Original Research Paper

Factors Affecting the Implementation of the National Programme for Information Technology in the National Health Services: The Case of Lorenzo in the North, Midlands and East of England Region

[1]**Wasfi Alrawabdeh,** [2]**Adel Salloum and** [1]**Fayiz Shrafat**

[1]*Department of Business Administration, Hashemite University, 13115 Zarqa, Jordan*
[2]*Department of Business Administration, Mu'tah University, 61710 Mu'tah, Jordan*

Corresponding Author:
Wasfi Alrawabdeh
Department of Business
Administration, Hashemite
University, 13115 Zarqa,
Jordan
E-mail: rawabdeh@hu.edu.jo

Abstract: This study is concerned with the aspect of revealing the factors that affect the adoption of IT programs in the health sector in the NHS in UK. It focuses on the identification of the factors that influence significantly the adoption of LORENZO, the Electronic Health Record system that is being implemented in the Strategic Health Authorities (SHAs) in the North, Midlands and East of England (NME) region as part of the National Program for Information Technology (NPfIT) in the NHS. This study is based on the Technology Acceptance Model (TAM). A qualitative research methodology was used to approach this area unlike the quantitative approach usually associated with the TAM. The data was obtained by conducting face-to-face semi-structured interviews with people who represented the end users in the NHS and the designing company (the LSP). By contrast with most academic studies, the research, therefore, studied the NPfIT from the bottom up (i.e., the end user perspective). The main tool used to aid the analysis of the interview data is NVivo. This analysis was used to develop an extended TAM model and to suggest a theoretical model of the relationship between LORENZO development methodology and users' acceptance. The study suggests some factors, apart from usefulness, which LORENZO's designers, the NHS should take into account when it comes to enhance users' usage of IT adoption. These factors are clinical safety, security, integration and information sharing.

Keywords: National Programme, Information Technology, National Health Services, LORENZO, England

Introduction

Today, there is a growing interest towards the adoption of new technology in the field of medical services and personal health care systems in general (Vladimir *et al*., 2012). The need for the adoption of Health Information Systems (HISs) and the positive impact that these systems can have on the quality, effectiveness and efficiency of health care services have been noticed over the past years in different parts of the world (Adnan *et al*., 2013). According to (Adnan *et al*., 2013) in many European nations, as well as other countries around the world, there is a growing awareness that strategic investments in innovative clinical information system as

well as other types of (HISs) can yield significant improvement for an entire healthcare system. An increase in allocating and financing sources and capital investment in the adoption of new technology may allow businesses to affirm themselves on the market in the long term by offering new products and gaingnig competitive advantage (Sgroi *et al*., 2014b; 2014c). For these reasons UK's government has tried to find a solution to balance the level of public support with the costs of technologies, providing stability and certainty to the market (Sgroi *et al*., 2014a; Di Trapani *et al*., 2014).

Technology, Knowledge and innovation are the main characteristics of successful organizations in Today's economy (Karlson *et al*., 2011; Hajikarimi *et al*.,

2013). The tremendous capabilities of Information Technology (IT) in processing, storing and retrieving information has resulted in fast growth in computer usage through the adoption of new technology (Rowley *et al.*, 2011; Damanpour and Aravind, 2011). IT has affected every sector in human life and health care is no exception. The use of IT in healthcare sector is one of the major factors that help in improving the services provided to patients. Although IT is widely used in hospitals but still there is a need for a comprehensive health care system that support the saving of time, money and effort. It has been one of the UK government's top priorities to adopt IT application in healthcare. The Department of Health (DoH) provides health care through the National Health Service (NHS), supported at a regional level by the Strategic Health Authorities (SHAs) and at a local level through local NHS organisations, as shown in Fig. 1 (DoH, 2002). As shown in Fig. 1, the NHS provides health care to patients regionally through 28 SHAs that were established in 2002. In July 2006, the number of SHAs was reduced to 10 covering the whole of England.

