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# INFORMATION SYSTEMS AND HEALTHCARE XXV: Factors and Actors Affecting the EAI Adoption in the Healthcare Sector

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Abstract:

This paper focuses on Enterprise Application Integration (EAI) adoption in healthcare organisations. EAI has emerged to support organisations overcoming their integration problems, and it has been adopted by many sectors. Despite its importance, the healthcare sector develops EAI solutions at a slower pace and can be characterised as a laggard compared to other sectors. The small number of EAI applications in healthcare has resulted in limited research in this area, with many issues requiring further investigation. The normative literature analyses the factors that influence EAI adoption in healthcare but it has not yet explored the role of actors during the adoption process. This paper makes a step forward and contributes to the body of knowledge as it: (a) highlights the role of healthcare actors and attitudes towards EAI adoption; (b) introduces an actor-oriented approach; (c) identifies those actors involved in this process; and (d) combines the actor-oriented approach with the factors influencing EAI adoption. The authors believe that such an approach is significant and novel as it: (a) enhances existing EAI adoption models by incorporating an actor-oriented analysis; and (b) facilitates healthcare organisations in making robust decisions for EAI adoption. The authors discuss the application of their approach through a hospital case study. While a single case study alone cannot be proof, the engagement of the actors was encouraging.

**Keywords:** Enterprise Application Integration (EAI), Healthcare Information Systems (HIS), adoption, factors, actors

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## I. INTRODUCTION

During recent years, Enterprise Application Integration technology has emerged to develop flexible and maintainable healthcare IT infrastructures by incorporating functionality from disparate IS. Many private and public organisations have deployed EAI solutions [Irani et al. 2003], with the healthcare sector having recently realised its effectiveness and functionality [Khoumbati et al. 2006]. These can be characterised as the early days in EAI research in healthcare, with the majority of the work done in this area focusing on the identification of parameters that influence its adoption [Khoumbati et al. 2007].

The EAI adoption process has been described as a lengthy, time-consuming and complex process with issues related to its management being of paramount importance. Primarily, existing models on EAI adoption emphasise technical and organisational parameters and underestimate the importance of human factors. According to Fitzerald et al. [2002], the consideration of human factors can enhance the management and may reduce the complexity of the adoption process. There is therefore room for further research as human factors can be combined with technical and organisational ones.

This paper aims to contribute in this area by proposing and validating a model that incorporates human factors to an existing model on EAI adoption. Section II critically reviews the literature and describes research in this area. The authors next derive and propose a conceptual model that incorporates human, organisational and technical factors. In Sections IV and V the research methodology and the case study used to evaluate the conceptual model are described. The findings and their analysis are then presented and explained before conclusions are drawn in Section VIII.

## II. BACKGROUND TO ENTERPRISE APPLICATION INTEGRATION

EAI has emerged to piece together inter- and intra-organisational systems and combines a variety of integration technologies such as web services, message and process brokers [Linthicum 1999]. It aims at building an integration infrastructure by bridging existing heterogeneous and incompatible applications. The development of EAI solutions has been reported to be a lengthy procedure that consists of eight descriptive stages [Themistocleous and Irani 2006]. This paper focuses on the first stage, which is related to the EAI adoption. During this stage, organisations measure the possible impact of EAI solutions and make decisions regarding the implementation of the EAI project. Regarding the EAI adoption in the healthcare sector, the literature reports a model (Model for the Adoption of Enterprise Application Integration in Healthcare Organisations - MAESTRO) that consists of 16 influential factors [Khoumbati et al. 2007] (Figure 1).

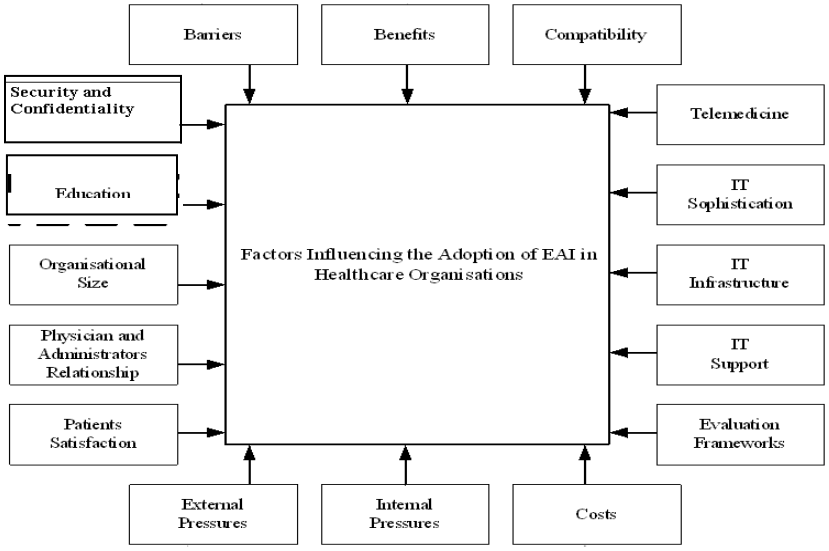


**Figure 1. Factors that Support EAI Adoption in Healthcare Organizations (MAESTRO) – Source:** Khoumbati et al. [2007]

The model proposed by Khoumbati et al. [2007] is based on a factor-oriented approach, which has its own limitations. Kautz and Henriksen [2002] suggested that the explicit use of a factors approach is inefficient to support the IS adoption, as it is inadequate to describe the interactions among the various stakeholders 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. Robey [1979] and Ginzberg and Zmud [1998] have studied the importance of actors' beliefs and attitudes and how these are affected and affect the factors influencing the innovations' adoption. Rogers [1995] proposed that the actors and the perceived characteristics of innovations have an impact on individual's adoption of IT.

