Heliyon 6 (2020) e03879

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Understanding the determinants of GIT post-adoption: perspectives from Mozambican institutions

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ARTICLE INFO

Keywords:
Geographical information technologies (GIT)
Institutions
Post-adoption
GIT drivers
Mozambique
Computer science

ABSTRACT

This study aims to understand the determinants of geographical information technologies at the scale of post-adoption use and intention to increase the level of use in Mozambican institutions. Three known theories (diffusion of innovation theory, technology – organisation – environment framework, and institutional theory) have been used in order to accomplish the study. The data analysis showed that the variables compatibility, geographical scope, expansion opportunities, and normative pressure contribute to explaining GIT use. Relative advantage, complexity, coercive pressure, and mimetic pressure contribute to explaining the intention to increase GIT levels of use. The model revealed substantial power of explanation for GIT post-adoption.

1. Introduction

In the 21st century, technology is a key enabler of the integration and prosperity of many institutions. Using it, institutions can have better visibility through real-time information sharing that will lead to internal and external improvements. Geographical information technologies (GIT) are gaining special attention based on their ability to support institutions in reaching their objectives (Harrison et al., 2007). This dimension is of particular importance in Africa, where GIT performs an extremely relevant role in development activities. In fact, sectors such as the environment and natural resources, economic development and agriculture, among others, greatly benefit from GIT use (Amade et al., 2018). The use of satellite imagery, global positioning systems and geographic information systems help in the management of information and decision support for those sectors enormously (Amade et al., 2018; ESRI, 2002; Mashimbye et al., 2012; Panek, 2013; Tanser and le Sueur, 2002). This use has been increasing steadily in the past few decades, and Mozambique is also following this trend (Amade et al., 2018). The growth and relevance of the use of GIT in Africa is also exemplified by its compulsory use in projects funded by donor and development organisations such as the World Bank.

Understanding the factors that lead institutions to adopt new technologies is a permanent issue in the field of information systems (Taylor and Todd, 1995). There is a clear need to understand the post-adoption stage of GIT in institutions; however existing studies focus more on the adoption of technology in general (Amade et al., 2017; Eslami et al., 2011; Hong, 2014; Li and Liu, 2014; Obal, 2017; Orimoloye et al., 2019; Schaefer and Thinh, 2019; Torresani et al., 2019; Van Westen, 2013; Wolf et al., 2015) and not on the post-adoption of GIT in the Mozambican context.

Inspired by these issues, this research seeks to improve the comprehension of GIT with attention in identifying the determinants behind the post-adoption use and intention to increase the level of use in Mozambican institutions. Through a proposed model based on a synthesis of three theoretical frameworks (the diffusion of innovation theory (DOI), technology – organisation – environment (TOE) framework, and institutional theory), the major priority of the study resides in seeking to comprehend what motivates organisations to keep using and increase the level of use GIT. The contribution of the article is threefold. First, the research addresses a gap by focusing on the post-adoption stages of GIT in an African context. Second, we integrated three well-established models, i.e., DOI theory, TOE framework, and institutional theory. We propose a holistic model that evaluates the direct and indirect effects of intention to increase the level of GIT. Finally, our model also analyses the moderation effects of the environmental context, as suggested by (Oliveira et al., 2019).

The paper is organised into seven sections. In the first and second sections, we provide an overview of GIT, compare differences with other technologies, and contextualise GIT in the African continent. Section 3 covers the research model. We present the methodology in section 4. In section 5, we introduce the study data. Section 6 contains the research

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https://doi.org/10.1016/j.heliyon.2020.e03879
Received 15 August 2019; Received in revised form 23 January 2020; Accepted 27 April 2020
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discussion and raises some implications pertinent to our study. Finally, we conclude the paper by summarising and providing closing remarks.

2. Theoretical background

2.1. The concept of GIT

Having a clear definition of GIT may not be trivial and inflexible because all or most authors define it according to their personal objectives. The term GIT can be used to describe all types of computer systems and sub-systems used in processing georeferenced information (Harrison et al., 2007; Sánchez-Lozano and Bernal-Conesa, 2017; Sánchez-Lozano et al., 2013). In other words, it can be assumed as a decision support system that can provide support for data analysis, question, and interpret data, patterns, trends, and handle geographical information. These systems have been applied for different purposes and objectives for decision-makers and top managers in institutions, such as planning infrastructures (Carsjens and Ligtenberg, 2007); land-use suitability (Zolekar and Bhagat, 2015); resource management (Mahboubi et al., 2015); education (Kim and Bednarz, 2011; Lateh and Muniandy, 2010; Li and Liu, 2014); health care (Joyce, 2009); banks (Ajah and Inyiama, 2011; Gabriela and Ph, 2010; Ngai et al., 2011) among many others.

2.2. Adoption models

With the advent of technologies, new models and theoretical frameworks emerged seeking to explain the dynamics of the evolution process. These models and theoretical frameworks have mostly heavily focused on use and adoption rather than on post-adoption and continuity of use. Among the many theoretical advanced perspectives to explain the post-adoption of technologies in information systems at an organisational level, three theories gain notoriety, DOI (Rogers, 1995, 2003), the TOE framework (Tornatzky and Fleischer, 1990), and Institutional theory (Dimaggio and Powell, 1991). The study will focus on these three theories for many reasons. (1) The DOI theory, TOE framework and institutional theory operate at an organisational level; (2) The theories complement each other and validate a theoretical model; (3) The combination of their elements and characteristics bring new insights that help to explain the post-adoption and continuity of use by institutions for these technologies; (4) The characteristics mentioned in the DOI theory, the three contexts from the TOE framework and the pressures presented in the institutional theory create conditions to improve the comprehension of the post-adoption process of one technology and their continuity use in organisations.

