

SOA implementation critical success factors in healthcare

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SOA
implementation
CSFs

Journal of Enterprise Information
Management
Vol. 26 No. 4, 2013
pp. 343-362
© Emerald Group Publishing
Limited 1741-0398
DOI 10.1108/JEIM-06-2012-0036

Abstract

Purpose – Service oriented architecture (SOA) is increasingly adopted by many sectors, including healthcare. Due to the nature of healthcare systems, there is a need to increase SOA adoption success rates as the non-integrated nature of healthcare systems is responsible for medical errors that cause the loss of tens of thousands of patients per year. Although numerous factors affect SOA success, these have not been explored and analysed yet, especially in the area of healthcare. This highlights a literature void and thus the purpose of this paper is to identify critical success factors (CSFs) influencing SOA implementation in healthcare.

Design/methodology/approach – The authors critically review the literature and identify individual factors that may form CSFs for SOA implementation in healthcare. In doing so, they synthesise and propose a conceptual model of SOA CSFs in healthcare. The conceptual model is tested in the practical arena using a qualitative research methodology that is based on a case study strategy.

Findings – The empirical findings verify the proposed model and reveal that an additional SOA CSF in healthcare does exist. It is also revealed that the proposed model helped the case organization to successfully implement an SOA solution.

Research limitations/implications – The implications that derive from this article are important for both theory and practice. At a practical level, the paper delivers a model that can be used as a decision-making tool by professionals when they implement SOA solutions in healthcare. At a theoretical level, the proposed model extends the body of knowledge on this area and opens new avenues for research. From another point of view, it is suggested that further research is required on this area as the proposed conceptual model was tested only through a single case study. Thus, multiple case studies or other types of research strategies should be used to better test the proposed model.

Originality/value – This work is original and focuses on CSFs related to SOA implementations in healthcare organizations. The work can be considered as novel as it identifies and classifies SOA CSFs for solutions that have been developed in the area of healthcare.

Keywords Healthcare information systems, Service oriented architecture, Critical success factors, Health care

1. Introduction

The motivation to investigate service-oriented architecture (SOA) critical success factors (CSFs) in healthcare is threefold. First, the Healthcare Information Systems (HIS) integration is a critical parameter for patients' well-being (Aron *et al.*, 2011; Currie and Finnegan, 2011; Petter *et al.*, 2008). Second, SOA is increasingly utilized as an integration paradigm for HIS (Blanton *et al.*, 2009; Nadkarni and Miller, 2007). Third, SOA implementations is an uncharted research area with many, especially non-technical factors surrounding it is successful implementation (Heffner, 2009).

Healthcare organizations demonstrate ongoing efforts to reduce costs and improve the quality of their services through systems integration. In these efforts, successful integration of new and existing systems is of high priority (Chiasson *et al.*, 2007).

HIS integration is of critical importance as even a small error in any one of the various pieces of information stored and used in the HIS could have consequences that directly influence the quality of human lives (Aron *et al.*, 2011). In more detail, HIS are embedded in clinical and diagnostics equipment, but most importantly are uniquely positioned to capture, store, process and successfully communicate medical data. These data aid the decision makers for better coordination of healthcare processes. In the past, medical errors that occurred through the non-integrated HIS are estimated to have resulted in the loss of 23,000 persons per year in the UK (Khoubati *et al.*, 2006). In the same lines, the USA's Healthcare reform plan (2010) highlights the correlation between medical errors and morbidity as a current problem responsible for the death up to 98,000 people per year. Thus, the need for successfully integrated HIS in a safer, interoperable and more manageable environment motivated organizations to consider the adoption of solutions, such as SOA.

SOA is an architectural paradigm that supports reusability and emphasizes on breaking business processes into smaller blocks of functionality (e.g. services). These small blocks are well defined, self-contained modules that provide standard business functionality and are linked together to build an integrated business process (Papazoglou *et al.*, 2008). Organizations that implement SOA can: reduce costs, reuse software (e.g. web services), integrate their legacy systems and IT infrastructures, and better align business with IT (Basias *et al.*, 2012; Koumaditis and Themistocleous, 2011; Mueller Benjamin *et al.*, 2010).

However, Heffner (2009) reports that: 41 percent of SOA implementers believe that SOA delivers less benefits than expected and another 17 percent that they are struggling enough with SOA and they will not expand its use. Based on these statistics it is obvious that 58 percent of SOA adopters have not yet figured out how to benefit from their projects. Thus, even though SOA is considered as a valuable architectural paradigm, there exist factors that are unclear to implementers exist. These are mainly non-technical factors and can affect the success of SOA implementations (Morabito *et al.*, 2010; Viering *et al.*, 2009). Therefore, motivated by these essential issues, this paper is seeks to answer the following research question:

RQ1. What are the CSFs influencing SOA implementation in healthcare?

Thus, we propose the identification of SOA CSFs in healthcare to provide initial insights for researchers and practitioners. Consequently, a literature review of published cases from various industries (non-specific sector) and healthcare was conducted. This review resulted in a proposition of a SOA CSFs model, which was then, tested using a qualitative case study strategy. The case study was carried out in a big public healthcare organization (PHOrg) with 1.5 million members that at the time required a cost reduction on expenditure by utilizing IT. Reflecting these challenges the administration decided to implement SOA-based e-health services.

The remaining of the paper is structured as follows: Section 2 presents the literature review on SOA, Section 3 the research methodology, Section 4 the empirical data, Section 5 the case study findings, Section 6 the discussion and lessons learned and Section 7 conclusions and future research agenda.

2. Literature review: SOA

SOA is an architectural paradigm in which business processes are composed using web services (Erl, 2005). From a technical perspective, SOA addresses issues related to

reuse, maintenance and integration. From a business perspective, SOA provides services that are aligned with internal or external business needs. Accordingly, healthcare organizations move toward redesigning their systems to utilize the SOA paradigm (Blanton *et al.*, 2009). In doing so, they can build upon previous architecture approaches while better addressing agility and effective reuse of services across and outside the organization (Mantzana *et al.*, 2010). SOA provides an opportunity to achieve broad-scale interoperability, while offering flexibility to adapt to changing technologies and business requirements (Mahmood, 2007). In addition to this, SOA implementations can offer benefits that are required particularly in healthcare, such as: improved medical data and services quality; improved accessibility/interoperability; enhanced decision making; and compliance with new laws/regulations.

For example, Ferguson (2010) reports that SOA-based electronic healthcare records (HER) can improve the quality of medical data and its outcomes due to enhanced interoperability. The fact that SOA integrates disparate applications and data sources allows us to clean data and produce more accurate and up to date information that are vital for the healthcare decision-making process. In an example reported by Leader (2010) medicines, prescribed through a traditional process, and changed later on due to changing treatment, exposed the patient to a higher risk as the doctor had no visibility to patients' data. This risk can be eliminated by adopting a SOA solution that allows doctor to have access to patients' medical data and see what other medicines s/he takes or what allergies s/he has. Also the doctor can check on-line for possible interactions of the patients' medicines.