It appears that individual actors (e.g., professionals) are critical in defining the success of IT adoption [Chan et al. 2005]. Chau and Hu [2002] stated that physicians have a significant role in the introduction and use of IT. Wiley-Patton and Malloy [2004] pointed out that the adoption process is highly affected by actors. Healthcare actors are not passive acceptors of an idea, but they have an essential role during the adoption process. In support of this, Chen [2003] recommended that actors should be considered and investigated along with other parameters affecting the decision making process. Moreover, Somers and Nelson [2004] studied Enterprise Resource Planning (ERP) implementations and proposed that the six-stage ERP implementation stage model should be integrated with the factors approach, as well as the key players to provide a more comprehensive research model for ERP implementations. Thus, the factors identified in the past as influential to EAI adoption in healthcare organisations (MAESTRO model) as well as the healthcare actors that have been stated to be critical in studying this area [Somers and Nelson 2004] should be investigated.

## III. FACTORS AND ACTORS INVOLVED IN EAI ADOPTION

The role of actors is considered to be of high importance during the Healthcare Information Systems (HIS) adoption process. As a result, the authors propose that when exploring EAI adoption in healthcare, the mapping of actors against the factors provides a deeper understanding of such interrelationships. Thus, an actor-oriented approach might be considered when EAI is introduced to: (a) extend the current research in EAI adoption; (b) enhance the level of analysis; and (c) support healthcare decision makers to adopt EAI. Hence, the authors propose the following issue for further investigation:

> ***Factors and Actors Issue:*** *Factors and actors should not be explored in isolation to one another during the EAI adoption in healthcare organisations.*

In an attempt to piece together these two approaches (factors and actors), there are numerous issues to be investigated. Among the first to be explored, is the identification of the healthcare actors that affect and are affected by the EAI adoption (actor-oriented approach). Thus, the "Individuals Groups Organizational Human Controllers Acceptors Providers Supporters" (IGOHcaps) method proposed by Mantzana et al. [2007] was employed in this study, as it refers specifically to healthcare actors' identification (Figure 2).

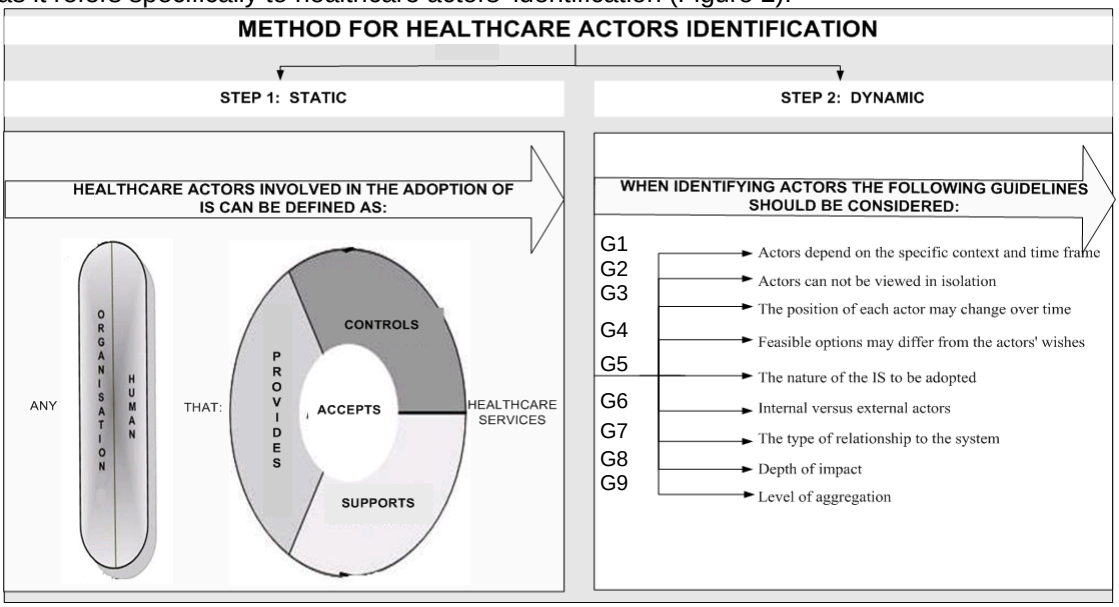


Figure 2. IGOHcaps Method for Healthcare Actor's Identification – Source: Mantzana et al. [2007]

As Figure 2 depicts, the IGOHcaps 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) [Mantzana et al. 2007]. This static step should be combined with the dynamic one 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. According to Mantzana et al. [2007], to apply the IGOHcaps 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 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. To this end, the authors propose that to study the EAI adoption in healthcare organisations the influential factors of MAESTRO model (Figure 1) and the IGOHcaps method for healthcare actors' identification (Figure 2) should be combined (Figure 3).