In the United Kingdom, the introduction of IT started from the 1960s illustrated by computer systems for Patient Administration Systems (PAS), followed by laboratory and radiology systems in the 1970s. Hospital information support systems and resource management systems were introduced in 1980s. In 1990s, the NHS developed an IT strategy that resulted in the introduction of Electronic Patient Record (EPR) and later an Electronic Record Development and Implementation Programme (ERDIP) (Currie and Guah, 2007). Modernising the NHS began in July 2000 as a 10-year reform programme. Since 2000, the NHS has initiated a series of reform programme that aimed at improving the quality of health services and providing healthy lives for the people of the UK.

The National Programme for Information Technology (hereafter, the NPfIT) is the World's largest IT upgrading project (Brennan, 2007). The NPfIT is a 10-year programme for creating a national and integrated IT infrastructure. The NPfIT is centrally controlled by the NHS Connecting for Health (CfH) agency to procure various IT applications with a total expected expenditure of £12.4 billion over the ten years until 2013/2014 (HoC, 2007). The NHS CfH is seen as the single national IT provider for the NHS and is responsible for delivering the NPfIT (Cresswell and Sheikh, 2009). Once the national systems are installed, they will connect 110,000 doctors, 390,000 nurses and 120,000 other health professionals (NHS, 2008). Moreover, patients will have access to their personal health information.

The main objective of the NPfIT is giving health professionals access to patient-related information safely, securely and easily whenever and wherever it is needed (NHS CfH, 2007). The NPfIT consists of four main components. The first component is the NHS Care Records Service (CRS). The second component is the electronic booking system (Choose and Book) that enables patients to choose their appointments. The third component is Electronic Transmission of Prescriptions (ETP) for generating and transmitting prescriptions electronically. The fourth component is the NHS National Network (N3) that provides the NHS with the IT infrastructure and networking services.

To understand how the NHS users' behaviour toward the use of technology affected the implementation of LORENZO, the author relied on the Technology Acceptance Model (TAM). However, the author adopted a qualitative approach to research this area instead of the quantitative methods that are usually applied to extend the TAM.
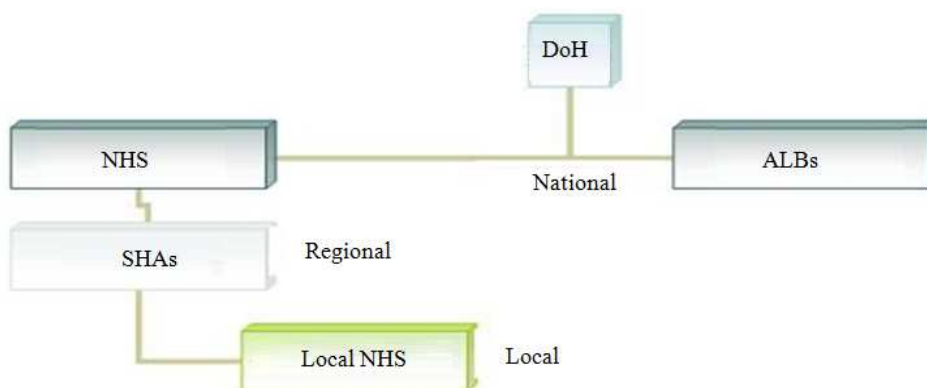

Fig. 1. The governance system of the DoH

Research Problem

Coplan (2012) claimed that the failure rate in healthcare IT projects is high. Moreover, unlike the small or midsized projects, large scale projects (NPfIT is an example) encounter implementation problems such as delays (Currie and Guah, 2006). One can notice that implementing IT initiatives in healthcare organisations incorporates challenges. Thus, the UK Government funded NPfIT as the biggest IT project in the world ever, needs special attention from the decision makers in the Department of Health (DoH), the NHS CfH, as well as researchers in order to sustain the resources that have been invested in it since its inception in 2002. Therefore, this research presents an exploratory study from the perspective of end users and developers of LORENZO to identify the significant factors that influence its implementation.

Research Objectives

The broad aim of the present study is to investigate the status of LORENZO implementation in the NME region at the local level (bottom-up approach). To achieve the broad aim, the present study focuses on end users' attitudes toward the use of LORENZO through the qualitative inquiry lens. The TAM is the theoretical model to be used in the present study.