From another point of view, SOA can help healthcare organizations to comply with new laws/regulations. As medical data and services are increasingly exposed among healthcare partners and patients, compliance with current and frequently revised laws and mandatory standards are set by governments to insure safety and security of the exchange process. National and international regulations such as: Health Insurance Portability Accountability Act and Health Information Technology for Economic and Clinical Health Act and standards, like: CEN/TC 215 EN 13606, and HL7 require all organizations to review their business processes and ensure that they meet the compliance requirements set forth in the legislation (Department of Health & Human Services, 2010; Rusu *et al.*, 2010). SOA can assist healthcare organizations in complying with new laws/regulations as it delivers faster response to change (e.g. new laws) and is evolving in accordance to standard (e.g. like the case of SOA/HL7) (Josuttis, 2007; HL7/OMG, 2008). It also supports flexible, scalable and extendable IT infrastructures that are easily adapted to the changing needs and requirements of the business environment.

Despite the benefits that SOA provides, not all SOA projects have delivered the expected outcomes due to organizations lack of understanding especially in non-technical factors (managerial, human, etc.) surrounding SOA implementations (Heffner, 2009). This is extremely important as investments of hundreds of thousands of euros do not lead to the expected outcomes and in some cases result in failure. A failure in a healthcare organization's IT infrastructure is not an option as the literature is full of cases where IT failures cost patients lives (Fitzgerald and Russo, 2005). For this reason, we decided to focus our study on CSFs of SOA implementations in healthcare given that: SOA projects are affected by various factors and the importance of healthcare projects success.

In reviewing the normative literature we first review the factors that critically affect the success of a SOA implementation. Thus, we initially search various databases, such

as: Google scholar, IEEE Xplore, AISeL and ScienceDirect. We run keywords, title and abstract, using specific keywords (e.g. “SOA Critical Success Factors” and “SOA implementation”) and seek representative studies. Alongside, a backward references search, with the references of the studies yielded from the keyword search, thus extending the knowledge of the theory and methodology used (Levy and Ellis, 2006). In an attempt to provide valuable insights for the information systems (IS) community we organized the review in a conceptual structure (e.g. CSF/CSF in healthcare) (Vom Brocke *et al.*, 2009). The literature review reveals nineteen individual factors that can be consider as important for SOA implementation in healthcare. It is worth noting that not all the factors are healthcare specific but some of them are more important and relevant in a healthcare environment rather than elsewhere. Also some factors like cost and risk are common factors that affect the success of any IT implementation and project.

Based on the 19 individual factors that are derived from the literature we synthesize a conceptual model. The factors are explained in alphabetical order:

- *Alignment*: in order to result in a successful SOA implementation there is a need to align the business strategy with the business processes, the SOA solution, the IT infrastructure and the actors involved. This is extremely important especially in a healthcare setting where numerous categories of human actors with different and often conflicting interests should be aligned too (Aier *et al.*, 2009; Antikainen and Pekkola, 2009; Chang and Lue, 2009; Haresh and Fethi, 2009; Lee *et al.*, 2010).
- *Clear goals form*: a significant element of a business strategy and a project. In the case of SOA implementation these should be set up in advance as upon them the service management and modification is based (e.g. mapping of measurement result). SOA goals require a good understanding of both IT and business parameters (Lee *et al.*, 2010).
- *Complexity*: healthcare organizations' IT infrastructures consist of hundreds of legacy, custom, packaged, e-services and other types of applications. These are based on multiple operational systems, programming languages and protocols and in their vast majority are not compatible. These systems partially integrate business processes but there is often no clear view about the processes and IS that automate these processes due to high complexity. When the discussion comes to systems integration through SOA, the complexity can affect the number of physical resources required to address integration and thus it may affect the whole project implementation (Lee *et al.*, 2010; Schelp and Aier, 2009).
- *Cost*: is a vital factor related to any project and in any sector. Usually organizations do not proceed to the implementation of a software solution without performing a detail examination of all cost types and categories associated with their project. The same happens when organizations implement SOA (Aier *et al.*, 2009; Haresh and Fethi, 2009; Lee *et al.*, 2010; Themistocleous and Mantzana, 2010).
- *Culture*: the lack of organizational culture that supports healthcare organizations to integrate their IT infrastructures is considered as a major factor. It is therefore crucial to cultivate a culture that supports a SOA friendly environment as such a culture may: reduce resistance to change, assist individual business units to take ownership of data, processes IT systems and get commitment at the board

level (Aier *et al.*, 2011; Antikainen and Pekkola, 2009; Chang *et al.*, 2006; Haresh and Fethi, 2009; Nasr *et al.*, 2011; Wong-Bushby *et al.*, 2006; Yoon and Carter, 2007).

- *Enforce decision*: Wendell (2009) and Mulrooney (2010), reflect on the need to establish tools and methods for the detailed execution of SOA related decisions and/or the ownership of specific services. They report that this enforcement can minimize the time delay experienced due to negotiations, unclear ownerships and misunderstanding and thus assist SOA implementation. The emphasis given to this factor (e.g. in healthcare) is supported by the view that the variety of the actors and the heterogeneity of the healthcare disciplines results in a time consuming and complex decision-making processes (Locatelli *et al.*, 2012).
- *Experience*: SOA requires the availability of experienced professionals from both IT and business orientations that can apply their skills during the SOA implementation (Aier *et al.*, 2009; Antikainen and Pekkola, 2009; Chang and Lue, 2009; Haresh and Fethi, 2009; Nasr *et al.*, 2011; Yoon and Carter, 2007). Especially in the area of healthcare it is expected that experienced staff with relevant skills can support the organization to address issues related to complexity.
- *Governance*: refers to an overall plan that: provides compliance with regulations (internal/external) and checks services concerning capability, security and strategic business alignment (Aier *et al.*, 2011; Antikainen and Pekkola, 2009; Chang and Lue, 2009; Haresh and Fethi, 2009; Kajko-Mattsson *et al.*, 2007; Lee *et al.*, 2010). SOA governance is considered as a significant factor that affects the implementation of SOA architectures as it allows the organization to control the service lifecycle, establish decisions rights (e.g. development, deployment, operations and management of new services) and monitor the progress of SOA initiatives.
- *Long-term planning*: SOA focusses on services reusability. Thus, a long-term business plan that includes reusable services to facilitate future business is required (Antikainen and Pekkola, 2009). Long-term planning is also necessary as organizations do not implement their SOA architectures in one wave but in a progressive manner. This is important in the area of healthcare where many incompatible systems do exist and need to be tested thoroughly before go live.
- *Measurement*: the success of a SOA implementation is measured against specific criteria such as availability, reusability, quality of service, performance, functionality, etc. For that reason it is important that healthcare organizations implementing a SOA solution should set their criteria for measurement in advance (Lee *et al.*, 2010; Schelp and Aier, 2009).
- *Maturity identification*: these are models that outline anticipated, typical, logical and desired evolution paths toward SOA maturity and are used to assess the AS-IS situation of an organization. SOA maturity identification is crucial as it illustrates future directions in a clear, meaningful and multidimensional way (e.g. technology, adoption, process, etc.) (Blanton *et al.*, 2009).
- *Project identification*: SOA can be utilized as part of a system and expanded over time. Thus, initial identification of the early SOA adopters, low-complexity pilots based on existing needs for change is important (Aier *et al.*, 2011; Lee *et al.*, 2010; Nasr *et al.*, 2011; Yoon and Carter, 2007).