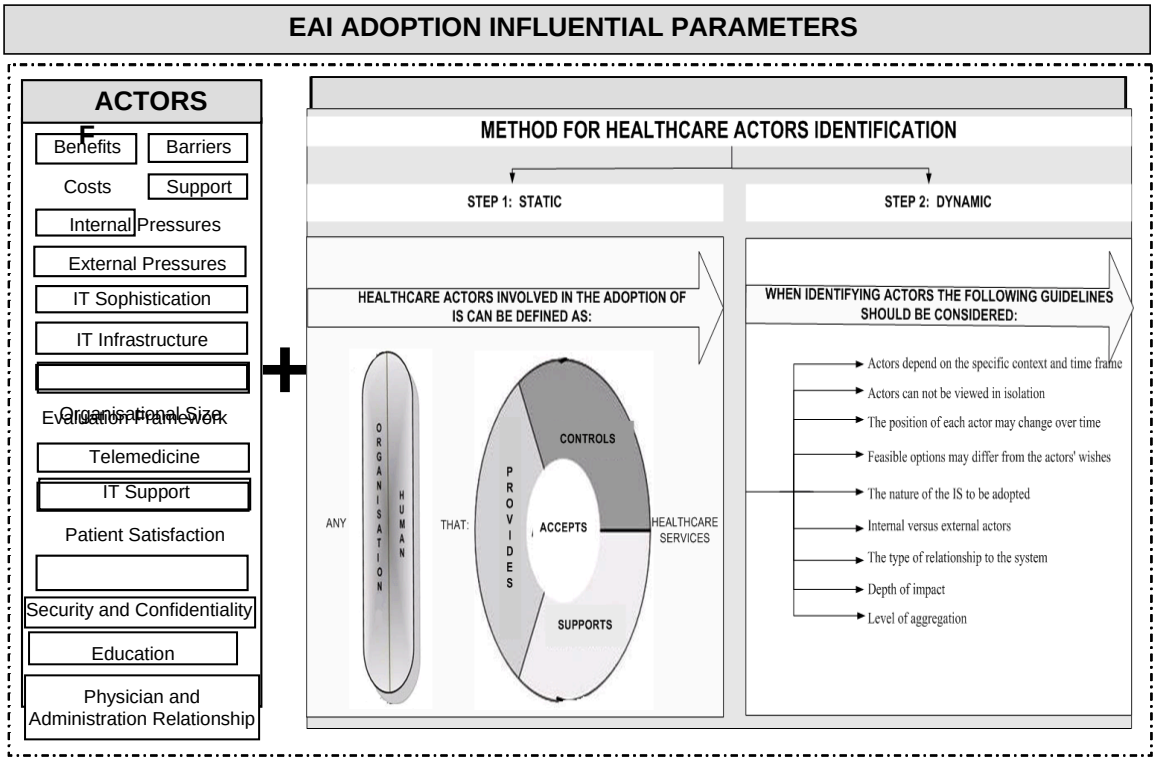


Figure 3: Proposed Conceptual Model (MAESTRO and IGOHcaps methods)

## IV. RESEARCH METHODOLOGY

An empirical research methodology has been used to study the factors and actors related to the EAI adoption in healthcare organisations (Figure 4).

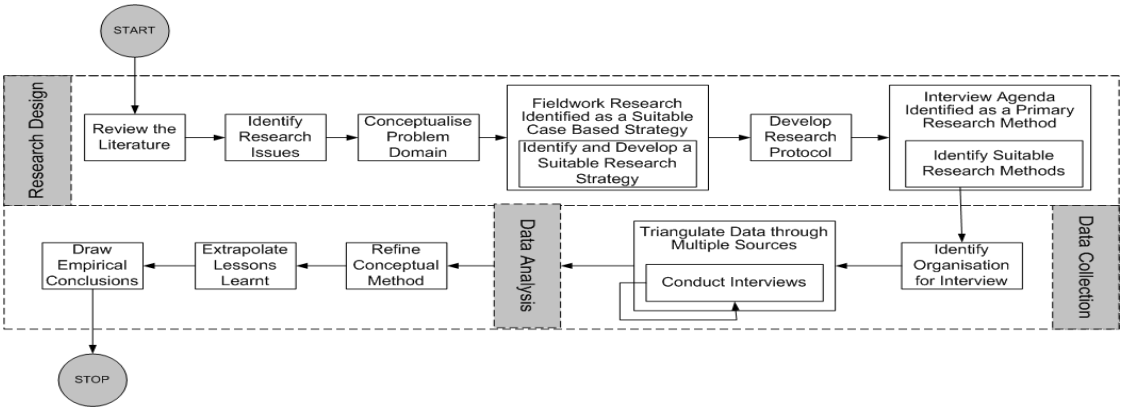


Figure 4. Research Methodology

This methodology is based on three development stages namely: (a) research design; (b) data collection; and (c) data analysis, which are described following. The starting point of the research design 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 to the identification of 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 protocol. Research protocols are a necessary investigative tool, as they support researchers to put the task of data gathering in a manageable format, to ensure that targeted data is collected and that the research follows a specific schedule. This is especially needed where the issues under investigation are subjective, and it depends on qualitative methods.

To reflect upon the aim of this paper, and to evaluate the proposed conceptual model (Figure 3), an interpretive research approach was followed. An interpretivism stance supports: (a) enhanced navigation and explanation of a phenomenon in its organisational setting [Walsham 1995]; and (b) the analysis of issues related to causality and human purpose [Pouloudi 1998]. Also, the authors propose that a qualitative strategy should be used to conduct this research, as it allows close involvement of the researcher in the case study, resulting in a considerable insight into the events and actions [Benbasat et al. 1987].

For the purpose of this paper, a single case study strategy was employed to explore and understand the EAI adoption in healthcare organisations. Various qualitative data collection methods such as interviews, documentation and observation were used. The bias that is considered to be a danger in using a 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].

