

Non-Technical Enterprise Architecture in Healthcare: Challenges and Recommendations

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Abstract

Enterprise Architecture (EA) is viewed as a crucial tool for the healthcare sector to facilitate digital transformation. Much of the research has revolved around the technical considerations of implementing EA in healthcare, such as the framework and architecture to use. For the successful implementation of EA, non-technical aspects should also be studied to achieve a more holistic understanding of the implementation challenges of EA in healthcare. This study addresses the gaps in the knowledge of non-technical issues, analysing the following four challenges: difficulty justifying EA value, segregated organisational structure, lack of skilled EA practitioners, and issues with data standards. The outcome of this research discusses how these challenges are a result of healthcare organisations not operating like a business, the unique needs of the healthcare industry and the potential solutions to these issues. This report concludes that the adage “culture eats strategy for lunch” is true. Healthcare is the perfect example of this adage, where a different business culture compared to other businesses or industries requires a different EA strategy.

1. Introduction

Enterprise Architecture (EA) is a management practice that enables an organisation to have a detailed, holistic view of its business practices, information flows and technology resources (Bernard, 2012). Not only is it good practice for when management wants to evaluate the current state of their organisation, but is also helpful in planning for and implementing a future state, as it allows management to plan and implement all required integrations and interdependencies.

According to Wilson (2004), the healthcare industry is the largest industry worldwide. This is to be expected considering the services provided, so much so that several countries have expansive public sectors to ensure their citizens have access to services (New York Department of Health, 2011). Due to the importance of the industry itself, significant resources are expended on making healthcare institutions as efficient and robust as possible, however, there are still areas for improvement.

In the healthcare sector, many studies discuss the various challenges to, and report the expected benefits from, EA adoption (Nygård & Olsen, 2016; Jonnagaddala et al., 2020; Júnior et al., 2020). Adnan et al. (2021) discusses these challenges from a technical focus, explaining “how EA consists of several layers of technical and non-technical aspects”. Non-technical issues were referred to as issues unrelated to the traditional EA content, frameworks, and artifacts that would be produced, and instead focus on organisation culture, legislation, and human-related factors (Adnan et al., 2021).

With a limited number of studies exploring the non-technical aspects of EA adoption in healthcare, this led the authors to the following research question:

“What are the non-technical factors that contribute to the challenges in the implementation of EA in healthcare?”

Principles express the basic elements and rules in the implementation process (Iyamu, 2012). Principles should be based on the business strategy that the organisation wants to achieve through EA (Iyamu, 2012). At the same time, the principles formulated by the organisation must be followed in the implementation of EA. Non-technical factors like organisational interests will influence the development of principles (Iyamu, 2009). Therefore, the process of formulating principles requires the involvement of not only IT technicians, but also senior leadership in the organisation (Iyamu, 2009).

2. Literature review

Bradley et al. (2012) discusses the growing need for EA in the healthcare industry due to growing pressure on health IT departments from ever more stringent regulations and mandates, as well as pressure from patients for better digitisation of healthcare services. There has been very little research on the application of IS studies, including EA, in the healthcare sector over the last 20 years despite being a such a significant industry (Wilson, 2004).

Most studies found were focused on technical aspects such as frameworks and architectures. Hence, four challenges were identified where a non-technical lens, focusing on organisation structure, culture, legislation, and people, would apply.

2.1. Challenges faced in Applying EA in Healthcare

Four issues relating to non-technical challenges were identified from the literature:

1. Difficulty justifying the strategic value of EA
2. Clinical vs business perspectives
3. Lack of skilled EA practitioners
4. Healthcare interoperability difficulties

These barriers come from the inherent characteristics of the industry itself, being highly regulated with significant standardisation in some areas and extreme tailoring in others.

2.1.1 Challenge 1: Difficulty Justifying the Strategic Value of EA

The highly complex nature of healthcare today makes it difficult to implement EA because it must deliver value for the entire system, process, and resources (Quiggle, 2010). One of the important roles of EA is to deliver effective and timely information to assist all medical personnel in making important decisions for patients' lives and improving existing medical services (Sajid & Ahsan, 2016). Senior management needs to enable EA to be based on strategic plans and maintain alignment with those plans (Azevedo et al., 2015). However, healthcare organisations lack a clear understanding of the value of EA at the management level, leading to a failure in relating the developed strategic plan to the value of EA (Jonnagaddala et al., 2020; Olsen, 2017).

This creates a bottleneck where management is unable to effectively communicate with EA practitioners for implementation plans (Jonnagaddala et al., 2020). Ineffective communication leads to prolonged implementation processes, causing hidden costs that are difficult to track, as well as benefits that are not measurable (Adnan et al., 2021; Tallé & Uche, 2021). Building onto that, long-term benefits, such as reputation, cannot be quantified and reflected in the short-term during implementation. Organisations are often reluctant to hire expensive EA consultants when managers are challenged to justify the return on investment and the benefits promised by its architects (Jonnagaddala et al. 2020). Therefore, the healthcare industry devalues the importance of EA due to the lack of demonstrable benefits.