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- *Resources*: SOA is adopted as a paradigm that utilizes existing IT infrastructure (e.g. applications and services) but also requires resources to be implemented (e.g. staff, experts, software, hardware). Thus, it is suggested that the availability of such resources is critical for SOA implementation (Chang and Lue, 2009; Lee *et al.*, 2010).
 - *Risk*: there are numerous risks like operational and financial need to be considered during the implementation of a SOA implementation. In a healthcare setting there exist additional risks that should be studied and analyzed like access control, privacy violations, medical fraud, medical identity theft and data confidentiality (Antikainen and Pekkola, 2009; Lee *et al.*, 2010).
 - *Roadmap*: roadmap is a high level plan and a guide for building a SOA architecture. SOA roadmap's importance is seen as it includes the goals and milestones usually set in a time/activity manner in conjunction with the maturity model phases (Blanton *et al.*, 2009; Lee *et al.*, 2010).
 - *Roles*: many individuals with different roles and level of responsibility participate, affect and or are affected by a SOA project. Placing the right role(s)-to-individual can be a crucial factor for SOA implementation as multidiscipline skills (e.g. IT and business) are required for a SOA implementation (Kajko-Mattsson *et al.*, 2007; Lee *et al.*, 2010; Nasr *et al.*, 2011). Also in the area of healthcare actors change roles over time. For instance, a doctor can act as a provider of a healthcare service (e.g. medical doctor) in one instance and in another can act as a patient who accepts healthcare services from another medical doctor or healthcare unit. The importance of actors' roles is well discussed and analyzed in the literature with Mantzana *et al.* (2007) suggesting that actors and their roles are affected by the organizational environment and the time. This indicates that the actors and their roles should be identified and managed in any case.
 - *Standards*: SOA is based on established global standards such as XML, UDDI, SOAP, WSDL, BPEL and REST (Lee *et al.*, 2010). The fact that SOA is a standard based paradigm supports its widespread. In healthcare sector there are standards that are used for technical issues like the HL7 which is used for integration issues. There is therefore a need to consider all these standards (healthcare and non-healthcare specific) when implementing a SOA solution.
 - *Team*: in a SOA implementation there are many team members with different sets of skills and expertise that participate. The project manager is usually responsible for the appointment of the team. Therefore, s/he has to build a balanced team that includes members that understand the technical, business and healthcare issues of the SOA implementation in healthcare (Antikainen and Pekkola, 2009; Lee *et al.*, 2010; Wong-Bushby *et al.*, 2006). The literature in the area of healthcare reports that IT projects usually fail when there is a non-balanced implementation team (Fitzgerald and Russo, 2005).
 - *Testing*: SOA is based on procedures, design rules and standards for ensuring that different services and components (technological and human) can successfully cooperate toward a shared business goal. Thus, tools and methods to test the integration approaches and services are required before the actual service implementation (Nasr *et al.*, 2011).

The above-mentioned factors that are derived from the literature review are in the form of a laundry list. For that reason we decided to classify them using the Shang and Seddon (2000) model. Despite this model was introduced to classify integration benefits we believe that it can be used to categorize the factors that affect the implementation of an integration paradigm like SOA. Shang and Seddon (2000) model is suitable for this categorization as it was originally derived from integrated IT infrastructure and widely used in the past to provide a distinctive view of integration technologies (Hsin, 2006; Khoubati *et al.*, 2006). We also argue that the model's categories can be efficiently used to present the proposed factors in a more organized and clear way. Based on Shang and Seddon (2000) model we classify the proposed factors into: operational, managerial, strategic, IT infrastructure and organizational categories. The proposed conceptual model for SOA CSFs is implemented to help practitioners and researchers to focus their attention to the significant role that each identified CSF plays. In addition, the categorization of the factors illustrates specific aspects of each factor (e.g. organization, management, etc.).

The classification of the CSFs of the proposed conceptual model is presented in Table I. In this table the first column from the left refers to the CSF category based on Shang and Seddon (2000) model. The second column from the left presents the factors identified in the literature and mapped with the preceding column. The remaining columns under the heading "references" map literature references with each factor.

3. Research methodology

In order to test the proposed model of SOA implementation CSFs in healthcare, an interpretive qualitative research approach was utilized that employs a case study strategy. This decision was based on the need to study the CSFs surrounding SOA implementations and on the unique nature of healthcare itself. In more detail, healthcare can be characterized by unique issues, such as: the interactive nature of practitioner/patient relationships; patients' subjective experiences of illness; their own personal understanding of human suffering; and stakeholders behavior and interpersonal interactions (Miles, 2009). The aforementioned healthcare characteristics drive effective clinical process to rely not to a single but rather to several different kinds of knowledge (e.g. medical, anthropological and instrumental). Consequently, giving the required depth of understanding that can be applied to a given problem situation. The same principle, as in clinical practice, is useful to be applied to the research methodology so as to research a healthcare setting (Fossey *et al.*, 2002). Moreover, as to understand the interplay between stakeholders (clinical and non-clinical) and IS, emphasis is required on the meanings, concepts, definitions, characteristics, descriptions and associations rather than numbers and statistics. Thus, as a more suitable candidate the interpretive qualitative research approach is followed in this research, as it can closely relate to the healthcare aspect of the research. Additionally, qualitative research methods are being used increasingly in evaluations of computer systems and IT both within and outside healthcare (Kaplan and Maxwell, 2005). Furthermore, the use of a case study was utilized as it is a widely used research mechanism for examining CSFs and supports the investigation of: little-known phenomena (SOA CSF in healthcare) and complex processes (SOA implementation) in their natural setting (Bairi and Manohar, 2011; Kamal, 2006).

Dimension	References																						
	Huf (2008)	Gilbertson (2008)	Vengco (2008)	Mirhaji (2008)	Giokas (2008)	Stephens (2008)	Wrightson (2008)	Riben (2008)	Welker (2009)	Miller (2009)	Wendell (2009)	Mulrooney (2009)	Smith (2010)	Gaydos (2010)	Weiler (2010)	Ferguson (2010)	Felton (2010)	Pant (2010)	Do (2010)	Bugra (2010)	Mulrooney (2010)	Rosen (2009)	
CSF																							
Operational																							
Maturity identification	✓																						
Roadmap			✓																				
Complexity																							
Roles																							
Team																							
Governance																							
Cost																							
Measurement																							
Risk																							
Long-term planning																							
Clear Goals																							
Project identification																							
Resources																							
IT Infrastructure																							
Standards																							
Testing																							
Organizational Alignment																							
Culture																							
Experience																							
Enforce decisions																							

Table I. Proposed SOA critical success factors in healthcare

In this research a qualitative research design is followed incorporating three stages: research design, data collection and data analysis, as seen in Figure 1. Whereas, the stages are presented, alongside the actions (e.g. identify research need, literature review, etc.) and the sections of the paper that each corresponds.

