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Vasiliki Mantzana
Brunel University, vasiliki.mantzana@brunel.ac.uk

Marinos Themistocleous
Brunel University, marinos.themistocleous@brunel.ac.uk

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BENEFITS AND BARRIERS RELATED TO EAI ADOPTION: THE CASE OF A HEALTHCARE ORGANISATION

Mantzana, Vasiliki, School of Information Systems, Computing and Mathematics, Brunel University, Uxbridge, UB8 3PH, UK, Vasiliki.Mantzana@brunel.ac.uk

Themistocleous, Marinos, School of Information Systems, Computing and Mathematics, Brunel University, Uxbridge, UB8 3PH, UK, Marinos.Themistocleous@brunel.ac.uk

Abstract

Enterprise Application Integration (EAI) technology has emerged to overcome integration problems at different levels such as process and data. Although, many public and private organisations have successfully implemented EAI solutions, the adoption of EAI in healthcare organisations is slow and problematic. The research that has been published in this area remains limited and has mainly focused on factors (e.g. benefits, barriers etc) that influence the decision making process for EAI adoption in healthcare. Notwithstanding, the implications of EAI have yet to be assessed, leaving scope for timeliness and novel research. The main contribution of this paper is the identification of the benefits and barriers associated with the EAI adoption in healthcare. In addition, this research has identified and mapped healthcare actors to these benefits and barriers. Therefore, it supports the decision making process as it results in more informed practices and thus speeds up EAI adoption in healthcare. This is of high importance as 23725 human lives are lost in UK every year due to the limitations of the non-integrated healthcare Information Technology (IT) infrastructures. The proposed approach is significant and novel as it (a) improves the realisation of EAI adoption benefits and barriers, (b) enhances the analysis of EAI adoption in healthcare by incorporating an actor-oriented approach and (c) facilitates healthcare organisations and decision-makers in realizing EAI adoption benefits and barriers. Thus, it significantly contributes to the body of knowledge and practice in this area. Thus, it provides sufficient support to the management and speeds up the adoption process.

Keywords: *Enterprise Application Integration (EAI), Healthcare Information Systems (HIS), Adoption, Benefits, Barriers, Actors.*

1   INTRODUCTION

The efforts to modernise the healthcare sector through the implementation of Information Systems (IS) have led to the development of Heterogeneous, Autonomous and Distributed (HAD) software applications (Howcroft and Mitev, 2000; Tai *et al.*, 2000). The heterogeneity of IS refers to systems that develop their own process model. IS autonomist is related to the systems' interdependent nature whereas the distributed applications refer to the non-shared implementations of multiple IS (Izza *et al.*, 2005). To this end, Enterprise Application Integration (EAI) has emerged to bridge together HAD systems and to develop flexible IT infrastructures. In doing so, EAI incorporates functionality from disparate IS. Only recently have healthcare organisations turned to EAI adoption, despite the amount of EAI applications in private and public domain (Puschman and Alt, 2001). To better realise the EAI effectiveness in healthcare organisations, more research should be conducted. This issue is of high importance, as the integration of Healthcare Information Systems (HIS) is related to human lives. To emphasise on this, it has been reported that the non-integrated nature of HIS results in medical errors, which are related to the loss of 64 persons per day in United Kingdom (UK) (Khoumbati, 2005).

The normative literature has focused on the identification of factors, such as benefits, barriers and costs, affecting the EAI adoption. Nevertheless, this is a new research area with many issues under research, like the role of actors during the adoption process. In this paper, the authors focus on the analysis of the benefits and barriers affecting the EAI adoption in healthcare organisations, as these have not been yet perceived as anticipated. In addressing this void, the paper initially introduces the area of EAI adoption and then EAI benefits and barriers (Section 2). Thereafter, the authors conceptualise a model to support the benefits and barriers analysis. The research methodology used to test this model is then reported. In Sections 5 and 6, the empirical findings are discussed, with key lessons learnt extrapolated and presented as implications to practice before offering conclusions.

2   ENTERPRISE APPLICATION INTEGRATION

The limitations of the "applications' spaghetti" have motivated healthcare organisations to seek for more advanced integration technologies, such as Enterprise Application Integration. EAI combines a variety of integration technologies such as web services, message and process brokers, to build an integration infrastructure (Linthicum, 1999). As a result, EAI incorporates functionality from a diversity of systems and leads to the development of flexible, and maintainable integrated IT infrastructures. There is therefore an increasing demand from different types of organisations to build EAI solutions, to integrate their systems at intra and inter-organisational level. Lam (2005) reported that EAI adoption and implementations differ from the traditional IS projects, as EAI: (a) refers to the integration of existing IS rather than the development of new, (b) affects multiple IS in organisations, (c) involves different stakeholder groups and (d) lacks of established development methodologies. As EAI differs from traditional systems, more research should be conducted in this area.

