International Journal of Computing and Digital Systems
ISSN (2210-142X)
Int. J. Com. Dig. Sys. 13, No.1 (Mar-23)

http://dx.doi.org/10.12785/ijcds/130145

Analysis of a Survey on the Role of Enterprise Architecture in the Field of Healthcare Technology by Knowledge-Based Research

Malcolm Rozario[1], Ahmad Anwar Zainuddin[2,*], and Puvanaah Manokaran[3]

[1]Information Technology Management (ITM), Manipal GlobalNXT University,Nilai Malaysia.
[2]Department of Computer Science, Kulliyyah of Information and Communication Technology, International Islamic University Malaysia,Kuala Lumpur, Malaysia
[3] Computer Engineering and Computer Science, Manipal International University, Nilai, Malaysia

**E-mail address: mr.anwarzain@gmail.com*

Received 26 Aug. 2021, Revised 24 Jul. 2022, Accepted 5 Mar. 2023, Published 16 Mar. 2023

Abstract: In this study, the researchers will examine the current state of Enterprise Architecture, EA in the healthcare system to determine which tools and methodologies are most appropriate, and why, as well as how these tools and methodologies can be used to improve the healthcare system. The authors' article, which includes a list of authors and publication channels (a systematic literature review protocol that incorporates seven research questions and four phases), identifies key challenges, impacts, and success factors that need to be addressed within the scope of this study. One of the databases used in this investigation was IEEE, which also included Science Direct, Scopus, and Hubmed. When evaluating studies, researchers used Cohen's Kappa to determine the level of disagreement. After the first phase of data selection, the SLR protocol returned 288 initial studies, of which 46 were included in the final analysis after the second phase. It has been determined that Archimate is the most commonly used EA model in the health care system, and thus TOGAF is the preferred framework. It was possible to learn from this study that the main challenges and problems encountered during the implementation of EA in the healthcare system are the complexity of an organisation and the integrity of data from various sources.

Keywords: Enterprise Architecture, Healthcare System, Key Challenge, Impacts, Success Factor, Cohen's Kappa. TOGAF

1. INTRODUCTION

John's 80s studies led to the first EA (Enterprise Architecture). With no knowledge of the information systems, Zachman defined their architecture. The analogy defines the architecture of information systems based on a neural framework. Nonetheless, the concept of Enterprise engineering and Enterprise modelling drew little attention. The information systems community could only use a few models and formalisms in application development [1]. The use of information technology in healthcare services has grown tremendously over the years because of technological advancements. The business operations at the hospital can benefit from both a boost in efficiency and an increase in value if complicated systems are distributed throughout the facility. Medical professionals are aided in making decisions that directly or indirectly affect the patients at the hospital thanks to the systems' ability to provide quicker responses [2]. The enterprise architecture seeks out the complexities of advanced information technology systems that are arranged in layers with varying relationships. Enterprise Architecture categorises an organization's future, application system, capabilities, IT infrastructure, and data. It lays out a strategy for achieving the goal given the current situation. To respond holistically to disruptive forces, a company's architecture, according to [3], should analyse and recognise execution changes to help the company achieve its desired business outcomes and visions. The enterprise architecture shows the IT and business leaders how to manage projects and policies to achieve the desired business results. It also lets businesses and people who use information technology to change things. When an organisation changes its methods, the project's benefits change, and so do the organization's benefits [1]. This study analysed a Knowledge-Based Research review survey on the Role of Enterprise Architecture in Healthcare Technology to evaluate existing Enterprise architecture practises in healthcare systems. The search for this work chose studies from 2017 to 2020 that used enterprise architecture tools in various

E-mail:ahmad.anwar@miu.edu.my

healthcare systems branches. For this work, there are two essential contributions. First, it will gather all relevant data from EA Healthcare System's studies. It presents all the innovative techniques so that professionals and researchers can improve healthcare and governance management. [4]. Second, the research will conduct a systematic review of the literature by focusing on enterprise architecture in healthcare systems, as there are no detailed reviews on this enterprise architecture topic within the scope of the research.

The following is how the paper is organised: Following this introduction, the literature review is presented in Section 2, which focuses on some of the most important aspects of an enterprise's state-of-the-art architecture that have been discovered because of this systematic literature review. Section 2 concludes with a discussion of future research directions. Section 3 is devoted to the theoretical basis of the study. The methodology for the study is discussed in Section 4. Section 5 of this study is devoted to the analysis of the results, and Section 6 closes this paper.

2. LITERATURE REVIEW

There are five papers that address some of the most important aspects of an enterprise's state art's architecture that have been uncovered during this systematic literature review. In Table I summarizes all the five reviews are described in this work.

TABLE I. LITERATURE REVIEW

Reference	Important Findings
[6]	To distinguish the primary themes and exploration strategies in investigations aimed at an open area of an enterprise's architecture.
[7]	Reviewing of the literature in the article about the BITA, "Business-IT Alignment", for utilizing an enterprise's architecture and addressing six inquiries through the 5W1H technique to comprehend BITA from the viewpoint of an enterprise's architecture.
[8]	It focuses on giving an outline of its advancement for more than 30 years, just as distinguish the current status of an enterprise's architecture and identifies patterns that can mostly affect an enterprise's architecture in the upcoming years.
[9]	To recognize the fantasies that associations endeavor to discover in the execution of EA, depending upon the case that an enterprise's architecture is a device that can settle practically any kind of business issue.
[10]	It aims on the sensitive factors of the success that are different from the actual reason for doing the research.