Discussion

Implementation of IS projects has witnessed a high failure rate in comparison with other high-tech projects (Mahaney and Lederer, 1999; Yeo, 2002; Laudon and Laudon, 2006; Karlson *et al*., 2011; Coplan, 2012; Hajikarimi *et al*., 2013). Since the IT applications of the NPfIT are designed and developed by commercial IT companies, those companies might not have been able to either deal with the people and the organisational arrangements in the NHS, or consider those factors which enhance the success of the technologically advanced programs within the NPfIT. Furthermore, given that CSC outsources LORENZO, which is the fundamental outcome of the NPfIT, the designers might not have taken into account the requirements of the intended users during the design and operation of the system. IS in healthcare, DeLone and McLean Model of IS Success, Components of the Npfit and Lorenzo are essential issues of the research to be discussed next.

Information Systems in Healthcare

Because healthcare industry is transaction-intensive, an enormous amount of information needs to be processed, stored and retrieved for future use (Drotz and Poksinska, 2014). This situation necessitates using IT in healthcare organisations to overcome some problems that have existed for a long time in the healthcare industry, such as lost, incomplete and inefficient information. With time, information systems have constituted an integral component in managing health services in the developed countries and a separate professional discipline regarding IT in healthcare emerged.

E-health is a health practice that is supported by electronic processes and communications (Rodrigues and Vaidya, 2010; Erik and Carlton, 2014). In spite of the intensive use of information and communication technologies, e-health still suffers from the poor management of information flows (Medina-Garrido and Crisóstomo-Acevedo, 2010; Huang *et al*., 2012). Therefore, it becomes necessary to create Computer Based Health Information Systems (CBHIS) that store and provide information to health professionals without hindering access.

One of the most important IT applications in the healthcare industry is the so-called Electronic Medical Record (EMR) (Goldsmith, 2005). The EMR is used in health organisations to document clinical information about patients and as a communication tool among health providers who are involved in patients' care (Wager *et al*., 2005). In addition, the EMR is also used as a tool, which provides clinicians with decision support capabilities and access to clinical knowledge resources, reminders and alerts (Spil *et al*., 2010).

It is argued that the healthcare sector has been slow to adopt HCIS (Wager *et al*., 2005) and other IT applications if compared with other sectors in the modern economy (Goldsmith, 2005). The reasons for the slow adoption of IT tools in health sectors according to (Goldsmith, 2005; Wager *et al*., 2005; Bates and Gawande, 2003) are related to complexity of healthcare information and procedures, complexity of healthcare organisations, difficulty of integrating healthcare systems, cultural barriers and financial barriers.

DeLone and McLean Model of IS Success

The IS literature offers a plethora of theories, which explain users' acceptance of the newly installed systems in terms of the factors that mostly affect their inclination to use new systems (Sharma and Yetton, 2003; Gelderman, 1998; Yuthas and Eining, 1995; DeLone and McLean, 1992). For instance, Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al*., 2003), Model of PC Utilization (MPCU) (Thompson and Higgins, 1991), Diffusion of Innovations (DOI) (Rogers, 2003), Perceived Characteristics of Innovations (PCI) (Moore and Benbasat, 1991) and Technology Acceptance Model (TAM) (Davis, 1989). However, little research has been conducted to utilise and adapt these theories to the healthcare sector, which causes a shortage of explanations of end users' usage of IT (Schaper and Pervan, 2004).

In this study the focus will be on (DeLone and McLean, 1992) theory who argue that the importance of UIS and system usage as surrogate measures of IS success. However, after a comprehensive review of 180 studies, which are concerned with IS success, DeLone and McLean (1992) found out that some IS researchers have focused on studying the characteristics of the system itself (system quality), other researchers have concentrated their study on the characteristics of the information generated (information quality) and others have focused on investigating the impact of IS on both individual and organisational performance. In sum, DeLone and McLean (1992) synthesized six dimensions, which constitute a wider taxonomy of IS success that is still widely used by IS researchers. This study concentrates on some variables that have been given greater importance in the IS literature due to their enormous effect on the destiny of the EHR systems. These include Top Management Support, User Involvement, User Support, User Training, Availability of Resources and Championship.