However, the focus of current research in the area of EAI is on the identification and analysis of the parameters affecting EAI adoption. Themistocleous (2002; 2004) studied the EAI application in private and public organisations, proposed and validated a model, which explains factors influencing EAI adoption. That model includes among others factors like: (a) cost, (b) barriers and (c) benefits. Khoumbati, (2005) applied and extended the model proposed by Themistocleous (2002) in the healthcare sector based on a comprehensive literature review on health informatics. In doing so, he suggested that other factors like medical (e.g. telemedicine and clinical support) should be considered during the EAI adoption by healthcare organisations. The factors proposed by Khoumbati (2005) include: (a) benefits, (b) barriers, (c) costs, (d) compatibility, (e) internal pressures, (f) external pressures, (g) IT infrastructure, (h) IT support, (i) IT sophistication, (j) evaluation framework, (k) telemedicine, (l) size of organisation, (m) patient satisfaction and (n) physician and administrator relationships (Khoumbati, 2005). This paper focuses on two of these factors, namely benefits and barriers, to further investigate this phenomenon in a healthcare setting.

3   CONCEPTUAL MODEL

Much of the research conducted by Themistocleous and Irani (2001) focuses on the classification of EAI benefits and barriers in multinational enterprises. Some of the benefits and barriers identified are specific for private companies and it is difficult to apply them in the healthcare sector (e.g. competitive advantage). However, there is a wide range of benefits and barriers identified that are generic and can also apply in the healthcare. For instance, Themistocleous and Irani (2001) supported and validated that EAI can integrate all systems' types (e.g. legacy and e-business). This benefit can not only be achieved in the application of EAI in private sector but in any environment. The authors have critically reviewed the normative literature, identified the sub-factors of EAI benefits and barriers in healthcare. In doing so, the authors have *synthesised a portfolio of benefits and barriers* and *classified* them using the same taxonomy evaluated by Themistocleous and Irani (2001). Accordingly, EAI benefits and barriers have been classified into organisational, managerial, operational, strategic and technical dimensions. Thus, the authors have extended the body of knowledge in this area, as well as the application of the aforementioned taxonomy in a new domain (healthcare).

	Factors	Sub-Factors	References
Operational	**Benefits**	▪ Increases productivity ▪ Reduces cost ▪ Improves data quality ▪ Improves data sharing/flow ▪ Provides better access to data ▪ Provides easier exchange of data ▪ Improves data presentation	▪ Duke *et al.,*(1999) ▪ Linthicum (1999) ▪ Ring and Ward-Dutton (1999) ▪ James (2002) ▪ Lubinski and Barr (2003) ▪ James (2002) ▪ James (2002)
	Barriers	▪ Extra cost to redesign business processes and structure ▪ High EAI implementation cost	▪ Duke *et al.,*(1999) ▪ Linthicum (1999)
Managerial	**Benefits**	▪ Improves managerial control ▪ Provides more understanding and control of processes ▪ Supports decision making ▪ Improves allocation of resources ▪ Improves quality of care provided	▪ Chwelos *et al.,* (1997) ▪ Duke *et al.,* (1999) ▪ Edwards and Newing (2000) ▪ James (2002) ▪ Ceusters *et al.,* (1997)
	Barriers	▪ Lack of employees with EAI skills	▪ Khoumbati (2005)
Strategic	**Benefits**	▪ Supports more effective planning ▪ Increases a/synchronous collaboration among actors ▪ Improves knowledge sharing	▪ James (2002) ▪ Edwards and Newing (2000) ▪ James (2002)
	Barriers	▪ Resistance to change ▪ Organisations resist to share their data with partners ▪ Security and confidentiality of patients' data	▪ Mantzana and Themistocleous, (2005) ▪ Khoumbati (2005) ▪ Zhanjun *et al.,* (2003)
IT Infrastructure	**Benefits**	▪ Reduces development risk ▪ Achieves process integration ▪ Provides objects/components integration ▪ Provides data integration ▪ Provides real-time integration ▪ Integrates packaged systems ▪ Integrates e-business solutions	▪ Martinez and Redondo (2001) ▪ Ring and Ward-Dutton (1999) ▪ Ring and Ward-Dutton (1999) ▪ Linthicum (1999) ▪ Zahavi (1999) ▪ Edwards and Newing (2000) ▪ Ring and Ward-Dutton (1999)
	Barriers	▪ Lack of knowledge related to EAI ▪ Existing systems are incompatible and complex ▪ Integration technologies are confusing	▪ Khoumbati (2005) ▪ Linthicum (1999) ▪ Themistocleous, (2002)
Organisational	**Benefits**	▪ Reduces hospitalisation ▪ Reduces waiting times ▪ Achieves effective clinical and administrative management ▪ Increases business efficiency ▪ Supports clinical decision making ▪ Reduces paper work processes	▪ Ginneken (2002) ▪ Godefridus *et al.,* (2004) ▪ Zhanjun *et al.,* (2003) ▪ Markus and Tanis (1999) ▪ James (2002) ▪ Martinez and Redondo (2001)
	Barriers	▪ Complexity of business processes ▪ Cultural issues ▪ Political issues ▪ Time needed for training	▪ Linthicum (1999) ▪ Mantzana and Themistocleous, (2005) ▪ Khoumbati (2005) ▪ Zhanjun *et al.,* (2003)