2.2.1. DOI theory

The theory relates to the impact of technological innovation versus the influence that it may create for potential adopters (Rogers, 1995). Rogers conceptualises five main stages (knowledge; persuasion; decision; implementation; and confirmation) to enable the innovation-decision process in which an individual or a group of individuals gain an attitude toward the innovation. On the other hand, the theory attributes organisational usage of an innovation to its characteristics: (1) Relative advantage (when an innovation is perceived as better than the idea. The more it is perceived, the more rapid its rate of adoption is going to be); (2) Compatibility (the degree to which an innovation is perceived to be consistently taking into consideration existing values); (3) Complexity (the degree to which an innovation is perceived as challenging to understand and use. Simple ideas will be adopted more rapidly); (4) Trialability (the degree to which an innovation may be tested on a limited basis); (5) Observability (the degree to which the results of an innovation are visible to others). Characteristics four and five (trialability and observability) were not incorporated in the model because the primary purpose of the study is to understand the post-adoption and continuity of use of GIT in organisations. Besides, much of the existing research has focused on adoption and intention to adopt (Amade et al., 2017; Fichman Robert, 2000). Although this is helpful to understand adoption decisions, we also need a better understanding of post-adoption use. This factor motivates the present study to focus on the post-adoption stage: use and intention to increase the level of use.

The literature illustrates that the DOI theory has a strong theoretical foundation and consistent, practical support (Abdollahzadehgan et al., 2013; Mustonen-Ollila and Lyytinen, 2003; Oliveira and Martins, 2011; Zhu et al., 2006; Zhu and Kraemer, 2005). The DOI theory also has strong support in recent post-adoption studies to explain software as a service (SaaS) (Martins et al., 2019), RFID (Hossain et al., 2017), mobile cloud applications (Carreiro and Oliveira, 2019), business analytics (Nam et al., 2019), and Twitter discontinuance (Ng, 2020), among others. Along the same line, the study combines the DOI theory with the TOE framework that adds the environmental context allowing for better comprehension of the post-adoption of GIT.

2.2.2. TOE framework

Tornatzky and Fleischer (1990) proposed this theory to explain how innovation processes occur in organisations. The theory seeks to explain how organisations can reach the optimum equilibrium between internal and external factors (Aboelmaged, 2014). In the same vein, the theory identifies three contexts that may influence organisational usage of technological innovation: (1) technological (the context evaluates the relation between existing technologies and technical skills available in an organisation); (2) organisational (refers to internal measures of an organisation); and (3) environmental (refers to the external environment in which an organisation is incorporated (Lippert and Govindrajulu, 2006; Tornatzky and Fleischer, 1990). The TOE framework, as designated above, has been incorporated in many studies and used for different purposes (Chau and Tam, 1997; Cruz-Jesus et al., 2019; de Mattos and Laurindo, 2017; Zhu et al., 2016). The TOE framework is incorporated to strengthen and complement the DOI theory.

2.2.3. Institutional theory

Institutional theory articulates that the institutional environment provides rule-like social pressures for appropriate organisational operations and practices (Dimaggio and Powell, 1991). Pressures are needed to create and maintain the legitimacy of institutions (Clemens and Douglas, 2005; Oliver, 1991). It highlights the aspects related to social culture (norms, routines, rules) and how they become established as guidelines for social behaviour (Scott and Christensen, 1995; Scott, 2004). The internal environment can contribute profoundly to the development of formal structures in an organisation (Dimaggio and Powell, 1991; Scott, 2004). The theory speaks about the pressures (mimetic, normative, and coercive) and establishes a boundary where a powerful organisation can apply pressures on its partners by imposing the adoption of technology infrastructure (Thomas et al., 2011). The theory seeks to explain how organisations become more shaped due to pressures (external sources or within an organisation).

2.3. Specifications of the African context

The African continent is characterised by its landscape and extension, diversity in plants and animals, including wildlife, and rapid population growth. Spatial planning and management are vital to the health of the continent. Many studies that include the use of GIT as decision support tools, involving government and Non-Governmental Organisations (NGOs), have taken place in various African countries (Amade et al., 2018; Dambach et al., 2012; ESRI, 2002; Mashimbye et al., 2012; Panek, 2013; Tanser and le Sueur, 2002; Vicente-Serrano et al., 2012). From these studies, the literature showed that this technology has a substantial contribution in organisational support. Some examples of the use of GIT in the African continent can be presented: in Mozambican education as a tool to provide content (Amade et al., 2018); to detect environmental variables influencing malaria vector densities in rural West Africa (Ferrao et al., 2018); to assess land suitability for agriculture (Bandyopadhyay et al., 2009); to evaluate the exposure to coastal climate hazards and

erosion (Cabral et al., 2017); to study South African soils (Cabral et al., 2017); for water provision and community planning; to understand, monitor, and mitigate drought (Vicente-Serrano et al., 2012).

However, the theoretical support targets these technologies mostly regarding use rather than adoption and, in this sense, there is a lack of studies that postulate to understand the determinants of GIT post-adoption in organisations.

3. Research model

We synthesise the DOI theory, TOE framework, and institutional theory and propose a research model, as shown in Figure 1. We specify three sets of factors, the technology context and DOI theory (H1–H3: relative advantage, compatibility, complexity), organisation context (H4–H6: organisation size, geographic scope, expansion opportunities), and institutional theory (H7–H9: coercive pressure, normative pressure, mimetic pressure). We also postulate a linkage from GIT use to intention to increase GIT levels (H10). The major goal of the proposed model is to enhance the comprehension of what fosters Mozambican organisations to continue using GIT (increase the level of use).

The proposed model combines three theories and enhances the TOE framework of organisations and the innovation characteristics of GIT that underline the post-adoption of GIT. It is different from other studies because the model aggregates and reflects a specific context never explored before or shared in this perspective. No study has so far empirically validated the indirect effects and the background of the determinants of the post-adoption of GIT.

3.1. Hypotheses on technology context and DOI theory

We consider three characteristics in the technology context and DOI theory: (1) relative advantage (RA), (2) compatibility (Comp), and (3) complexity (CX). The variables can be identified in the literature (Cooper and Zmud, 1990; Lippert and Govindrajulu, 2006; Lippeveld and Sapirie, 2000; Rogers, 1995; Tornatzky and Fleischer, 1990).

Relative advantage is the "degree to which an innovation is perceived as better than the idea and can bring advantages to an organisation" (Rogers, 1995). It has been widely recognised as a significant factor in leading organisational usage. Innovations that strategically create organisational effectiveness by improving productivity, efficiency, cost-saving have a good impact for adoption (in this case, GIT) (Wu and Chen, 2014), and will positively influence its adoption. Hence,

H1a: Relative advantage will positively influence GIT use.

H1b: Relative advantage will positively influence users to increase GIT levels.