3. THEORETICAL FRAMEWORK

An enterprise's architecture is a practise of administration and innovation that aims to improve the performance of the organisation. In this way, they are able to see themselves from a holistic and integrated perspective, which includes strategic, strategic approaches, data streams, and innovation assets [5]. EA incorporates insights regarding an association's cycles, capacities, information, application frameworks, and Information Technology (IT) foundation utilizing an assortment of normalized portrayal procedures [6]. All aspects of enterprise-wide engineering should serve as an authoritative guide, standard for measuring and assessing performance/assets, and source of future working plans. Due to execution and support technique costs, the extension is not comprehensive due to accepted procedures being asset-intensive [23]. The association must decide which to receive, how to do it, what covers, logical inconsistencies, and holes from the subsequent selection. Processes produce poor results because they are based on predictable ontological models. They rely solely on their professional expertise for those who are not put together [24]. EA research includes not only IT frameworks, but also the connections and underpinnings of corporate entities. [9]. The "essential" ramifications of EA's endeavours in the operations, objectives, actions, mission, operations, and actions of the examined business frameworks will thus be the focus of EA research in general. When it comes to administering medical services, medical service administrations are being inundated with an increasing amount of IT as innovation advances. Dissemination of these unpredictably structured systems is common. When it comes to making decisions that affect patients directly or in a more indirect manner, the clinic's business will benefit from the faster response times [10]. The complexity of contemporary information technology systems—which are made up of many components that are connected to one another in a variety of different ways—should be reflected in an organization's architecture. Currently, there are a variety of enterprise architectures that can assist associations with their management and administration measures. Every one of them has characteristics that can be used in a variety of contexts and situations. For instance, in a similar report among a few EA structures, [11], the TOGAF, "The Open Group Architecture Framework", is the most proper emergency clinic framework. The TOGAF was first evolved in 1995 and depends on the DoDAF, "Department of Defense Architecture Framework" [12]. Their rules and consistency rules can be examined, ensuring a typical reason for joining and comparing the framework families that interoperate their structures using this system. The Open Group standard for ArchiMate®, a free and open display language for Enterprise Architecture. Term used to describe how business metrics, hierarchical

designs, data streams, and IT frameworks interact. Informed partners can discuss, evaluate and design decisions made within and between these business areas. Standard ISO/IEC 42010:2007 defines a framework's main ideas or properties as "exemplified in its components, connections, and standards of plan and development". ISO/IEC 42010:2007:

- A well-explained arrangement or a proper depiction of a framework can manage its usage at the segment level.
- The parts' construction, their interrelations, standards, and rules administer their plan and advancement over the long run.

It is a "Adaptive Integrated Digital Architecture Framework" (AIDAF) that includes a flexible EA cycle for various specialty units. Included in this are engineering surveys and empowering the IT design procedure and every arrangement design in Information System or IT projects [13]. In any case, mention the various enterprise structure architectures in writing. Studies from 2015 to 2019 that use these segments in medical settings are selected for this systematic review.

A. Research Technique

For this survey, the techniques which are utilized are given below:

- Scopus (https://www.scopus.com/home.uri)
- Science Direct (https://www.sciencedirect.com/)
- HubMed (https://www.ncbi.nlm.nih.gov/)
- IEEE Xplore Digital Library (https://ieeexplore.ieee.org/Xplore/home.jsp)

B. Search String

As indicated by [14] contingent upon the requirements of every data set web index, SLR conventions assemble strings from the exploration structures of the question, and occasionally transformations are important. Now, this examination string thought about investigations with the accompanying terms: Enterprise Architecture and Health. In the searched records, terms can be found anywhere. For each internet searcher, they were combined into the Boolean articulation AND, but still adhered to the accompanying articulation: At the end of the day, S1 equals to EA AND Health. Some web indexes have string articulation or usage restrictions that are unique to them [15]. However the findings of this audit were maintained by the connection between the architecture of an enterprise and the health of its employees, which were found in the records gathered for this study..

C. The Techniques for Data Extraction

From phase 1 and 2 of the study, the analysis analysts read the included investigations completely. The phase of Information Extraction looks to respond to the exploration questions. At this phase, all analysts freely played out the examination and analyzed the outcomes. Clashes were settled by agreement through a different meet. The device utilized for synthesis and extraction of information was called MaxQDA, a subjective examination application. In this stage, the data need to be removed from the investigations where the questions are identified or addressed. Whenever important, specialists took fundamental notes that assist them during synthesizing [16]. MaxQDA was used by the scientists to perform article extraction, and they followed a path to merge (consolidate) all of the extractions using the MaxQDA itself..

D. Analytical Processes

The use of this combination strategy necessitates homogeneous examinations. To help in the process of analysis we have utilized the toll called MaxQDA to generate the reports. Because of this it was also possible to recognize the connection between the research and studies questions and to measure these connections with tables and graphs.

4. RESEARCH METHODOLOGY

The methodology for the study is discussed in this section. It is started with the research methodology structure which discussed the research question, eligibility requirements and studies selection. In this paper, the protocol conforms to the rules and strategies of [49] to systematically direct Reviews of the Literature in Software Engineering. [30] is added as a supplement to it in terms of planning and methodological proof pertaining to an organization's innovative application in medical care conditions. The outcome can assist scientists in understanding the current driving.