Components of the Npfit

The NHS decided to adopt a strategic outsourcing approach, which entails selectively outsourcing the major components of NPfIT in an incremental 3-phase change strategy (DoH, 2002). There are four main components of the project: The NHS Care Records Service (NHS CRS), Electronic Transmission of Prescriptions (ETP), Electronic appointment booking (Choose and Book) and, the NHS National Network (N3), which provides high-speed internet connection (DoH, 2002).

The North, Midlands and East Programme for IT (NMEPfIT)

There are six SHAs in the NMEPfIT (60% of the contract) which are; North East, North West, East Midlands, West Midlands, East of England and Yorkshire and the Humber SHAs. CSC is the LSP and its main subcontractor is iSOFT. The NMEPfIT is committed to LORENZO, which is procured by CSC.

LORENZO: The NHS CRS in the Nmepfit

The LORENZO Regional Care system or the so-called LORENZO has been designed by iSOFT subcontractor in the CSC alliance (CSC, 2009). LORENZO is being implemented in the NMEPfIT that covers six out of the 10 SHAs covering the whole of England. LORENZO was chosen and accredited by the NHS CfH as a key system on which the creation of the NHS CRS is based, to develop connected EHRs for the 30 million patients in the NME region (Moran, 2010). LORENZO replaces the existing patient administration and clinical management systems in the NHS organisations to give them an extraordinary ability to share clinical and patient information among them. In addition, LORENZO is expected to provide more integrated and complete EHR that covers the complete healthcare journey.

Methodology

Qualitative research, broadly defined, is 'any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification' (Strauss and Corbin, 1990). According to (Sekaran, 2003; Holloway, 2005; Silverman, 2005; Sarantakos, 2005; Shah and Corley, 2006; Bryman and Bell, 2011; Mazzetti, 2013) qualitative research approaches aim to discover meanings and patterns through observations and interviews.

The current research adopts the qualitative approach in order to interview end users or those who represent them and understand what influences their attitudes toward the use of LORENZO. Based on what has been discussed, it would be useful to go to the field and talk to the people who actually use LORENZO in the NHS. The interaction with the intended users enables the author to gain better understanding of the factors and other issues related to LORENZO's implementation. Qualitative approach allows to identify what are the factors that influence significantly end users' acceptance of LORENZO and to understand how LORENZO's development methodology affects users' attitude toward the use of LORENZO.

The author adopts semi-structured interviews to establish a professional conversation with the target participants who agreed to be interviewed. The author's decision to use semi-structured is based on a set of reasons that justifies the author's choice. Saunders *et al.* (1997) stated that the nature of the research in terms of what it tries to achieve determines the type of the interview to be adopted.

The author interviewed six participants who occupy senior positions in their organisations. Sekaran (2003) stated that researchers can conduct their interviews online, face-to-face or by telephone. The author used in-situ, face-to-face semi-structured interviews. It is the author's belief that meeting expert people face-to-face to obtain their views requires good "social skills and personal sensitivity" (Walsham, 1995).

In light of the above discussion, the author uses a non-probability snowball sample. The selection criterion of the sample subject is that the participants to be interviewed from either the NHS or the LSP side should possess the required knowledge and expertise in LORENZO's implementation. The selection criterion implies that people from the LSP side should be involved in designing and implementing the system in the NHS and be familiar with or have had prior contact with the target users in the NHS organizations.

Analysis of the Collected Data

The author relied on computer-based analytical tools to assist the achieving of the objective of storing, coding, retrieving and linking data (Bryman and Bell, 2011; Patton, 2002). The software that was used to analyze the data refers to Computer-Assisted Qualitative Data Analysis Software (CAQDAS) (Patton, 2002). The use of NVivo does not mean that the data entered into the software has ready explanatory potential. Instead, the author followed certain steps/stages to assure the full usage of data with its descriptive and explanatory power.