The authors conducted interviews to collect data and to capture the verbatim. Multiple actors were interviewed through structured (and semi-structured or unstructured) interviews. Using an interview agenda that was designed for this case, the interviewees replied to specific questions regarding EAI adoption. Semi-structured interviews took place without the use of an interview agenda and were conducted during breaks. Using this type of interview the authors attempted to clarify issues that derived from structured interviews and to collect some important data regarding actors' beliefs.

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. The availability of interviewees was a problem during the case study, since they had demanding schedules. Taking notes during interviews is time consuming thereby reducing the discussion time, and as a result, the authors considered tape recording a more effective way to conduct interviews.

## V. THE CASE OF EAI-HOSPITAL

A hospital (EAI-HOSPITAL) with more than 1,200 employees, in 11 sites, has been studied to test the proposed conceptual model (Figure 3). EAI-HOSPITAL is a specialised acute trust, a major international centre for postgraduate teaching and research in the UK. The hospital consists of four divisions and nearly forty departments. The existing IT infrastructure of the hospital has caused numerous problems including the lack of: (a) integration of primary, secondary, and tertiary services; (b) collaboration between research and development; (c) communication between the trust and its patients from admission to discharge; and (d) delivery of high-quality services and care.

The limitations of the existing IT infrastructure led the EAI-HOSPITAL to take a decision to significantly advance its services. This decision was also supported by the UK Commission for Health Improvement (CHI), in accordance with the practices of the UK healthcare sector modernisation effort that is taking place. The analysis of relevant documents that were collected during the case study indicates that the UK government through the UK National Health Service (NHS) Care plan has focused on the development of an essential patient-centric IS. The key objectives of the NHS plan is to efficiently and effectively provide care, based on an integrated IT infrastructure [DoH 2004; Wanless et al. 2002]. It is suggested that such an infrastructure will result in the delivery of quality care 24 hours a day - seven days a week (24/7) [NHSIA 2004]. To this end, it appears that the problems with the existing infrastructure in the EAI-HOSPITAL and the NHS plan formed internal and external pressures. This finding validates the normative literature, which supports that, among other factors, the *IT infrastructure* and *Internal* and *External Pressures* influence the decision making process for EAI adoption [Khoumbati et al. 2007]

Thus, EAI-HOSPITAL 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 was to seek a low-cost solution that will: (a) develop an integrated patient centric IT infrastructure; (b) keep the health professionals informed in their

practices with up-to-date information; (c) deploy and integrate telemedicine and e-Health applications with existing systems; and (d) reduce medical errors and patients' waiting times.

Since the EAI-HOSPITAL 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 and other experts to evaluate and adopt 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, they proposed the development of a pilot project to assess: (a) the performance and efficiency of EAI; and (b) the various organisational and managerial parameters associated with its adoption (e.g., restructuring, costs, and benefits). The pilot project focused on the integration of a small number of processes and services at EAI-HOSPITAL. 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 lasted for one year in which the solution was implemented, tested, and used.

Through the pilot system, the hospital managed to evaluate the EAI application by assessing parameters such as benefits, barriers and costs. Since the pilot system was successful, the hospital decided to fully integrate its IT infrastructure. Due to the hospital's lack of technical knowledge, the hospital formed an alliance with an EAI vendor to build the solution, which is in accordance with the normative literature [Lam 2005]. Despite the success of the pilot system, the same can not be argued for the system that is under implementation. As it was revealed, the case organisation did not consider the critical role of the actors that affect and are affected by the adoption of the EAI solution. These actors were not informed about the changes that such a project will bring. To this end, the project manager reported that:

> *We may have to address a lot of problems when the system is finished. We have not had any discussion with the clinicians and the other professionals. We estimated that we need to spend 20,000 staff hours for training after the implementation. Currently the clinicians are not aware of this. Staff are too busy . . and the question is when this training will take place. We have not informed them [clinicians] about the changes to their processes and services that this project brings.*

Thus, the changes associated with this project have not been understood by the multiple actors. As a result, the actors' reaction and attitude toward EAI adoption is unclear, and it therefore forms a risk for the project [Lim et al. 2005]. With regard to this issue, the same person reported that:

> *These issues may result in conflicts and resistance to change. We have to find a way to control these people's reaction. In our area the consensus of professionals is of high importance as all are significant for the operation of the hospital. For instance, if nurses decide to boycott the new system, the system will be out of order.*

The project mainly involved IT staff, which presents a myopic and one-dimensional view. The explanation for this is that an IT development in such a critical environment should consider non technical staff as well. In doing so, social, organisational, and managerial aspects will be explored in detail. In this case, there were issues regarding the control of the processes and the changing role of the actors that had not been explored or discussed.

These concerns indicate that it is of high importance to study and analyse the actors' views since their actions can have a great impact on IS adoption. These comments are 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, these views further support the aim of this research and demonstrate that there is therefore scope for timeliness and novel research in this area. Therefore, it is important to identify the actors and understand their stance toward EAI adoption. In addressing this need, the IGOHcaps method presented in Figure 2 was introduced.

## Application of IGOHCAPS Method to EAI-HOSPITAL

To identify healthcare actors, the IGOHcaps method's guidelines (Figure 2) were applied individually to the four categories (acceptors, providers, supporters, and controllers) of the human and/or organisational lenses (e.g., the guidelines were applied to the human acceptor, organisational acceptor etc). For instance the authors applied the fifth guideline (related to the nature of IS) to the organisational providers (subcategory). The type of IS to be adopted is an EAI solution that will be used to integrate inter and intraorganisational systems. Therefore, the organisational providers identified are the Hospitals and the Medical Departments (both intra and inter-organisational). Thus, using the guidelines within the specific case context and timeframe the following healthcare actors were identified (Table 1).