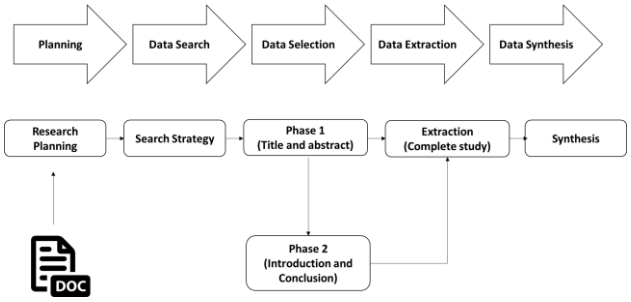

Figure 1. Research Methodology Structure

These inspirations prompted the selection of tools, methodologies, frameworks, methods, and models to apply the enterprise architecture in medical services frameworks. Below, the summarization of a systematic review has been given.

A. *Research Questions:*

The main questions of the search that will help to motivate this research study are:

a) Which Enterprise Architecture methodologies, frameworks, and best practises are most used in healthcare systems?

b) Which tools and models are most used in healthcare systems to develop the Enterprise Architecture?

c) Which EA methodologies, frameworks, and tools should be considered before making a final decision?

d) What are the most significant problems and difficulties associated with EA in the healthcare industry?

e) What are the most important advantages of utilising enterprise architecture?

f) Who are the most influential authors and publication channels on EA in healthcare systems?

According to these questions, the author extracted some of the constructs given below in Table II to codify and recognize the important features of the study.

B. *Eligibility requirements*

TABLE II. ELIGIBILITY REQUIREMENTS CRITERIA

Question (Q)	Codes (Constructs)
1	Methodology, Framework and Guide for best practices
2	Tool and Model
3	The requirement for selecting the tool/ framework
4	Problems and Challenges
5	Positive impacts
6	Application/ Environmental context of enterprise architecture
7	Authors and channels of publication
8	Important success measures

Table II shows the inclusion and exclusion criteria have been applied to every research review of the literature systematically.

C. *Studies Selection*

The investigations gathered by the strings from the internet experienced a set of filtering divided into two stages. The interaction that has chosen the investigations as per their pertinence concerning the examination addresses tended in this survey. In the first phase, the examined protocol of the investigations' title, outline, and keywords, barring the articles that couldn't answer any examination questions (Question 1 & 8). The chosen article in the first phase goes to the second phase in which analysts read the examinations' presentation and the conclusion. Similarly, as in the first phase, this stage disposed of the studies that didn't respond to the exploration questions (Question 1 & 8), that is, explorations that didn't support the topic of this detailed review. All analysts' choice of studies was made, decreasing the odds of disposing of important examinations [23]. During the selection process, depending upon the strategy utilized by [51], the specialists worked through our whole indexed lists to determine if the distributions we discovered were pertinent

to a conversation of the utilization of architecture of Enterprise in medical services frameworks. The analysts were part into two groups, and each played out the perusing and determination, everything being equal, as per the meanings of each stage.

Cohen's Kappa was used to assess the degree of understanding (unwavering quality and accuracy) between the groups. [50] portrayed various reaches for Cohen's Kappa esteems, concerning the level of understanding that these qualities propose, as indicated by the accompanying portrayal in Table III:

TABLE III. EVALUATION OF DEGREE OF ARRANGEMENT

Value	Meaning
<0.00	Low
0.00 to 0.20	Average
0.21 to 0.40	Neutral
0.41 to 0.60	Moderate
0.61 to 0.80	Substantial
0.81 to 1.00	Great

If Kappa = _____1 P(E) is used to calculate Cohen's Kappa, then:

P(0) was aware of the scope of the arrangements (the proportion of appropriate responses agreed upon, as a proportion of the aggregate);

The phrase "P(E)" refers to the typical extent of the arrangements (amount of the normal estimations of the appropriate responses concurred isolated by the aggregate).

Normal arrangement size is referred to as P(E) (amount of the normal estimations of the appropriate responses concurred isolated by the aggregate). Kappa is a measure of a proposal of an interobserver which allows surveying if some of the proposal is beyond the expectation and the level of this agreement. The unit value of this procedure is its maximum value that states the total agreement. Values which are close or near zero state no disagreement or agreements between authorities.

5. DISCUSSION AND RESULTS

A. Introduction of Enterprise Architecture

The steps or cycles that are used to plan the HIS (Healthcare Information System) are displayed in enterprise architecture. The goal of this planning is to ensure that the individual building blocks are compatible with one another and can communicate with one another. Many international organisations, such as the World Bank, consider enterprise engineering to be an enabling force that can bring about fundamental shifts in the public sphere. When it comes to managing the development of data frameworks for medical care, using an endeavour design approach to manage the process can help identify fundamental interrelationships that need to be modified. There is a comprehensively planned enterprise architecture that eliminates the risk of serious mistakes brought on by the utilisation of various information and communication technologies (Information and Communications Technologies). An EA can be thought of as the first global store and collection of tools that any public or private organisation, including businesses and governments, can use to develop the ideal framework for their healthcare system [17]. Beside that the engineer will assume to play a part for displaying the countries health data framework. Suggested design will help to clarify the new state of a country's medical care data framework and help to accomplish development with the progression of time, which nations could use to educate plans for medical services data framework speculations. Integration of Enterprise Architecture in healthcare organizations: Integration is a vital component of big business engineering that assumes an exceptionally huge part in the mix of medical care assets, for example, staff, innovation, and medical services conveyance measure. Various associations or firms of the healthcare work together to provide extraordinary medical care and cure nowadays. In this specific circumstance, they face mix issues due to the various foundations and distinctive Information Technology or Information System frameworks. These coordination issues happen on two levels: the business cycle level and the Information Technology or Information System level [18]. The main purpose behind business measure problem is the coordinated effort of at least two associations utilizing diverse business structures. Healthcare Organization's Enterprise interoperability: After the year 1990s, the possibility of big business joining has been changed over into another arising idea of an enterprise's interoperability. Interoperability is the ability to share information, data, and knowledge across hierarchical boundaries using information and communication technology, ICT systems and business measures. Enterprise interoperability involves at least two companies. Medical care Organizations need to get data from various recourses in this specific situation or else the association will face an Information interoperability issue. Certain medical care associations keep vital information in a variety of locations, such as an appropriated data set structure and conflicting organisations, which makes information management a board issue [19]. Kristofic and Solotruk characterize three standards for interoperability which are Intersection, Interlinking, and Unification. Unification Principle: For various information systems, the utilization of information technology is considered as the most basic model. Several unification principles are