The first step of the data analysis was the transcription of the digital audio-recorded interviews. The second step is Creating NVivo Projects. The third step is coding the Transcripts. The fourth step is Writing Memos. The fifth step is Creating Tree Nodes. The sixth step is bringing the project together. The resulting core categories were illustrated in schematic diagrams (Models). These models enabled the author to see how the various concepts are linked together and to read beyond participants' words to understand LORENZO implementation and to shed light on issues related to it. These categories are explained in the next sections:

The First Category: Clinicians' Attributes

This category includes seven concepts as shown in Table 1. Clinicians' attributes category highlights how end users' traits influence and/or explain their acceptance or/resistance to using LORENZO. The author used clinicians to denote end users who are entitled to use LORENZO in the NHS. To have a clear picture of where the seven concepts came from and how they were included in the clinicians' attributes category, Table 1 shows the source of each concept which occurred in all projects except R4?

The Second Category: Departmental Factors (Nature of Working Environment)

This category encompasses concepts that describe the nature of the working environment in the bottom line of the NHS. For instance, the wards in a certain hospitals or the various medical specialties that compose a medical journey, through which patients pass to get health care. By looking at Table 2, one can observe that the Departmental Factors category occurred in three projects, which are R1, R4 and R5. Each of the three projects contains two or more factors (i.e., concepts).

The Third Category: Organisational Factors

The Organizational Factors category has the lion's share in terms of the number of the concepts that comprised this category. By looking at Table 3, one can notice that the Organisational Factors category was mentioned in four projects, which are R2, R4, R5 and R6. R1 and R3 did not mention this category except for the Lack of Medical Input that was an aggregation of the entire main categories in R1. The fact that R3 is a US consultant in one of the NHS trusts in the NME region, justifies why not mentioning any of the concepts that shaped the Organisational Factors category, because he was not familiar with the NHS organisational context.

The Fourth Category: LSP Related Factors

Table 4 shows that LSP Related Factors category occurred in three projects, R1, R2 and R6. Analysis of the data revealed six concepts. Interviewees' professional backgrounds and expertise of working in the LSP' company assisted the author to compose this major category. It should be mentioned that three (R2, R5 and R6) work with the LSP of LORENZO and R1 had experienced working with the LSP of LORENZO.

The Fifth Category: System Related Factors

Table 5 depicts the concepts of the System Related Factors category. Analysis of the data revealed some factors that are related to the system, which is LORENZO (the NHS CRS) that has been deployed in the NME region. Some of these factors are related to LORENZO as well as the NPfIT in general, because NPfIT (the context) within which LORENZO was developed influenced LORENZO implementation either, directly or indirectly. Table 5 shows that System Related Factors category was repeated in five projects, R1, R2, R3, R4 and R5. Analysis of the data revealed 13 concepts that shape the present category.

The Sixth Category: The Nature of Clinical Processes

Table 6 shows that The Nature of Clinical Processes category was highlighted in two projects R1 and R6. R2, R3 and R4 mentioned merely one concept that is included in this category and therefore the author could not create The Nature of Clinical Processes category in R2, R3 and R4 (the star on the top of the check mark indicates the concept that stood alone in these projects). Analysis of the data ended up with four concepts under The Nature of Clinical Processes category.

The Seventh Category: Clinical Safety

Table 7 shows four concepts that were mainly derived from R6. Despite the fact that Clinical Safety category was not repeated in other projects, R1, R2 and R4 highlighted the notion that clinical safety was of importance for LORENZO to be accepted by clinicians. Thus, their views were embedded in the concept of clinical safety rather than the concepts that formed the current category.