Compatibility is the degree to "which an innovation is perceived to be consistently taking into consideration existing past values, and the needs of potential adopters." As an important determinant, compatibility will boost the organisation in accomplishing their goals (Macredie & Mijinyawa, 2011; Dedrick and West, 2004). For example, if the purpose of having GIT in an organisation is to gain an advantage over competitors, a compatible technology will help the integration with the existing systems and procedures within the organisation. Hence,

H2a: Compatibility will positively influence GIT use.

H2b: Compatibility will positively influence users to increase GIT levels.

Complexity is the "degree to which an innovation is perceived as difficult to understand and use" (Rogers, 1995). This element has revealed to be an important factor to explain innovation usage in organisations. The smoother the technology proves to be successfully integrated into organisational operations, the greater the chances of its adoption will be. GIT offers countless benefits for the working environment and data processing. However, adopting GIT in institutions can be challenging if the institutions have a lack of expertise (for example, integrating data from different layers and sources, predicting some event, or maintenance). Hence,

H3a: Complexity will negatively influence GIT use.

H3b: Complexity will negatively influence users to increase GIT levels.

3.2. Hypotheses on organisational context

GIT is used in different contexts in organisations nowadays. Within the organisational context, organisation size (OS), geographical scope (GS), and expansion opportunities (EO) are key elements to the success of an organisation (Lippert and Govindrajulu, 2006).

Large organisations usually have an advantage over small organisations because they have allocated more resources to be able to

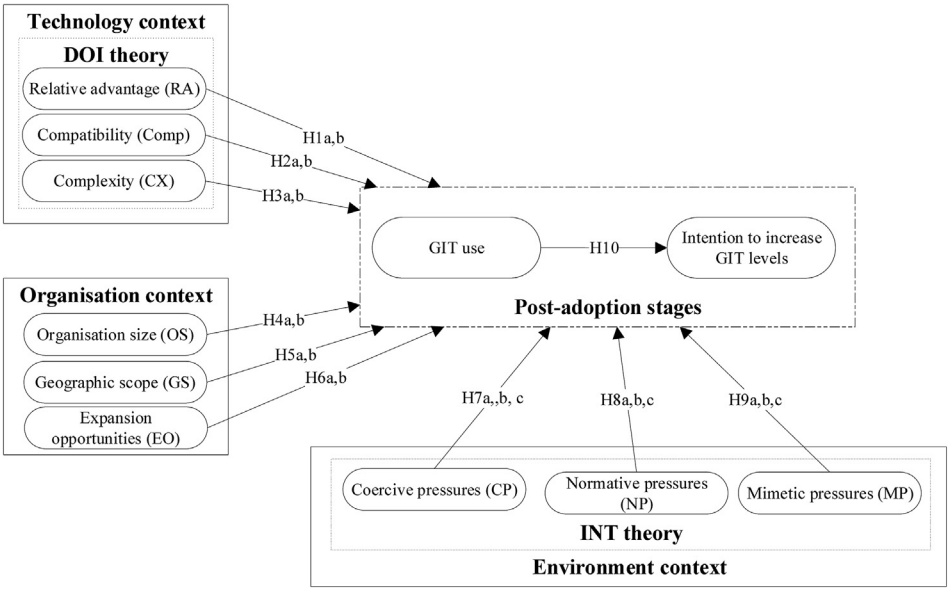


Figure 1. Research model.

accomplish their goals. On the other hand, studies reveal that in large organisations there is much bureaucracy and a need for everything to be well aligned and this can make the decision-making process more difficult regarding new ideas of introducing new technologies (Lee and Xia, 2006). Studies have illustrated that small organisations do not instantly adopt new technologies (Lippert and Forman, 2005; Lippert and Govindrajulu, 2006). The adoption of GIT may create changes in organisational structure and data processing. Hence,

H4a: Organisation size will positively influence GIT use.

H4b: Organisation size will positively influence the intention to increase GIT levels.

The geographic scope is another organisational factor that can influence post-adoption and increase levels of GIT use in Mozambican institutions. It can be understood as the geographical area that an organisation can cover (geographic extent of the operations). In any activity, the geographical scope can contribute to providing an advantage over competitors (Lippert and Govindrajulu, 2006; Zhu et al., 2006; Zhu and Kraemer, 2005). In the context of post-adoption and increasing levels of GIT use, an organisation that has operations in several physical areas covering different businesses and connecting different partners and players has more possibilities to increase the levels of GIT use than an organisation with a limited scope (Lippert and Forman, 2005; Lippert and Govindrajulu, 2006). Thus, geographical scope is a determinant in the post-adoption of GIT. Hence,

H5a: Geographical scope will positively influence GIT use.

H5b: Geographical scope will positively influence the intention to increase GIT levels.

Expansion opportunities is another organisational factor that can influence post-adoption and increase GIT levels in Mozambican institutions. Large organisations intend to bring organisational innovativeness by expanding their business to seek new opportunities (Lippert and Govindrajulu, 2006; Tatiana and Angela, 2012; Zhu and Kraemer, 2005). The adoption of technologies is one of the organisational strategies to reach new opportunities (Chang et al., 2013). GIT can easily support organisations to expand their business to other areas. Expansion opportunities reveal to be an important factor in ensuring GIT usage. Hence,

H6a: Expansion opportunities will positively influence GIT use.

H6b: Expansion opportunities will positively influence the intention to increase GIT levels.

3.3. Hypotheses on environment context

The environmental context postulates the way an organisation conducts its activity and is influenced by internal and external factors (nature of the industry), including competitors (Tornatzky and Fleischer, 1990). The determinants demonstrated to have an impact on GIT post-adoption and continuity of use are coercive, mimetic and normative pressures.

Coercive pressure can be understood as a set of formal and informal forces exerted on an institution by other institutions upon which the former institution depends (Dimaggio and Powell, 1991; Teo et al., 2003). Coercive pressure highly contributes to the prosperity of the organisation in the way that it becomes aligned with the activity environment. Empirical evidence suggests that coercive pressure contributes to building a relationship between institutions and some dependence. Hence,

H7a: Coercive pressure will positively influence GIT use.

H7b: Coercive pressure will positively influence the intention to increase GIT levels.

H7c: Coercive pressure will moderate the effect of GIT use on the intention to increase GIT levels.