there, like various entities connected and collided with an entity and multiple systems standardizations. Intersection Principle: The Intersection Principle unifies all frameworks to receive and update data. The main thought behind the intersection standard is to enhance the accessibility and quality of data by eliminating the redundancies [20]. This rule gives a linked workspace climate to taking an interest association based on business interest. Through this linked workspace of various partaking associations, they can share knowledge, data, and information, as they can likewise refresh the data set on interest. Data sharing becomes data creation with the Interlinking Principle. The Interlinking Principle created the Internet. The relations' predefined messages connect at least two associations. Understanding the data sent to and distributed among at least two organisations should be prioritised over understanding other organisations' frameworks. In the Principal of Interlinking of information, partaking associations' construction stays unique and associated through planning. The upsides of interlinking are that the framework can be supplanted with no adjustments.

B. Role of Healthcare Enterprise Architecture

There are a number of challenges that medical care organisations face, including clinical blunders and providing clinical assistance where specialists are either unavailable or unpracticed. An Electronic Medical Record would never be beneficial to the medical care industry if interoperability and framework reconciliation were not implemented (EMR). A great number of organisations that provide medical care are currently free to work on Electronic Medical Record systems [21]. These frameworks are inadequate to associate with different frameworks. The essential purpose behind these frameworks' lack of ability is distinctive business strategies, Information Technology or Information System design. The architecture of an Enterprise provides an exit from this issue. Appropriate and ideal data concerning wellbeing is critical for settling on essential choices that improve wellbeing, help, and save several lives. Enterprise Architecture offers help to accomplish and guaranteeing this. Skilled medical care providers may have access to trustworthy and practical health data through coordinated medical care data frameworks. These medical care providers consult the health information system for more comprehensive perspectives. The main reason for coordinated healthcare system is to cover a perfect establishment that tends to the whole healthcare framework. Without coordinated healthcare information, labourer's deal with various issues, for example, copy information, clashing techniques, and instruments for information assortment will not occur [22]. There are few data and correspondence innovation that are dispatched for assisting information frameworks. However, these are discontinued in the plan, and usage is not precise. HMN (Health Metrics Network): In 2005, the HMN was begun to help the Ministry of Health and partners improve world medical services by guaranteeing the openness and legitimate use of data about wellbeing for cutting-edge proof-based dynamics. Ministry of Health is the principal worldwide medical care coordinated effort, and this cooperation focuses on two fundamental necessities. The main necessary arrangements with a representative of a Ministry of Health of information frameworks hold the healthcare framework and the subsequent necessity is influencing the country's initiative to contribute and reinforce healthcare information to the board and its utilization. The Health Metrics Network structure is planned dependent on a gathering of directing working standards. More than 65 partaking nations create these standards. These standards are as per the following:

- The customary utilization of better data relates to better medical care results, and a solid medical care data framework is one effective method for giving limit.
- Support of top country authority is fundamental for keeping up medical services benefits and empowering medical services data frameworks.

C. Strategy for Search

The pursuit system discovered 302 investigations, as per Table IV shows the inquiry string expected to adjust to every vault's specificity. The convention sifted the determinations by the most recent a long time from the earliest starting point of the examination (2015-2019). To guarantee dependability, each group played out similar methods and thought about the future effects of the quantitative investigations chosen.

TABLE IV. THE ENQUIRY STRING

Engines for search (From 2015 to 2019)	Quantity
SCOPUS	55
IEEE	16
Hubmed	47
Science Direct	184
Total search	302

D. Selection for Study (Phase 1 &2)

In the first phase, after the eliminating processes of duplicate research and applying the rejection rules characterized in the convention, specialists examined the presentation, the theoretical, and even the credentials of the leftover of the 280 investigations. On the off chance that an examination prompted a dissimilarity between the groups on the incorporation/rejection models, specialists

incorporated it for the second phase. It brought about an aggregate of 68 investigations, as demonstrated in Table V. Cohen's Kappa for the first phase came about because of the two groups' examinations, which was 0.79, that addresses a great understanding, as outlined beneath.

TABLE V. AGGREGATION OF 68 INVESTIGATION

Kappa from the first phase			
		Team 1	
		Included	Excluded
Team 2	Included	49	8
	Excluded	11	212
Total chosen studies		68	
Determined Cohen's Kappa		0, 79	

In the second phase, the examinations were accumulated in PDF design, yet it was unrealistic to get 3 of them essentially because of their accessibility; subsequently, specialists rejected these investigations considering avoidance models EC06 "inaccessible studies". In this way, the presentations, and conclusions of the 65 investigations were broke down at the same time with eleven rejections. Cohen's Kappa was additionally utilized in this stage and was scored 0.59 (moderate understanding level), as indicated by Table IV.

