

ACTOR-NETWORK THEORY TO DEPICT CONTEXT-SENSITIVE M-LEARNING READINESS IN HIGHER EDUCATION

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ABSTRACT

This study has taken a relatively unusual approach to assessing technology readiness within a higher educational institution by using Actor Network Theory (ANT) as a lens instead of the more common adoption models and indices. The study sets out to identify the key actors within an actor network and to describe how these actors are recruited during the problematisation stage of building the actor network. The actors were identified by means of the input from three groups participating in this study, namely the students, lecturers and non-academic staff members. The paper then goes on to explain how the actors influence one another to become and remain m-Learning ready. This influence is described in terms of attributes found as part of the inscription process. The construction and stabilization of the naturally dynamic actor network is intended to achieve a common goal, in this case, to use mobile learning effectively within South African higher educational institutions. The study contributes practically as an analytical process is demonstrated and that this could be used as a guide for future m-Learning readiness studies with the existing findings being used as a reference point. Once the actors are identified, their participation in the project and the extent to which they are aligned in terms of the attributes can be used to assess the readiness of the institution to use m-Learning. Theoretically, this paper provides evidence that sociological theories such as ANT can be used to complement traditional technology readiness, adoption and use models.

KEYWORDS

Mobile Learning, M-Learning, Actor Network Theory, ANT, e-Readiness, Higher Educational Institution, Context-Sensitive

1. INTRODUCTION

Mobile technologies are currently changing the way in which people source information, how they learn and even how they are entertained (Mochiko, 2013; Voigt & Matthee, 2012). Empirical studies provide evidence that most of the university students around the globe own at least one mobile device and that they are always in possession of those devices. This presents universities with opportunities to integrate those devices into their learning systems and introduce mobile learning (Ng'ambi & Lombe, 2012; Taleb & Sohrabi, 2012).

The term “*mobile-Learning*” (m-Learning) is not new but has been the topic of a long-standing discussion in developing and developed countries (Barker et al., 2005; Bhaskar & Govindarajulu, 2008; Jacob & Issac, 2008; Kekwaletswe, 2007; Liu, 2008). Several studies have been conducted, even recently, related to the adoption and use of m-Learning. Some adopted well-known technology acceptance models (UTAUT and TAM) to study various levels of education in Africa and abroad (Abu-Al-Aish & Love, 2013; Brown, 2005; Dankasa, 2014; Mac Callum & Jeffrey, 2013). However, there are a limited number of m-Learning readiness studies in the literature. Most of the existing studies based their arguments on the use of mobile devices for learning with higher educational institutions but did not investigate all the elements influencing m-Learning readiness. (Arif et al., 2013; Chen et al., 2012; Cheon et al., 2012; Choon-Keong et al., 2013; Mahat et al., 2012). These studies also

tend to follow a quantitative research approach and surveys are used to collect data for most of them. This implies that, to certain extent, their value might be limited as they neglect the aspects of cultural environment, reality of situations, social interaction and negotiations that could not only influence the study's outcomes but also the constructs under investigation (Neuman, 2014; Schulze, 2003). Hence, the complementary approach adopted here will add to their value. Recognising these limitations, this paper will explore how Actor-Network Theory (ANT) can be used in an inquiry into m-Learning readiness within one South African university (the full research project compares several universities but this is unnecessary here). ANT is used as a lens for empirical data collection and also as the framework used to analyse the collected data. The paper discusses m-Learning readiness in a developing country's context. As discussed in the literature, context plays an important role in the learning activity (Bhaskar & Govindarajulu., 2008) and it influences the nature of learning. Hence, the primary research question addressed in this paper, "*How should a context-sensitive m-Learning readiness actor network be developed?*" refers to the South African context. As a result, the findings of this study will be used to present a context-sensitive (South African context) m-Learning readiness actor network using a South African University as a case study.

This paper is laid out as follows: firstly, the literature review on m-Learning readiness studies and the theoretical framework, ANT, are presented, followed by a description of the research methodology applied. Following this the results are given and a discussion of findings and the presentation of a context sensitive m-Learning readiness actor network concludes the paper.

2. LITERATURE REVIEW

2.1. M-Learning Readiness Studies

As outlined in the previous section, there are few m-Learning readiness studies specifically in the higher educational context. A discussion of those found follows. Hamat et al. (2012) assess m-Learning readiness at Universiti Kebangsaan Malaysia (UKM). This study focuses on the functions and services that UKM lecturers believe they need for successful implementation of m-Learning within the university. The UKM staff view m-Learning favourably, but despite this there are challenges that need to be addressed. A lack of m-Learning benefit awareness and the low level of mobile device ownership among academics are noted as being challenges that UKM needs to prioritise resolving in order to become m-Learning ready. m-Learning is more than using mobile devices for e-learning; it requires a completely different mind-set in education and Hamat et al. (2012) did not manage to apply this view to this study. Despite the fact that the Hamat et al. (2012) study was titled mobile learning readiness among UKM lecturers, the actual m-Learning readiness assessment within the university was not discussed.

A further m-Learning readiness study was conducted at the University of Jordan (Ibrahim & Hamdi, 2012). This study claims to understand the degree of readiness of the student to accept mobile learning as well as the degree of readiness of the students to cope with future challenges arising from the application of mobile learning. The study used three levels of rating, (that is, High, Medium, and Low) to evaluate learners' intentions to engage in certain mobile learning activities. It indicated that the learners were most ready to use mobile learning to read e-books and to listen to recorded lectures, while the acceptance of the idea of learning anytime, anywhere was the lowest. This implies that students might accept m-Learning but its usage in the educational field to learn anytime anywhere is still questionable. Even though the overall degree of students' readiness to engage in m-Learning activities was rated medium in this study (Ibrahim & Hamdi, 2012), there is evidence that there are some activities that learners still fear to engage with in the m-Learning environment.

As the study does not outline factors to be addressed to make students entirely ready to accept m-Learning, it can be concluded that a true reflection of the University of Jordan students' readiness towards m-Learning is not completely achieved in this study.

Almutairy et al. (2014) investigated the readiness of Saudi Arabian students to use m-Learning. In their study (Almutairy et al., 2014) students' m-Learning readiness is investigated by looking at the students' mobile device habits and their daily activities on their handheld devices. Even though this study revealed that Saudi Arabian students are ready to use m-Learning, the gap identified is that investigations were only based on the students' daily activities and did not consider infrastructural and organisational issues such as, the cost of engaging in m-Learning, the availability of content for the mobile devices, and the accessibility of information through mobile devices. Furthermore, although the study was titled the readiness of applying m-Learning among Saudi Arabian students in higher education, the study was conducted in the United Kingdom. It can be argued that the views presented by the participants of this study are not necessarily the views of students at higher education in Saudi Arabia hence the m-Learning readiness of Saudi Arabians is still not clear.

The examples of readiness studies discussed here provide evidence that there is still a gap in understanding what is required and which actors must be involved in order for the university to be m-Learning ready. As argued in the literature, the key determinant to technological innovation acceptance is readiness (Hamat et al., 2012; Mahat et al., 2012). Therefore, this paper describes an analytical process that could be used as a guide for future m-Learning readiness studies within higher educational institutions. The study evidenced the use of ANT to understand m-Learning readiness. The following section presents the review of literature relating to ANT.

2.2. Actor Network Theory

This paper adopts ANT as an underpinning theoretical framework. The philosophy of ANT is based on "generalised symmetry", that is, human and non-human actors (also known as actants) are treated equally with no distinctions between them (Figueiredo, 2008; Iyamu, 2013). Hence, ANT creates a heterogeneous network of aligned interest; that is, it identifies relationships that are simultaneously material (among things) and semiotic (among concepts). ANT aims to rebuild social theory by focussing on these networks and relations (Latour, 1996). The insight emphasised by ANT is that technology is not determined by society nor vice-versa, however, both appear as partners through the construction process of artefacts, facts, and relevant social groups (Elbanna, 2009).