Table 1. The sources of the concepts in clinicians' attributes category

| | The project | | | | | |
Concepts	R1	R2	R3	R4	R5	R6
Difficulty in Reaching Consensus	×	√	×	×	×	×
End Users' Autonomy abd Power	√	×	×	×	×	×
Lack of End Users' Informatics Experience	√	×	√	×	√	×
Busy Clinicians (Lack of Time)	×	×	√	×	×	√
Anxiety in Using the System	×	×	×	×	√	×
Generational Gap	√	√	√	×	√	×
End Users' Training (inappropriate)	√	×	×	×	×	×

Table 2. The sources of the concepts in the departmental factors category

| | The project | | | | | |
Concepts	R1	R2	R3	R4	R5	R6
Diversity of IT Applications	√	×	×	×	×	×
Individualistic Nature of the Practise	√	×	×	×	×	×
Lack of Benefits Realisation	×	×	√*	√	√	×
Lack of Clinical Input	√*	√*	×	√	×	√*
Non-Practising Clinicians	√	×	×	√	×	×
Tension within and between End Users Groups	√	×	×	×	×	×
Various System Deployment Environments	×	×	×	√	×	×
Various User Groups and Specialties	√	×	×	×	√	×
Work Pressure	√	×	×	×	×	×

Table 3. The sources of the concepts in the organisational factors category

| | The project | | | | | |
Concepts	R1	R2	R3	R4	R5	R6
Focus on Single Organisations for Deployment (absence of Critical Mass)	×	×	×	√	×	×
Lack of Clinical Input	√*	√	×	√*	×	√
Lack of NHS Trusts Involvement	×	√	×	√	√	√
Lack of Organisational Readiness	×	×	×	×	√	×
Lack of Senior Level Awareness of the Project	×	×	×	√	×	√
Lack of Senior Level Medical Expertise	×	√	×	×	×	×
Lack of Top Management (NHS) Support	×	√	×	√	√	×
Legal Implementation of Procedures vs. Guidance	×	√	×	×	×	×
NHS Organisational Structure	×	×	×	×	√	×
Non-Supportive NHS organisational Culture	×	×	×	×	√	×
Political Influence on System Deployment	×	×	×	√	√	×
Rewards for Adopting the System	×	×	×	√	×	×
Stakeholders and Communications Management	×	√*	×	×	√	√
Undocumented tacit knowledge-absence of externalisation	×	√	×	×	×	×

Table 4. The sources of the concepts in the LSP related factors category

| | The project | | | | | |
Concepts	R1	R2	R3	R4	R5	R6
Lack of Clinical Input	√*	√	×	√*	×	√*
Lack of Interaction between the LSP and the Local NHS	×	√	×	×	×	×
Lack of LSP's HIS Development Expertise	√	×	×	×	×	√
Lack of Technical Support	√	×	×	×	√*	×
Limited Influence to Facilitate Software Usage	×	√	×	×	×	×
Reliance on LSPs to Standardize Clinical Processes	×	×	×	×	×	√

Table 5. The sources of the concepts in the system related factors category

Concepts	The project					
	R1	R2	R3	R4	R5	R6
The Newness of the System	√	×	×	×	√	×
Complexity of the Software	×	√	√	×	×	×
Changing (Creeping) Requirements	√	√	×	√	×	×
Compatibility of the System	×	×	×	×	√	×
Large Scale of the Project	√	×	×	×	×	×
Limited Completion Time	×	×	√	√	×	×
System Development Methodology	×	×	√	×	√	×
System's limited Functionality	×	×	×	×	√	×
Determination of system's Strategic Objectives	×	×	×	×	√	×
Problem Recognition and Definition	×	×	×	√	×	×
Integration and Information Sharing	×	×	√	×	×	×
Highly Configurable System	×	×	×	√	×	×
The Technological Nature of the Programme	×	√	×	×	×	√*

Table 6. The sources of the concepts in the nature of clinical processes category

Free nodes	The project					
	R1	R2	R3	R4	R5	R6
Ambiguous, ill-defined Business Processes	√	×	×	×	×	×
Lack of Understanding of Clinical Processes	√	×	×	×	×	×
Variation in (Unstandardised) Clinical Processes between and within NHS Organisations	√	√*	√*	√*	×	√
Lack of Task-Technology Fit	×	×	×	×	×	√

Table 7. The sources of the concepts in clinical safety category

Free nodes	The project					
	R1	R2	R3	R4	R5	R6
Lack of importance placed on clinical safety	×	×	×	×	×	√
Risk Assessment	×	×	×	×	×	√
Local ownership of risk	×	×	×	×	×	√
Reporting system of safety issues	×	×	×	×	×	√

Conclusion

The main aim of the research is to extend the TAM by examining the implementation of LORENZO? This objective is achieved and is explained in three parts. These parts are listed below:

Evaluating the suitability of the TAM to assess and predict users' behaviour toward LORENZO usage in the NHS.