Additionally, EA implementation requires a long-term investment for the enterprise to see value, hence it is difficult to materialise the benefits immediately (Niemi & Pekkola, 2019). In healthcare, clinical decision making involves a high level of uncertainty and rapidly evolves with new technology requiring constant investment. The benefits of application of EA to improve business processes and decision making will be realised only in the future, creating a time lag between the current state required by healthcare practitioners and the benefits that EA can bring after adoption (Tallé & Uche, 2021). Thus, benefits of EA are unlikely to be recognised as quickly as, for example, the installation of new equipment, further hindering the strategic value EA can unlock.

The outcome approach needs to be addressed at the macro and meso-levels. EA for healthcare must consider dynamic factors in business processes, government policy standards, and social environment at a macro level (Mariam & Bygstad, 2019). Senior management in the organisation needs to measure whether EA can help the process adapt to the above dynamic factors faster to meet the investment in EA and the value of satisfaction from the perspective of strategic development. Organisations need to take these macro factors as qualitative standards in the process of implementing EA and consider how the entire organisation can ensure the effectiveness of EA under the influence of the above factors. Organisations need to add knowledge resources and industry culture to the quantitative standards of EA at the meso-level (Mariam & Bygstad, 2019). Healthcare organisations need to ensure that management views industry knowledge as a quantifiable asset, and each stakeholder needs to incorporate knowledge into the EA. Better EA implementation requires management to actively promote organisational culture and knowledge resources to organisational teams (Adnan et al., 2021).

2.1.2 Challenge 2: Clinical vs. Business Perspective

The challenge of managing hospital IT strategy like other businesses versus the human clinical aspects has long been documented. A seminal work published at the beginnings of modern, GUI Electronic Medical Records (EMR) already highlighted the traditional clash between IT and clinicians:

“Politics and Control Issues. As with any major strategic change, reporting structures and departmental relationships will be affected by new technology and business processes, and often cultural barriers can derail strategy implementation before it even begins. The most famous examples in the healthcare IT industry of this phenomenon are found in the area of physician compliance with IT policies” (Gunasekaran & Garets, 2004).

Hospitals exhibit the concept of institutional pluralism (Kraatz & Block, 2008) to the extent that, “Tension[s] typically emerge between medical professionalism and managerialism. In hospitals, medical professionalism is oriented to quality of care, while managerialism is mainly occupied by efficiency” (Ajer et al., 2021). Lately, business, policy, and patient demands have forced hospitals to change their strategy from one of best of breed products, designed for a specific department or specialty, towards a best of suite or single vendor strategy. This change reduced the challenge of integrating disparate systems with different databases and interoperability standards within the organisation, but came with the potential downside of single departments not having their ideal application (LeMaistre & Biskup, 2004). As a result, the clinical / patient care versus efficiency division was exacerbated as newer systems needed to support a diverse workforce, with different driving factors across specialties, disciplines, and clinical points of view.

EMR strategy, like many IT decisions in healthcare, is a manifestation of EA. One literature review looked at the challenges of implementing EA in healthcare and found, “Organisational complexity of health environments” being a challenge in 13 different articles, while there was evidence of 7 instances of “Heterogenous stakeholder interests; communication problems” (Júnior, et al., 2020). Similarly, Ajer & Vassilakopoulou (2019) documented specific challenges implementing EA in the Norwegian healthcare system, and found four major themes, three of which were tied to the concept of institutional pluralism. The first theme dealt directly with the patient care versus efficiency issue in identifying that non-clinical managers often could not determine the best way to treat a patient, and that even amongst the clinicians “There are many little kings”. The other two themes looked directly at the clash between local versus national systems for strategy and planning at a local or clinician level versus a top-down strategy from higher authorities (Ajer & Vassilakopoulou, 2019).

Luckily, many of these documents show evidence that implementing traditional change management techniques, providing incentives to acquire systems that meet minimum requirements, and supporting local clinical guidelines

with slight variations, can all be used to overcome these issues (Ajer & Vassilakopoulou, 2019; Júnior et al., 2020; LeMaistre & Biskup, 2004). Interestingly, some hospital systems are starting to also train clinicians in the business world to help cross the traditional chasm (Stoller, et al., 2016).