Tatnall and Burgess (2002) define an actor as an object or entity whose presence or absence can be felt independently by other actors. An actor is also defined as any element which makes other elements dependent upon it and translates their will into the language of its own interests (Páscoa & Tribolet, 2014). This translation is very important as it allows the actors to identify common interests and mutual benefit in their relationships (Silvis & Alexander, 2014). Simply, a network in ANT can be seen as an association of heterogeneous elements (actors) (Tatnall, 2009). The network remains dynamic and ever changing as the resources, interests and viewpoints of the actors are continuously changing and as a result their relationships strengthen or weaken within the network.

M-Learning readiness cannot depend solely on the interests of the human elements but needs to include the readiness (characteristics and availability) of non-human elements as well. Hence the m-Learning readiness phenomenon depends on a fairly complex network of inter-connected actors and requires a comprehensive approach to research. In a substantial proportion of research, human and technical participants are separated into two disconnected 'camps' with the assumption that one energizes and has uni-directional control over the other (Law, 1992). This assumption regarding the human and the technical is considered by those

taking a non-deterministic view to misrepresent the objective or analysis of the study (Cresswell et al., 2010). ANT does not accept any form of separation between the participants, it emphasise that human and non-human actors should be analysed in the same way. This gives ANT an advantage over other social theories, such as Activity Theory where tools and rules are seen as separate from the human subjects, as it allows the inclusion of many actors that might otherwise have been left out, forgotten or undervalued when investigating the phenomena (Elbanna, 2009). ANT allows actors to establish a negotiation space in which to build relatively stable networks of sociotechnical entities (Law, 1992). It allows the actors (human and non-human) to negotiate their roles in the network. It discards a priori perceptions about either social or technical actors through its principle of free association (Callon, 1984). This principle is valuable in Information Systems (IS) studies, more specifically where the phenomena or levels of analysis vary (different actors in the same network may be individuals, groups, organisations, policies, devices) as is the situation for m-Learning.

In other words, m-Learning is viewed in this paper as a socio-technical network that incorporates various actors in a heterogeneous network. Therefore, it is important to use a theory that does not impose an a priori philosophical point of view on actors as this assists the researcher to remain open to the idea that the relationships between actors are of paramount importance, and that it is relatively unimportant whether any particular actor is a person or a thing. This assisted the researcher to understand actors influencing m-Learning readiness within the South African University.

2.3. Concepts of ANT

In this study, three ANT concepts were adopted, that is, Problematisation, Obligatory Passage Point (OPP), and Inscription (see Figure 1). Figure 1 depicts this paper's research model.

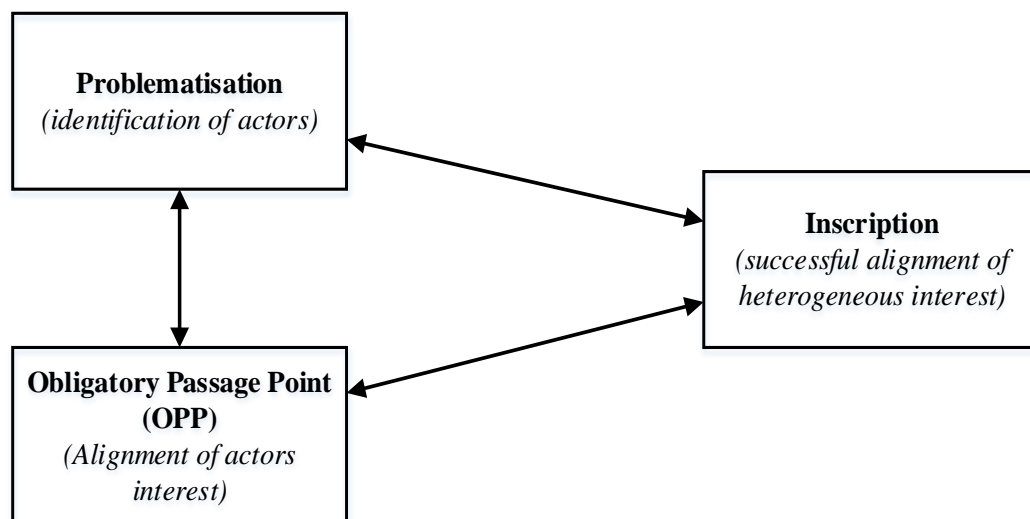


Figure 1: Research Model

The following section discusses these ANT concepts (problematisation is discussed as as part of the translation process).

2.3.1. Translation

Translation is the process of identifying and aligning various actors' interests to the interests of the principal actor or of other, less influential, actors. Translation can also be viewed as the process of creating an actor-network (Páscoa & Tribolet, 2014). It is the process that actors engaged in to understand and adapt to the behaviour of other actors and explains how they

relate with each other (Callon, 1984). Translation is composed of four moments, that is, problematisation, interessement, enrolment and mobilisation (Gunawong & Gao, 2010; Iyamu & Sekgweleo, 2013; Miettinen, 1999). This paper is limited to the problematisation moment because e-Readiness is preliminary (it precedes the operationalisation of m-Learning). Therefore, other three moments of translation (interessement, enrolment and mobilisation) are not discussed in this paper.

Problematisation is the process where the principal actor defines its interest and then recognise the identities and interest of other actors that are or could become aligned or are consistent with its own interest (Rhodes, 2009). This process renders the principal actor indispensable in the network as it defines the problem and motivates other actors to accept the proposal of the network (Gunawong & Gao, 2010). In short, problematisation defines a system of agreements, or associations, among actors, thus defining their identities and what they want (Callon, 1984). The problematisation process includes the identification and recruitment of actors, which is the process of bringing the most relevant actors to the network (Cresswell et al., 2010). During this process, some of the actors may remain in the network, others might be silent actors, other actors may be frozen (black boxed), while yet others might totally fall out of the network. At any stage the actors might have individual goals and objectives that they need to reach by themselves. However, there might be obstacles that these actors experience and that make their journey of realising their goals difficult. Therefore, they need to align their interests with other actors and diverse solutions will be sought (Avgerou & McGrath, 2007). As a result, some actors may decide not to be part of the network system while new actors can also emerge in this process (Gunawong & Gao, 2010). Hence the outcomes of problematisation are not clear cut (Callon, 1984; Gunawong & Gao, 2010). Problematisation allows a researcher to follow how various actors become involved in constructing the phenomena (Broer et al., 2010).

2.3.2. *Obligatory Passage Point (OPP)*

Obligatory passage point (OPP) has been defined as a process in which all the actors engaged within the network satisfy the interest recognised in them by the principal actor in order to render themselves indispensable to the network (Callon, 1984; Iyamu et al., 2014; Tsohou et al., 2012). As a result, OPP paves the way for the actors to align their interest with other actors' interests and to remain part of the network. OPP is centred around the principal actor (Blomme, 2012). Therefore, it is the responsibility of the principal actor to convince the actors to pass through the OPP (Sarker et al., 2006). As noted by Rhodes (2009), OPP must emerge or be recognised for all actors to achieve their interests as proposed by the principal actor whenever a change in a network is realised. As discussed by Iyamu (2013), the human or non-human actor that is regarded as an OPP actor within the network has "power", and the more this actor successfully aligns the interest of other actors within the network, the more powerful the OPP actor becomes. This implies that without this actor's presence in the network, the network will be unstable and other actors' interests will be compromised. Therefore, in this study, OPP is seen as an actor (s) that could influence the other actors to participate in m-Learning. This actor must establish itself to be indispensable to the extent that its absence is recognised.

2.3.3. *Inscription*

When the network is stable, inscription materialises (Callon, 1984; Latour, 1996; Sarker et al., 2006). This is the process where innovators inscribe their ideas, knowledge, beliefs and values to design and implement new artefacts in order to protect the actors' interests. This implies that artefacts should not be constructed blindly but must be in line with the ideas, knowledge, beliefs and assumptions of the innovators (Faraj et al., 2004). Successful

inscription can, therefore, be seen as the result of the successful alignment of heterogeneous interest (Chen et al., 2009). This notion of inscription is recently being applied in information systems studies, where it is argued that some of the aspects that influence inscription are a consideration of previous patterns of technological usage, the role of users, and the actors actions which are influenced by the technological functions (Faraj et al., 2004; Elbanna, 2009; Eze et al., 2014). For example, the actors might compile new policies or design new m-Learning content. This process is often subjected to and may inherit aspects of previous technological usage patterns, organisational beliefs and expectations over functionalities of the technology. Therefore, in this study, inscription is seen as a way of evaluating the strength of the relationships between the actors.