Table 1 shows how the guidelines were used to identify healthcare actors, with the first column referring to the guidelines and the rest to the actors being identified using these guidelines. The symbol (✓) indicates that the specific actor is identified by the specific guideline, where the symbol (×) shows the opposite.

Table 1. Actors Identification through the IGOHcaps Method

| | | | IGOHcaps Method's Guidelines | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 |
| Acceptor | H | Patients | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Next of kin | ✓ | ✓ | ✓ | × | × | × | × | ✓ | ✓ |
| Provider | H | Clinicians | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Non-clinicians | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Clinical students | ✓ | ✓ | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ |
| | O | Hospitals | ✓ | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Medical departments | × | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Supporter | H | Administrators | ✓ | ✓ | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Legal professionals | ✓ | ✓ | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Researchers | ✓ | × | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ |
| | O | Suppliers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Technologists | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Insurance companies | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Controller | H | Managers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | O | Government | × | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Health authorities | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

After identifying the list of healthcare actors, the following issue has arisen:

> ***Actors' List Issue***: *The list of healthcare actors presented in Table 1 is complete and representative, in the specific time frame and context.*

Figure 5 illustrates the outcome of the IGOHcaps method's application as it was presented in Table 1 and analysed in this section.

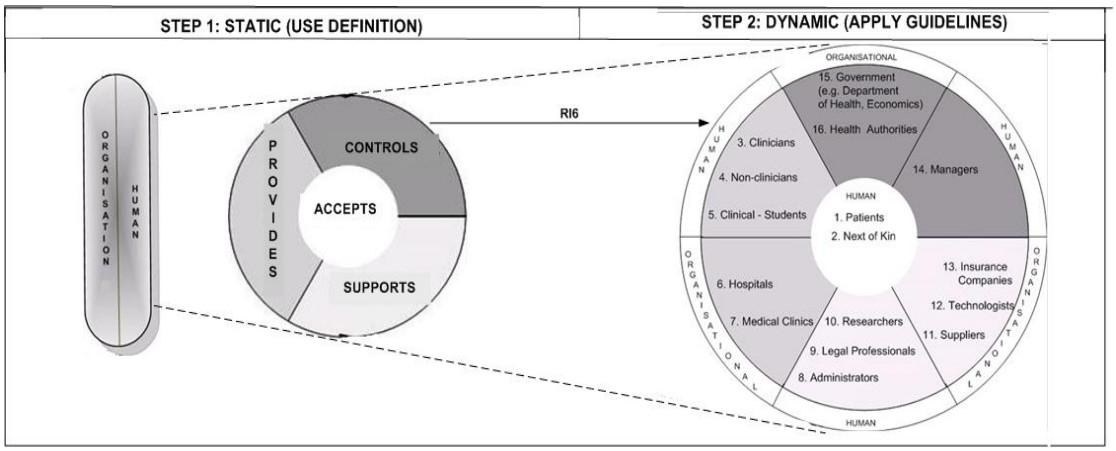


Figure 5. Identification of EAI Adoption Actors through the IGOHcaps Method

## VI. CASE ANALYSIS

The authors suggest that it is not efficient to study the adoption of EAI in healthcare organisations by using only a factor-oriented analysis, as such an approach has its own limitations (as explained in Section III). For that reason it

is proposed to combine the factor approach (MAESTRO model) with an actor-oriented one (***Factors and Actors Issue***). In addition, the authors used the IGOHcaps method proposed by Mantzana et al. [2007] to identify a comprehensive list of actors (***Actors' List Issue***). These issues are discussed in the following subsections in the light of the evidence that were collected.

## Testing *Actors' List Issue*

Initially, the interviewees were asked to comment on the proposed list of healthcare actors presented in Figure 3. Nearly 66 percent of interviewees from different actors' categories mentioned that other actors exist, such as the Bank. Also, the empirical data reveals that the various actors should be analysed in more detail. For instance, in the proposed taxonomy (in Table 1) the actor manager (in the category Controller) represents all managers at all levels. Nonetheless, this is not accurate in terms of analysis, as diverse categories of managers exist with different interests (e.g., IT manager, clinicians' manager, finance manager).

In addition, it has been reported by a clinician that "patients should be differentiated from citizens, for whom the government is trying to improve the quality of life." In support of this, it has been mentioned in different European Union (EU) plans that the focus of healthcare should not be on how to provide treatment to patients but on minimising the percentages of people that need treatment. In doing so, the healthcare should improve citizens' quality of life.

It appears that the citizens could not be identified by the use of the guidelines (see Figure 3). This is attributed to the fact that the authors contacted interviewees in different time periods. During the first round of field work visits, the information about citizens was not available. When the authors revisited the EAIHOSPITAL a couple of months later, the patients had been separated from the citizens. Thus, although the authors failed to identify the actor citizen, the guidelines covered this issue as the first guideline suggests that the actors depend on the specific context and timeframe. Moreover, a clinician (doctor) mentioned that:

> *It is good to see that you separate the human actors from the organisational because in many cases human actors express different views from their organisations.*

The same person gave as an example the case of clinicians and clinics. As he reported,

> *There are instances where we [doctors-humans] disagree with the suggestions of our clinics [organisational] in terms of IT use.*

An interesting issue, which came out during the interviews is that humans and organisations should not only be seen individually but also as groups (of people or organisations) [individuals and groups sub-lenses]. This is in accordance to the normative literature [Sarker et al. 2005]. For example, a clinician might have a different stance toward the adoption of a system, than a group (or different groups) of clinicians. In addition, the authors suggest that further issues such as power, control, legitimacy, and influence might be related to the formulation of opinions of these individuals and groups. These issues as well as the aforementioned sub-lenses are proposed for further research.

