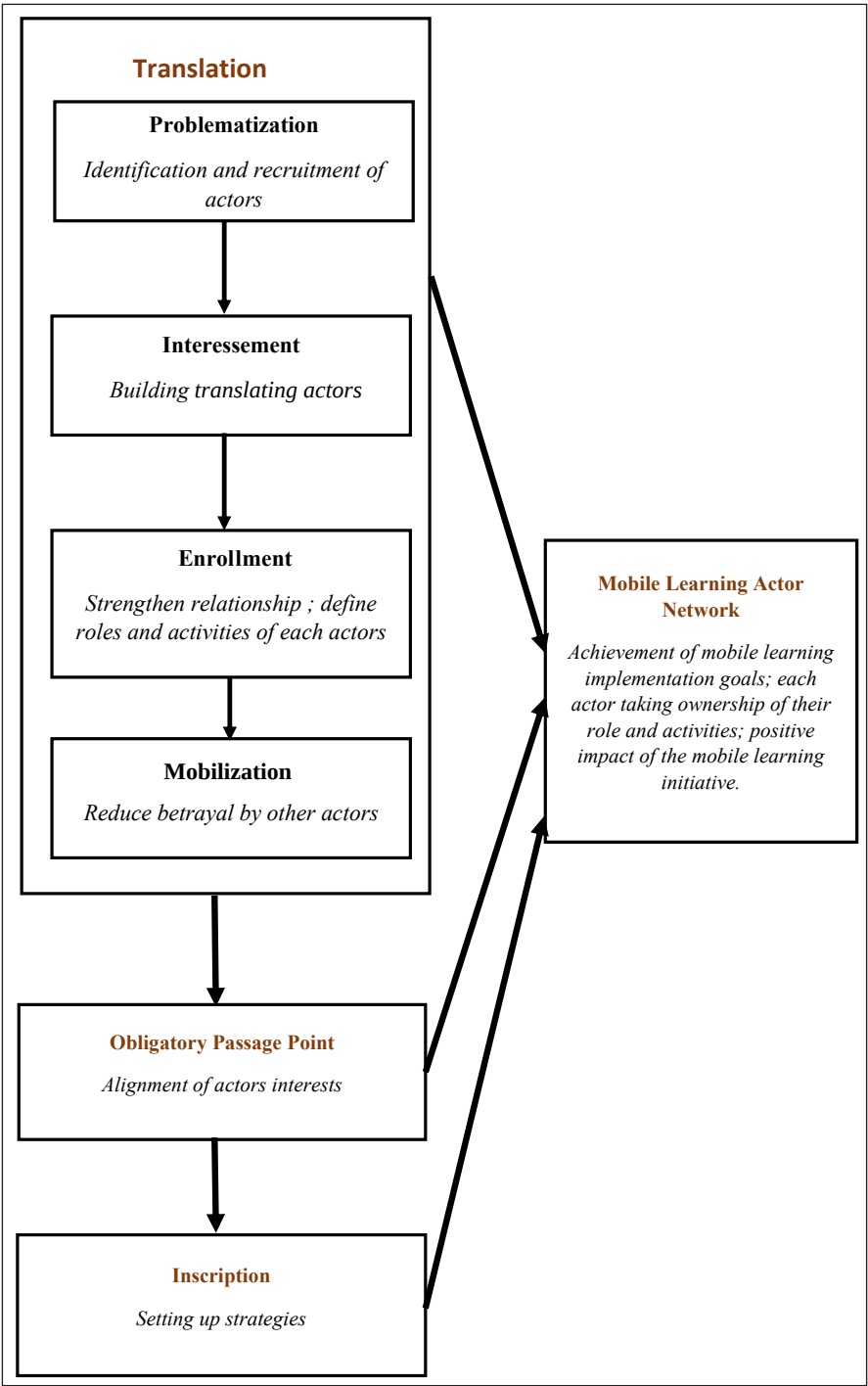


Fig. 4: Digital Transformation Model

A. Translation

Translation is a set of methods by which actors within a network try to put other actors in positions

that can serve their own purposes [15]. This set of methods has four steps, as mentioned above: Problematization, Interessement, Enrollment, and

Mobilization. The following section outlines the process of problematization.

i) Problematization

The problematization step involves the identification and recruitment of actors. It is also the process of bringing the most relevant actors into the network [16]. This search provides the main actors that can be recruited in the mobile learning readiness assessment actor network to solve the problem. After identifying the problem, identifying and recruiting actors, the next stage allows to define the negotiations that will take place with other actors regarding the roles they can play within the network.

ii) Interessement

Interessement includes the strategies by which the focal actor tries to include others according to the entities and roles defined for them in the problematization [17].