3. RESEARCH METHODOLOGY

3.1. Scope

In this study inscription is looking forward to the later adoption and use of m-Learning. It involves the planning and preparation for that later operationalisation. The ANT notion of problematisation allows the researchers to trace and explain actors influencing m-Learning readiness, their relative importance and their relationships. As noted earlier, this paper is limited to the problematisation moment because e-Readiness is preliminary.

3.2. Methodology

This study follows a qualitative research approach. As the aim of this study is to understand m-Learning readiness actors within a South African University, it is important to employ research methods and techniques that examine m-Learning readiness from the points of view of the many participants (students, lecturers, and non-academic staff members) taking into consideration their social and institutional context. Qualitative research is concerned with understanding the meaning of real-life events rather than the timing or frequency of occurrence of the events (Yin, 2009). It is also important to note that the informants and participants of this study describe issues that might be related to human or non-human actors.

3.3. Study Participants

As this paper's objective was to understand a variety of actors influencing m-Learning readiness within a South African University, data needed to be collected from within the natural setting and from participants who are considered to be knowledgeable about the subject. Since some potential informants are likely to have a richer understanding of the phenomenon than others, they are likely to provide more useful insights. Therefore, the selection of participants randomly would not be appropriate in this study (Marshall, 1996). As a result, the primary researcher used personal judgement to select participants that appear best able to address the research question and also to meet the objectives of the study (Saunders et al., 2009). The researcher selected participants that are seen as having the needed insight and are prepared to share the information. Hence, the participants of this study were selected from the directorate of teaching and learning with technology, students and lecturers from a department related to teaching ICT at the South African University.

3.4. Data Collection

In this paper semi-structured interviews and questionnaires with open-ended questions were used to collect the primary data from the lecturers, non-academic staff members, and from the students. A total of eight staff members (three lecturers and five non-academic staff members) were interviewed and sixteen completed questionnaires were collected from the students within the South African University. Since this the interpretivist research paradigm is used these numbers are considered to be sufficient. The questionnaires were given to the

lecturers for distribution to the students after their classes. The lecturers notified the researcher after all the questionnaires were collected from the students. The objective in deploying these methods was to collect data in the natural settings in which m-Learning takes place as that assists the researcher to gain a deep understanding of opinions as to what constitutes m-Learning readiness within the selected higher educational institution.

3.5. Data Analysis

Qualitative data is largely textual. Therefore, the analysis of such data includes organising, accounting for and explaining the data to understand and make sense of data in accordance with participants' definitions of a situation, noting patterns, themes, categories and regularities (Cohen et al., 2007; p. 461). The process of qualitative data analysis also comprises of the summarisation, classification and interpretation of data (Lillis, 1999). As discussed by Bhattacharjee (2012), qualitative data analysis requires an inventive and analytical mind-set, an ethically enlightened and participant-in-context attitude, along with the set of analytic strategies. This study adopted an inductive data analysis technique. Thomas (2003) defines this as a systematic technique where the analysis is defined by a particular objective. The use of the inductive approach in this study attempts to minimise the criticism that qualitative data analysis usually faces regarding authenticity and increases the validity of this study's findings. As noted in the literature, the use of a systematic analytical technique enhances confidence in the results of the data analysis (Lillis, 1999). According to Thomas (2003) the primary purpose of the inductive approach is to permit research findings to materialise from the frequent, dominant or significant themes inherent in the raw data, without the limitations that might be imposed by other structured methodologies. The outcome of an inductive analysis approach is the development of a model or framework that summarises the categories embedded within the raw data and presents key themes and processes (Thomas, 2003).

4. RESULTS

As this study employed ANT as the lens, the presentation of its results will be categorised according to the ANT concepts adopted (see Figure 1), that is, Problematization, Obligatory Passage Point (OPP) and Inscription. Following is the discussion of this study's results.

4.1. Problematization

Even though some pre-determined actors were identified from an earlier literature review (Paledi & Alexander, 2017), the researchers allowed the data to confirm whether the pre-determined actors were part of the network and also to identify new actors that emerged from the data. The questionnaires collected from the students and the staff interviews assisted in identifying both internal and external actors who may contribute to the success of m-Learning. All three participating groups identified actors. A discussion of the m-Learning actors and their relationships from each of the three groups of research participants' perspectives follows.

4.1.1. Students' Perspective

The responses show that the university (institution and principal actor) needs to understand its context and its students as this will assist it in determining what it requires to engage in m-Learning. This encompasses the development of a detailed plan on how m-Learning can be implemented. As part of this process, the institution may appoint a Chief Information Officer (CIO), Project Management Team, ICT technical staff or a University Executive team (Vice-Chancellors and relevant authorities), Heads of Departments (HODs) as its representative.

“...thorough analysis is the most important stage, this enables the university to understand its context and the level at which m-Learning adoption should be pitched...all members of the university community should be involved: The Deputy Vice Chancellors, Deans, HOD’s, ICT Director and Support staff, lecturers and students” (P9). “...the first stage can be the initiation stage where the brainstorming and establishing the context is done. It’s imperative to understand what needs to be taken into account... understanding the scope...Developing a detail plan on how m-Learning will be implemented. All the activities resources, tools will be identified and documented in this phase...The CIO, Project Management Team, ICT technical staff and the University Executive team (Vice-Chancellors and relevant authorities) must be involved...” (P13)

From the analysis of the students’ questionnaires, actors such as mobile devices and infrastructure are considered to be embedded within the university actor. However, these are the key actors from the students’ perspective as they indicated that there is a need for Wi-Fi campus wide (infrastructure) and due to their various backgrounds, it is important for the university to provide them with devices as this will confirm their participation in m-Learning.

“...the university needs to provide electronic devices to learners in order to participate on m-Learning” (P17). “...management must provide devices to students that enrol in the institution, this will afford to offer everyone to experience or use the m-Learning regardless of their background” (P18). “...Just as the institution has to provide for internet and computing services, there should be facilities in place for m-Learning like tables and campus wide Wi-Fi” (P19).

The participants’ responses are evidence of a strong relationship between the university and the infrastructure as well as between the university and the devices. According to the participants it is the responsibility of the university to make the devices and the infrastructure available to the students. The participants further indicated that the university should provide guidance by making rules and regulation available on how to use and monitor m-Learning.

“The things that need to be in place is the rules and regulation of how the m-Learning is supposed to be used and monitored...” (P22)

This statement also provides evidence of a strong relationship between the university and m-Learning policies (rules and regulation). The other relationship noted is the relationship between the university, ICT Department and students. The ICT Department should be responsible for collecting and specifying system requirements. The participants’ highlighted that m-Learning should benefit the students (the interest of the student Actor was clearly identified). Therefore, the ICT Department should involve them at every stage of system implementation in order for the students’ interest to be made visible (translated) so that other actors are aware of it. The ICT Department together with the university should develop a detailed plan on how to implement m-Learning.

Depicted in Table 1 are the actors and their relationships from students’ perspective.

Table 1: Actors' Relations – Students' perspective

Actor 1	Relation	Actor 2	Supporting cases
University	Provide	Infrastructure	P19, P23
University	Provide	Devices	P17, P18
University	Set up	m-Learning Policies (Rules and Regulations)	P22
Learning Material	Understanding	Students	P15
University	Availability	Learning Material	P15
Students	Effective communication	Lecturers	P15, P23
ICT Department	Involve	Students, Lecturers	P16, P21, P23
ICT Department	Develop	Implementation plan	P19
Lecturers	Appointment	Students assistance	P11

Figure 2 depicts the actors' relations as noted from students' responses which were used as the supporting cases. Using the ATLAS.ti software, the researcher visualised the actors' relations for better presentation. During this exercise, the researcher categorised actors such as CIO, Project Management Team, HODs and other similar actors as Top management. These actors are the representatives of the university actor (see P9, P13). Figure 2 presents the actors and their relationships as identified by the students.