From the empirical data, it was revealed that:

- Not all factors were analysed in full detail and considered thoroughly. For instance, there are many issues related to cost that were not estimated,
- The changes that are associated with this project have not been understood, analysed and explained to the multiple actors. Thus, there are major concerns related to their reaction,
- The whole project is at major risk, as a negative reaction from one actor may result in failure and
- The project was considered as one in which mainly IT staff are involved. As a result, social, organisational and managerial aspects were not explored in detail. For instance, there are issues regarding the control of the processes and the changing role of the actors that have not been explored or discussed.

## Testing of *Factors and Actors Issue*

After testing the ***Actors' List Issue***, the interviewees were asked to express their views regarding the mapping of actors against the factors that affect the EAI adoption process in healthcare organisations (***Factors and Actors Issue***). In response, the vast majority of interviewees agreed that the factors influencing EAI adoption should be presented and explained to the multiple healthcare actors involved in the decision making process.

In Table 2, the authors present the results obtained by the combination of: (a) EAI influential factors (Figure 1) and (b) the taxonomy of the healthcare actors (Figure 3). Such a combination can provide a more detailed level of analysis.

Horizontally, Table 2 illustrates the factors influencing the EAI adoption process. Vertically the healthcare actors are illustrated, grouped into acceptors, providers, supporters and controllers. Each of these categories is broken down into human and organisational lenses. Due to space limitations the authors refer to each of the actors using (a) its initial letter and (b) the corresponding number given to them in Figure 3. For instance actor number 1 refers to the patient (P) whereas actor number 16 to the health authorities (HA). The symbol (✓) indicates that the specific actor is related to a specific factor where the symbol (×) shows no relationship.

Table 2. Mapping of Actors and Factors Influencing the EAI Adoption

| | | EAI Adoption Actors in Healthcare | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Acceptor | | Provider | | | | | Supporter | | | | | | Controller | | |
| | | H | | H | | | O | | H | | | O | | | H | | O |
| EAI Adoption Factors | | 1 P | 2 NK | 3 C | 4 NC | 5 CS | 6 H | 7 MD | 8 A | 9 LP | 10 R | 11 S | 12 T | 13 IC | 14 M | 15 G | 16 HA |
| 1 | Cost | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | ✓ | ✓ | ✓ | × | ✓ | ✓ | ✓ |
| 2 | Barriers | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3 | Benefits | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4 | IT Support | × | × | × | × | × | ✓ | ✓ | × | × | × | ✓ | ✓ | × | ✓ | ✓ | ✓ |
| 5 | Internal Pressures | × | × | ✓ | ✓ | × | ✓ | ✓ | × | × | × | ✓ | ✓ | × | ✓ | ✓ | × |
| 6 | External Pressures | × | × | ✓ | ✓ | × | ✓ | ✓ | × | × | × | ✓ | ✓ | × | ✓ | ✓ | × |
| 7 | IT Infrastructure | × | × | × | × | × | × | × | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | × | × |
| 8 | IT Sophistication | × | × | × | × | × | × | × | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | × | × |
| 9 | Evaluation Frameworks | × | × | × | × | × | × | × | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | × | × |
| 10 | Organisational Size | × | × | × | × | × | ✓ | ✓ | × | × | ✓ | × | ✓ | × | ✓ | × | × |
| 11 | Telemedicine | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | ✓ | × | × | × | ✓ | ✓ | ✓ |
| 12 | Patient Satisfaction | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | ✓ | × | × | ✓ | ✓ | ✓ | ✓ |
| 13 | Security and Confidentiality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 14 | Compatibility | × | × | × | × | × | × | × | × | × | ✓ | ✓ | ✓ | ✓ | ✓ | × | × |
| 15 | Physicians and Administrators Relationship | × | × | ✓ | ✓ | × | × | × | ✓ | × | × | × | × | × | ✓ | × | × |
| 16 | Education | × | × | ✓ | ✓ | × | ✓ | ✓ | × | × | ✓ | × | × | × | ✓ | × | × |

The interviewees reported that such an action will support them, realising the nature of EAI technology and the factors related to its adoption. It is worth reporting the views of a clinician:

> *The development of the new system will probably affect the way we work. We need to know in advance the changes associated with this system. The hospital should inform us about the nature of the changes and how we will be affected by that. Many times we react to the introduction of new systems as these are proposed quite often. For that reason we can not base our work on these systems as we need to be trained all the time and change the way we work. On the other hand, if you knew that a system makes our life easier or significantly improves the delivery of services and care, we will accept and use it with pleasure.*

Since many other actors share similar views to the one reported above, it appears that the various influential factors should be examined in relation to the actors who affect and/or are affected by the EAI adoption.