Table 1: Proposed Benefits and Barriers of EAI Adoption in Healthcare Organisations

To this end, the benefits and barriers identified and presented in Table 1 should be validated in the practical area. Thus, the first Research Issue (RI) suggested for further investigation will examine whether:

***RI₁: The proposed benefits and barriers influencing EAI adoption in healthcare (Table 1)
are complete and representative***

As reported above and presented in Table 1, this paper studies the benefits and barriers that influence the EAI adoption in healthcare. Nonetheless, a factor oriented analysis of the adoption of a technology has its own limitations. In support of this, Kautz and Henriksen (2002) argued that the explicit use of a factor-oriented is inefficient to support the IS adoption. The reason for this is that it is inadequate to describe the interactions among the various actors'-stakeholders'[1] influencing this process. As a result, the actors involved in the adoption should be studied and analysed in relation to the influential factors. In doing so, their interrelations and roles should be identified and explained. In addressing this need, the authors propose that initially the actors should be identified, and then the actors' and factors' approaches should be combined. Such an approach will significantly increase the level of understanding, as well as the technology's adoption.

Robey (1979) and Ginzberg and Zmud (1998) have studied the importance of actors' beliefs and attitudes and how these are affected and/or affect the factors influencing innovations' adoption. Thus, particular attention needs to be paid to these "softer" issues, which are usually underestimated (McGrath and More, 2001). Rogers, (1995) proposed that the actors and the perceived characteristics of innovation have an impact on individual's adoption of IT. Thus, individual actors (e.g. professionals) are critical in defining the success of IT adoption. Chau and Hu (2002) argue that physicians have a significant role in introduction and use of IT. Fitzerald *et al.*, (2002) and Wiley-Patton and Malloy (2004) pointed out that the uptake process is highly affected by actors involved in or "adopters" of the innovation. Healthcare actors are not *passive* acceptors of an idea, but they have an essential role during the adoption process.

The role of actors is considered to be of high importance during the HIS adoption process. As a result, the authors propose that an actor-oriented approach should be considered when EAI is introduced in healthcare organisations. Such an approach should be examined in relation to the benefits and barriers influencing this process to: (a) enhance the level of analysis and (b) support healthcare decision makers to adopt EAI. The combination of benefits and barriers with actors (to study the EAI adoption) could be applied to the rest of the influential factors. However, this paper emphasises on benefits and barriers and leaves the remaining factors for further research. Thus, the following Research Issue arises for further investigation:

***RI₂: The actors should be studied in relation to the benefits and barriers influencing EAI
adoption in healthcare***

In an attempt to piece together these two approaches (factors/sub-factors and actors), there are numerous issues that should be investigated. Among the first to be explored, is the identification of the healthcare actors that affect and are affected by EAI adoption (actor-oriented approach). Thus, the method proposed by Mantzana *et al.*, (2006) was employed in this study as it is specific for healthcare actors. In the conceptual model illustrated in Figure 1, the authors present the different influential factors related to EAI adoption in healthcare organisations (Component 1) and the method for actors' identification (Component 2). The focus of this paper will be on the proposed benefits and barriers, which are identified and analysed in Table 1. As Figure 1 depicts, the method for actors' identification indicates that healthcare actors involved in the adoption process can be defined as any human and/or organisation that accepts, provides, supports and controls healthcare services (static step). This static step should be combined with the dynamic to enhance the actors' identification process. The dynamic step consists of a set of guidelines that can be used to identify a full range of actors. To apply this method in the practical arena, initially the static step (definition) should be understood. Then each of the guidelines should be applied to each of the proposed human and/or organisational categories (static

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[1] In this paper, the terms actor and stakeholder are used equally to refer to all individuals and organisations that are affected and/or affect the adoption process.