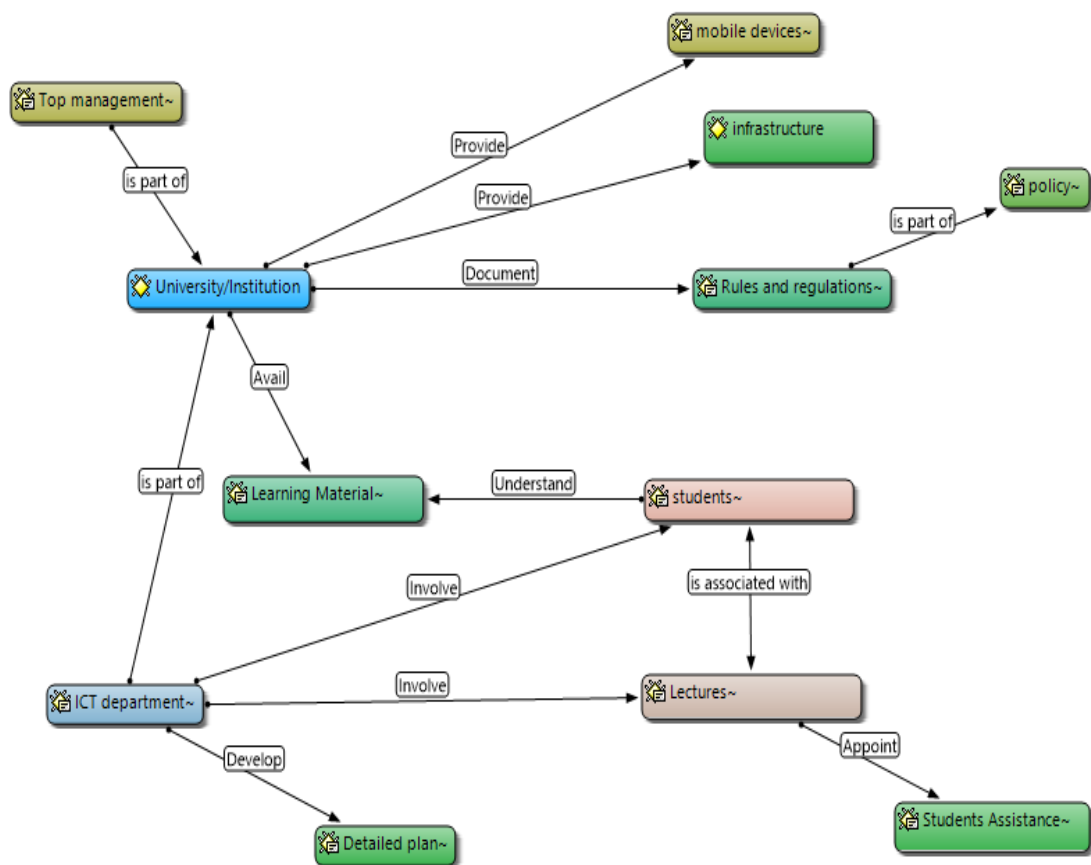


Figure 2: Actors relationships - students' perspective

4.1.2. Lecturers' Perspective

The lecturers' responses give evidence of strong relationships between them and other actors within the network. The first relationship that was noted was between the lecturers and the students. Lecturers must actively prepare the students and try to improve their attitude towards (and encourage them to participate in) m-Learning. Hence there is evidence that lecturers recruit students into the actor network.

“Prepare the mid-set of students for this innovation, you know as a lecturers, we have the responsibility to try and encourage students and make them think beyond what they see” (P3). “All we as lecturers what we can do is to encourage them (Students) and present the course work as best as we can for them” (P2). “...we need to change their mind-set, and we need to change their attitude towards m-Learning” (P1).

A further relationship was noted between the lecturers and top management. Lecturers could also initiate m-Learning discussions within their departmental or faculty. Hence there is evidence that lecturers may recruit management into the actor network or may reinforce the ongoing commitment to active participation of management to the project. Ongoing commitment is essential for sustainability and this also recognises that relationships change over time as when top management members leave.

“Remember from the academic point of view, we have staff meetings, we have departmental boards, and we have faculty boards, so in this kind of meetings I think staff can initiate that” (P1).

The third relationship noted was between the university and the infrastructure. Similar to the students' responses, the lecturers indicated that the university should provide internet infrastructure across all the campuses. Here there is evidence that there is an indirect relationship between the actors. That is, lecturers are commenting on the importance of an actor that they are not in a direct relationship with. Hence there is evidence that actors may influence the relationships of the others indirectly. Lecturers in this case may report issues that they observe in concerning infrastructure to the actor that does control it.

“In the university like this one, we have Wi-Fi (Tshwane Wi-Fi), we have university Wi-Fi sometimes it works, and sometime it doesn't work, so from the resources point of view we need a way to create a bandwidth availability, especially for the learners given their background as most are coming from poor backgrounds” (P1). “We have network problems especially in this campus...I can give you example, every time my 1st years going to write a web test, they usually complain that network is slow, the system is kicking me out due to network, or I get timeout because the question are not reflecting as fast as the time we are allocated” (P2). “Actually going Wi-Fi is even going a step higher, internet itself, we don't even have internet in our labs. Students are struggling with the internet connection. We as lecturers, we are still struggling with internet connection within our office buildings” (P3).

There was also a relationship between lecturers and university. In order to successfully implement m-Learning, the university should provide training to lecturers and students. The university should inform new lecturers and students about technologies uses for learning within the university. Training is evidence of a translation of the view of the university to practical experience of lecturers. Hence training could be seen as a translating actor as it exists separately from management and lecturers but helps them to cooperate.

“Training needs to be provided for lecturers to ensure that the services and the innovation itself works effectively... also involving students by providing them training” (P3). “From the students’ point of view or lecturers, let’s say a new lecturer is coming here when we do orientation we need to make them conscious of some of the technologies that are available, and for the students as well in their first year, we need to make them conscious that we can utilise m-Learning” (P1). “1st year students, because they are new, they don’t really understand, like how university works because they just finished high school” (P2).

A further relationship was noted between the policy office and the lecturers. According to the responses, the policy office could not be able to compile an m-Learning policy without understanding what is required for m-Learning. They have indicated that in order for the policy office to understand m-Learning they should involve lecturers in their processes. Hence there is evidence that policy office may recruit lecturers to the network as the translating actor to align their interest with the policy actor (the interest of the lecturers’ actor are clearly expressed to other actors).

“...the policy office as well, can play a role. Remember the policy office just focus on the policy and sometimes it might not know what really is burning at the lower level. I don’t think they will start a policy in m-Learning without really understanding what is required” (P1).

Lastly, there is a relationship between top management and the university. The responses provide evidence that top management should familiarise themselves with the processes and the guidelines of the university. Clearly top management should align their interests with the interest of the university. As the interest of the university regarding m-Learning should be clearly articulated in the policies and processes, top management recruit the policies actor into the m-Learning network as a translating actor to strengthen the ongoing commitment of management to that network.

“First, it has to start at the strategic level, management needs to make provision that this kind of service is offered within the university, but with the same breath, they need to look at the processes and the guidelines of the institution” (P3).

Table 2 summaries the relationships amongst the actors from the lecturers’ perspective.

Table 2: Actors’ Relationships – Lecturers’ perspective

Actor 1	Relationship	Actor 2	Supporting cases
Lecturers	Prepare	Students	P1, P2, P3
Lecturers	Initiate	Top Management	P1, P3
University	Avail	Infrastructure	P1, P2, P3
University	Train	Lecturers and Students	P3
University	Orientate	Students and Students	P1, P2
Policy Office	Involve	Lecturers	P1
Top Management	Familiarise	Policies and guideline	P1, P3
Top Management	Support	University	P1, P3

Figure 3 gives an overview of the actors’ relationships from the lecturers’ perspectives.