Normative pressure relies on the relationship where organisations share information (norms) and get persuaded to behave similarly (Burt, 1987; Teo et al., 2003). The impact of sharing information, including norms and getting involved in many scenarios brings advantages to organisations. Sharing norms within a network of organisations facilitates consensus and enhances their influence behaviour (Dimaggio and Powell, 1991). Normative pressure can highly contribute to align the internal norms of the organisation and contribute to the well-being of the activity. Hence,

H8a: Normative pressure will positively influence GIT use.

H8b: Normative pressure will positively influence the intention to increase GIT levels.

H8c: Normative pressure will moderate the effect of GIT use on the intention to increase GIT levels.

Mimetic pressure exists when an institution imitates a competitor by adopting its practices and innovation (Soares-Aguiar; Palma-Dos-Reis, 2008). Currently, organisations that play aside from business trends are not capable of surviving in the market for much time. In this sense, mimetic pressure ensures that the organisation is aligned with the industry. It can manifest itself in two ways: perceived success and the prevalence of a practice (Teo et al., 2003). Hence,

H9a: Mimetic pressure will positively influence GIT use.

H9b: Mimetic pressure will positively influence the intention to increase GIT levels.

H9c: Mimetic pressure will moderate the effect of GIT use on the intention to increase GIT levels.

3.4. Hypotheses on post-adoption context

A technology that is perceived to be easier to use facilitates user comprehension and increases the interest in the technology. As far as the user can get confirmation experience, more possibilities are open to increasing the level of technology. The better the flexibility and adaptability of one technology, the better the continuity of usage. The continuity of use of GIT in one organisation will also be determined from any good feedback that the organisation receives (e.g., good results; increased levels of productivity; compatibility over existing technologies; simpler to operate). Thus, higher degrees of post-adoption usage will be associated with levels of adaptability of the GIT. Hence,

H10: GIT use will positively influence the intention to increase GIT levels.

4. Research methodology

4.1. Measurement

A questionnaire was developed with support in previously published studies to develop and estimate the model shown in Figure 1. The questionnaire had as its target, public institutions, private organisations and non-government-organisations in Mozambique that utilise GIT. The questionnaire respondents are people that work with GIT (see Table 1 for the profile of respondents). The inspirations from the items in the questionnaire arise from different sources (see Appendix). The constructs relative advantage and complexity were predicated on (Oliveira et al., 2014); compatibility was based on (Chong and Chan, 2012; Zhu et al., 2006); organisation size was drawn from (Zhu et al., 2006); geographic scope was self-developed and elicited from (Zhu et al., 2006) expansion

Table 1. Respondents profile.

Respondents	Sector of Activity	Location (region)		
		Centre	North	South
13	Agriculture	3	4	6
10	Environment	5	2	3
1	Trade	0	0	1
4	Construction	0	2	2
27	Education	6	13	8
7	Information and Communication	4	2	1
1	Production and Industry	0	0	1
8	Social and Economic Development	2	0	6
10	Natural Resources	2	3	5
4	Services	0	4	0
9	Health	3	4	2
4	Transport and Communications	1	0	3
12	Other (specify)	7	2	3

opportunities was self-developed; coercive pressure was built on (Liang et al., 2007; Teo et al., 2003); normative pressure and mimetic pressure stem from (Liang et al., 2007; Teo et al., 2003); GIT use was centred on (Chan and Chong, 2013); and intention to increase the GIT level was formulated on (Benlian and Hess, 2011). The creation of the questionnaire followed different steps, namely: A group of university staff helped to create a feasible questionnaire in English. The survey was later translated to Portuguese because it is the official language in Mozambique. A professional translator translated the questionnaire to guarantee content validity. All constructs (relative advantage, compatibility, complexity, organisation size, geographic scope, expansion opportunities, coercive pressure, normative pressure, and mimetic pressure) used in the study were measured using a seven-point range scale on an interval ranging from "strongly disagree" to "strongly agree" to be consistent with the sources.

4.2. Data

Although our institutions do not require approval from an ethics committee for this type of experiment, the researchers made sure that institutional and personal data are kept private and non-accessible at all times and all participants were informed of the purpose of the data collection. Data were collected using survey monkey (a web-based application). A pilot study was conducted in 30 Mozambican institutions (public institutions, private organisations and NGOs) to test the questionnaire and ensure content validity.

The investigators sent an email to Mozambican institutions containing a complete explanation of the study and its relevance for the country in order to obtain the contacts of people qualified to participate in the survey. Another strategy used was perusal through the Mozambican yellow pages to create a database of contacts. The questionnaire was administered, and data collected in the 2nd semester of 2015. The study targeted a universe of 2000 Mozambican organisations and received 110 valid responses, divided into 82 early and 28 late respondents. The study used a "key informants" approach to identify people more involved in GIT, representing organisations with the profile described in Table 1. They are a sample of micro (10.0%), small (31.8%), medium (38.2%) and large (20.0%) organisations. The respondents were 60.9% male and 39.1% female, including eight managers and 102 GIT technicians. To reach these respondents, we provided a clear description of GIT.

The researchers introduced a clear explanation of GIT in the questionnaire to increase content validity. The respondents had the opportunity to choose to receive the results of the study by providing their emails in the questionnaire.

The weak feedback from the target group was attributed to diverse issues, namely, invalid email addresses, inbox full, lack of updated emails, and lack of appropriate people to respond to the questionnaire, among others. The nonresponse bias test, the sample distribution of the early and late respondent groups, was compared using the Kolmogorov-Smirnov (K–S) test (Wilcox, 1998) and the results demonstrated that there are no statistical differences. Table 3 presents the mean and standard deviation of all the constructs.

4.3. Methods

Structural equation modelling (SEM) is a statistical technique for testing and estimating the linkage between constructs. There are two families of SEM techniques: (i) covariance-based techniques and (ii) variance-based techniques. In this research, we used partial least squares structural equation modelling (PLS-SEM), which is a variance-based technique. We considered the PLS-SEM technique to be the most appropriate method for three reasons (Hair et al., 2017): (i) the research model has not been tested in the literature; (ii) the research model is considered as complex; (iii) not all items in our data are distributed normally ($p < 0.01$ based on Kolmogorov–Smirnov's test) (Chin et al., 2003). Consequently, PLS-SEM is an adequate method for this research. Smart PLS 3 software (Ringle et al., 2015) was employed to analyse the relationships defined by the theoretical model.