To achieve these strategies, a lot of negotiation between actors has to take place. That's why interessement can also be defined as the process of building translating actors that can be placed among actors to influence their involvement and interests. These translating actors and other sets of actors that are part of the actor network are not finite. So, boundaries of the network as dynamic, actor should be added to the network to the extent that the problem is addressed [18]. At this level, it is not possible to define exactly the boundaries of any actor's network.

iii) Enrollment

Actor Network Theory is considered as a technology of description [7], where having actors, the most important thing is not what they can do, but how they can be connected to achieve some purposes. The enrollment answers the question of how to define and coordinate the roles of actors. To do this, it is necessary to analyze the activities involved to each actor. So it is important to mention the actors, their roles and activities. Note that the activities led by these actors must contribute to achieving the

goals of the actor network. The enrollment process also examines how relationships within the network are strengthened or weakened. These relationships between actors should be represented.

iv) Mobilization

The key process of the mobilization moment is to reduce the betrayal by other actors to ensure that the enrolled actors abide by the commitments made by their representative or either by themselves through the enrollment moment of translation [1, 5, 19]. Pedri and Alexander [16] also argue that the alliance can strengthen or weaken over time and that the strengthening of translation and alliances with a larger group of actors is mobilization.

B. Obligatory Point of Passage (OPP)

The OPP is centered around the primary actor [16, 19]. In this model, we assume that OPP is an actor(s) that can influence the other actors to participate in digital transformation and without them, interests of some actors may be included, activities involved to the network may not take place. The consequence is that the goals of the actor network will not be achieved. Paledi and Alexander [16] argue that OPP can change over time and when the network stabilizes.

C. Inscription

The notion of inscription is influence by: a consideration of previous patterns of technological usage, the role of users, the actors' actions which are influenced by the technological functions [11, 19]. Inscription includes identifying attributes to align actors' interest in order to stabilize the actor network.

V. A CASE STUDY AT A STATE UNIVERSITY IN CAMEROON

There are 11 public universities in Cameroon, which have more or less the same structure. Thus, the generic model of a university as seen in this study allows us to take into account the basic elements found in these universities. To this end, the following descriptions allow us to include all these state universities.

A. Problematization

In our case study, we provide the main actors that can be recruited to facilitate digital transformation in state universities in Cameroon, in order to assist them in scoping with the overcrowded students on campus in universities. For a given state university, the following actors have been identified: university, top management, student, teacher, technology, learning material, learning management system, m-learning policy, implementation plan, partner, academics center of technology of information, and we adapt this review of actors to construct the conceptual actor network by adding state as black box actor and parent as ordinary actor. All these actors have their roles, own interests and goals that they need to achieve. These goals are linked to activities they can perform. However, they may have obstacles that prevent them from achieving their goals. That's the reason why they need to coordinate their interests with other actors, and various solution will be sought.

B. Interessement

Interest encompasses the strategies by which the focal actor attempts to include others according to the entities and roles defined for them in the problematization. Some of these strategies in our case study can be described as follows:

- Raising awareness among students and teachers about the importance and benefits of digital transformation;
- Creating a platform where students have to download their courses with their mobile devices;
- Establishing a digital transformation policy and implementation plan in state universities;
- To find the availability of sufficient funds that can support the digital transformation initiative.

Conceptually, we can see that our network concerns all the actors inside or outside the state universities that can improve or involve learning and teaching practices. We can identify the following translating actors in a given state university in Cameroon: Dashboard, communication channel, computer science department, governance strategy, administrative document and agreement.

C. Enrollment

In our defined model, we have mentioned in Table I the actors, their roles and activities that can help us to build the digital transformation actor network of state universities. Note that the activities led by these actors must contribute to achieving the goals of the digital transformation actor network.

TABLE I: ACTOR RECRUITMENT AND ACTIVITIES

Actors	Activities
1. Top management (Board of Director, Senate, Rector, Vice-Rector, Head of Department)	• Define an appropriate strategy for implementing digital transformation. • Define the modality to implement an m-learning platform. • Define the session of retraining teachers in distance learning pedagogical approach. • Develop proposals for funding to support an m-learning research project. • Define m-learning policies. • Define guidelines for m-learning use and adoption.
2. Teacher	• Participate in the recycling of the distance learning approach. • Provide the content of their course in digital support as a video. • Explain m-learning to learners and increase their motivation.
3. Student	• Changing attitudes towards m-learning and understanding the principle of learner-centered approach.
4. Academic Center of Technology of Information	• Lay the groundwork for successfully enhancing learning with mobile technology. • Support key players in the implementation plan. • Ensure maintenance of student and teacher devices.