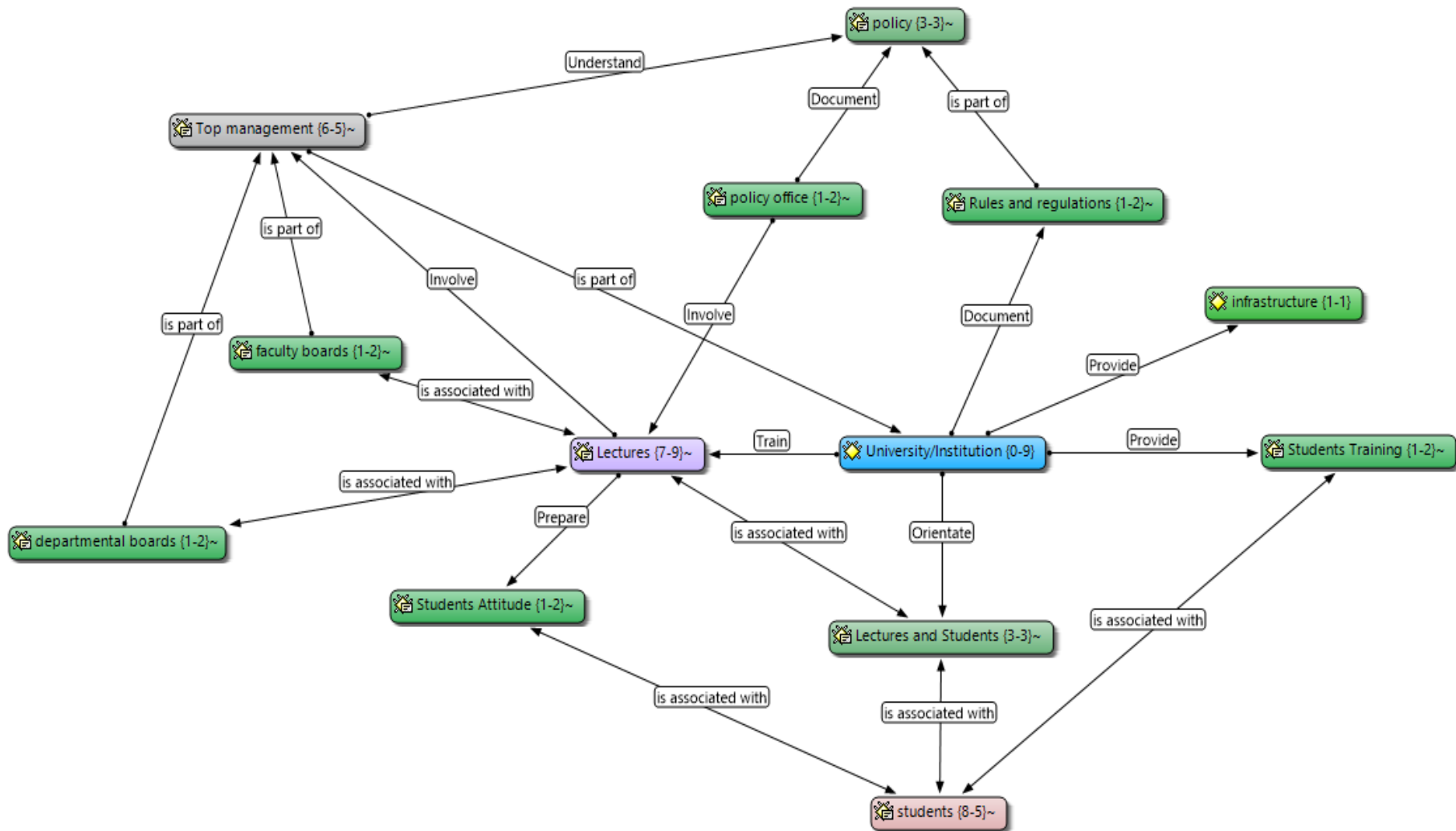


Figure 3: Actors’ relationships – Lecturers’ perspective

4.1.3. Non-Academic Staff Members' Perspective

The empirical data collected from non-academic staff members introduced additional actors such as governance strategy, marketers and instructional designers into the network. The non-academic staff highlighted some strong relationships amongst the identified actors. For the purpose of this paper, when analysing the non-academic staff members' input only the actors' relationships and their significance in terms of ANT will be noted for the following discussions. Example of quotations as provided above and as well as in previous discussions will be dropped to limit the length of this paper. However, at some instances, quotations will be indicated to emphasise the relation.

The participants argued that the university must approve the governance strategy document because, without the governance strategy, there will not be any funds made available for m-Learning. Therefore, it is critical to obtain such approval. Here there is evidence that top management (EMC) needs to be recruited to the network as a translating actor to align the views of the university and those of the governance strategy actor. Furthermore, there is evidence that there is indirect relationship between the top management actor and university actor. Due to the fact that EMC actor together with other actors such as lecturers, must come together and align their interest on how m-Learning could be approached and come up with the governance strategy. Therefore, the governance strategy actor can be seen the candidate actor for OPP. There is evidence that this actor should basically assist in managing various phases, people and departments to ascertain the success of m-Learning.

“First of all, before we start with technology, there should be a governance strategy, where both EMC (Electronic Management Committee) as well as the lecturers and the academic component actually come together and agree upon how this will be executed. Because, if there is no agreement, it is not going to be funded. So without funds we are not going to have technology, then is just an idea.” (P4)

The relationship between the infrastructure actor and the university actor was also emphasised. (All the participants groups emphasised the importance of the infrastructure actor within the network.) Hence there is evidence that the infrastructure actor can be seen as a candidate actor for OPP. There is evidence that without a proper infrastructure m-Learning will not be successful.

“I really believe that there should be an accessible hotspot everywhere every classroom, in the libraries wherever, where students can access their learning material and that should be based on free data...but as a service provider for our students, I need to come with something and I believe our role should be Wi-Fi network that is covered to ensure that students have access” (P4). “I think what needs to be improved is the issue of the network” (P6).

There is a strong relationship between the learning material actor and the Learning Management System (LMS) actor. Both the learning material and LMS need to be recruited into the network by the university actor. The evidence illustrates the dynamic nature of the relationships between content and devices (current and future technology). Over time, the design of the learning material must remain compatible with the current platform in which it is administered and accessed by the students and the lecturers.

“...the content needs to be available, because in order to design content for access on to the device it takes longer than putting down the technology. If we put down the

technology first it might be outdated by the time the content is designed. Then the content needs to be available because content and the way is designed for online learning is not the same as what is available on the small little screen of yours... But always when they design they need to take in cognisance fact that they will be access on other devices” (P4).

The university must also market the m-Learning to the lecturers and students. Hence there is a need for the university to recruit m-Learning experts (a translating actor) to the network to showcase m-Learning to the lecturers.

Some of the participants indicated that the university should develop a context-based business case documenting the requirements for m-Learning. A proper needs analysis is needed to investigate the type of devices, the platforms, and how it can be ensured that every student and lecturer has access to appropriate devices. Hence there is evidence that the university actors must recruit a business case as a translating actor to align the interests of the university actor to the interest of other actors in the network.

“Once you have that, is developing the business cases for each and every environment. Technical needs to understand what is expected, the guys developing the content needs to understand, registration needs to understand because they will be another delivery method. Students needs to understand that I need to have my own device, is the requirement before enrolling for that course to have that” (P4). “When you get to m-Learning, which means we are going to have or take the information into a mobile device, which means that the proper needs analysis needs to be performed to determine that are we ready as an institution to use mobile, in terms of what type of mobile device are we going to use, Tablets or what other devices can be used that are defined as mobile” (P5). “We need to come up with a document, a model that will direct us that this is how it should happen. At moment in this institution we don’t have that model” (P7).

The other relationship identified was between the university actor and the instructional designer actor. Here the introduction of training is also evidence of a translation of the view of the university to the practical experience of instructional designers.

Depicted in Table 3 are the relationships amongst the actors from the non-academic staff perspective.