2.1.3 Challenge 3: Lack of Skilled EA Practitioners

Another EA implementation challenge in healthcare is a lack of EA practitioners that are equipped with the right knowledge and skills (Adnan et al., 2021). The role of an enterprise architect is significant as they ensure that EA is successfully adopted in the organisation. However, in healthcare, most organisations face the challenge of unclear EA role responsibilities which has hindered their commitment to EA projects. Often architects are unsure of what they are expected to deliver, causing their abilities and competence to not be fully utilised as required (Olsen, 2017). Olsen (2017) also mentioned that architects are sometimes given tasks that are not part of their responsibilities which creates confusion in their role. This creates redundancy in resources as available enterprise architect's skills are not leveraged to implement EA in the organisation.

Additionally, the healthcare industry runs on various siloed systems as the sector structure contains specialised treatment streams. As a result, it is difficult to create the architecture vision as each department is unique, especially if these sub-departments are autonomous, which in turn increases the difficulty in coordination within the entire enterprise (Bakar & Selamat, 2016; Ajer & Olsen, 2018). This technical strategy implementation requires a professional and experienced EA practitioner who understands the concepts and principles required to align all departmental processes to meet EA objectives. Even where healthcare organisations invest in EA practitioners, they do not invest enough resources to support initial EA strategy creation and post-implementation support (Adenuga et al., 2015; Júnior et al., 2020). Hence, external EA professionals can be hired to perform thorough analysis of the enterprise to form a suitable EA plan for the organisation (Jonngaddala et al., 2020). The presence of EA consultants helps mitigate the following concerns:

- **Competency:** Policies and rules should also be put in place to shape the expectations from an enterprise architect so that these practitioners' roles are defined, tasks are distributed accordingly to their abilities, and expert guidance can be offered (Banaeianjahromi & Smolander, 2016). This ensures commitment to the adoption of EA.
- **Human resource availability:** The constant shortage of human labour and resources in the healthcare sector can be resolved by hiring external experts as the use of third-party consultants does not sacrifice the limited EA expertise in healthcare organisations.
- **Commitment to EA adoption:** When hiring an EA consultant, they come with knowledge and skills to implement EA in the enterprise. These consultants can immediately get started on the EA project for healthcare organisations without delay. This encourages the commitment to EA implementation as these professionals are already in place with the project, and all relevant stakeholders can work with them should there be any uncertainty, for example, to understand technical terms in documentation (Banaeianjahromi & Smolander, 2017).

2.1.4 Challenge 4: Healthcare Interoperability Difficulties

Healthcare faces two key issues with regards to interoperability. First, with the types of data standards used (Feldman et al., 2018; Haendel et al., 2018) and second, data siloes due to the large number of health services (Abdulnabi et al., 2017).

Within healthcare, many data standards in the form of semantics exist to describe demographics, clinical attributes, and disease definitions. Feldman et al. (2018) suggests that so many standards exist because “a single-source approach is insufficient to capture the complexity of the human condition”. Within a patient record, different standards could be used to describe a disease such as ICD-10, SNOMED-CT or ICD-O-3 (Jouhet et al., 2017). These standards vary due to the unique needs of each medical specialty. ICD-O-3 describes the location and physical characteristics of cancers and tumours while ICD-10 only provides the named description to the condition where other diseases like flu or fever does not require a location to describe treatment. Most systems can only

recognise one of these standards in their system, causing internal and external interoperability issues among different health providers (Jonngaddala et al., 2020).

A reluctance to exchange information exists due to issues such as lack of appropriate standards, privacy concerns, policies, and legislation, leading to data silos in many health service providers (Jonngaddala et al., 2020). These data silos cause external interoperability issues which further causes complexity in the implementation of EA in healthcare.

Adenuga et al. (2015) discusses how the current EA frameworks have weaknesses, but the adoption of the right framework can eliminate interoperability issues. The EA frameworks provide a method of viewing a segmented system with many components into a model (Higman et al., 2018). Healthcare needs to adapt the current EA frameworks to suit the unique needs of the healthcare industry. More regulation in healthcare, and more maturity in vendors' health information systems, provide better interoperability (Jonngaddala et al., 2020). EA cannot directly solve the problems of interoperability directly, however, specific EA activities (Kurnia et al., 2020) can help in the governance of standards and provide a change management plan.

Even with better systems, standards will continue to evolve. For example, in 2022, the World Health Organization released the ICD-11 terminology, which seeks to improve the current disease definition standards. Investment in technology or systems have a limited impact to solving interoperability issues given that these varying standards are a requirement for specific aspects of healthcare.

3. Conclusion

From the analysis of issues with implementing EA in healthcare, several similar studies, such as those by Jonngaddala et al. (2020) and Júnior et al. (2020), were uncovered which have documented similar challenges. However, unlike the other studies, this study focuses specifically on the non-technical issues faced during the implementation of EA.