Actors	Activities
5. Technology (mobile devices and IT infrastructure)	• Availability and serviceability.
6. Learning materials (online course, pen, lab materials, etc.)	• Availability, useful and usable.
7. Learning Management System (LMS)	• Must support the exchange of information between learners and other learners, and between teachers and learners. • Availability of the platform. • Access to content.
8. M-learning policy	• Student and teacher reporting requirements.
9. Staff	• Improve the profitability of public services by leveraging mobile technology.
10. Partner	• Support research funding and sign agreement.
11. Parent	• Changing attitudes toward m-learning. • Creating an in-house digital workspace for mobile learners.
12. State	• Democratize access to the Internet. • Approval and recognition of certificates based on the pedagogical approach of mobile learning. • Install free public Wi-Fi. • Provide mobile devices to students and teachers.
13. Governance Strategy	• Provide guidance on how to operationalize and institutionalize mobile learning. • Determine the pay scale for teachers.
14. Implementation plan	• Provide guidance on how m-learning should be implemented.
15. University	• Acquisition of technological infrastructure. • Availability of funds. • Partnership with external parties.

The enrollment process also examines how weakened. These relationships between actors are relationships within the network are strengthened or shown in Table II below:

TABLE II: ALLIANCES AND ACTOR ROLES

Actor 1	Actor 2	Alliances/Relationships
Top Management (Source actor)	M-learning policy (Target actor)	Define digital transformation policies; Take actions to effectively apply these digital transformation policies.
Top management (Source actor)	Dashboard (Translator actor)	Consultation
Dashboard (Translator actor)	Learning Management System (Target actor)	Integrated into LMS
Teacher (Source)	LMS (Translator actor)	Sharing information
LMS (Translator)	Student (Target actor)	Sharing information
Top management (Source actor)	Technology (Target actor)	Ensure technology availability (Internet connection).
Teacher (Source actor)	Top management (Target actor)	Apply management decisions.

Actor 1	Actor 2	Alliances/Relationships
Top management (Source actor)	Computer Science Department (Translator actor)	Supervise m-learning research.
Computer Science Department (Translator)	Student (Target actor)	Valorization of m-learning research.
Teacher (Source actor)	LMS (Target actor)	Accessibility
Parent (Source actor)	Communication duct (Translator actor)	Get information about m-learning.
Communication duct (Translator actor)	University (Target actor)	Get information about m-learning.
Academics center of technology of information (Source actor)	Implementation plan (Translator actor)	Develop implementation plan.
Implementation plan (Translator actor)	Top management (Target actor)	Provide technological requirement.
Student (Source actor)	Learning Material (Translator actor)	Download content
Learning Material (Translator actor)	LMS (Target actor)	Accessibility
Technology (Translator actor)	Learning Material (Target actor)	Accessibility
Teacher (Source actor)	Student (Target actor)	Preparing mindsets and changing attitudes toward m-learning.
University (Source actor)	Governance strategy (Translator actor)	Approve and update governance strategies.
Governance strategy (Translator actor)	Partner (Target actor)	Provide credibility to obtain funding; Financial support; Collaborative research.
State (Source actor)	Governance strategy (Translator actor)	Take measures to evaluate the work of teachers in the new education system based on m-learning.
Governance strategy (Translator actor)	University (Target actor)	Increase institutional credibility of the university.
State (Source actor)	University (Translator actor)	Provide technology infrastructure.
University (Translator)	Student (Target actor)	Deploy Technologies (Mobile Devices).
State (Source actor)	Technology (Target actor)	Create free public wifi.
Parent (Source actor)	Student (Target actor)	Provide internet connectivity to mobile learners at home.

D. Mobilization

The research reveals two weaken relationships which are: relationship between parent, communication channel, university and top management, dashboard and LMS. The break of these alliances cannot negatively affect the achievement of mobile learning initiative goals. Top management, student,

teacher, m-learning policy, state, technology, partner, university, LMS, governance strategy, implementation plan, academics center of technology of information, and learning material are the large group of actors who have strengthen alliances among them. We can agree that in our case study mobilization occurs.

E. Obligatory Point of Passage (OPP)

Despite the fact that a state university is not autonomous and in practice human actors are those who pilot all strategies for improving the organizational process, the analysis of the existing procedures and processes of a given state university reveals that top management, technology, implementation plan and m-learning policy are the OPP of this actor network.