Although the TAM is one of the most useful models in explaining users' behaviour toward the use of technology, it might not be the same in the case of studying clinicians' behaviour toward the use and acceptance of LORENZO in the NHS. This is because users' behaviour toward the use of technology (according to the TAM) is mainly determined by the perceived characteristics of the computerised system, which is ready to be used and fully functional. In LORENZO the perceived features of the system are not clear, as the system is not fully functional due to the Deployment Units methodology.

Thus, one can conclude that the methodology, by which LORENZO was developed, affected users' attitude toward its usage. Moreover, the author claims that the TAM is based on the evaluation of a certain IS that is used by a certain group of users. In LORENZO, it is not the same as LORENZO encompasses various sub systems (deployment units); each deployment unit accomplishes different tasks and consequently might entail different methods of usage. One point to bear in mind is that LORENZO is a mega IT project, which makes it difficult to study its level of usage through the TAM lens. This necessitates taking into account the size of the project when studying users' behaviour.

Identifying the set of features of LORENZO that enable end users to hold positive attitudes toward its usage.

Despite the drawbacks that are associated with using the TAM in predicting users' behaviour toward

LORENZO usage, the author suggests some factors, apart from usefulness, which LORENZO's designers, the NHS CfH agency and the SHAs should take into account when it comes to enhance users' usage of the deployment units. These factors are clinical safety, security and integration and inforzmation sharing. The author should mention the fact that not all of the factors are perceived characteristics of the system; for instance, security may be seen as an embedded system feature that users perceive when they use the system, whereas, clinical safety and information sharing may be perceived as an outcome of using the system. Figure 2 shows the factors influencing end users' attitudes in a modified TAM. These include clinical safety, security, usefulness and integration and information sharing.

Identifying the set of external variables, which influence end users' behaviour toward the use of LORENZO.

The fact that the author aimed at studying the status of implementation LORENZO in the NME region as the broad aim of the present study was met by adopting a multi- perspective approach. The adoption of this approach is represented in the inclusion of the various healthcare actors involved in the implementation of LORENZO. Figure 3 shows the set of external variables, which influence end users' behaviour toward the use of LORENZO. These include clinicians' attitudes, departmental factors, organizational factors, system related factors, LSP related factors and the nature of clinical processes.
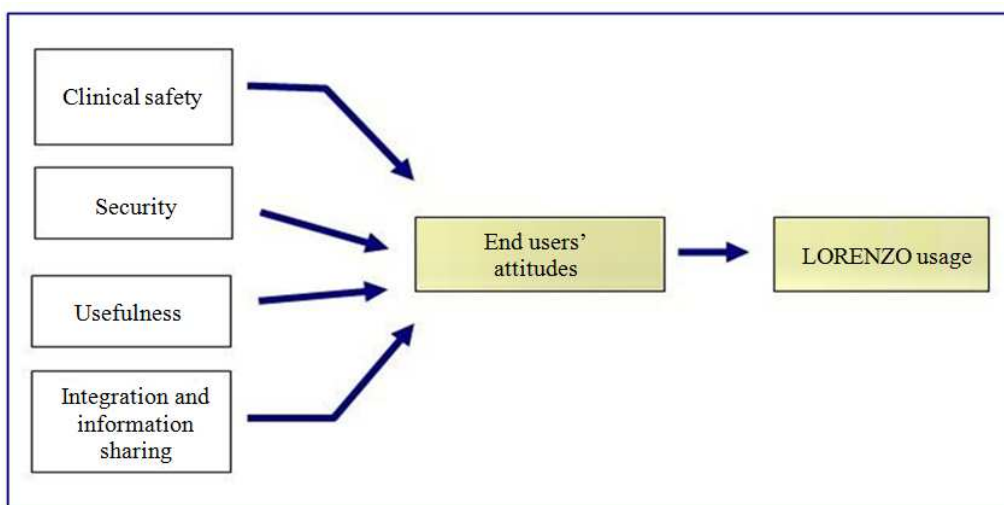