Table 3: Actors' Relationships - Non-academic staff’s perspective

Actor 1	Relationship	Actor 2	Supporting cases
University	approve	Governance Strategy	P4
Governance Strategy	Avail	Funding	P4
University	Provide	Infrastructure	P4, P6
University	Document	Business Cases	P4, P5, P7
University	Empower	Lecturers and Students	P4, P6
Learning Material	Compatible	Learning Management System (LMS)	P4, P5
University	Provide	Data	P4
University	Market	LMS	P4
M-Learning Expects	Understand	LMS	P7
Lecturers	Design for	LMS	P6
University	train	Instructional Designers	P5

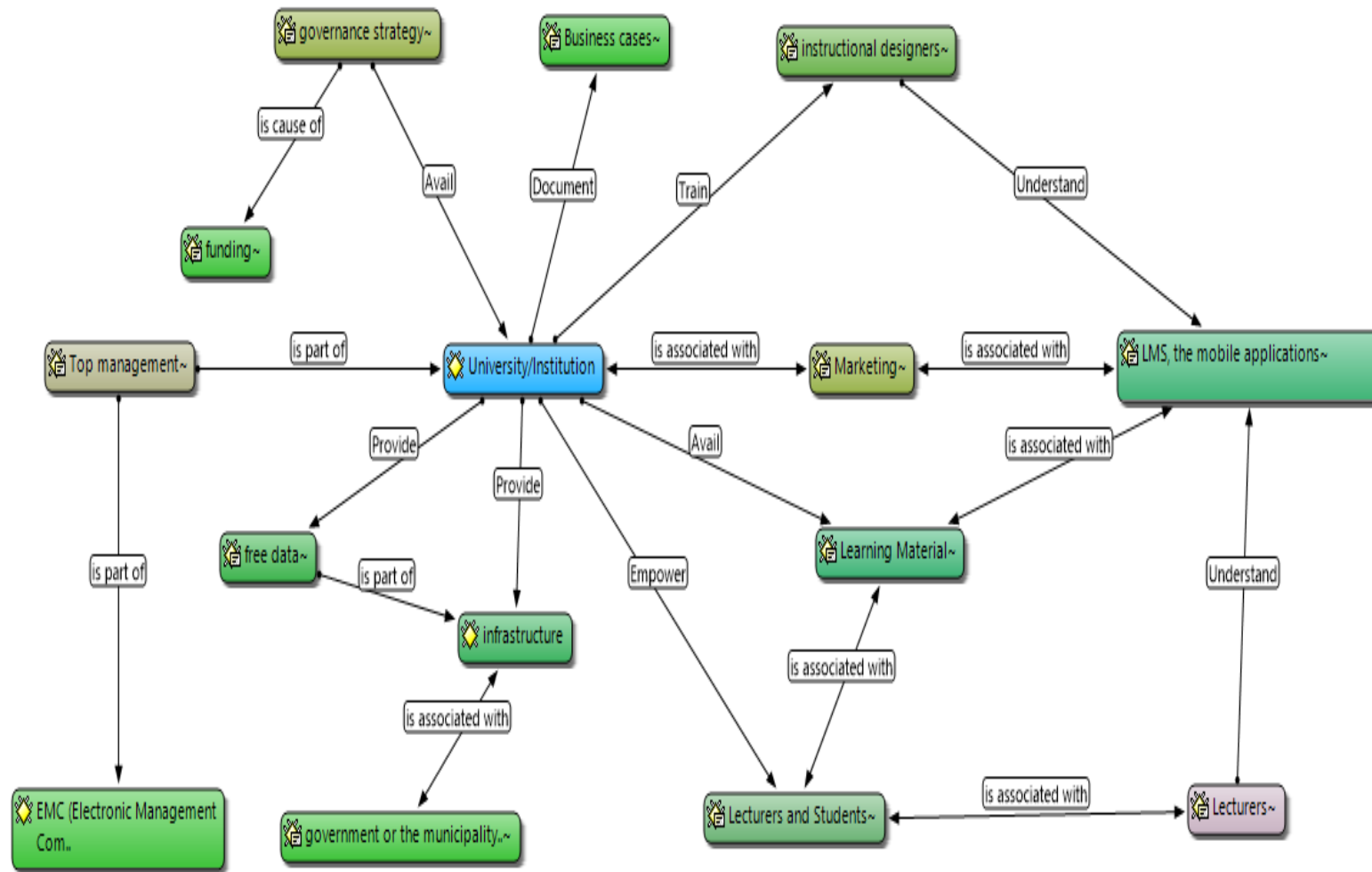


Figure 4. Actors’ relationships - non-academic staff’s perspective

Depicted in Figure 4 is the visualised actors' relationships from non-academic staff members' perspective.

In the preceding sections we explained how actors were recruited to the network. We also explained how the relationships between the actors were recognised and negotiated by other actors. In the following section the data is analysed to show the obligatory passage point (OPP).

4.2. Obligatory Passage Point (OPP)

As discussed in Section 2.3.2, the discussion of ANT concepts in the literature review, the establishment of an OPP was highlighted as an important aspect of the ANT. OPP is seen as the situation that has to occur among the actors to satisfy the interests that have already been allocated to them by the principal actor (Tsohou et al., 2012). In this study, there is evidence that the OPP can change over time as and when the network stabilises. For example, in the initiation stage of the m-Learning project, as discussed in Section 4.1.3, there should be a governance strategy where the actors agree upon how m-Learning will be executed. Therefore, the approval of the governance strategy by the University will be the Obligatory Passage Point (OPP) of the network at this stage. *"One thing that needs to be done is getting your governance strategy approved that is step 1."* (P4). Therefore, when the actors' align themselves to OPP Actor at this stage, to certain extend the interest of the principal actor will be clearly voiced to them which prepares them to respond appropriately. For example: *"Technical needs to understand what is expected. The guys developing the content needs to understand, registration needs to understand because they will be another delivery method. Students need to understand that I need to have my own device as is the requirement before enrolling for that course to have that"* (P4).

The second OPP that was proposed in this study is the infrastructure. There is evidence that without a proper infrastructure m-Learning will not be successful. The infrastructure must be available, maintained and accessible. Therefore, for students or lecturers to partake in m-Learning, there should be uninterrupted network connectivity on and off the campus. There was even the proposal to recruit a government or municipalities actor, to assist with internet connectivity when students are off campus as some of the municipalities currently do offer connectivity services. *"One of the key stakeholders will be the government or the municipality, City of Tshwane have City of Tshwane Wi-Fi which is free to students, they need to be involved as well. Actually the municipalities should provide resources like Wi-Fi, City of Tshwane is doing it but we know is not adequate. But if we have support of municipalities or support of government from that point of view that will work."* (P1). This is evidence that the infrastructure actor will be the Obligatory Passage Point (OPP) of the network at this stage. Without this actor in the network, the m-Learning actor network will unstable.

Depicted in Figure 5 is the example of actors as they align themselves to the OPP.

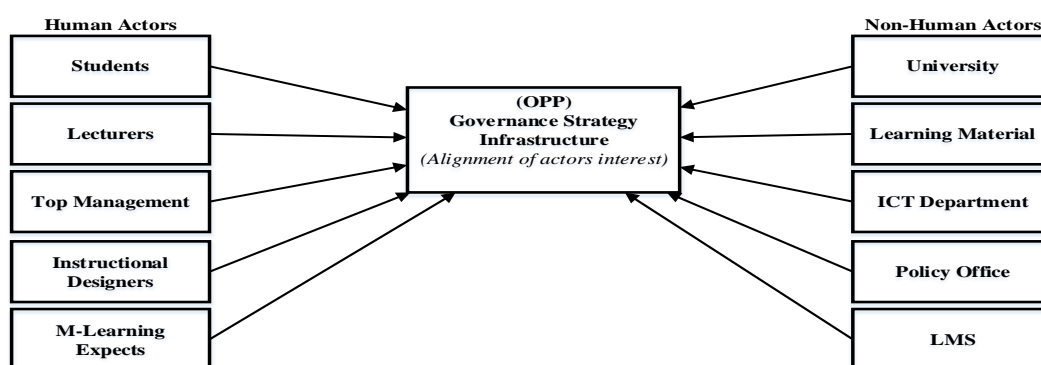


Figure 5: Alignment of Actors to OPP

Figure 5 shows how the governance strategy actor (OPP) and infrastructure actor (OPP) attempt to align the interest of the principal actor to other actors. However, actors can still decide not to be part of the network if their interests are not clearly aligned.