TABLE VI. MODERATE UNDERSTANDING LEVEL

Kappa from the first phase			
		Team 1	
		Included	Excluded
Team 2	Included	44	1
	Excluded	9	11
Total chosen studies after gathering		49	
Determined Cohen's Kappa		0, 59	

Considering the philosophy proposed in the convention, the two groups settled the contradictions coming about because of the second phase through a "controversial meeting." They re-examined the contradictions by re-perusing the presentation and the conclusion of the ten investigations being referred. By agreement, they chose to incorporate 5 of them for the third phase, bringing about an aggregate of 49 investigations.

E. Extraction of Data (Phase 3)

In the third phase, each group went through the complete 49 investigations. There was an agreement to reject three additional articles that didn't answer any of the examination inquiries in this deliberate survey, adding up to 46 investigations. The specialists utilized the application MaxQDA to lead the whole extraction process, a subjective investigation device utilized to arrange significant data using codes, shadings, images, or even emojis. They perform measurable examinations of this information, permitting a comprehensive perspective of every product's work. For group analysis, the MaxQDA-generated annotations and encodings were transferred to an xml-formatted spreadsheet and used during the synthesis process' information phase.

F. Synthesis of Data (Phase 4)

In the fourth phase, the analysts led the information blend measure on an intensive examination of the graphs and spreadsheet from the extraction interaction process by the two groups of specialists utilizing the MaxQDA Excel and apparatus. The two groups dissected the coded selection and comments in the 46 examinations to check whether there was any irregularity in the connection between the removed fragments and the exploration

TABLE VII. DATA SYSNTESIS OVERVIEW

Investigation between 2015 – 2019	
Years	Papers
2015	10
2016	5
2017	9
2018	12
2019	10

questions. Table VII displays the diagram with the dispersion of these investigations in 2015-2019, which addresses a normal of 9 examinations distributed each year. It is reported that cloud with a word, created from the 46 investigations, is shown, in which roughly 15500 words are available. The most famous words, barring connectors, for example, "the," "of," "in," that don't enhance the development of the cloud were "engineering", "wellbeing", "data", "undertaking", "business", "information" and "medical care".To rearrange the game plan of information in the tables that react to the question's, we made comparability codes for every one of the 26 references of the chosen examines, as demonstrated in Table VIII.

TABLE VIII. COMPARABILITY CODES FOR 26 REFERENCES

Ref./Year	Code	Objectives
[26] 2017	A1	To present a Primary health care implementation in Indonesia
[27] 2017	A2	To demonstrate the use of archimate® in an African healthcare information system case study.
[28] 2019	A3	To present an evaluation framework for architectural patient identification solutions used in health information systems.
[29] 2018	A4	To present a sustainable medical tourism framework based on the enterprise architecture design of the country of Thailand.
[30] 2018	A5	To present the open healthcare platform of the future, in the year 2030.
[31] 2014	A6	To improve the responsibility modelling in Enterprise Architecture, Case Study in the Healthcare Sector.
[32] 2018	A7	To present an E-Health Enterprise Architecture Framework: Integration of Thailand Case.
[33] 2017	A8	To present an Enterprise Architecture Perspective to Electronic Health Record Based Care Governance
[34] 2019	A9	To present the ArchiMate Business Model Patterns to e-Healthcare
[35] 2017	A10	To present the Architectural frameworks: defining the structures for implementing learning health system
[36] 2018	A11	To present the practises of the architecture board in the adaptive enterprise architecture combined with a digital platform: an example from the global healthcare industry
[37] 2016	A12	To present the Enterprise architecture development for the hospital information system
[38] 2018	A13	To present the importance of architecture and governance in developing country health information systems is examined, with the goal of mitigating the "dam effect."
[39] 2018	A14	To present a protocol for conducting research on the design and validity of a questionnaire to evaluate the national eHealth architecture (NEHA).
[40] 2015	A15	To create a proof of concept for an enterprise architecture in a hospital in Portugal.
[41] 2019	A16	To manage the inconsistencies through enterprise architecture in healthcare institutions
[17] 2017	A17	To present the problems with Enterprise Architecture management in the Norwegian health sector
[42] 2018	A18	To perform an analysis and Modeling of Risk in Healthcare Cloud Ecosystems Using the FAIR Method: A Case Study of ArterysTM on Amazon Web Services
[11] 2018	A19	To present an Enterprise-level architecture framework for hospitals (study of Iranian university hospital organization).
[43] 2018	A20	To study the case study of some reflections on the use of an architecture model for the purpose of matching existing applications to a radical change in the requirements of the business
[13] 2017	A21	To study the case study on the global enterprise that focuses on risk management for the digital transformation of the architecture board.
[44] 2018	A22	To study the integration of data based on interoperability standards is the focus of the Smart Medical Information Technology for Healthcare (SMITH) initiative.
[45] 2017	A23	To present the approaches to interoperability on national eHealth that combine openEHR, SNOMED, IHE, and Continua are being proposed.
[46] 2015	A24	To present the newly developed data-driven enterprise architecture for electronic healthcare: lessons learned from India's public sector
[47] 2015	A25	To review a pluralistic strategy is being taken in the direction of collaborative health information systems.
[48] 2018	A26	To present the Vision paper for the facilitation of applications related to digital healthcare in OHP2030.