step) individually (e.g. human acceptors, human supporters etc). In doing this, a list of healthcare actors will be identified and then evaluated in the case study, as the full actors' list depends on the specific context and timeframe.
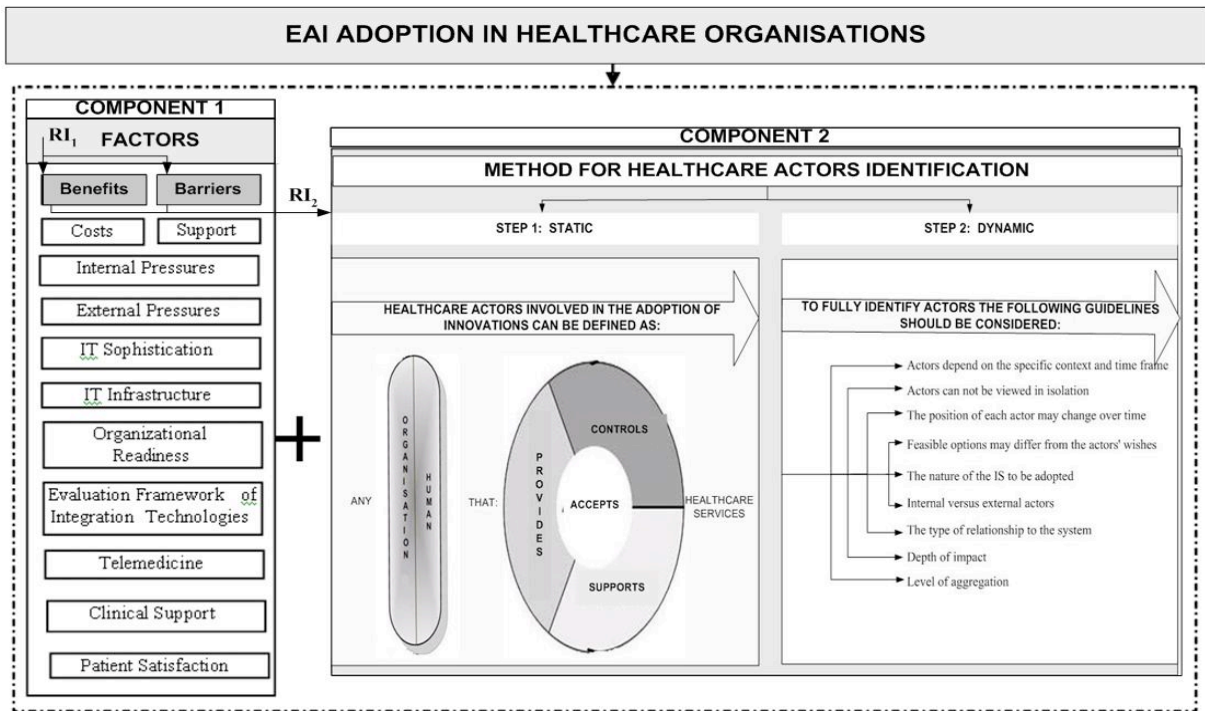

Figure 1: Conceptual Model for EAI Adoption Benefits and Barriers in Healthcare Organisations

4 RESEARCH METHODOLOGY

The authors have developed an empirical research methodology to study the benefits and barriers related to the adoption of EAI in healthcare organisations. This methodology is based on three development stages namely: (a) research design; (b) case study data collection and, (c) case study data analysis. The research design proposed is the first independent part of the empirical research methodology (illustrated in Figure 2). The starting point is to review the literature, thus developing an understanding of the research area under investigation. From the literature review, several research issues were highlighted for a more focused study (EAI adoption in healthcare). This led to a specific research area and identified a research need. Thereafter, a conceptual model that represents the intended empirical research was developed. Aspects of the model were investigated through empirical study. Based on the needs of the empirical study, it was decided that the research design would utilise a case study strategy through the employment of qualitative research methods. The research design was then transformed into a plan of action or protocol. Research protocols are a necessary investigation tool for a number of reasons, including: (a) to put the task of data gathering in a manageable format, (b) to insure that targeted data is collected and (c) to insure that the research follows a specific schedule.

Within the protocol, a qualitative research method was developed to gather data as required by the units of analysis. In particular, a qualitative strategy was employed to conduct this research as it supports the investigation of: (a) little-known phenomena (e.g. actors and factors that affect EAI adoption in healthcare) and, (b) complex processes (EAI adoption) in their natural setting. The method was in the form of an interview agenda, which is a series of questions, related to the units of analysis, and designed to guide the authors, during the structured interviews. In addition to the interviews, data were collected through several sources like archival documents, minutes for meetings, consultancy

reports, and the website of the organisation. The use of multiple data collection methods makes the triangulation possible which provides stronger substation of theory (Eisenhardt, 1989).
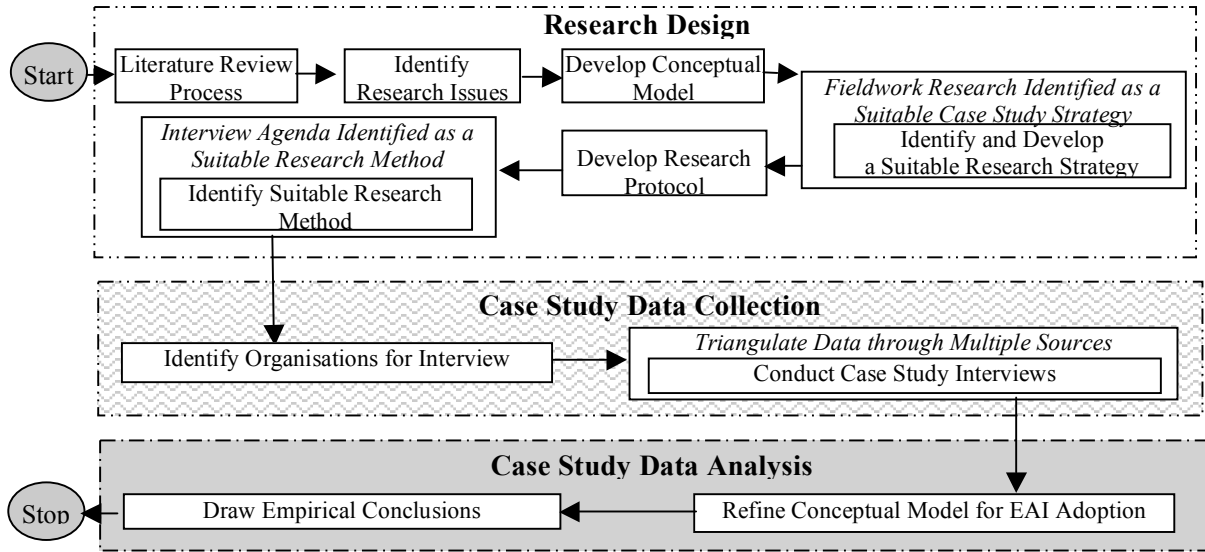