5. Results and analysis

5.1. Measurement model

The measurement model results are shown in Tables 2 and 3. The measurement model was tested using composite reliability. From Table 3, the results demonstrate that they are greater than 0.7, confirming that the scales are reliable (Henseler et al., 2009). The average variance extracted (AVE) value should be greater than 0.5 to guarantee the appropriate degree of convergent validity in the study (Fornell and Larcker, 1981). In Table 3, all constructs have an AVE greater than 0.5 loadings greater than 0.7, which reveals that they are statistically significant at the 0.01 level. Finally, the discriminant validity of the constructs was assessed using the Fornell – Larcker and cross-loadings criteria. The first criterion suggests that the square root of AVE should be greater than the correlation between the constructs (Chin, 1998; Fornell and Larcker, 1981) and the second criterion postulates that the loadings of each indicator should be greater than all cross-loadings (Chin, 1998). Based on Table 3 (first criterion) and Table 2 (second criterion), both criteria were satisfied.

Table 2. PLS loadings and cross-loadings.

	RA	Comp	Cx	OS	GS	EO	CP	NP	MP	GITu	GITe
RA1	**0.824**	0.500	0.038	0.250	0.042	0.230	0.201	0.359	0.264	0.309	0.386
RA2	**0.938**	0.363	0.007	0.241	-0.006	0.122	0.294	0.285	0.291	0.202	0.525
RA3	**0.858**	0.264	0.004	0.276	-0.125	0.032	0.309	0.207	0.297	0.109	0.505
RA4	**0.860**	0.291	0.100	0.154	-0.019	0.191	0.295	0.217	0.197	0.177	0.460
Comp1	0.357	**0.745**	0.003	0.194	0.099	0.218	0.182	0.308	0.237	0.286	0.265
Comp2	0.379	**0.845**	-0.084	-0.041	0.043	0.207	0.255	0.285	0.188	0.425	0.278
Comp3	0.314	**0.781**	-0.147	-0.018	0.029	0.224	0.160	0.133	0.187	0.318	0.245
Comp4	0.108	**0.615**	-0.198	-0.053	0.081	0.239	0.060	0.224	0.168	0.269	0.106
Cx3	-0.044	-0.085	**0.794**	-0.119	-0.139	0.122	0.008	0.002	0.006	-0.043	-0.172
Cx4	0.080	-0.133	**0.945**	-0.044	-0.154	-0.063	0.063	-0.100	-0.140	-0.222	-0.199
OS	0.264	0.026	-0.079	**1.000**	0.208	0.092	0.027	0.107	0.041	-0.089	0.091
GS	-0.032	0.078	-0.166	0.208	**1.000**	0.081	-0.118	0.075	0.118	0.231	-0.165
EO	0.162	0.288	0.002	0.092	0.081	**1.000**	0.359	0.489	0.275	0.530	0.258
CP1	0.192	0.231	0.064	0.048	-0.213	0.272	**0.843**	0.472	0.282	0.269	0.313
CP2	0.231	0.222	0.064	-0.011	-0.085	0.287	**0.905**	0.405	0.224	0.288	0.378
CP3	0.361	0.163	0.009	0.034	-0.038	0.352	**0.834**	0.457	0.367	0.355	0.473
NP1	0.265	0.237	-0.012	0.153	0.144	0.443	0.398	**0.869**	0.407	0.583	0.303
NP2	0.259	0.337	-0.139	0.039	0.070	0.390	0.382	**0.858**	0.266	0.552	0.280
NP3	0.196	0.156	-0.008	0.049	-0.096	0.322	0.510	**0.626**	0.218	0.308	0.241
MP1	0.349	0.264	-0.151	0.063	0.026	0.262	0.380	0.392	**0.937**	0.281	0.275
MP2	0.265	0.265	-0.051	0.023	0.158	0.234	0.273	0.330	**0.936**	0.196	0.155
MP3	0.204	0.186	-0.050	0.017	0.183	0.269	0.288	0.338	**0.925**	0.237	0.165
GITu1	0.228	0.482	-0.262	-0.011	0.219	0.505	0.329	0.554	0.307	**0.853**	0.311
GITu2	0.202	0.370	-0.086	-0.065	0.211	0.474	0.294	0.573	0.240	**0.903**	0.297
GITu3	0.161	0.295	-0.113	-0.166	0.174	0.406	0.321	0.520	0.131	**0.871**	0.266
GITe1	0.414	0.283	-0.262	0.100	-0.089	0.250	0.348	0.351	0.217	0.357	**0.838**
GITe2	0.395	0.254	-0.235	0.090	-0.182	0.181	0.433	0.289	0.177	0.286	**0.883**
GITe3	0.565	0.252	-0.051	0.043	-0.149	0.227	0.398	0.246	0.178	0.212	**0.828**

Notes: Relative advantage (RA); Compatibility (Comp); Complexity (CX); Organisation size (OS); Geographic scope (GS); Expansion opportunities (EO); Coercive pressure (CP); Normative pressure (NP); Mimetic pressure (MP); GIT use (GITu); Intention to increase de GIT level (GITe). PLS loadings (in bold) and cross-loadings.

Table 3. Descriptive statistics, correlations and AVE.

	Alpha	CR	AVE	RA	Comp	Cx	OS	GS	EO	CP	NP	MP	GITu	GITe
RA	0.893	0.926	0.759	**0.871**										
Comp	0.741	0.836	0.564	0.404	**0.751**									
Cx	0.710	0.864	0.761	0.041	-0.130	**0.873**								
OS	1.000	1.000	1.000	0.264	0.026	-0.079	**NA**							
GS	1.000	1.000	1.000	-0.032	0.078	-0.166	0.208	**NA**						
EO	1.000	1.000	1.000	0.162	0.288	0.002	0.092	0.081	**NA**					
CP	0.829	0.896	0.742	0.317	0.233	0.049	0.027	-0.118	0.359	**0.861**				
NP	0.701	0.832	0.628	0.305	0.316	-0.072	0.107	0.075	0.489	0.517	**0.792**			
MP	0.927	0.953	0.870	0.302	0.257	-0.099	0.041	0.118	0.275	0.346	0.384	**0.933**		
GITu	0.848	0.908	0.767	0.227	0.441	-0.179	-0.089	0.231	0.530	0.360	0.628	0.262	**0.876**	
GITe	0.808	0.886	0.723	0.540	0.309	-0.213	0.091	-0.165	0.258	0.463	0.346	0.224	0.334	**0.850**

Notes: The diagonal in bold is the square root of the average variance extracted (AVE); Relative advantage (RA); Compatibility (Comp); Complexity (CX); Organisation size (OS); Geographic scope (GS); Expansion opportunities (EO); Coercive pressure (CP); Normative pressure (NP); Mimetic pressure (MP); GIT use (GITu); Intention to increase the GIT level (GITe).