6. CONCLUSION

Currently, EA is widely used in business and science, with researchers and professionals worldwide applying and studying its theory. There are numerous tools, frameworks, and methodologies available to organisations that use EA for management support and governance. Choosing the most accurate tools or methods can be difficult and costly. There are no systematic guidelines to implement EA in a specific area that can be adopted to meet the needs of any company. Most publications on EA implementation lack proper data and details that are essential for proper practises and factors of success. Their lack of detail and inaccurate information makes data extraction difficult. For example, few studies characterise hospitals as large, medium, or small, or as emergency or clinical hospitals. For organisations looking for methods, tools, and methodologies to help their governance and management, the research that have given proper information about the health environment nature suggested essential basis. These studies can be used to select a collection of good practises that allows for new genuine studies. According to analysts, this is due to a lack of information sharing between organisations, or cultural or ethical reasons. This research's outcome describes how professionals and researchers applied practises and theories to EA's healthcare system. The key positive effects chosen by the writers are dependent on the experimental method's outcomes. In a few of these implementations, it also includes success factors. Additionally, this study identifies the most influential authors and publication channels on Healthcare EA. This paper's initial motivation is to fill the SLR, and SM (Systematic Mappings) concerned with the success of every EA application. This study also assesses the current state of EA in the healthcare system. It focuses on a specific research question that enabled certain EA aspects. By answering these questions, this SLR helps researchers find and understand EA cases. The information gathered helps the researchers learn more about EA. This promotes new practical and scientific tasks. Even though we have a set time for our work, the topic is usually broad. It may also restore the advancement of other specific questions that clarify this event. As a result, we expect this research to help researchers create new SLRs and spread knowledge about the EA phenomenon in the healthcare system [52-54].

ACKNOWLEDGMENT

The work was supported by Advance Computer Engineering and Technology (ACET) Research Group and Department of Computer Science and Engineering, Manipal International University in Negeri Sembilan, Malaysia.

REFERENCES

[1] Shanks, G., Gloet, M., Someh, I. A., Frampton, K., & Tamm, T. (2018). Achieving benefits with enterprise architecture. *The Journal of Strategic Information Systems*, *27*(2), 139-156.

[2] Osei-Tutu, K., & Song, Y. T. (2020, January). Enterprise Architecture for Healthcare Information Exchange (HIE) Cloud Migration. In *2020 14th International Conference on Ubiquitous Information Management and Communication (IMCOM)* (pp. 1-8). IEEE.

[3] Gartner, 2020. Gartner Glossary. https://www.gartner.com/en/information-technology/glossary/enterprise-architecture-ea /Accessed 19 May 2020.

[4] Kotusev, S. (2019). Enterprise architecture and enterprise architecture artifacts: Questioning the old concept in light of new findings. *Journal of Information technology*, *34*(2), 102-128.

[5] Anthony Jnr, B. (2020). Managing digital transformation of smart cities through enterprise architecture–a review and research agenda. *Enterprise Information Systems*, 1-33.

[6] Dang, D. D., & Pekkola, S. (2017). Systematic Literature Review on Enterprise Architecture in the Public Sector. *Electronic Journal of e-Government*, *15*(2).

[7] Zhang, M., Chen, H., & Luo, A. (2018). A systematic review of business-IT alignment research with enterprise architecture. *IEEE Access*, *6*, 18933-18944.

[8] Gampfer, F., Jürgens, A., Müller, M., & Buchkremer, R. (2018). Past, current and future trends in enterprise architecture—A view beyond the horizon. *Computers in Industry*, *100*, 70-84.

[9] Gong, Y., & Janssen, M. (2019). The value of and myths about enterprise architecture. *International Journal of Information Management*, *46*, 1-9.

[10] Ansyori, R., Qodarsih, N., & Soewito, B. (2018). A systematic literature review: Critical success factors to implement enterprise architecture. *Procedia Computer Science*, *135*, 43-51.

[11] Haghighathoseini, A., Bobarshad, H., Saghafi, F., Rezaei, M. S., & Bagherzadeh, N. (2018). Hospital enterprise architecture framework (study of Iranian university hospital organization). *International journal of medical informatics*, *114*, 88-100.

[12] Kotusev, S. (2017). Enterprise architecture: what did we study?. *International Journal of Cooperative Information Systems*, *26*(04), 1730002.

[13] Masuda, Y., Shirasaka, S., Yamamoto, S., & Hardjono, T. (2017, July). Risk management for digital transformation in architecture board: a case study on global enterprise. In *2017 6th IIAI International Congress on Advanced Applied Informatics (IIAI-AAI)* (pp. 255-262). IEEE.

[14] Levina, A., & Iliashenko, O. (2017). Enterprise architecture approach to mining companies engineering. In *MATEC Web of Conferences* (Vol. 106, p. 08066). EDP Sciences.

[15] Jallow, A. K., Demian, P., Anumba, C. J., & Baldwin, A. N. (2017). An enterprise architecture framework for electronic requirements information management. *International Journal of Information Management*, *37*(5), 455-472.

[16] Bui, Q. (2017). Evaluating enterprise architecture frameworks using essential elements. *Communications of the Association for Information Systems*, *41*(1), 6.

[17] Olsen, D. H. (2017). Enterprise Architecture management challenges in the Norwegian health sector. *Procedia computer science*, *121*, 637-645.