This case study is an exploratory one with issues arising being significant and of relevance to this research. An example of this is that one issue that came up pointed out that each actor was interested in specific factors affecting the EAI adoption process. For instance, not all actors are interested in the technical factors. This implies that multiple interrelationships among factors and actors do exist. However, these interrelationships and their nature (negative, positive) remain unknown. Hence, the following proposition is put forward: *It appears that the causal interrelationships that exist among the actors and the factors are of high importance and, thus, should be investigated in depth.* Despite the fact that the authors attempted to explore this proposition during the data collection process, more research is required to fully understand this phenomenon. Below, the findings from the examination of the ***Factors and Actors Issue*** are reported.

**Cost factor:** It appears that the following actors are related to different parameters of the cost factor: (a) clinicians, (b) non-clinicians, (c) clinical students, (d) hospitals, (e) medical departments, (f) administrators, (g) researchers, (h) suppliers, (i) technologists, (j) managers, (k) government, and (l) health authorities. For example, clinicians and other actors are related to one or more parameters of cost factor (e.g., training) whereas the actor hospital relates to the overall cost of EAI adoption. This indicates that a detailed classification of the cost factor (e.g., like the one proposed by Themistocleous, [2004]) should be used to facilitate this study. In doing so, the causal interrelationships among actors and the specific cost types (e.g., direct, indirect) and parameters (e.g., training cost, maintenance) should be identified. This might lead to the development of a frame of reference that will enhance the decision making process (e.g., identify different strategies for EAI uptake). As a result, knowledge regarding: (a) the actors related to a specific cost parameter and (b) the nature of this relationship (positive-negative), will be available when taking decisions for EAI adoption. Hence, the authors suggest that further research is required in this area.

**Barriers and benefits factors:** All the actors interviewed are interested in understanding the EAI Benefits and Barriers related to healthcare organisations. *This finding highlights that actors should be informed (e.g., through workshops or discussion forums) during the EAI adoption process.* Such an issue is also emphasised in the normative literature [NHS 1993; Siau 2003]. The findings for cost factor (reported previously), the interrelationships between the actors and the different parameters of benefits and barriers should be identified. From the discussion with the interviewees it seems that this evidence applies to all the influential factors. It is therefore pointed out that: *It would be more interesting to investigate the interrelationships among a full range of factors (including parameters) with actors involved in EAI adoption in healthcare to facilitate a deeper level of analysis.*

**IT support factor:** The empirical data reveals that the suppliers, technologists, human and organisational controllers and the organisational providers are related to this factor (support). It appears that due to the complexity of EAI and the lack of employees with EAI skills, there is a need to support the interrelated actors. As it has been reported above, the hospital seeks support from consultants. This is also highlighted in other relevant studies or in the adoption of technologies in which there was a lack of employees skills, e.g., ERP systems [Ginzberg and Zmud 1998].

**Internal and external pressures factors:** The clinicians, non-clinicians, the organisational providers, suppliers, technologists and managers are related to the internal and external pressures factors. *This indicates that these actors cause or receive pressures during the EAI adoption process.* The conflicting interests of these actors have been seen to lead to internal and external pressures. For example, a healthcare manager may be positive toward EAI adoption as s/he believes that such a solution will improve the delivery of services. Admittedly, a supplier may resist as his/her company does not have the resources to implement an EAI solution. Thus, it appears that these pressures and their interrelationships with the aforementioned actors should be designated in depth.

**IT infrastructure, IT sophistication, compatibility and evaluation framework of integration technologies factors:** The empirical data indicate that these technological factors can be examined and analysed as a group since they are related to the same set of actors: organisational supporters, researchers (human supporters) and managers (human controllers). This finding suggests that *the technological factors should be studied in relation to the aforementioned actors (supporters) to support EAI adoption.* In support of this, Grimson et al. [2000] reported that the existing healthcare IT infrastructure and sophistication are the main barriers in healthcare services improvement.

**Telemedicine factor:** The patients and next of kin (acceptors), the human and organisational providers (non-clinicians, clinical students, hospitals, medical departments – clinics), researchers and managers are related to the telemedicine factor. From this finding it appears that the application of EAI should support the telemedicine that is significant for the EAI hospital as well as the aforementioned actors. However, not all the managers and researchers appeared to be interested in these factors, as they were not familiar to EAI technology and its advantages. *It is worth noting that researchers and managers should be broken down into subcategories* (e.g., type of manager, researcher [IT manager, financial manager, hospital manager etc]) to better support the analysis of data.

**Patient satisfaction factor:** The patients' satisfaction factors affect and/or are affected by all the actors except the legal professionals, suppliers, and technologists. As the vision of the healthcare sector is toward the development of a patient-centric IT infrastructure [Wanless et al. 2002], *it appears that most of the actors are interested in the EAI adoption's effect upon the clinical processes and the patient satisfaction.*

**Organisational size factor:** Khoumbati et al. [2007] mentioned that the size of healthcare organisations can be described by the number of beds, total assets and number of personnel. However, the main measure used is the number of beds as the operational definition of size that influences the adoption of technological innovations. From the data retrieved, it appears that it is an issue that affects the EAI adoption and the actors interested in this factor

are the: (a) organisational providers (hospitals and medical departments – clinics), (b) researchers, (c) technologists and (d) managers. This is in accordance to the normative literature, which suggests that the larger the organisational size, the greater the need for integrating the heterogeneous systems [Khoumbati et al. 2007].

**Security and confidentiality factor:** The security and confidentiality of patients' data is a factor that affects all the actors' decision making toward EAI adoption. This finding highlights the need for patients' data security and confidentiality. This is according to the normative literature that suggests security and confidentiality is critical during the implementation and adoption of integrated solutions in a healthcare setting [Huston 2001].