The heart of the issue is that many healthcare organisations do not fully see themselves as running a *business*. Factionalism between different medical specialties, such as between oncology and anaesthesia, and various levels of professions, such as between doctors and pharmacists, along with the primary goal of providing the best possible patient care, combine to make the application of EA all the more challenging. Healthcare practitioners working in hospitals make decisions based on their experience and what the best treatment is for the patient at the point of diagnosis, which may not match with the most optimal business decision (Hajjaj et al., 2010). As the nature of this industry is dynamic and there are always varying patient cases and treatments, the value of EA is a challenge to realise (van Olmen et al., 2019). This is because EA addresses the organisational processes and ensures that all aspects of the business, such as technology and strategy, are functionally aligned throughout the entire enterprise to meet business goals. However, due to the fluid nature of the business and the unpredictable situations of patients, it is difficult to design EA that provides direct benefits to these medical practitioners in patient care today.

Separately, the varied use of data standards leading to a lack of interoperability stems from the unique needs of medicine, where precision medicine and medical informatics require specific data standards which are limited to specific medical specialties, such as understanding morphology and topography of tumours in oncology (Jouhet et al., 2017). Health standards will continue to evolve with new medical conditions and improvements in health research which may see current standards insufficient to describe a complex condition. Jonngaddala et al. (2020) discussed that internal interoperability has become less of an issue with modern systems making improvements in that area. However, external interoperability issues are further impacted by the reluctance to share data (Jonngaddala et al., 2020), where non-technical issues such as privacy, policy and legislation are barriers to interoperability. The structure of the healthcare landscape, supported by many health services, is not something that EA can easily navigate.

When combining the social and technical industry issues, it is easy to understand that generic EA artifacts and trained practitioners would find it difficult to work in the healthcare space. Complex knowledge is needed to understand the requisite clinical, financial, and political drivers to create an architecture which is acceptable to all stakeholders. Organisations must treat an EA project as a classic change management exercise to encourage active participation.

This leads us to hypothesise that the root cause of the issue lies in needing a proper governance framework within healthcare organisations. The development of this framework cannot occur unless an organisation commits enough to EA to hire both the EA and clinical or financial informatics practitioners who can support the EA in designing and testing a practical roadmap in partnership with clinicians. As there is no evidence that the current EA frameworks are completely ill-suited for healthcare, the EA and informatics teams will have to work together to adapt the framework to include all the clinical, financial, technical, and administrative interdependencies. Out of that work, benefits and value can then be established. From those benefits, the body of knowledge will eventually coalesce into an updated governance framework with healthcare-specific artifacts to ultimately create the required governance framework.

As a result, this report finds that the adage “culture eats strategy for lunch” is true, at least for EA in the healthcare industry. In this instance, healthcare is the perfect example where a different business culture in relation to other businesses or industries requires a different EA strategy.

4. Limitations

Through an analysis of the existing literature, this report analyses four key challenges to the implementation of EA in healthcare organisations. Although existing articles provided reliable information for this report, limitations exist. This research report emphasises that the healthcare sector is vulnerable to change due to external factors, and the research topic cannot predict the future developmental direction of EA in the healthcare industry or additional challenges that needs to be tackled. Therefore, the multifaceted complexity brought about by the healthcare industry may result in the research direction of the report being dependent on the current literature provided by academia.

The first limitation is the professional field's restrictions. The researchers for this paper were not personally involved in the healthcare industry. Therefore, the lack of professional medical personnel and patient feedback leads to a lack of first-hand information in the reported research. The absence of data on the medical elements of organisational EA in this paper is more relevant to occupational sectors and industries. Data that truly reflects a healthcare organisation's systems and operations may contain sensitive and confidential data material. Furthermore, limited published research on government regulations and policies in relation to EA may restrict application of the findings.

5. Recommendations

The recommendations presented in this paper are avenues that the authors propose to explore in further research to gain a better understanding of the role EA plays in the healthcare industry.

Given that this paper limited its scope to information found in academic journals and other research papers, it is recommended that future research include first-hand information from individuals and/or organisations in the healthcare space, such as hospital employees and management, patients, regulators, and people involved in healthcare supply chains. Getting first-hand accounts from people employed in the functions of the healthcare sector will allow future research to better understand the factors that influence the decision-making regarding EA implementation in the healthcare sector. Research should include a variety of individuals, including strategic decision-makers and IT management, as they are the biggest stakeholders of an EA implementation.

A qualitative interview with industry stakeholders should also be conducted to validate the findings within this paper. As this research paper has focused on a qualitative review of non-technical aspects of EA implementation, it is recommended that more quantitative research be conducted on the levels of EA maturity within the healthcare sector to look for correlations between the different technical and non-technical barriers to EA implementation.

6. References

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Key terms:

Non-technical factors: factors affecting EA implementation that are not related to the level or type of technology in question but has more to do with the entity/organisation itself.

Technical Factors: factors affecting EA implementation that are related to the type of technology in question, such as capabilities, system interoperability, reliability, security, etc.

Enterprise Architecture: a method of documenting the technical business processes that an organisation utilises for its operations.