Figure 2: Empirical Research Methodology

For the purpose of this paper, a single case study strategy was employed to explore and understand the EAI adoption in healthcare organisations. A qualitative case study strategy can offer a 'holistic' view of the processes involved, as well as a realisation of the topic under research (Zmud et al., 1989). The bias that is considered to be a danger in using qualitative research approach was overcome in this study through data triangulation. The use of multiple data collection methods makes data triangulation possible, which provides stronger substantiation of theory (Eisenhardt, 1989). In this paper, three types of triangulation were used namely: (a) data (Denzin, 1978), (b) methodological and, (c) interdisciplinary triangulation (Janesick, 2000).

Therefore, various data collection methods such as interviews, documentation and observation were used. In the context of this research, interviews constituted the main data source in the case. Multiple actors were interviewed through structured (and semi-structured or unstructured) interviews to investigate the decision making process for EAI adoption. The actors that had been interviewed are the following: (a) Patient, (b) Next of Kin, (c) Clinician, (d) Non-Clinician, (e) Clinical Student, (f) Hospital, (g) Medical Department, (h) Researcher, (i) Supplier, (j) Technologist, (k) Insurance Company and (l) Manager. All interviews were tape recorded and transcripts prepared as soon as possible after each individual interview. Tape recording supported the authors in collecting accurate data and for its analysis. Using an interview agenda that was designed for this case, the interviewees replied in specific questions regarding EAI adoption and actors' classification and identification. Semi-structured interviews took place without the use of an interview agenda. Using this type of interview the authors attempted to clarify issues that derived from structured interviews.

5   CASE STUDY

To test the proposed conceptual framework, the authors studied a hospital (HOSP_VM) in UK, that has more than 1,000 employees. HOSP_VM faced many problems related to its existing IT infrastructure, such as lack of: (a) integration of primary, secondary and tertiary services, (b) integration of research and development, (c) communication between the trust and its patients from admission to discharge and (d) delivery of high quality services and care. These limitations led HOSP_VM to significantly advance its IT infrastructure by integrating the existing IS.

Since, HOSP_VM has limited knowledge on the area of systems integration, it turned to consultants for support. This decision is in line with the published literature, which suggests that organisations

seek *support* from consultants when adopting EAI solutions (Skoumpopoulou and O'Kane, 2004). As a result, the consultants suggested that the hospital should rely on EAI technology to build the proposed integrated IT infrastructure. Moreover, a pilot EAI project was proposed to assess: (a) the performance and efficiency of EAI and, (b) the various parameters associated with its adoption (e.g. restructuring, costs, benefits, barriers). The aim of the pilot project was to demonstrate that EAI can result in the development of an efficient, flexible, reliable and maintainable IT infrastructure. The pilot project lasted for one year. Based on the outcome of the pilot system, the hospital managed to evaluate the EAI application by assessing a diversity of parameters including benefits, barriers and costs.

Since, the pilot system demonstrated that the application of EAI was successful; HOSP_VM took the decision to build an end-to-end integrated IT infrastructure using EAI technology. This decision was in accordance with the practices of the UK healthcare sector modernization effort that is taking place and has focused on the development of an essential patient centric IS (Wanless *et al.*, 2002). In 2003 the HOSP_VM initiated a plan for developing a more efficient IT infrastructure, to address the limitations of its existing systems, and to meet the targets set by the NHS. The decision for this plan was made by the managing board after discussing this issue with the IT manager. The proposed plan sought for a low cost solution to: (a) develop an integrated patient centric IT infrastructure, (b) keep the health professionals up to date informed in their practices and (c) reduce medical errors.