[18] Mirsalari, S. R., & Ranjbarfard, M. (2020). A model for evaluation of enterprise architecture quality. *Evaluation and Program Planning*, *83*, 101853.

[19] Brosius, M., Aier, S., Haki, K., & Winter, R. (2018). Enterprise architecture assimilation: An institutional perspective. Association for Information Systems.

[20] Nowakowski, E., Farwick, M., Trojer, T., Häusler, M., Kessler, J., & Breu, R. (2017, January). Enterprise architecture planning: analyses of requirements from practice and research. In *Proceedings of the 50th Hawaii International Conference on System Sciences*.

[21] Saint-Louis, P., & Lapalme, J. (2018). An exploration of the many ways to approach the discipline of enterprise architecture. *International Journal of Engineering Business Management*, *10*, 1847979018807383.

[22] Martynov, V. V., Shavaleeva, D. N., & Salimova, A. I. (2018, November). Designing optimal enterprise architecture for digital industry: state and prospects. In *2018 Global Smart Industry Conference (GloSIC)* (pp. 1-7). IEEE.

[23] Van den Berg, M., Slot, R., van Steenbergen, M., Faasse, P., & van Vliet, H. (2019). How enterprise architecture improves the quality of IT investment decisions. Journal of Systems and Software, 152, 134-150.

[24] Lnenicka, M., & Komarkova, J. (2019). Developing a government enterprise architecture framework to support the requirements of big and open linked data with the use of cloud computing. *International Journal of Information Management*, *46*, 124-141.

[25] Korhonen, J. J., & Halén, M. (2017, July). Enterprise architecture for digital transformation. In 2017 IEEE 19th Conference on Business Informatics (CBI) (Vol. 1, pp. 349-358). IEEE

[26] Nugraha, D. C. A., Aknuranda, I., Andarini, S., & Roebijoso, J. (2017). A business architecture modeling methodology to support the integration of primary health care: Implementation of primary health care in Indonesia. *Internetworking Indonesia Journal*, *9*(1), 39-45.

[27] Yamamoto, S., & Traoré, M. (2017, July). A case study of archimate® for the african healthcare information system. In *2017 6th IIAI International Congress on Advanced Applied Informatics (IIAI-AAI)* (pp. 285-288). IEEE.

[28] Memon, Z., Noran, O., & Bernus, P. (2019). A Framework to Evaluate Architectural Solutions for Ubiquitous Patient Identification in Health Information Systems. In *ICEIS (2)* (pp. 580-587).

[29] Mayakul, T., Kiattisin, S., & Prasad, R. (2018). A Sustainable Medical Tourism Framework Based on the Enterprise Architecture Design: The Case in Thailand. *Journal of Green Engineering*, *8*(3), 359-388.

[30] Masuda, Y., Yamamoto, S., & Shirasaka, S. (2018, June). A vision for open healthcare platform 2030. In *International Conference on Intelligent Interactive Multimedia Systems and Services* (pp. 175-185). Springer, Cham.

[31] Feltus, C., Petit, M., Dubois, E. (2014). Improving Responsibility modelling in Enterprise Architecture, Case Study in the Healthcare Sector. University Library of Munich, Germany. https://ideas.repec.org/p/pra/mprapa/77313.htmlFeltus2014ImprovingRM

[32] Mayakul, T., & Kiattisin, S. (2018, November). An E-Health Enterprise Architecture Framework: Integration of Thailand Case. In *2018 Global Wireless Summit (GWS)* (pp. 204-208). IEEE.

[33] Motoc, B. (2017, January). An Enterprise Architecture Perspective to Electronic Health Record Based Care Governance. In *ITCH* (pp. 243-248).

[34] Yamamoto, S., & Zhi, Q. (2019). ArchiMate Business Model Patterns to e-Healthcare. In *Innovation in Medicine and Healthcare Systems, and Multimedia* (pp. 11-20). Springer, Singapore.

[35] Lessard, L., Michalowski, W., Fung-Kee-Fung, M., Jones, L., & Grudniewicz, A. (2017). Architectural frameworks: defining the structures for implementing learning health systems. *Implementation Science*, *12*(1), 1-11.

[36] Masuda, Y., Shirasaka, S., Yamamoto, S., & Hardjono, T. (2018). Architecture board practices in adaptive enterprise architecture with digital platform: a case of global healthcare enterprise. *International Journal of Enterprise Information Systems (IJEIS)*, *14*(1), 1-20.

[37] Purnawan, D. A., & Surendro, K. (2016, May). Building enterprise architecture for hospital information system. In *2016 4th International Conference on Information and Communication Technology (ICoICT)* (pp. 1-6). IEEE.

[38] Gebre-Mariam, M., & Fruijtier, E. (2018). Countering the "dam effect": the case for architecture and governance in developing country health information systems. *Information Technology for Development*, *24*(2), 333-358.

[39] Mousavi, S. M., Takian, A., & Tara, M. (2018). Design and validity of a questionnaire to assess national eHealth architecture (NEHA): a study protocol. *BMJ open*, *8*(12), e022885.

[40] Rijo, R., Martinho, R., & Ermida, D. (2015). Developing an enterprise architecture proof of concept in a Portuguese hospital. *Procedia Computer Science*, *64*, 1217-1225.

[41] Ajer, A. K. S., Hustad, E., & Vassilakopoulou, P. (2019). Enterprise architecture in hospitals: Resolving incongruence issues. In *Health and Wellbeing e-Networks for All-Proceedings of the 17th World Congress on Medical and Health Informatics*. IOS Press.