The literature review (as explained in Section 2) helps us to develop the conceptual model of the SOA CSFs in healthcare (Table I) and in this section the research methodology is presented. This study employs multiple data collection methods, such as: documentation, interviews, direct observation, participant observation and archival records (Strauss and Corbin, 1998). For the purpose of this research, we conducted face-to-face semi-structured interviews with five professionals during a period of four months. These interviews lasted from 60 to 90 minutes. The following stakeholders were interviewed in the case organization: top-manager A, top-manager B, project manager internal, project manager external and administrator. In addition, appropriate documents and records portraying the issues at hand, were retrieved. The interviews were digitally recorded and the transcription outcome was discussed and verified with the interviewees. The bias that may be presented when using qualitative, case study research approach was overcome by data triangulation. The use of multiple data collection methods (interview, archive reports and raw data) makes the triangulation possible and preserves the reliability and validity of findings

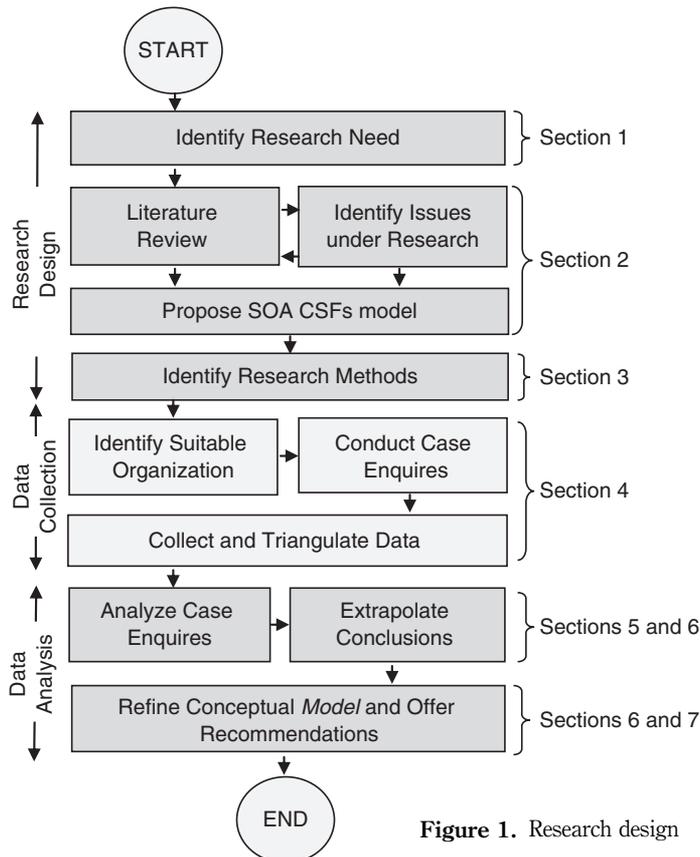


Figure 1. Research design

(Myers and Newman, 2007). The finalized material was then compared with the outcome of the literature review (Table I). The data analysis stage is presented in the following sections.

4. Case study analysis

Due to confidentiality reasons we cannot report the identity of the case organization. For this reason we refer to this organization using the coded name PHOrg. PHOrg has more than 1.5 million members and consists of 57 regional healthcare services and contracted partners (pharmacists, doctors, diagnostic centers, private clinics and physiotherapists). It is estimated that PHOrg monitors and interacts with 12,744 doctors, 2,685 diagnostic centers and labs, 710 physiotherapists, 1,100 opticians and 9,735 pharmacies making it a large multidimensional organization.

When a new administration was appointed to manage PHOrg the organization was facing two major problems: the cost of the services provided were exceeding by far the amount of revenue it produced and a change in the institutional framework regarding the hiring of contractors resulted to personnel reduction of 44 percent. In an attempt to address these issues several IT and other solutions were introduced. The most strategic action that PHOrg took focussed on the implementation of a SOA-based electronic prescribing system with an integrated sub-system, that records diagnostically and medical referrals, named integrated services (iServ). The system was created with the assistance of an external sub-contractor and funding placed by an external sponsor. The system's platform is web-based open source and was provided for free to the contracted physicians and diagnostic centers. The physicians use the platform to refer the patient to a diagnostic center and the diagnostic center execute the referred diagnostic tests and charge the PHOrg. The initial objective of PHOrg was to create a proof-of-concept pilot version of iServ with appropriate functionality and evidence of cost reduction. The overall project can be characterized of success in many levels. To verify the success of the project we applied the six major success dimensions of a well-known model (Petter *et al.*, 2008). A summary of the findings portraying the success of the project is seen as follows:

- *system quality*: the system in its final state met the desirable characteristics, such as: ease of use, system flexibility, system reliability and ease of learning, but overall was lacking sophistication;
- *information quality*: the desirable characteristics of the system outputs as management reports and other data formats were of: relevance, understandability and accuracy;
- *service quality*: the quality of the support that system users receive from the IS department and IT support personnel was responsive, reliability with technical competence;
- *system use*: the degree in which the end-user utilized the service showed high level (84 percent of the doctors);
- *user satisfaction*: users' level of satisfaction was reported very low at first (initial pilot stage) but grow to be of high levels as the project reached its final stages; and
- *net benefits*: the system contributed to the success of individuals (top management), groups (project and IT), the organizations (cost reduction and reputation) and even had an effect on national level as it will be explained in the following sections of this paper.

5. Case study findings

Initially, the interviewees were asked to comment on the proposed conceptual model of SOA implementation CSFs as these were classified in the five dimensions of Table I namely: operational, managerial, strategic, IT infrastructure and organizational. All interviewees were positive about the use of the classification and they approved the five dimensions.

Operational dimension: empirical evidences indicated that PHOrg addressed maturity identification as part of a SWOT analysis thus placing itself in an initial SOA maturity stage. Furthermore, this process identified the steps required to improve the SOA maturity level. The steps that PHOrg identified toward this direction were: utilize expertise; use related technology; and integrate, educate and influence others (employees, stakeholders and funds). These steps were achieved through a gradual transition and formed a roadmap toward SOA implementation. Empirical evidence indicated that complexity was not realized as a CSF in this case. The reason for this was that most of the business processes of PHOrg were not automated and thus there was no complexity in terms of systems integration. However, it should be noted that this is not a typical case as many organizations have at least automated but not integrated HIS.

Managerial dimension: PHOrg created dedicated teams with a clear structure. A project Team A (three members) and an IT team containing members of a larger IT team were appointed at PHOrg to run the project. Also a project Team B (external developers) was appointed too to cover the project's needs. Team B consisted of two project managers and a dedicated IT team (three members). PHOrg gave roles only to Team A (e.g. project manager, integration advisor, management representative) and assigned task to the rest employees.