Although, the pilot system was successful, it can not be argued the same for the system that is under implementation. From the empirical data, it has been revealed that not all benefits and barriers have been analysed in full detail and considered thoroughly by the multiple actors. Thus, there have been major concerns related to their reactions. As a result, the whole project has been on major risk, as a negative reaction from one actor may result in failure. This is in line with the normative literature which highlights that actors' reactions might lead to IS failure (e.g. London Ambulance System) (Fitzgerald and Russo, 2005). Thus, it is important to identify the actors and understand their stances against the EAI adoption. In addressing this need, the method (Component 2) presented in Figure 1 was introduced. In doing so, the authors applied both static and dynamic steps of the method to identify a list of healthcare actors that are involved in the EAI adoption. As a result, the full list of actors identified is presented in Table 2. To this end, the following Research Issue is arising too:

RI₃: The list of healthcare actors presented in Table 2 is complete and representative, in the specific time frame and context

		ACTORS			
		Acceptor	**Provider**	**Supporter**	**Controller**
L E N S E S	**Human (H)**	1. Patients (P) 2. Next of kin (NK)	3. Clinicians (C) 4. Non-clinicians (NC) 5. Clinical students (CS)	8. Administrators (A) 9. Legal professionals (LP) 10. Researchers (R)	14. Managers (M)
	Organisational (O)	-	6. Hospitals (H) 7. Medical departments (MD)	11. Suppliers (S) 12. Technologists (T) 13. Insurance companies (IC)	15. Government (G) 16. Health authorities (HA)

Table 2: Proposed List of Actors Identified for HOSP_VM

6   EMPIRICAL FINDINGS AND DISCUSSION

6.1   Testing Research Issue 1 (*RI₁*)

When the interviewees were asked to comment on *RI₁,* they reported that the benefits and barriers presented in Table 1 are representative. However, some actors recommended new barriers and benefits that were not identified by the authors. This is an important finding since the benefits and barriers identified by the authors are coming from the literature. Thus, this finding expands and validates the proposed portfolio of benefits and barriers related to EAI adoption in healthcare. The benefits and barriers recommended by the interviewees are presented in Table 3.

Category	Benefit	Barriers
Operational	-	Requires organisational restructuring
Managerial	Increases the work efficiency Improves performance	Lack of employees with skills related to integration (e.g. legacy systems) Lack of employees with experience in HIS integration
Strategic	Enhances knowledge sharing.	-
IT Infrastructure	Supports Telemedicine integration Complexity of HIS	Some systems are critical (related to human lives) and not available for integration testing
Organisational	-	Staff is too busy to attend training

Table 3: Additional EAI Benefits and Barriers Identified by Interviewees

6.2   Testing Research Issue 2 (*RI₂*)

The empirical data are displayed in Table 4 by using a combination of the taxonomy of: (a) EAI benefits and barriers (Table 1) and (b) healthcare actors (Table 2). Table 4 illustrates the EAI benefits and barriers (horizontally) and the healthcare actors (vertically) which are grouped into acceptors, providers, supporters and controllers. Each of these categories is broken down into human and organisational sub-actors. Due to space limitations the authors refer to each of the actor using their initial letters (e.g. **MD** stands for **M**edical **D**epartments) as these are shown in Table 2.

The ranking of the benefits follows a low (○), medium ( ), high (●) scale of ranking similar to the scale used by Miles and Huberman (1994). In addition, two other symbols are used for ranking. The symbol (–) indicates that there is no available information where the symbol (✗) codes that a benefit has no impact on a specific actor. In the following paragraphs, the authors discuss and analyse the main findings of the case study presented in Table 4.

Operational EAI Benefits and Barriers: From the findings it appears that the actor *Next of Kin* is lowly benefited by the reduced cost and improved data quality and not benefited by the remaining five benefits of this category. Also, the Acceptors are not affected by the cost that is required for business processes redesign and EAI implementation (barriers). Another actor that is partially benefited is the *Legal Professional* whom the level of benefit is not similar to the rest actors. Moreover, this actor has no interest in the operational barriers of EAI adoption. Its level of benefit is much higher than the *Next of Kin* but lower than other actors. The remaining (14) actors are highly benefited from this category of benefits and they reported almost the same level of satisfaction. It appears as well, that the *human Providers* are mainly seeking for technologies that support improved data quality, presentation and exchange, without caring about the implementation and redesign costs (barriers).

Managerial EAI Benefits and Barriers: There are evidences from Table 4 depicting that the organisational dimension of actors (e.g. *Hospitals, Government*) is more benefited comparing to the human actors (e.g. *Patients, Doctors*). Also, the *organisational Providers and Controllers* have exactly the same level of benefit in this category (Managerial EAI benefits). In addition from human actors only the Managers have the same level of satisfaction with the organisational dimension of the two aforementioned categories of actors. It appears that the improvement of quality of care provided is a managerial factor that influences all healthcare actors towards EAI adoption. A worth noting observation should be made for the lack of employees with EAI skills is a barrier to EAI adoption and this is in accordance to the normative literature (Lam, 2005). Much emphasis should be given at this barrier, to reduce resistance to change associated with EAI adoption.

Strategic EAI Benefits and Barriers: Similarly to the findings of the Managerial category, it appears that the *Controllers* and the *Organisational Providers* are highly affected by the Strategic EAI benefits. Thus, when approaching these actors (hospitals, managers, government, and health authorities) emphasis should be given on Strategic benefits since, all of them are involved in the decision making process. Another important finding is that EAI increases synchronous-asynchronous collaboration among actors as it is reported to be of high importance. *To this end, the authors suggest to explore this dimension in the future since much work in the area of healthcare is based on the actors' interrelationships.* However, it has to be stated that the actors believe that the resistance to change is a critical barrier affecting EAI adoption in healthcare. It appears that healthcare actors'

resistance affects their decision towards adoption, despite the benefits provided to them (e.g. improved synchronous – asynchronous collaboration among actors and high quality of integrated data).