[42] Traoré, M., & Yamamoto, S. (2018, July). Healthcare CloudEcosystem Risk Analysis and Modeling: A FAIR Approach—A Case Study of Arterys™ on AWS. In *2018 7th International Congress on Advanced Applied Informatics (IIAI-AAI)* (pp. 841-844). IEEE.

[43] Tarenskeen, D., Hoppenbrouwers, S., & van de Wetering, R. (2018, October). Reflections on Using an Architecture Model for Matching Existing Applications to a Radical Business Requirements Change: a Case Study. In *IFIP Working Conference on The Practice of Enterprise Modeling* (pp. 383-393). Springer, Cham.

[44] Winter, A., Stäubert, S., Ammon, D., Aiche, S., Beyan, O., Bischoff, V., ... & Löffler, M. (2018). Smart medical information technology for healthcare (SMITH): data integration based on interoperability standards. *Methods of information in medicine*, *57*(Suppl 1), e92.

[45] Beštek, M., & Stanimirović, D. (2017). Special Topic Interoperability and EHR: Combining openEHR, SNOMED, IHE, and Continua as approaches to interoperability on national eHealth. *Applied clinical informatics*, *8*(3), 810.

[46] Kaushik, A., & Raman, A. (2015). The New data-driven Enterprise Architecture for e-Healthcare: Lessons from the Indian PublicSector. Government Information Quarterly. doi:10.1016/j.giq.2014.11.002

[47] Noran, O. (2015). Towards collaborative health information systems: a pluralistic approach. *International Journal of Biomedical Engineering and Technology*, *17*(2), 127-147.

[48] Toma, T., Masuda, Y., & Yamamoto, S. (2018, June). Vision paper for enabling Digital Healthcare applications in OHP2030. In *International Conference on Intelligent Interactive Multimedia Systems and Services* (pp. 186-197). Springer, Cham.

[49] Hazen, B. T., Bradley, R. V., Bell, J. E., In, J., & Byrd, T. A. (2017). Enterprise architecture: A competence-based approach to achieving agility and firm performance. *International Journal of Production Economics*, *193*, 566-577.

[50] Dwipriyoko, E., Bon, A. T. B., & Sukono, F. (2019, July). Enterprise Architecture Planning as New Generation Cooperatives Research Methods. In *Journal of Physics: Conference Series* (Vol. 1179, No. 1, p. 012094). IOP Publishing.

[51] Tallon, P. P., Queiroz, M., Coltman, T., & Sharma, R. (2019). Information technology and the search for organizational agility: A

systematic review with future research possibilities. *The Journal of Strategic Information Systems*, *28*(2), 218-237.

[52] Zainuddin, A. A., Superamaniam, S., Andrew, A. C., Muraleedharan, R., Rakshys, J., Miriam, J., ... & Taufik, M. S. M. (2020, September). Patient monitoring system using computer vision for emotional recognition and vital signs detection. In 2020 IEEE Student Conference on Research and Development (SCOReD) (pp. 22-27). IEEE.

[53] Zainuddin, A. A., Bhattacharjee, S., Kalliat, S., Shrestha, S., Sivaraman, S., Khalique, M. M., ... & Manokaran, P. (2021). Trends and Challenges of Internet-of-Things in the Educational Domain. Malaysian Journal of Science and Advanced Technology, 81-88.

[54] Rozario, M., Zainuddin, A. A., & Gamage, S. A. (2021). Artificial Intelligence and Machine learning in the Healthcare Sector: A Review. Malaysian Journal of Science and Advanced Technology, 89-96.

[55] Rajiv, S. A., & Zainuddin, A. A. (2021). Review of New Trends and Challenges of Android-Based Home Security Robot. Malaysian Journal of Science and Advanced Technology, 103-108.

Malcolm Rozario was born and raised in Singapore and continues to call the city-state home. Since graduating from university with a bachelor's degree in finance, he has accumulated more than two decades of professional experience, the last ten of which were spent in Melbourne, Australia, working for one of the main four banks. He is currently employed as a public servant by a government agency that is a sub-department of the Ministry of Human Resources. He will obtain a credential in information technology management after completing my Master of Science in Information Technology Management at Manipal GlobalNxt Malaysia, in December 2021. He was awarded an Executive Doctorate in Business Administration by the University of Phoenix, which I am now pursuing. He is now pursuing a doctorate in business administration to better his education.

Ahmad Anwar Zainuddin currently works as a senior lecturer at Department Computer Science, Kulliyyah of Information and Communication Technology, International Islamic University Malaysia,Kuala Lumpur, Malaysia. He has extensive international collaborative networks and has been a guest researcher at Linkoping University in Sweden and Limoges University in France during his PhD studies. His areas of expertise include Micro-electro-mechanical Systems (MEMS), Biosensors, Internet of Things (IoT), Big Data Analytics, and Cloud Computing. Currently, he decided to work on the development of acoustic wave sensors for breath analysis as a noninvasive solution for early detection of critical disease. Besides, his research interests include dependable distributed systems, as well as smart and connected health. His work has been published in over 30 papers in journals and proceedings both locally and internationally.

Puvanaah Manokaran is currently pursuing a Bachelor of Science in Computer Engineering at Manipal International University in Malaysia (MIU). Prior to receiving her degree, she also completed a Foundation in Engineering programme at MIU. In addition,she is currently taking part in an externship collaboration between MIU and the International Business Machines Cooperation (IBM) for an upcoming Artificial Intelligence course.