Empirical evidences indicate that PHOrg addresses governance as the alignment of strategic business goals (e.g. e-health services) with the current legislation. This was the case as many laws issued decades ago did not foresee the use of e-health services and opposed issues related to e-health, such as: privacy and patient's data confidentiality, functionality and management. The project had to be in accordance to the legislation running at that point. Thus, Team A with the legal service team (already running as part of PHOrg) produced a legislation proposal. After revision, the top management of the PHOrg with the aid of government officials produced a new law proposal, which was the first directed to assist e-health services and to cover the project. Furthermore, as stated PHOrg's approach involving sensitive patient data Team A always confirmed their approach with the Country Data Protection Authority considering all risks and safety measures.

Additionally, PHOrg's plan was based on utilizing the results from measurement (usage and cost reduction) to push the change for the initiative. Thus, top management aimed to get results as quickly as possible. Additionally, managers produced weekly reports and communicated the results, as to create a positive view of the project. The measurement was conducted through an IT system (data collection software) set up by the developer (external) during the pilot phase. The measurement focussed on the use and functionality of the services and the data retrieved were mapped with the cost reduction produced. In addition to this, four interviewees reported that communication should be included as a CSF. In more detail, communication was seen as a tool to promote the project (established through the campaign), get commitment, motivate the users and get feedback (established by a one day formal presentation of the pilot to local union's representatives) and as part of everyday business (different

communication channels were created between project teams, the top management and users).

Strategic dimension: the top management recognized that: iServ was a revolutionary system and the healthcare environment was in a reform state. Therefore, PHOrg planned for immediate results but recognized the long-term usage of the project by other organizations as well. Accordingly, the focus was divided between getting the system to work but also build a reputation around it. Thus, the goals were placed accordingly. As far as, the project identification PHOrg concentrated in a project that could produce cost reduction and be based on IT sophistication.

IT infrastructure dimension: empirical evidences indicate that PHOrg estimated the use of technological resources needed, but they were also flexible to allow the use of any applicable resource from external stakeholders (other public bodies, contractor) so as to overcome problems and depletion. The only standards applied were the standardization and coding of medical data. These proved time consuming and required more resources than originally planned. The testing was based on the functionality and usage of services at the pilot phase. The recorded problems were reported back to Team A in a formal way (report). Then a procedure was followed in which the problem was evaluated, discussed with the project manager (sub-contractor) and resolved, or if needing an approval, Team A reported back to top management.

Organizational dimension: PHOrg's top management was the driving force behind the initiative and only when the first results (demo and cost reduction reports) appeared the rest of the stakeholders started to align with the aim of the project.

PHOrg's top management cultivated a SOA friendly culture, which with the relevant experience in IT already in place (IT culture) grasped the opportunity to install a system that could reduce the cost, enhance the services provided and be used as a guide for other organizations. In this respect, many decisions were deliberately imposed from the top management level to rest of the organization stakeholders (especially managers) and the outcome was presented as a functional solution that everyone had to adopt and use. PHOrg's IT department was considered an asset from the start. Their sophistication came from training, educated personnel and related projects. A compact training plan with seminars and presentations was delivered to iServ users (doctors and pharmacists) and guidelines/manuals made available on PHOrg's web site.

6. Discussion and lessons learned

Complexity was a factor that was not reported by interviewees. Apparently this was not a CSF in this case as PHOrg developed a new system from scratch and its dependencies with other co-existing systems were small. The reason for this was that most of the business processes of PHOrg were not automated and thus there was limited complexity in terms of systems integration. However, it should be noted that this is not a typical case as many organizations have at least automated but not integrated HIS.

Another interesting point disclosed by the case data, was a new CSF called communications that was revealed by our field work (mentioned by three interviewees) and added to the managerial dimension, as seen in Figure 1. Communication in a SOA implementation is the exchange of project-specific information with the emphasis on creating understanding between the sender and the receiver and has characteristics of effectiveness, responsiveness and is directly linked with feedback of an action. Effective communication can be an important factors contributing to the success of a

SOA project. In this respect, the project team is required to provide timely and accurate information to all stakeholders. Thus, members of the project team prepare information in a variety of ways (e.g. e-mails, memos, presentations, etc.) to meet the needs of project stakeholders. Team members also receive feedback from these stakeholders. Recent studies on CSFs concur that communications play a critical role in IS project success (Nasir and Sahibuddin, 2011).

Empirical evidences revealed that emphasis was given on familiarizing PHOrg's staff to iServ's functionality and thus disseminating this knowledge by training seminars to doctors and pharmacists. The training process, included members of project teams giving short presentations of the system, analyzing the trainees' requirements and regularly amending the training process (presentation, manuals, on-line information) to include any new requirements recognized. The training process acknowledged that healthcare holds tension between the need for orderly routines and sensitivity to variation in local conditions (Locatelli *et al.*, 2012). This flexibility and adaptation followed in the training was a critical factor for its success and helped the users adapt to the changes brought by the iServ implementation.

A different approach between the literature review and empirical data was seen in the roles appointed to employees. The tasks they were assigned required the ability to take decisions that the role they held did not allow them to. Thus, in many cases caused operational problems (e.g. delays, arguments) and had to engage in meetings with the top management that hold the appropriate roles to resolve them. In SOA projects placing roles and responsibilities instead of tasks is seen as a better approach (Biske, 2008).

Empirical findings revealed that governance holds a top priority among the CSFs model. The top priority given to SOA governance is in accordance with the views of many researchers (De Haes and Van Grembergen, 2009; Josuttis, 2007; Marks, 2008; Niemann *et al.*, 2008). They reported that SOA implementations require governance mechanisms to excel, otherwise the architecture will end up complex, uncontrolled, brittle and eventually discarded (Koumaditis *et al.*, 2009). For example, in the case of the PHOrg, the creation of a tight, IT skilled, organizational structure (Team A), alignment of services with strategic business goals (iServ and cost reduction) and compliance with regulations (legislation proposal) provided valuable governance to SOA implementation.

Additionally, according to our fieldwork culture was observed as a vital CSF. Organizations can be benefited from SOA implementations by cultivating SOA culture. Thus, reduce the resistance to change, especially observed in healthcare and motivate individuals (users or decision makers) to assist the maturity of SOA (Locatelli *et al.*, 2012). For example, the PHOrg followed the pilot/proof-of-concept approach to disseminate the SOA benefits and gain the stakeholders/users cooperation. Thus, cultivate a growing favorable climate toward the SOA project. Although, it was top management dedication to the project that first and foremost drove the project to its successful outcome.

Based on the case findings it appears that PHOrg critically addressed the vast majority of the proposed SOA CSFs (Table I). Only complexity was not observed but as it is explained earlier this is not a typical case as the complexity of PHOrg's IT infrastructure was limited. Apart from these factors communication and training factors were observed and added to the proposed model for as it is seen in Figure 2.