	Acceptor		Provider					Supporter						Controller		
	H		H			O		H				O		H	O	
EAI BENEFITS AND BARRIERS	P	NK	C	NC	CS	H	MD	A	LP	R	S	T	IC	M	G	HA
OPERATIONAL — Benefits																
Increases productivity	–	✗	●	●		●	●	●		●				●		●
Reduces cost	●	○	○	○	○	●	●	○	–	●			○	●	●	●
Improves data quality	●	○	●	●	●	●	●	●		●	●	●		●		
Improves data sharing/flow	●	✗	●	●	●	●	●	●		●	●	●	●	●	●	●
Provides better access to data	●	✗	●	●	●	●	●	●		●	●	●	●	●	●	●
Provides easier exchange of data	●	✗	●	●	●	●	●	●		●	●	●	●	●	●	●
Improves data presentation	○	✗	●	✗	●	●	●	○	–	●	●		●	●	●	●
OPERATIONAL — Barriers																
Extra cost to redesign business processes	✗	✗	○	○	○	●	●	●	–	●	●	●	●	●	●	●
High EAI implementation cost	✗	✗	○	○	○	●	●	●	–	●	●	●	●	●	●	●
MANAGERIAL — Benefits																
Improves managerial control	✗	✗	○	○	✗	●	●	○	✗	✗	●		●	●	●	●
Provides more understanding and control of processes	✗	✗				●	●	○					○	●	●	●
Supports decision making	✗	✗	○	○	✗	●	●	○	–	✗	●	○		●	●	●
Improves allocation of resources	✗	✗			✗	●	●	✗	○	○	○	○	○	●	●	●
Improves quality of care provided	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MANAGERIAL — Barriers																
Lack of employees with EAI skills	✗	✗				●	●	✗	○	●	○			●	●	●
STRATEGIC — Benefits																
Supports more effective planning	●		●	●	●	●	●	○	✗	✗	●		●	●	●	●
Increases synchronous asynchronous collaboration among actors	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Improves relationships with suppliers	✗	✗			✗	●	●	●	✗	✗	●		●	●	●	●
STRATEGIC — Barriers																
Resistance to change	●	●	●	●	●	●	●	●	✗	○	●	●	●	●	●	●
Organisations resist to share their data with partners	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Security and confidentiality of patients' data	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
IT INFRASTRUCTURE — Benefits																
Reduces development risk	✗	✗	✗	✗	✗	●	●	✗	✗	○	○	●	○	●	●	●
Achieves process integration	✗	✗	●	●	○	●	●	●	-			●		●	●	●
Provides objects/components integration	✗	✗	✗	✗	✗	✗	✗	●	✗	○	✗		✗		✗	✗
Provides data integration	●		●	●	●	●	●	●		●	●	●	●	●	●	●
Provides real-time integration		✗	●	●	○	●	●	●	✗					●	-	-
Integrates packaged systems	✗	✗	✗	✗	✗	●	●	●	✗	○	✗		✗	●	✗	✗
Integrates e-business solutions	✗	✗	✗	✗	✗	●	●	●	✗	○	✗		✗	●	✗	✗
IT INFRASTRUCTURE — Barriers																
Lack of knowledge related to EAI	✗	✗	○	○	○	●	●	✗	●	●	●	●	●	●	●	●
Existing systems are incompatible and complex	✗	✗	✗	✗	✗	●	●	●	✗	●	●	●	●	●	●	●
Integration technologies are confusing	✗	✗	○	○	○	●	●	●	✗	●	●	●	●	●	●	●
ORGANISATIONAL — Benefits																
Reduces hospitalisation	●	●	○	○	-	●	●	●	○	○	○	-	●	●	●	●
Reduces waiting times	●	●	○	○	-	●	●	●	○	○	○	✗	●	●	●	●
Achieves effective clinical and administrative management	✗	✗	●	●	-	●	●	●	✗	✗	✗	✗	○	●	●	●
Increases business efficiency	✗	✗				●	●	●	-	-	●	-	●	●	●	●
Supports clinical decision making	●		●	●	●	●	●	●	●	●	-	-	●	●	●	●
Reduces paper work processes	○	○	●	●	○	●	●	●	○	○		○		●	●	●
ORGANISATIONAL — Barriers																
Complexity of business processes	✗	✗	✗	✗	✗	●	●	●	✗	●	●	●	●	●	●	●
Cultural issues	○	○	●	●	●	●	●	●	✗	●	●	●	●	●	●	●
Political issues	○	○	●	●	●	●	●	●	✗	●	●	●	●	●	●	●
Time needed for training	○	○	●	●	●	●	●	●	✗	●	●	●	●	●	●	●

Table 4: Empirical Data Retrieved from HOSP_VM

IT Infrastructure EAI Benefits and Barriers: The empirical evidences suggest that the *human Controllers (Managers)*, the *Administrators* and the *Organisational Providers (Hospitals, Medical departments - Clinics)* are really interested in the technical benefits and barriers affecting the EAI adoption process. The rest of the actors are not so highly benefited or affected by the barriers related to the IT Infrastructure. To this end, it is suggested not to focus on the technical benefits and barriers when introducing the concept of EAI applications to actors, such as *Patient*. The majority of the actors perceive the data real-time integration provided by the EAI adoption as really important benefits.