F. Inscription

The inscription includes the identification of attributes to align the interest of actors in order to stabilize the m-learning readiness assessment actor network. These attributes reflect the themes for

stabilizing the m-learning actor network. To find these themes, we were inspired by the UNESCO policy guidelines for mobile learning and literature review. After reading and analyzing the content of UNESCO policy, considering the context of learning system of a certain state university, we have mentioned the following inscription theme, which are not discussed in this paper. We can mention: updating the m-learning policy, regularly retraining teachers in teaching techniques using mobile technologies, optimizing educational content for use on mobile devices, ensuring gender equality for mobile students, awareness strategy, reward strategy, and ease of use of the application. Thus, we obtain the following network of actors of a public university in Cameroon, on which the digital transformation model presented above is based.

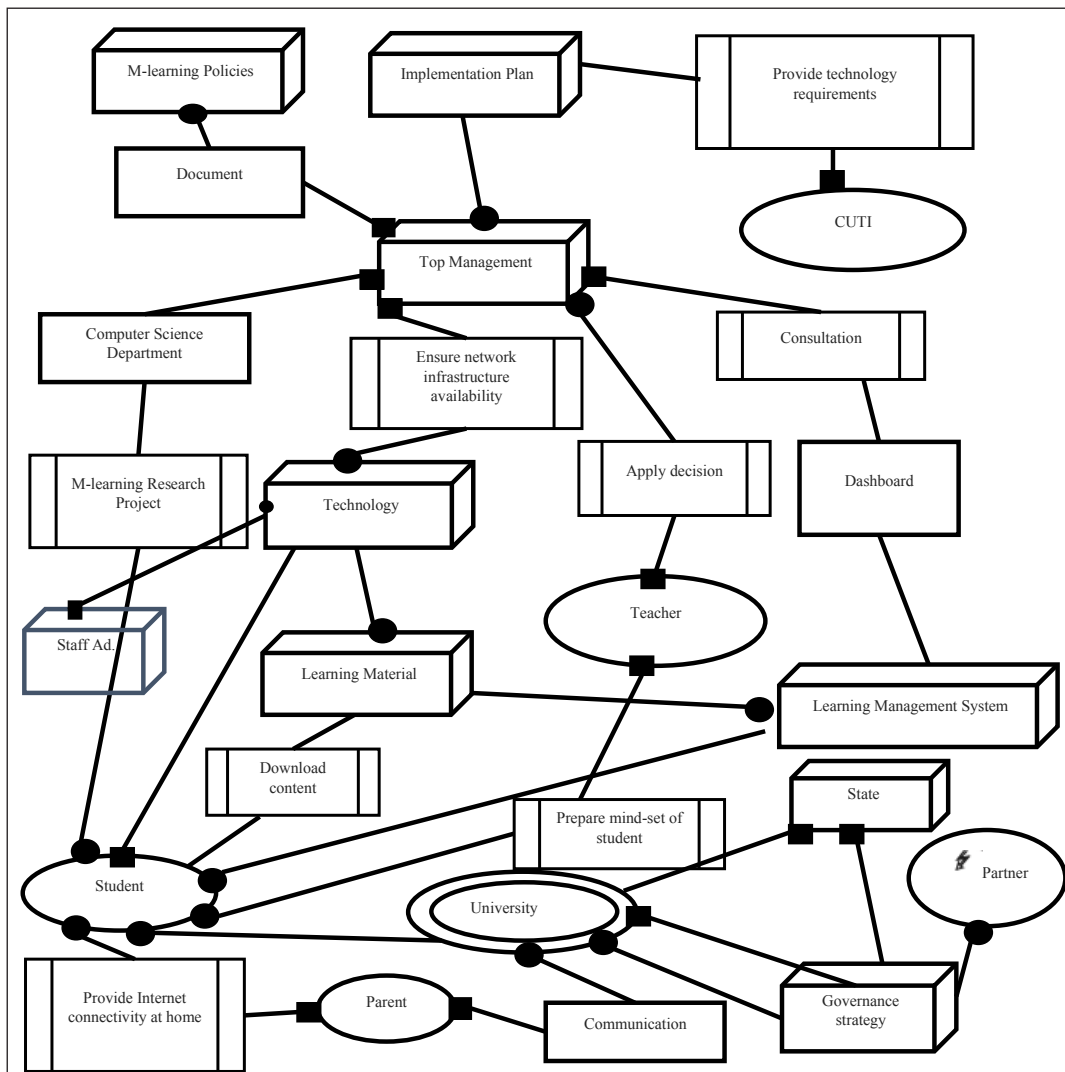


Fig. 5: Actor Network of a State University in Cameroon

VI. RESULTS AND DISCUSSIONS

This part will be divided into two main ideas. First, we will explain the choice of some types of actors and second, we will analyze the types of translation between actors to better understand how this network of actors can contribute to the digital transformation in state universities in Cameroon.