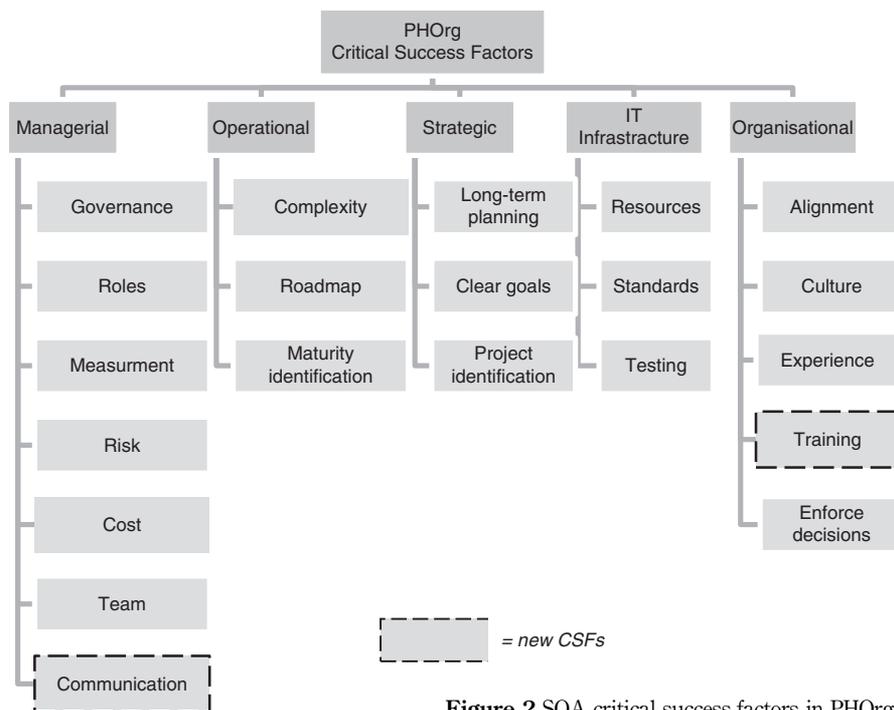


Figure 2.SOA critical success factors in PHOrg

As a result of the work carried out in this paper and the case study findings, the key lessons that can be learnt from the experiences of the SOA implementation in PHOrg are as follows:

Lesson 1: The proposed model can be used for successful SOA implementation in healthcare: The normative literature highlights a theoretical gap that refers to the lack of a conceptual model that categorizes and explains the SOA CSFs in healthcare. The empirical findings reveal that the use of such a model can have a positive impact on a healthcare organization implementing SOA. Moreover, empirical data revealed from the case organization confirm that the CSFs proposed in our model affected the implementation of its SOA solution. The utilization of such a model guided PHOrg to run the project without problems and implement it with success.

Lesson 2: The proposed conceptual model provides new insights and associations of SOA CSFs in healthcare: The critical analysis of the literature indicates that nineteen SOA CSFs do exist. These CSFs are then categorized and associated with specific organizational categories (e.g operational, managerial, strategic, IT infrastructure and organizational) they impact. This provides a clear presentation of the SOA CSFs and their association. Based on the empirical findings, we incorporate the factors communication and training in our model.

Lesson 3: Not all the factors are seen with the same critical importance: Each factor identified in this research has a critical role related to SOA implementation in healthcare. However, not all of the CSFs were seen in the same importance. In more detail, PHOrg reflected on cost and complexity with different importance value than the others. This indicates that these factors each for its own different reason may

have a value that differs from the rest and requires further investigation. There is therefore a need for further research in this area to better understand the importance of each SOA CSF.

7. Conclusion and future research agenda

In this paper, we investigated issues associated to CSFs related to SOA implementations in healthcare organizations. Despite, numerous factors affect SOA success, these have not been explored and analyzed yet, especially in the area of healthcare. This highlights a literature void and thus in this study we identified and classified SOA CSFs as these were derived from an extensive literature review. The value of proposing this model of SOA CSFs is twofold: it can help practitioners and researchers focus their attention to the significant role that each identified CSF plays and the categorization of the factors illustrates the specific category that each factor impacts (e.g. operational, managerial, strategic, IT infrastructure and organizational).

The proposed model is tested in the practical arena using a case study strategy. The case organization (PHOrg) validates the utilization of these factors during a SOA implementation. From empirical data two new factors were revealed: communication and training. We have amended our model to include these new CSFs and we are planning to test it again through a new case study in another healthcare setting (e.g. public hospital).

Another interesting finding was the fact that PHOrg has the power to impose the implementation of the new system. The power of this organization was such that persuaded the government to change the legislation to support the smoother adoption of the system. Thus, top management support and involvement was of high importance in this case.

Given the nature of healthcare systems, the importance of integrated HIS to minimize medical errors we believe that research on SOA CSFs is an important priority in the research agenda. The proposed SOA CSFs model will help healthcare organizations when implementing SOA, extends the body of knowledge on this area and opens new avenues for research.

References

- Aier, S., Bucher, T. and Winter, R. (2011), "Critical success factors of service orientation in information systems engineering", *Business & Information Systems Engineering*, Vol. 3 No. 2, pp. 77-88.
- Aier, S., Ahrens, M., Stutz, M. and Bub, U. (2009), "Deriving SOA evaluation metrics in an enterprise architecture context service-oriented computing – ICSOC 2007 workshops", Vol. 4907, Springer, Berlin, Heidelberg, pp. 224-233.
- Antikainen, J. and Pekkola, S. (2009), 17th European Conference on Information Systems, Verona, June 8-10.
- Aron, R., Dutta, S., Janakiraman, R. and Pathak, P. (2011), "The impact of automation of systems on medical errors: evidence from field research", *Info. Sys. Research*, Vol. 22 No. 3, pp. 429-446.
- Bairi, J. and Manohar, M. (2011), "Critical success factors in gaining user customer satisfaction in outsourced IT services", *Journal of Enterprise Information Management*, Vol. 24 No. 6, pp. 475-493.
- Basias, N., Themistocleous, M. and Morabito, V. (2012), "Influential factors of SOA adoption in e-banking", in EMCIS (Ed.), *Proceedings of European, Mediterranean and Middle Eastern Conference on Information Systems, June 6-7, Munich*, ISEing, Uxbridge, pp. 161-180.