Organisational EAI Benefits and Barriers: The *Controllers,* the *Administrators* and the *Organisational Providers* appear to be highly benefited from organisational EAI benefits. Another interesting finding is that the *Patients,* the *Next of Kin* and the *Insurance Companies* reported highly benefited from the reduced hospitalisation and the reduced waiting time whether clinicians and non-clinicians reported low benefits. In this case it appears that an EAI solution will achieve more important benefits for the patients' world rather than the clinicians. This also indicates that an EAI solution is possibly more patient centric and this is in accordance to the healthcare plans for developing an integrated patient centric system (Wanless *et al.*, 2002). Thus, healthcare authorities should turn to EAI technology to meet their goals for patient centric systems. However, they should focus on cultural and political issues to overcome the organisational barriers. As it is depicted in Table 4, one important barrier that affects all actors (except *Patients* and *Next of Kin*) towards EAI adoption is the time needed to train the staff use the new system. This in according to the normative literature, which indicates that EAI complex projects require training of employees (Lam, 2005).

6.3   Testing Research Issue 3 (*RI₃*)

The interviewees were asked to comment on the proposed list of healthcare actors. The empirical evidences extrapolated that the various actors presented in Table 2 should be analysed in more detail. For instance, in the actor *Manager* (in the category Controller) represents all managers at all levels. As it was reported by the majority of the interviewees, this is not accurate since diverse categories of managers exist with different interests (e.g. IT Manager, Clinicians' Manager, Finance Manager). This indicates that the method used for actors' identification should be revised to capture all these sub-categories of actors. Moreover, it was revealed that among the multiple actors there exist interrelationships that affect the adoption process. This issue has also been highlighted in the normative literature and characterised as critical (Menachemi et al., 2004). From a different point of view, it is suggested that these interrelationships could be mapped using modelling techniques like Fuzzy Cognitive Mapping. In doing so, the effect of one actor to another can be deviated. This might lead to better understand the stances and interrelationships among actors and thus, improving the decision making process.

7   CONCLUSIONS AND FURTER WORK

The need to improve the healthcare services through the HIS integration has been highlighted and explained in this study. EAI is an emerging technology and although it is widely applied in many sectors, its adoption in healthcare is underutilized. For that reason, there is a necessity to investigate this area in more detail and contribute to the body of knowledge. This is of high importance as HIS are critical to human lives and thus information about their integration might be equally significant. In this paper, the authors attempted to do so by reviewing the normative literature on benefits and barriers affecting the EAI adoption in healthcare organisations and building a conceptual model on the outcomes of this review. From the literature review it appears that the previous published works on EAI benefits and barriers focused on a factor oriented approach and did not pay the appropriate attention to the human and social issues, which are considerable important in the healthcare sector. To overcome this limitation, the authors propose a combination of the factor and actor oriented approaches. This, increases the level of analysis and contributes towards a more detailed and systematic study of this phenomenon. The authors identified the actors related to the EAI adoption in healthcare using a proposed method.

In doing so, the authors proposed a conceptual model that incorporates benefits and barriers reported in previous studies and combines them with the healthcare actors. The proposed model makes contribution at both practical and conceptual level. At a practical level, the model contributes towards a deeper understanding of the EAI adoption benefits and barriers in healthcare. At the conceptual level, it identifies healthcare actors that should be considered during the adoption of EAI in healthcare. The identification of the actors is based on the theoretical work conducted by others. Hence, the identification of actors is grounded in literature. The combination of actors and factors approaches: (a)

supports managers and researchers in understanding which actors should be considered during the study of EAI adoption benefits and barriers, (b) facilitates the multiple healthcare actors in the realization of the benefits and barriers related to the EAI adoption process and (c) might increase the adoption of EAI in healthcare. Although the case data validated the proposed model a couple of propositions were made for further research. The paper suggests that:

> The additional EAI benefits and barriers identified by the interviewees should be extended and evaluated in the practical arena.
> The interrelationships that exist between full range of factors (including parameters) with a full range of actors should be studied to enrich the level of understanding of this phenomenon. These causal interrelationships could be mapped and analysed using modelling techniques like Fuzzy Cognitive Mapping.

One of the limitations of this research is that the outcomes presented herein are based on a real life case study. Thus, the data and the observations derived from this case cannot be generalized. Nonetheless, it is not the intention of this paper to offer prescriptive guidelines about which actors are affected and/or affect each influential factor in healthcare but rather, describe a case study perspective that allows others to relate their experiences to those reported. Therefore, this paper offers a broader understanding of the phenomenon of EAI realization in the area of healthcare.

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