**Physicians and administrators relationship factor:** The relationship between physicians and administrators is an important factor influencing the EAI adoption in healthcare organisations. The physician's role has been characterised as crucial during the adoption of integrated technologies [Chan et al. 2005; Stefanou and Revanoglou 2006] as It can be a barrier during this process. Thus, it has been reported that the administrators should consider physicians during the integration process [Khoumbati et al. 2007].From the empirical data, it appeared that the actors, whose decision towards the EAI adoption is affected by this factor are the following: (a) clinicians, (b) non-clinicians (c) administrators and (d) managers. A clinician reported that: "The integration technology should support not only the systems' integration, but also the employees' cooperation."

**Education factor:** From the findings it appears that: (a) clinicians, (b) non-clinicians, (c) hospitals, (d) medical departments – clinics, (e) researchers, and (f) managers are related to this factor. Along similar lines to the literature [Iacovou et al. 1995], the education is strongly related to other parameters such as training and skills development (e.g., technical) [Bhattacherjee 2000; Stefanou and Revanoglou 2006]. All these parameters derive from different factors (in this case, barriers and cost) influencing and being influenced by various actors. This indicates that the analysis should focus on the interrelationships among different factors and actors (e.g., how a specific actor or a parameter of a factor affects or is affected by other factors, actors or parameters of the same factor). Since the complexity of this observation is high, it might be more helpful if modelling techniques were used to model and analyse these interrelationships. Thus, the authors propose that: *The interrelationships between a full range of factors (including parameters) with actors might be studied and mapped using modelling techniques (e.g., Fuzzy Cognitive Mapping and Structural Equation Modelling), to enhance the decision making process.*

## VII. LESSONS LEARNED

Through the empirical evidences presented in the previous sections, the authors studied the area of EAI adoption in healthcare by combining the factor- and actor-oriented approaches. No claim for generalisation is made for interpretive research of this type. Thus, the lessons learned are a result of the description provided and do not seek to be prescriptive. These lessons might be helpful to healthcare organisations as well as to researchers and IT practitioners and are summarised below:

**Lesson 1** Healthcare actors have an important role during the EAI adoption process. This crucial role has been reported in the literature and was validated through this research. Within the context of healthcare organisations, it appears that the role of actors is more significant than expected, as some actors (e.g., nurses, clinicians) seem to have the power to hold back the adoption or even lead to the system's failure.

**Lesson 2** Since not all the members of one actors' category share common views, it is suggested that individual and group sub-lenses should be used in combination with the human and organisational lenses. This will support actors to be further distinguished and will help organisations to better understand, analyse and manage the reactions of actors.

**Lesson 3** The IGOHcaps method used in this paper for healthcare actors' identification provides a structured way to identify healthcare actors and classifies them into different categories (e.g., acceptors) and lenses (human and organisational). Thus, IGOHcaps method leads to more systematic way to identify healthcare actors and can enhance the level of analysis and understanding.

**Lesson 4** The combination of the factor- and actor-oriented approaches can support a better realisation and understanding of the factors affecting the EAI adoption in healthcare organisations.

**Lesson 5** The proposed approach can support decision-makers and managers to realise to which factors the different actors are mapped. Moreover, it can help them better manage the actors involved in the EAI adoption, as well as the adoption process per se.

## VIII. CONCLUSIONS

The need to improve healthcare services through 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 under-utilized. 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 address this issue by reviewing the normative literature and building a conceptual model on the outcomes of this review. From the literature review it appears that previous published work on the adoption of EAI did not pay appropriate attention to the human and social issues. Despite the fact that the factor-oriented approach for EAI adoption in healthcare is a validated approach that explains the uptake of EAI, it has its own limitations. The explanation of this relies on the fact that it ignores the human and social aspects which are considerable for the study of healthcare. To overcome this limitation, the authors propose a combination of the factor- and actor-oriented approaches. This novel approach extends the normative literature and increases the level of analysis by providing a more detailed and systematic study of this phenomenon. The authors identified and categorised the actors related to the EAI adoption in healthcare since there was a void in the literature.

In doing so, the authors produce a conceptual model that incorporates influential factors reported in previous studies and combines them with the proposed classification of healthcare actors. This conceptual model makes a novel contribution at both a practical and a conceptual level. At a practical level, the model contributes toward a deeper understanding of the EAI adoption in healthcare. At the conceptual level, it identifies and proposes a classification of healthcare actors that should be considered during the adoption of EAI in healthcare. The identification of the actors is based on theoretical works conducted by others. Hence, the justification and identification of actors is grounded in literature. The combination of actors and factors-oriented approaches: (a) supports managers and researchers in understanding which actors should be considered during the study of EAI adoption factors; (b) supports the multiple healthcare actors in the realisation of the factors related to the EAI adoption process; and (c) might increase the adoption of EAI in healthcare. Consequently, it is suggested that this approach might reduce the resistance to change and speed up the adoption of EAI. Therefore, the services provided to patients and citizens will be improved.

One of the limitations of this research is that the outcomes presented herein are based on a single case-based strategy. Thus, the data and the observations derived from this case cannot be generalised. Nonetheless, it is not the intention of this paper to offer prescriptive guidelines about which actors are affected and affect the EAI adoption process. The purpose of the paper is to allow others to relate their experiences to those reported herein. Therefore, this paper offers a broader understanding of the phenomenon of EAI adoption in the area of healthcare.

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