5.2. Structural model

Analysis of the correlation table for evidence of multicollinearity among exogenous constructs in Table 3, showed that the highest correlation between exogenous constructs is 0.54. The Variance inflation factor (VIF) is lower than 3, which is less than the conservative threshold of 5. This point suggests that there are no multicollinearity concerns. The analysis of the ten hypotheses was based on the examination of the standardised paths. The path significant levels were estimated using the bootstrapping method with 5000 re-samples and the results of the analysis are presented in Table 4. The examination of R^2 as a descriptive measure shows that the research model explains 59.2% of variation in GIT use and 57% of variation in intention to increase GIT levels of use.

The hypotheses on GIT use: compatibility (H2a) ($P < 0.05$), geographical scope (H5a) ($P < 0.01$), expansion opportunities (H6a) ($P < 0.01$), and normative pressure (H8a) ($P < 0.01$) are confirmed. The hypotheses relative advantage (H1a), complexity (H3a), organisation size (H4a), coercive pressure (H7a), and mimetic pressure (H9a) are not confirmed.

Table 4. Relevant constructs for the structural model.

	GIT use		Intention to increase the GIT level	
	$R^2 = 59.2\%$		$R^2 = 57.0\ \%$	
	Path coeff.	t-Value	Path coeff.	t-Value
Relative advantage (RA)	0.060	0.748	**0.416**	**3.688*****
Compatibility (Comp)	**0.190**	**2.344****	-0.008	0.083
Complexity (Cx)	-0.121	1.637	**-0.230**	**3.052*****
Organisation size (OS)	**-0.231**	**2.670*****	-0.015	0.222
Geographic scope (GS)	**0.208**	**2.986*****	**-0.171**	**2.207****
Expansion opportunities (EO)	**0.268**	**3.516*****	0.127	1.347
Coercive pressure (CP)	0.045	0.593	**0.251**	**2.744*****
Normative pressure (NP)	**0.429**	**5.217*****	-0.057	0.555
Mimetic pressure (MP)	-0.086	1.115	-0.024	0.257
GIT use (GITu)	-	-	0.088	0.860
CP*GITu	-	-	**-0.297**	**3.463*****
NP*GITu	-	-	-0.011	0.124
MP*GITu	-	-	**0.157**	**1.924***

Note: * Significant at $p < 0.10$, ** Significant at $p < 0.05$, *** Significant at $p < 0.01$. The statistically significant constructs are in bold.

The hypotheses on the intention to increase the GIT level of use: relative advantage (H1b) ($P < 0.01$), complexity (H3b) ($p < 0.01$), coercive pressure (H7b) ($P < 0.01$), coercive pressure (H7c) ($P < 0.01$), mimetic pressure moderate the effect of GIT use (H9c) ($P < 0.10$), are confirmed. The hypotheses compatibility (H2b), organisation size (H4b), geographical scope (H5b), expansion opportunities (H6b), normative pressure (H8b), mimetic pressure (H9b), normative pressure moderate the effect of GIT use (H8c) ($P > 0.10$), and GIT use (H10) are not confirmed. Table 5 illustrates the summary of all hypotheses confirmed or not confirmed. Figure 2 depicts the significant level results from Table 4 based on Figure 1.

6. Discussion

6.1. GIT use

Continuous GIT use in an organisation can be fostered by opening the organisation to new business (expansion opportunities) and geographical (geographic scope) areas. Continuous use can be strengthened if the expansion is performed by maintaining current organisational conditions which make GIT use compatible in the current technological context (compatibility). The use of GIT is also reinforced if the internal and external relations of a network of similar organisations develop an environment for sharing best practices and norms (normative pressure). Organisations that require GIT use geographic information as a basis (or complement) for their normal functioning. In these cases, all expansion plans (new business or geographical area) will demand a stable technical environment that can promote the expansion opportunities as well as respond to norms established in the institutional setup of similar organisations. Expansion opportunities are not statistically significant on the intention to increase GIT levels as many organisations do not include the technology agenda in their expansion master plan. The compatibility variable contribution is only statistically significant in GIT use. On the other hand, the variable is not statistically significant in the intention to increase GIT levels. A system can be useful when it is compatible with other existing systems (Chan and Chong, 2012; Dedrick and West, 2004; Zhu et al., 2006). Normative pressure usually comes from indirect sources in an organisation. The variable contributes to explaining a positive impact for GIT use (Burt, 1987; Dimaggio and Powell, 1991; Tornatzky and Fleischer, 1990). On the other hand, it is not statistically significant in continuity to use GIT because the policies and regulations are not promoting and motivating the organisations to increase the levels of GIT.

The difficulty of certain aspects of the management of geographic information and geographic information technology increases with the dimension of data sets and their integration as well as the intricacy of the institutional organisation. These factors tend to increase with the size of the organisations, and thus, organisational size seems to affect GIT use negatively. The organisation size variable proved to be statistically significant for GIT use because most of the companies that adopt these technologies are small (Susan K. Lippert and Govindrajulu, 2006; Lippeveld and Sapirie, 2000; Zhu et al., 2006). On the other hand, the hypothesis is not verified in the intention to increase GIT levels because large organisations usually have many procedures, policies, and rules that may lead to inefficient processes.

6.2. Intention to increase GIT levels

The perception that an idea can bring advantages to an organisation (relative advantage) together with an external technological environment (coercive pressure) creates a technological context that is appropriate for the development of GIT. In many organisations and sectors where geographic information plays an important role, such as in natural resource exploitation or transportation, GIT innovation can promote an increase in its use (Amade et al., 2017). The external environment composed of different stakeholders that include, similar competitive organisations, the government, and demanding clients such as international donors in general, lead organisations to increase their levels of GIT use (Amade et al., 2017). Relative advantage plays a vital role in helping organisations to boost business activity. In our study, the variable revealed to be not statistically significant for GIT use. It is only statistically significant for increasing GIT levels in organisations (Rogers, 1995; Ruivo et al., 2014; Zhu et al., 2006). Coercive pressure represents the internal and external forces that organisations face. It contributes to explaining the positive impact to increase the intention of GIT levels (Dimaggio and Powell, 1991; Tornatzky and Fleischer, 1990). The variable is not statistically significant in GIT use because organisations may be assuming that they have all the needed skills, competencies, and technology to run the business, in order to face their competitors and industry.