-
- Biske, T. (2008), *SOA Governance*, Packt Publishing Ltd, Birmingham.
- Blanton, J., Leski, J., Nicks, B. and Tirzaman, T. (2009), *Proceeding of the 24th ACM SIGPLAN Conference Companion on Object Oriented Programming Systems Languages and Applications*, Orlando, FL, October 25-29.
- Bugrara, K. (2010), *In SOA in Healthcare: Improving Health through Technology*, Westin Arlington Gateway, Arlington, VA.
- Chang, H.-L. and Lue, C.-P. (2009), "An exploratory study of risk factors for implementing service-oriented IS projects designing e-business systems. Markets, services, and networks", in Weinhardt, C., Luckner, S. and Stöber, J. (Eds), *An Exploratory Study of Risk Factors for Implementing Service-Oriented IS Projects Designing E-Business Systems. Markets, Services, and Networks*, Vol. 22, Springer, Berlin, Heidelberg, pp. 83-95.
- Chang, M., He, J., Tsai, W., Xiao, B. and Chen, Y. (2006), "UCSOA: user-centric service-oriented architecture", in CS (Ed.), *Proceedings of IEEE International Conference on e-Business Engineering*, Shanghai, October 24-26, pp. 248-255.
- Chiasson, M., Reddy, M., Kaplan, B. and Davidson, E. (2007), "Expanding multi-disciplinary approaches to healthcare information technologies: what does information systems offer medical informatics?", *International Journal of Medical Informatics*, Vol. 76 No. 1, pp. S89-S97.
- Currie, W. and Finnegan, D. (2011), "The policy-practice nexus of electronic health records adoption in the UK NHS: an institutional analysis", *Journal of Enterprise Information Management*, Vol. 24 No. 2, pp. 146-170.
- De Haes, S. and Van Grembergen, W. (2009), "Exploring the relationship between IT governance practices and business/IT alignment through extreme case analysis in Belgian mid-to-large size financial enterprises", *Journal of Enterprise Information Management*, Vol. 22 No. 5, pp. 615-637.
- Do, N. and Nguyen, H. (2010), "Lessons learned from a information exchange (IHE) pilot", *Proceedings of SOA in Healthcare: Improving Health Through Technology*, Westin Arlington Gateway, VA, June 12-14.
- Erl, T. (2005), *Service-Oriented Architecture (SOA): Concepts, Technology, and Design*, Prentice Hall, Upper Saddle River, NJ.
- Felton, D. (2010), *Implementing the DoD/VA Virtual Lifetime Electronic Record*, SOA in Healthcare: Improving Health through Technology, Arlington, VA.
- Ferguson, J. (2010), *SOA in Healthcare: Improving Health Through Technology*, Westin, Arlington Gateway, VA.
- Fitzgerald, G. and Russo, N. (2005), "The turnaround of the London ambulance service computer-aided dispatch system (LASCAD)", *European Journal of Information Systems*, Vol. 14 No. 3, pp. 244-257.
- Fossey, E., Harvey, C., McDermott, F. and Davidson, L. (2002), "Understanding and evaluating qualitative research", *Australian and New Zealand Journal of Psychiatry*, Vol. 36 No. 6, pp. 717-732.
- Gaydos, S. (2010), *The Plan vs The Reality: Navigating SOA Challenges in Federal Healthcare*, SOA in Healthcare: Improving Health through Technology, Arlington, VA.
- Gilbertson, D. (2008), "The role of SOA in near-term evolution of EHR", *Proceedings of SOA in Healthcare Realizing Quality-of-Care*, Chicago, IL, April 15-17.
- Giokas, D. (2008), "Industry studies: what impact did SOA have on your business-IT alignment and organizational agility?", *Proceedings of SOA in Healthcare Realizing Quality-of-Care*, Chicago, IL, April 15-17.

-
- Haresh, L. and Fethi, R. (2009), "Service oriented computing in practice – an agenda for research into the factors influencing the organizational adoption of service oriented architectures", *Journal of Theoretical and Applied Electronic Commerce Research*, Vol. 4 No. 1, pp. 256-270.
- Heffner, R. (2009), *Forrester Report: Survey Results Show SOA Governance Improves SOA Benefit Realization*, Forrester Inc, Cambridge, MA.
- HL7/OMG (2008), "The practical guide for SOA in health care", Healthcare Services Specification Project (HSSP), available at: <http://hssp.wikispaces.com/file/view/2008-1229+SOA%2BHealthcare%2BPractical%2BGuide%2Bv1.0.pdf> (accessed October 1, 2010).
- Hsin, C. (2006), *Adopting Emerging Integration Technologies in Organisations*, School of Information Systems, Computing and Mathematics, Brunel University, West London.
- Huff, S. (2008), "Impact of SOA initiatives on business", *Proceedings of SOA in Healthcare Realizing Quality-of-Care*, Chicago, IL, April 15-17.
- Josuttis, N. (2007), *SOA in Practice: The Art of Distributed System Design*, O'Reilly Media Inc, Sebastopol, CA.
- Kajko-Mattsson, M., Lewis, G. and Smith, D. (2007), *Proceedings of the 29th International Conference on Software Engineering Workshops*, IEEE Computer Society, Minneapolis, MN.
- Kamal, M. (2006), "IT innovation adoption in the government sector: identifying the critical success factors", *Journal of Enterprise Information Management*, Vol. 19 No. 2, pp. 192-222.
- Kaplan, B. and Maxwell, J. (2005), "Qualitative research methods for evaluating computer information systems: evaluating the organizational impact of healthcare information systems", in Anderson, J. and Aydin, C. (Eds), *Evaluating the Organizational Impact of Health Information System*, Springer, New York, NY, pp. 30-55.
- Khoubati, K., Themistocleous, M. and Irani, Z. (2006), "Evaluating integration approaches adopted by healthcare organisations", *Journal of Management Information Systems*, Vol. 22 No. 4, pp. 69-108.
- Koumaditis, K. and Themistocleous, M. (2011), "The importance of SOA governance in HIS integration: a literature review", in EMCIS (Ed.), *Proceedings of Proceedings of European, Mediterranean and Middle Eastern Conference on Information Systems, May 30-31, Athens, Greece*, Selfpublishing, Athens, pp. 260-275.
- Koumaditis, K., Themistocleous, M., Mantzana, V. and Basias, N. (2009), "A new perspective on healthcare information systems & Service-Oriented-Architecture", IADIS International Conference e-Health 2009, Algarve, June 21-23.
- Leader, E. (2010), *SOA in Healthcare: Improving Health through Technology: The Role of SOA on the Path to Meaningful Use*, OMG, Arlington, VA.
- Lee, J., Shima, H. and Kim, K. (2010), "Critical success factors in SOA implementation: an exploratory study", *Information Systems Management*, Vol. 27 No. 2, pp. 123-145.
- Levy, Y. and Ellis, T.J. (2006), "A systems approach to conduct an effective literature review in support of information systems research", *Informing Science Journal*, Vol. 9 No. 9, pp. 181-212.
- Locatelli, P., Restifo, N., Gastaldi, L. and Corso, M. (2012), "Health care information systems: architectural models and governance", in Kalloniatis, C. (Ed.), *Innovative Information Systems Modeling and Techniques*, TechOpen, p. 26, DOI: 10.5772/38212.
- Mahmood, Z. (2007), "The promise and limitations of service oriented architecture", *International Journal of Computers*, Vol. 1 No. 3, pp. 74-78.