4.3. Inscription

The previous sections described how actors are identified and recruited to the actor network and how their interest can be aligned. As discussed in the prior section, in this paper inscription is achieved by identifying attributes that can assist in the successful alignment of heterogeneous interests. Due to the large number of associated quotations in the data and for the purpose of limiting the length of this paper, only the attributes and references to the supporting cases from the empirical data are presented. Table 5 depicts the attributes needed to stabilise m-Learning Actor Network.

Table 4: Attributes that facilitate the stabilization of an Actor Network

Attributes	Supporting Cases
Skills level	P1, P3, P7, P9, P11, P12, P14, P17, P18, P20
Awareness of multiple platforms	P1, P2, P3, P4, P7, P9, P14
Understanding people's needs	P2, P3, P9, P16
Costing and funding	P3, P4, P11, P12, P16, P18
Content presentation	P2, P4,
Technological Anxiety	P2, P4, P6, P7
Ease of use	P2, P11, P23
Readiness to change	P3, P4, P5, P7, P1
Marketing	P4, P6, P7, P10, P11, P16
Rewarding of students	P7, P13, P17

Ten attributes have been identified from the participants' responses which are presented as the mechanism to stabilise the m-Learning readiness actor network. As argued by Paleti & Alexander (2017), when the m-Learning readiness actor network is stable then the university will be m-Learning ready. Each of these attributes will be discussed in the following section when discussing the findings of this study in terms of the literature.

5. DISCUSSION OF FINDINGS

5.1. Problematization

The findings of this study began by confirming some of the pre-identified m-Learning readiness actors conceptualised through the review of the literature discussed elsewhere (Paleti & Alexander, 2017). Evidence of the recruitment of human actors such as students, lecturers, and support staff were expected to emerge from the empirical data as was evidence that these are the key actors. However, the data collected showed the need for recruitment of some additional human actors, namely, top management, m-Learning experts and instructional designers. The data also confirmed the importance of non-human actors - non-human actors such as university, learning material, ICT department, policy office, governance strategy, Learning Management System (LMS), Infrastructure, and mobile devices were also identified.

It was argued earlier in this paper that without a proper infrastructure on and off the campus m-Learning could not be successfully implemented. This finding concurs with the findings of Bhuasiri et al. (2012) which revealed that infrastructure is the most critical factor influencing technology adoption within institutions. Students and lecturers spend much of their time off campus and this limits their access to infrastructure even though such access might be available at all times on campus (D Ng'ambi & Knaggs, 2008). Therefore, to alleviate this challenge, the findings of this study proposed the recruitment of new and

important external actors, such as the government actor. The university needs to align its interest in m-Learning with the interest of local government (the Tshwane Wi-Fi mission and vision is similar to that of the university. It is proposed that students (who might not be rate payers) are entitled to the service. Unanswered but important questions, which are beyond the scope of this paper, are: What might the predicted cost increase be? How a might such a partnership work? This study indicates that for the university to be m-Learning ready it must find ways that facilitate students access to the learning material through their devices when they are on or off the campus.

An important part of the value of mobile devices as learning tools resides in their capacity and affordance to allow people to connect and download study materials anytime and anywhere even while travelling (Maria et al., 2012). Other important aspects are allowing easy communication between lecturers and students so as to allow active knowledge building. The reliability, speed and accessibility of the mobile cellular network might be a drawback as students travel through a number of geographical areas. Constant connectivity is a key factor in m-Learning environments. Ideally, students should always be connected to their curriculum, classmates and teachers regardless of location. Slow connectivity and slow response time may result in frustration which may interfere with the learning process. Unstable connectivity may also hinder the acceptance of m-Learning.

The findings of this study further indicated that for students and lecturers to participate in m-Learning they must have active mobile devices in their possession permanently. Because students come from various backgrounds, the university must make sure that all students have appropriate devices to participate in m-Learning. Hence there is a need for the recruitment of another external actor, mobile service providers, to assist in making device accessible by the students.

5.2. Obligatory Passage Point (OPP)

The findings of this study indicate that it is important to establish the OPP which can facilitate the alignment of all the other actors' interests to the interest of the principal actor to remain part of the network. The findings of this study evidence that OPP is not static but can change as the network stabilises. This implies that during the m-Learning implementation stage, the new OPP can emerge. For example, governance strategy actor emerged as the OPP from the planning and initial stage of the m-Learning project, while Infrastructure has emerged as an OPP from the resources point of view. This finding emphasise the importance of OPP within the network. It evidence that only if all actors' interest are aligned then the network become stable.

5.3. Inscription

Lastly, the findings of this paper indicate that in order for the actor network to remain stable, the heterogeneous interests of actors must be successfully aligned. This study identifies ten attributes that are predicted to influence the alignment of the principal actor's interest to various other actors at any stage.

5.3.1. Skills Level

The findings of this study indicate that human actors need to change their mind-sets and attitudes toward m-Learning and this will be reflected in new skills levels and the demonstration of features and their use. Students, lecturers and instructional designers need to be equipped with necessary skills to increase their skills level regarding m-Learning. This finding is supported by Mac Callum et al. (2014) as they indicated that continuous training provided by institutions may improve attitudes towards m-Learning. The findings show that it

is important to understand the extent to which training is required or should be provided to support various actors' roles within the network.

5.3.2. Awareness of Multiple Platforms

The finding of this study indicate that both students and lecturers should be made aware of the technologies that the university uses to facilitate teaching and learning. This will assist in communicating the interest of the principal actor to lecturers and students immediately when they get to the university. This is very important as students come from many different places and prior exposure to technology or the use of technology for learning might be limited. Institutions should provide user-friendly and accessible software systems and interfaces to lecturers and students as this will influence the acceptance and use of m-Learning (Oye et al., 2011).

5.3.3. Understanding People's Needs

The findings of this study further indicate that it is important to understand the different actors' expectations concerning m-Learning when they are recruited to the network.

5.3.4. Cost and Funding

The respondents indicate that funding might be a challenging factor which might hinder students' and lecturers' participation in m-Learning. Institutions are also likely to experience high costs associated with equipment, connectivity, maintenance, technical support and teachers training. The study conducted by Ally et al. (2007) noted cost as the students' and lecturers' major concern. However, it is important to note that the cost of mobile device related use differs across counties and this could mean that the adoption rate, users' attitude, and viability of m-Learning is also variable (Sattler et al., 2010). Hence this is a context related issue. In this study some of the participants indicated that the university should come up with strategies to provide free data to the students and lecturers as most of the students are put off by the associated cost. It is believed that this would be a matter that students and lecturers in developing countries are more concerned about than those in more developed economies.

5.3.5. Content Presentation

The findings of this study further indicate that the way content is presented in an m-Learning platform might influence the use and adoption of m-Learning. The finding indicate that content must be user friendly, exciting, short, and media enriched type of content otherwise students might opt for social networks. *"...it should be an exciting content, it should be short 30min, 30sec multimedia, and media enriched type of content. Otherwise we are competing with Facebook and things like that. It should be short and quick"* (P4). As noted from the literature, the attraction of social networks threatens students' concentration when using mobile devices for learning (Gikas & Grant, 2013). Hence content presentation is very important.

5.3.6. Technological Anxiety

The findings of this study indicate that lecturers are still afraid to use technology for learning. Therefore, the university should develop strategies to lessen the existence of technological anxiety among its lecturers and to motivate them to use technology for learning. *"Everyone is willing to use the available tools that we have, problem is things changes, so we have to learn new things every semester, and we have a problem of learning new things..."* (P2). Technological anxiety is defined as a deleterious emotional response resulting from a fear that the use of technology could have a negative impact or outcome (Mac Callum et al.,

2014). This finding was supported by Castro Sánchez & Chirino Alemán (2011) as they also indicated that teachers are of the opinion that the use of technology tools will increase their workload and require extra efforts to facilitate learning. As discussed by Adam et al. (2011), technological anxiety is a serious barrier to lecturers' willingness in using technology for learning.