In the same way that organisational size harms GIT use, complexity will also negatively influence the intention to increase GIT levels. As

Table 5. Summary of all the hypotheses.

Hypotheses	Conclusion
H1a: Relative advantage will positively influence GIT use	Not confirmed
H1b: Relative advantage will positively influence users to increase GIT levels	Confirmed
H2a: Compatibility will positively influence GIT use	Confirmed
H2b: Compatibility will positively influence users to increase GIT levels	Not confirmed
H3a: Complexity will negatively influence GIT use	Not confirmed
H3b: Complexity will negatively influence users to increase GIT levels	Confirmed
H4a: Organisation size will positively influence GIT use	Not confirmed
H4b: Organisation size will positively influence the intention to increase GIT levels	Not confirmed
H5a: Geographical scope will positively influence GIT use	Confirmed
H5b: Geographical scope will positively influence the intention to increase GIT levels	Not confirmed
H6a: Expansion opportunities will positively influence GIT use	Confirmed
H6b: Expansion opportunities will positively influence the intention to increase GIT levels	Not confirmed
H7a: Coercive pressure will positively influence GIT use	Not confirmed
H7b: Coercive pressure will positively influence the intention to increase GIT levels	Confirmed
H7c: Coercive pressure will moderate the effect of GIT use on the intention to increase GIT levels	Confirmed
H8a: Normative pressure will positively influence GIT use	Confirmed
H8b: Normative pressure will positively influence the intention to increase GIT levels	Not confirmed
H8c: Normative pressure will moderate the effect of GIT use on the intention to increase GIT levels	Not confirmed
H9a: Mimetic pressure will positively influence the GIT use	Not confirmed
H9b: Mimetic pressure will positively influence the intention to increase GIT levels	Not confirmed
H9c: Mimetic pressure will moderate the effect of GIT use on the intention to increase GIT levels	Confirmed
H10: GIT use will positively influence the intention to increase GIT levels	Not confirmed

geographic information applications become more specialised and establish different relationships with the diverse information systems from various organisational sectors, they will become more technically complex as well. Innovations proposed for these systems are perceived as difficult to implement and thus, will play a negative role in the intention to increase GIT use. Complexity is not statistically significant on GIT use which satisfies the hypothesis. Complex systems are frequently put aside in organisations because they are not user-friendly and sometimes not compatible (Rogers, 1995; Ruivo et al., 2014). On the other hand, the results proved that the complexity variable is statistically significant to increasing GIT levels, contradicting the hypothesis. The reason lies in that complex systems many times offer security and stability for the organisation.

It is interesting to observe that in the organisational context, geographic scope, organisations find it necessary to use GIT in order to manage their assets, processes, and business models that are spread throughout a territory. It is thus natural to expect that geographical scope would positively influence both GIT use and intention to use GIT levels. While the former is true, the latter revealed instead to have a negative impact. This factor could be explained by the fact that an increase in geographical scope will necessarily increase the complexity of the systems to be developed, the business processes, and respective workflows. Furthermore, it also contributes negatively in intention to increase GIT levels over organisations that have their branches thousands of kilometres away (Zhu et al., 2006). This dispersed situation may lead to an increase in difficulty to control the growth of GIT levels.

The mimetic pressure variable does not have a positive impact on the use and intention to increase GIT levels. For this scenario, the adoption of technology does not reflect the aims of the organisation (Teo et al., 2003). The variable does not meet the hypotheses declared because many times the industry plays a different role from the organisation master plan, vision, and policies.

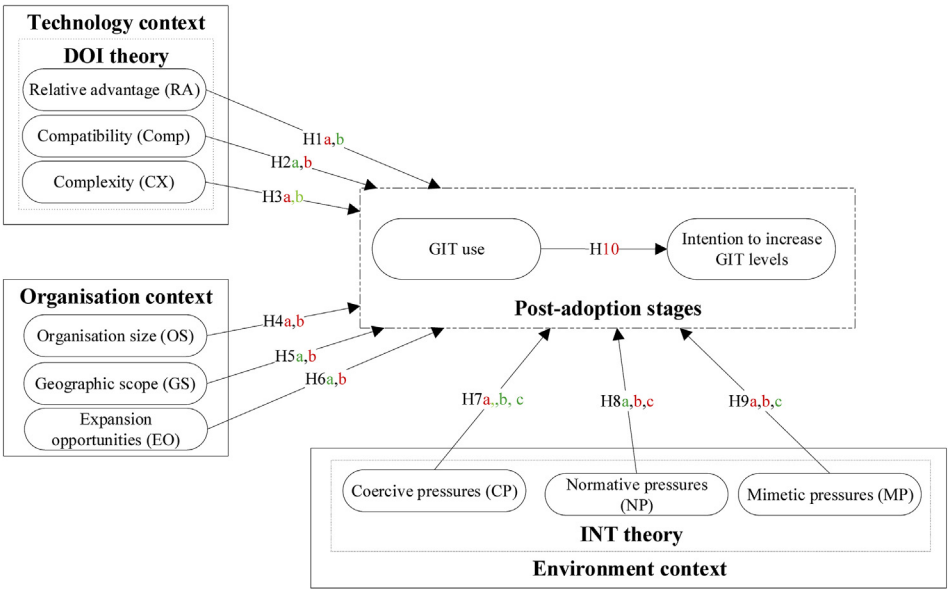
The model demonstrated that the environmental context variables moderate the relation between use and intention to continue use. Through Figures 3a and 3b, it is possible to identify that pressure can help to explain the intention to increase GIT use. From Figure 3a, we can see that in a context of low coercive pressure, GIT use has a positive effect on the intention to increase GIT use. On the opposite spectrum, for high coercive pressure, GIT use harms the intention to increase GIT use. From Figure 3b, we can see that in a context of high mimetic pressure, GIT use has a positive effect on the intention to increase GIT use. On the opposite end, in the low mimetic pressure context, GIT use has a negative effect on the intention to increase GIT use.