Learning material is a black box actor because it includes all materials used by students or lecturers in all faculties of a state university. State is also considered as a black box actor because it takes into consideration a lot of actors that directly influence decisions that can be applied in a given university and lifelong of students and teachers. This actor includes the following actors: ministry of higher education, social media, local government, community, etc. It's also important to add parents like an actor, because he must first be prepared to accept the fact that they can see their soon should be all the time in the home or in mobile learning environment space constructed by the state; this idea, which indicates that the context in which learning occurs is clearly an important factor.

Thus, this digital transformation model of state universities gives a conceptual view of the different actors that can influence the adoption of m-learning in a given state university in Cameroon. Its main objective is to show whether a state university is ready to adopt m-learning as a pedagogical approach.

Thus, in order to implement a digital transformation model in a given state university in Cameroon, the top management of this university should make an inventory of the existing technological equipment, the level of research enhancement in this area, to see what remains to be done and to seek help from partners.

Top management also develops funding proposals to support student-led m-learning research projects through the Department of Computer Science. In addition, top management convenes recycling sessions of m-learning for teachers through mobile devices. These training sessions will be most important for teachers other than those from IT department. At the end of this retraining, data record should be collected and analyzed to see

the percentage of teachers who can be m-learning ready. Another aspect in which top management can be a crucial actor in this network assessment is to revise the existing learning policies to implement m-learning policies, thence a strengthening relationship is established between top management and m-learning policies through administrative document. This revision of the existing legislative text contributes to the assessment of m-learning readiness of state universities. Further, Academic Center of Technology of Information of each state university should provide to top management the report watchfulness of technology; with this report he can know the real level for integration of mobile technology in the university compared to other university and there, these actors should share their interest, finally to know what remains to do. Moreover, top management makes sure that IT infrastructure is available and smooth.

Academic staff is also a black box. We choose academic staff as black box actor because due to the fact that it is composed of person who render a public service, friendship relationship can be created among them. So, we use a black box to simplify the diagram. LMS aggregates all those applications and software that ensure learning process in a state university. In addition, communication channel influence on student's perception and teacher's perception towards m-learning. Communication channel is view in this actor network like translating actor because it allows parents to align their interests in the network. This actor can be represented by social media, ministerial regulation, etc.

In this actor network we can also mention the presence of some ordinary actors like teacher and student. Teachers provide the content of their courses to students through LMS and students are supposed to download these courses through LMS. These relationships are strengthened in this network and these actors have common interests: to improve the process of learning and teaching.

VII. CONCLUSION

This study was focused on the definition of the digital transformation model to facilitate the adoption of

technologies in the teaching and learning process in state universities in Cameroon. Thus, to carry out this work, first, we have briefly reviewed three main theories commonly applied in m-learning; but we decide to work with ANT because this theory take into account the presence of human or non-human entity to analyze the problem encountered by the organization due to technological mutation. Also, it focuses more on the role that actor should assume to perfectly achieve the goals of digital transformation imposed in organization. While activity theory doesn't really manage the impact of technology in settlement process of problem of real worlds. UTAUT is most accentuated in the behavioral aspects of people in some organization towards technology. Using ANT, we have traveled all the stages of translation by showing how these steps could be theoretically applied. Furthermore, this paper presents the basis for an effective integration of m-learning in a given state university through the digital transformation actor network. This study shows that factors that can contribute to digital transformation are: organizational m-readiness, teacher m-readiness, student m-readiness, and society m-readiness. So, in the specific context of the state universities in Cameroon, many efforts have been done concerning organizational M-readiness, but the actions remain to lead on teacher namely: the new role of teacher (e-tutor, tutor at distance, etc.), supplementary hour and grid of salary. Moreover, the remuneration of e-tutor depends on the time spent on course preparation, interaction and feedback with students. Regarding students' readiness, although majority of students have a smartphone, their m-learning perception still needs to be analyzed. M-learning regulation and large campaign of m-learning awareness for students and teachers are also necessary. The proposed digital transformation model also reveals that a state university must wake up to find the real adequacy between digital ability of students and employment; to form students to documentary research and evaluation of the quality of contents. This paper also indicates that the organigram of organization is the tool that can help us to select actors that can have important role in actor network. This study also shows that an OPP

can be the focal actor. From an economic point of view, this research reduces expenses in the sense that the number of key actors that can receive funding for activities to be managed is known in advance and limited; it is not necessary to find an external mobile learning expert. However, this study doesn't study the enrollment phase of ANT in detail; this can be the perspectives of the future work.

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