5.3.7. Ease of Use

The findings of this study further indicate that the m-Learning application should be easy to navigate and use. Therefore, the University should have a strategy to ascertain that m-Learning is user friendly. According to the literature, the underutilisation of the m-Learning by students and lecturers can be prevented if the m-Learning system or application is both easy to learn and use (Mac Callum & Jeffrey, 2013; Theng, 2009). Therefore, a perception of ease of use is positively linked with students' and lecturers' intentions to adopt m-Learning (Wang et al., 2009). This idea is endorsed by Abad et al. (2010) who indicated that ease of use determines learners' willingness to adopt mobile technologies.

5.3.8. Readiness to change

Readiness to change has been defined as the extent to which students and lecturers hold positive views about the need for change, as well as their belief that changes are likely to have positive consequences for them and the university (Kwahk & Lee, 2008). The findings of this study indicated that people must have the political will to change. Hence the university should create an environment where they prepare students and lecturers to embrace change. According to Jafari & Kalanaki (2012) readiness to change can be experienced in three ways, that is, the cognitive aspect - refers to the extent of an individual understanding towards change and the tendency of taking advantage of it, the emotional aspect - refers to the tendency of individual for enjoying the change, and the behavioural aspect - refers to the extent an individual conduct certain engagements to support change.

5.3.9. Marketing

The findings of this study also indicate that m-Learning should be marketed to the students and lecturers. The institution should make everyone aware of the m-Learning implementation. "...*You need to make students to be willing to use it (hungry for it), why is there a need for it, or is it for announcements only? Why do we need to do it...*" (P7). "*The institution have to give enough advantages of using m-Learning so that lecturers and students will be able to support their system*" (P10). "*People need to be made aware of the good things and how easily it (m-Learning) can make learning...*" (P11). According to the responses, marketing is a key as people need to be made aware of the m-Learning initiatives within the university. As part of marketing, the university should come up with a strategy to motivate students to participate in m-Learning.

5.3.10. Rewarding Students

As noted under marketing, this study reveals that students need motivation to engage in m-Learning and the best motivation is to have a rewarding strategy in place. "*Putting in rewards system to encourage students to opt for m-Learning as opposed to old traditional face-to-face integration*" (P13). The participants gave an example of a reward system that could be introduced as the motivation. According to the participants, students want rewards for everything, they are unwilling to do something without the incentive of marks. This finding was supported by Gautreau (2011), as she indicated that one of the motivational factors for the use of the technology for learning is the system of rewards and incentives.

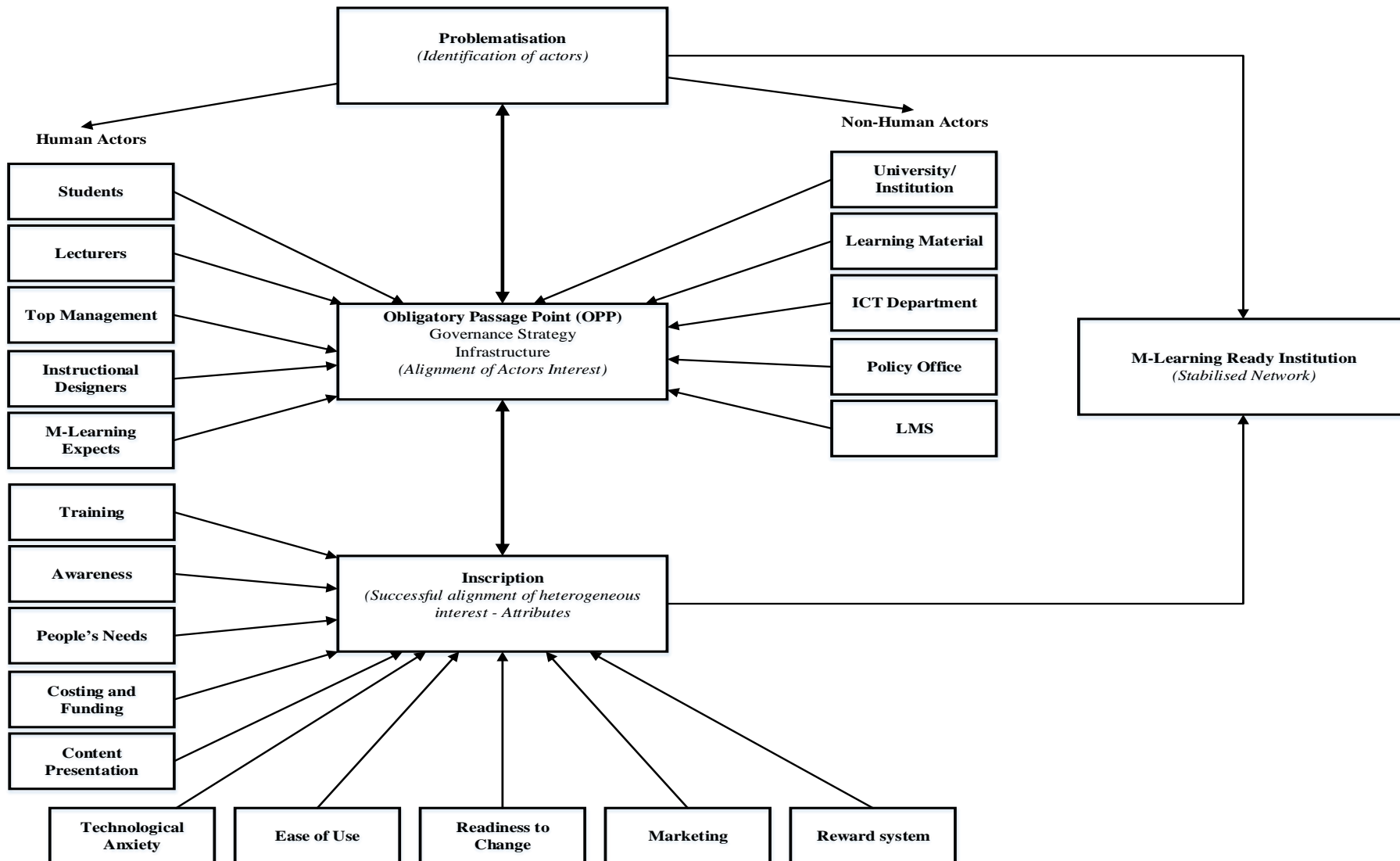


Figure 6: Context-Sensitive M-Learning Readiness Assessment Model

5.4. A Context-Sensitive M-Learning Readiness Model

Figure 6 pulls the findings from the research into a context-sensitive m-Learning readiness model.

6. CONCLUSION

This paper demonstrates how ANT concepts can be used to understand m-Learning readiness within higher education. It highlights key actors that the research respondents identified as being necessary role players in m-Learning readiness within high educational institutions and then looks at evidence about the relationships between those actors. The paper looks at three main concepts from ANT, namely the problematisation moment during translation, recognition of one or more OPPs, and the inscription process and associated attributes as a way to evaluate the stability of the actor network. In the case of this paper, that provides a way of assessing the e-Readiness for m-Learning of a particular institution of higher education. It is important to note that, although many of the actors and attributes may be found in all e-Readiness for m-Learning cases this paper recommends that for any university the identification of actors and attributes be done systematically, using input from lecturers, students and non-academic staff. This is because the authors believe that the model is context sensitive.

This paper contributes to the literature in two ways: The study contributes practically by demonstrating an analytical process which could be used as a guide for future m-Learning readiness studies with the existing findings being used as a reference point. Theoretically, this paper shows that traditional technological adoption theories are not the only way to assess the adoption and readiness of technology usage; the use of sociological theories such as ANT can complement those views by providing more detailed information while still being systematic.

The important part of the future research is the comparison of the context sensitive actor networks from different universities, that is, distance learning universities or traditional universities in a South African context to established whether a holistic m-Learning readiness assessment actor-network emerges that could be applicable at a variety of university settings in developing countries. The possibility that there are different important actors and attributes for different universities should not be ignored.

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