6.3. Theoretical implications

The theoretical contributions of this study are that it pushes the edge of GIT post-adoption research further out to institutions by understanding what determines the continuity of users to keep using GIT in a post-adoption stage. In this study, we contribute to the information technology (IT) field in a post-adoption stage by providing empirical and practical evidence. An important implication of this study lies in the strengths of the newer model used to explain the post-adoption of GIT in Mozambican institutions. Another significant implication lies in a new model to be used as a vehicle to study in a specific type of institution (public, private, or NGO) and be a target to other African countries and at the end, creating a comparative study based on different realities. To be able to come up with a feasible research model, the researchers combined three models and theories that work at an institutional level, namely, DOI theory, TOE framework, and institutional theory. The research model is composed of ten hypotheses. Future studies can extend these determinants by integrating and combining with existing adoption models and exposed in different realities (institutions and countries).

6.4. Managerial implications

Through the study, it is possible to reveal some implications. The study brings important characteristics of post-adoption of GIT that managers have to analyse. The variables declared in the study, relative advantage, compatibility, complexity, organisation size, geographical scope, expansion opportunities, coercive pressure, normative pressure, mimetic pressure are subjects of consideration for managers concerning GIT use and increasing GIT levels. The study also covers three contexts, technological, organisation, and environmental contexts. Top managers from institutions/organisations need to put them into consideration. The results demonstrated a critical role that the variables compatibility, organisation



Legend: Green → Confirmed; Red → not confirmed.

Figure 2. Significant level results from Table 4, based on Figure 1.

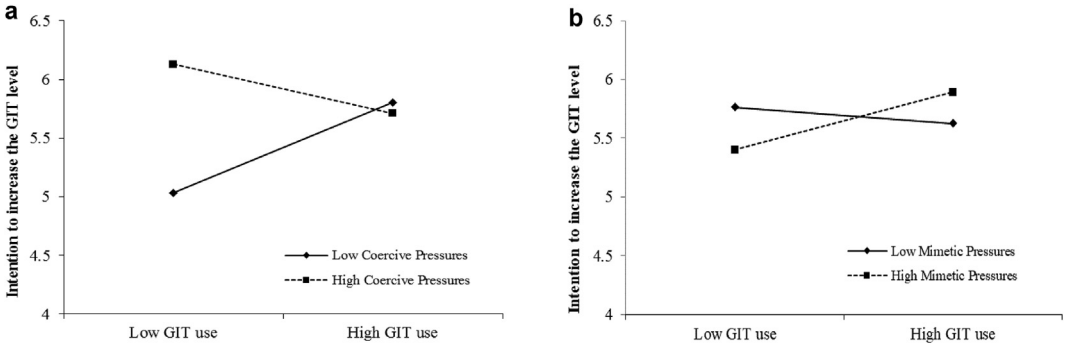


Figure 3. **a**: The moderate effect of coercive pressure on GIT use over continuity use of GIT. **b**: The moderate effect of mimetic pressure on GIT use over continuity use of GIT.

size, geographical scope, expansion opportunities, and normative pressure contribute to explaining GIT use. On the other hand, the variables relative advantage, complexity, geographical support, coercive pressure, and the moderation effect of mimetic pressure on GIT use are pointing to explain the intention to increase GIT levels. Managers have to understand the role of each variable to run their organisations better.

It is important to remark that the use of GIT in African countries in the last decades contributed to responding to many sensitive issues related to biodiversity, sustainable agriculture, natural hazards, transportation, migration and urbanisation and health care (Amade et al., 2017; Amade et al., 2018). In Mozambique, it was possible to identify through a survey that GIT contributes to different sectors of activities such as the environment, economic development, education, agriculture, transportation, health, services, ICT, natural resources, and education. The education sector represents those who most use GIT in Mozambique (Amade et al., 2018).

6.5. Limitations and further research

Our research has some limitations. The first limitation springs from a tool that the researchers used (online survey). The current study does not include users who do not use an e-mail address; thus, a segment of potential users was not able to be covered. The second limitation was related to the process of acquiring potential e-mail addresses and the way the process takes place. In Mozambique, it is still a huge challenge to have all institutional contacts updated on the internet or in a database. The third limitation found was related to the terminology of our research, GIT remains a new technology in Mozambique, and many users are still in the process of assimilating these technologies. Another limitation is related to the target group, Mozambican institutions that started to use these technologies in recent years. While the limitations were identified, they do not bear influence on the results of the study. The research model is focused on understanding the determinants that take GIT to post-adoption stages in Mozambican institutions. We encourage additional studies that focus on the continuity of the use of GIT in Mozambican institutions. The study targets public, private and non-governmental institutions; thus, we encourage further studies to a specific type of institution with more than one country in order to cross data between countries.

7. Conclusion

GIT boosts the way processes and data are collected, stored, manipulated, analysed, processed, and presented in organisations. This study sought to understand the determinants of GIT post-adoption in Mozambican institutions based on a research model that combines three theoretical models, the DOI theory, TOE framework, and institutional theory. The results on GIT use show that compatibility, geographical scope, expansion opportunities, and normative pressure contribute positively

and are confirmed. The remaining hypotheses on GIT use are not confirmed. On the other hand, the hypotheses relative advantage, complexity, coercive pressure, mimetic pressure contribute positively to explain the intention to increase GIT levels of use and are confirmed. The remaining hypotheses were not confirmed. We can conclude that the drivers for GIT use are not the same for the intention to increase GIT levels. From these results, we can figure out that future research should analyse different adoption stages to understand the GIT diffusion process better. Coercive and mimetic pressures moderate the effect of use on the intention to increase GIT use. Our study also demonstrates the importance of moderator effects on intention to increase GIT levels. Finally, the model explains 59.2% of variation in GIT use and 57.0% of variation in intention to increase GIT levels which reveals that our model has a substantial power of explanation for GIT post-adoption.

Declarations

Author contribution statement

Nelson Amade: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Tiago Oliveira, Marco Painho: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interest statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at https://doi.org/10.1016/j.heliyon.2020.e03879.

Acknowledgements

This study was conducted as part of a PhD program of the NOVA Information Management School.

The authors would like to acknowledge and show their gratitude to the anonymous reviewers and editor for their helpful comments and insights on the previous version of the manuscript.

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