-
- Mantzana, V., Koumaditis, K. and Themistocleous, M. (2010), "Is SOA a solution to healthcare information systems interoperability?", *Proceedings of 10th IEEE International Conference on Information Technology and Applications in Biomedicine*, Corfu, November 2-5, p. 5.
- Mantzana, V., Themistocleous, M., Irani, Z. and Morabito, V. (2007), "Identifying healthcare actors involved in the adoption of information systems", *European Journal of Information Systems*, Vol. 16 No. 1.
- Marks, E. (2008), *Service-Oriented Architecture (SOA) Governance for the Services Driven Enterprise*, John Wiley & Sons Inc, Hoboken, NJ.
- Miles, A. (2009), "Complexity in medicine and healthcare: people and systems, theory and practice", *Journal of Evaluation in Clinical Practice*, Vol. 15 No. 3, pp. 409-410.
- Miller, C., Cromwell, T. and Steffensen, S. (2009), "CONNECTing to the NHIN", *Proceedings of SOA in Healthcare Conference, Hyatt Regency O'Hare*, Chicago, IL, OMG, June 2-4.
- Mirhaji, P., Srinivasan, A., Kunapareddy, N., Cascells, W. and Arafat, R. (2008), "SOA and rapid deployment of ad-hoc health surveillance systems: lessons from Katrina relief efforts", *Proceedings of SOA in Healthcare Realizing Quality-of-Care*, Chicago, IL, April 15-17.
- Morabito, V., Themistocleous, M. and Serrano, A. (2010), "A survey on integrated IS and competitive advantage", *Journal of Enterprise Information Management*, Vol. 23 No. 2, pp. 201-214.
- Mueller Benjamin, G.V., Legner, C. and Riempp, G. (2010), "Understanding the economic potential of service-oriented architecture", *Journal of Management Information Systems*, Vol. 26 No. 4, pp. 145-180.
- Mulrooney, G. (2009), "Information modeling SOA", *Proceedings of SOA in Healthcare Conference Hyatt Regency O'Hare*, Chicago, IL, June 2-4.
- Mulrooney, G. (2010), "Information modeling SOA", *Proceedings of SOA in Healthcare: Improving Health through Technology*, Westin Arlington Gateway Arlington, VA, June 12-14.
- Myers, M. and Newman, M. (2007), "The qualitative interview in IS research: examining the craft", *Information and Organization*, Vol. 17 No. 1, pp. 2-26.
- Nadkarni, P. and Miller, R. (2007), "Service-oriented architecture in medical software: promises and perils", *Journal of the American Medical Informatics Association*, Vol. 14 No. 2, pp. 244-246.
- Nasir, M. and Sahibuddin, S. (2011), "Critical success factors for software projects: a comparative study", *Scientific Research and Essays*, Vol. 6 No. 10, pp. 2174-2186.
- Nasr, K., Gross, H. and van Deursen, A. (2011), "Realizing service migration in industry – lessons learned", *Journal of Software Maintenance and Evolution: Research and Practice*.
- Niemann, M., Eckert, J., Repp, N. and Steinmetz, R. (2008), "Towards a generic governance model for service-oriented architectures", *Proceedings of 14th AMCIS, AIS*, Toronto, August 14-17.
- Pandit-Pant, R. (2010), "Creating an effective response to the reform maelstrom", *Proceedings of SOA in Healthcare: Improving Health through Technology*, Westin Arlington Gateway Arlington, VA, June 12-14.
- Papazoglou, M., Traverso, P., Dustdar, S. and Leymann, F. (2008), "Service-oriented computing: a research roadmap", *International Journal of Cooperative Information Systems (IJCIS)*, Vol. 17 No. 2, pp. 223-255.
- Petter, S., DeLone, W. and McLean, E. (2008), "Measuring information systems success: models, dimensions, measures, and interrelationships", *European Journal of Information Systems*, Vol. 17 No. 3, pp. 236-263.

-
- Riben, M. (2009), "Terminology services for the enterprise application environment utilizing the SOA Paradigm", *Proceedings of SOA in Healthcare Conference*, Hyatt Regency O'Hare, Chicago, IL, OMG, June 2-4.
- Rosen, M. (2009), "Service oriented architecture and design strategies", *Proceedings of SOA in Healthcare*, Chicago, IL USA, OMG, 26. June 2-4.
- Rusu, L., Podean, M., Szabo, S. and Costin, R. (2010), "A hierachical model for medical, registrations, Bucharest, 2010", *Journal of Information Systems and Operations Management*, 2010, Vol. 2 No. 2, pp. 32-42.
- Schelp, J. and Aier, S. (2009), "42nd Hawaii International Conference on System Sciences", *Proceedings of the 42nd Hawaii International Conference on System Sciences*, Computer Society, pp. 1-8.
- Shang, S. and Seddon, P. (2000), "A Comprehensive Framework for Classifying the Benefits of ERP Systems", in AIS (Ed.), *Proceedings of 2000 Americas Conference on Information Systems*, Long Beach, CA, pp. 1005-1114.
- Smith, M., Buchanan, W., Thuemmler, C. and Hazelhoff Roelfzema, N. (2010), "Information governance and patient data protection within primary health care", *International Journal for Quality in Health Care*, Vol. 7.
- Stephens, E. (2008), "Managing IT investment – the role of EA and SOA with governance", *Proceedings of SOA in Healthcare Realizing Quality-of-Care*, Chicago, IL, April 15-17.
- Strauss, A. and Corbin, J. (1998), *Basics of Qualitative Research: Techniques and Procedures for Developing*, Sage Publications Inc, London.
- Themistocleous, M. and Mantzana, V. (2010), *Web Services and SOA*, UoP, Piraeus.
- US Department of Health & Human Services (2010), "Reports on health reform", available at: www.healthreform.gov/reports/index.html#online (accessed October 10, 2010).
- Vengco, J. (2008a), "Thinking SOA: how to get your organization ready", *Proceedings of SOA in Healthcare Realizing Quality-of-Care*, Chicago, IL, April 15-17.
- Vengco, J. (2008b), *In SOA in Healthcare Realizing Quality-of-Care*, Chicago, IL.
- Viering, G., Legner, C. and Ahlemann, F. (2009), "The (lacking) business perspective on SOA-critical themes in SOA research", in H.R., H. (Eds), *Proceedings of 9th International Conference on Business Informatics*, Wein, pp. 45-54.
- Vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R. and Cleven, A. (2009), "The 17th european conference on information systems", *17th European Conference on Information Systems*, Verona, p. 13.
- Weiler, J. (2010), "Service Orient Acquisition Roadmap", *Proceedings of SOA in Healthcare: Improving Health through Technology*, West Arlington Gateway, Arlington, VA, June 12-14.
- Welker, B. (2009), "Lessons learned on implementing SOA at veterans affairs", *Proceedings of SOA in Healthcare Conference*, Hyatt Regency O'Hare, Chicago, IL, OMG, June 2-4.
- Wendell, O. (2009), "Integrated requirements design: a practical methodology for SOA", *Proceedings of SOA in Healthcare Conference*, Hyatt Regency O'Hare, Chicago, IL, June 2-4, p. 2.
- Wong-Bushby, I., Egan, R. and Isaacson, C. (2006), *Proceedings of the 39th Annual Hawaii International Conference on System Sciences*, Vol. 8, IEEE Computer Society, KAUAI, pp 179-172.
- Wrightson, A. (2008), "Information aspects of SOA in healthcare", *Proceedings of SOA in Healthcare Realizing Quality-of-Care*, Chicago, IL, April 15-17.
- Yoon, T. and Carter, P. (2007), "Investigating the antecedents and benefits of SOA implementation: a multi-case study approach", in AIS (Ed.), *Proceedings of Americas Conference on Information Systems Keystone Colorado*, August 9-12.