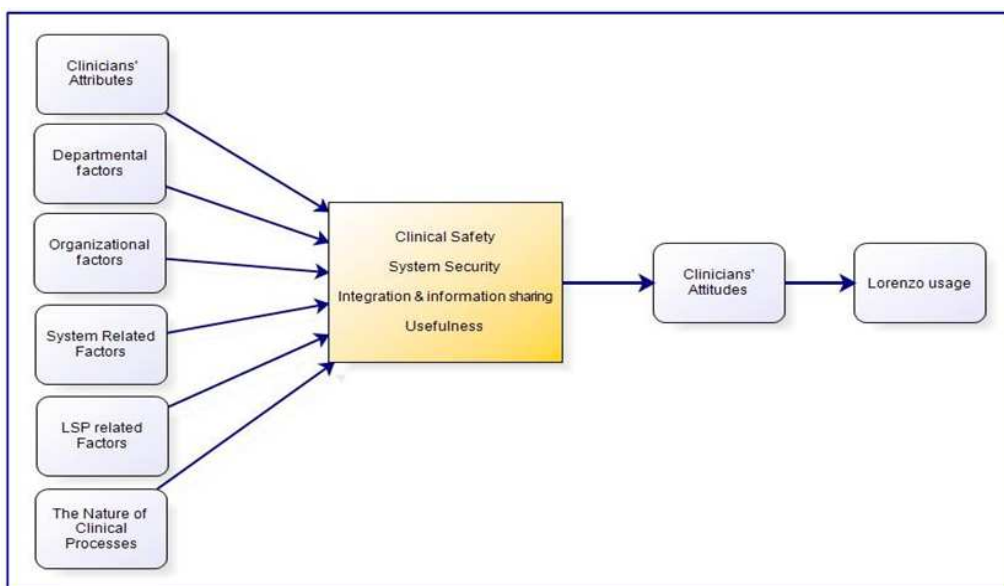Fig. 2. Factors affecting end users' attitudes in a modified TAM

Fig. 3. External variables in modified TAM

Contributions of the Research

This study came at a time when NHS organisations started rolling out some of LORENZO's deployment units in the NME region. The huge government investment in the NPfIT was made to improve the health service in England and enable patients and health providers to obtain complete and up-to-date information anywhere and at any time. The contribution of this research can be summarised in the following:

- Unlike previous studies that investigated specific IT-based health applications, this research focused on LORENZO as a whole in order to enable the author to examine the outcome of this application on end users. The decision to study LORENZO represents an opportunity to study a mega IT project that has not been applied in other healthcare sectors in Europe
- This research presented a proposed extended TAM model that was created using qualitative data obtained from informed, internal views. This is considered as a departure from the usual way of extending the TAM quantitatively. The perceived features of LORENZO reflect the special nature of that system and the real setting (i.e., the NHS)
- From a theoretical point of view, this research adds a contribution to the IS literature by exploring a potential relationship between the development methodology of an IS and the intended users' acceptance (usage). In practice, this potential relationship proved to exist between LORENZO's development methodology and its usage. This relationship is medicated by the extent to which the benefits of LORENZO are realised
- This research provide a research-based evidence that the human factors involved in the implementation of IS should be seen at a micro and macro level. The micro level is represented in the individual users and their influencing internal and external traits. The macro level is represented in the groups of individual users

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Author's Contributions

Authors equally contributed to this article.

Ethics

We confirm that this manuscript has not been published elsewhere and is not under consideration by another journal. Each author confirms the manuscript represents honest work. All authors have approved the manuscript. Each author agrees with the order in which his name appears on the title page.

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