

5-2023

IDENTIFYING EFFECTIVE ATTRIBUTES AND TRENDS IN THE EVOLUTION OF ENTERPRISE ARCHITECTURE IN HEALTHCARE

Brian Gaul

Follow this and additional works at: <https://scholarworks.lib.csusb.edu/etd>



Part of the [Business Administration, Management, and Operations Commons](#), and the [Business Intelligence Commons](#)

Recommended Citation

Gaul, Brian, "IDENTIFYING EFFECTIVE ATTRIBUTES AND TRENDS IN THE EVOLUTION OF ENTERPRISE ARCHITECTURE IN HEALTHCARE" (2023). *Electronic Theses, Projects, and Dissertations*. 1662.
<https://scholarworks.lib.csusb.edu/etd/1662>

This Project is brought to you for free and open access by the Office of Graduate Studies at CSUSB ScholarWorks. It has been accepted for inclusion in Electronic Theses, Projects, and Dissertations by an authorized administrator of CSUSB ScholarWorks. For more information, please contact scholarworks@csusb.edu.

IDENTIFYING EFFECTIVE ATTRIBUTES AND TRENDS IN THE EVOLUTION
OF ENTERPRISE ARCHITECTURE IN HEALTHCARE

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
in
Information Systems Technology

by
Brian Gaul
May 2023

IDENTIFYING EFFECTIVE ATTRIBUTES AND TRENDS IN THE EVOLUTION
OF ENTERPRISE ARCHITECTURE IN HEALTHCARE

A Project
Presented to the
Faculty of
California State University,
San Bernardino

by
Brian Gaul
May 2023
Approved by:

William Butler, Committee Chair
Conrad Shayo, Committee Member and Department Chair

© 2023 Brian Gaul

ABSTRACT

The purpose of this study was to determine which attributes within existing Enterprise Architecture frameworks are trending in recent, successful implementations within healthcare. The research questions were: Q1. What attributes were used within Enterprise Architecture in the healthcare industry? Q2. What are the limitations of those attributes? Q3. How can those attributes assist in successful Enterprise Architecture implementations? To uncover these attributes in practical work, this study used a trend analysis of current qualitative data of the healthcare industry and in recent implementations. The findings were as follows: Q1. Eight attributes were identified in practical healthcare work, the two most important being Cloud Computing and the Internet of Things. Q2. Cloud Computing and the Internet of Things both require significant resources from the organization to be utilized effectively. Q3. Successful Enterprise Architecture implementation centers around communication, knowledge, and training, and Cloud Computing and the Internet of Things offer a variety of solutions in this space to assist in business processes to deliver efficient communication, store a knowledge base, and administer trainings. The conclusions were: (Q1) Cloud Computing is being heavily utilized in the healthcare industry, especially after the COVID-19 Pandemic. The Internet of Things pairs well with Cloud Computing as many devices utilize a cloud infrastructure. (Q2) Regardless of the limitations of Cloud Computing and the Internet of Things, they are still vital to the successful implementation of Enterprise Architecture methodologies. (Q3) Cloud Computing and the Internet

of Things offer a wide variety of solutions to deliver successful communication, knowledge, and training like Microsoft Azure paired with Microsoft Teams. Areas for further study include: (a), investigating healthcare organizations now that the surge of COVID-19 patients has subsided, and (b), monitoring changes in Enterprise Architecture frameworks over time.

TABLE OF CONTENTS

ABSTRACT	iii
CHAPTER ONE: INTRODUCTION	viii
1.1 Overview.....	1
1.2 Problem Statement.....	5
1.3 Organization of The Study	6
CHAPTER TWO: LITERATURE REVIEW.....	8
2.1 Chapter Overview.....	8
2.2 What attributes were used within Enterprise Architecture in the healthcare industry?	8
2.3 Identified Trends.....	9
2.4 What are the limitations of those attributes?.....	11
2.5 How can those attributes assist in successful Enterprise Architecture implementations?	12
2.6 Further Research.....	12
CHAPTER THREE: RESEARCH METHODS.....	14
3.1 Chapter Overview	14
3.2 What attributes within Enterprise Architecture were used in the healthcare industry?	14

3.3 What are the limitations of those attributes?	15
3.4 How can those attributes assist in successful Enterprise Architecture implementations?	15
CHAPTER FOUR: DATA ANALYSIS AND FINDINGS.....	17
4.1 Case Studies	17
4.2 Case 1: Healthcare	17
4.3 Case 2: Data Centers	20
4.4 Case 3: Global Manufacturing	22
4.5 Case 4: 6 Implementations	23
4.6 Case 5: Software Development	23
CHAPTER FIVE: DISCUSSION	25
5.1 What attributes within Enterprise Architecture were used in the healthcare industry?	25
5.2 What are the limitations of those attributes?	25
5.3 How can those attributes assist in successful Enterprise Architecture implementations?	25
CONCLUSION.....	26
5.4 What attributes within Enterprise Architecture were used in the healthcare industry?	26
5.5 What are the limitations of those attributes?	26

5.6 How can those attributes assist in successful Enterprise Architecture implementations?	27
FURTHER STUDY	27
APPENDIX	28
REFERENCE	30

LIST OF TABLES

Table 1. Percentage of EA publications related to subject	10
Table 2. EA Framework Approach	11

CHAPTER ONE: INTRODUCTION

1.1 Overview

The discipline of Enterprise Architecture (EA) has grown substantially from the 1980's to the 2020's (Gampfer et al., 2018). Enterprise Architecture is an approach that helps businesses innovate and adapt to remain competitive and grow to be more effective and profitable (Laschitza & Undén, 2017). Enterprise Architecture provides means to manage the solutions with the complexity of business-IT alignment, improved communication, reduced costs, and better change management (Laschitza & Undén, 2017). By evolving and using the most effective Enterprise Architecture frameworks, organizations can improve business processes to become more efficient, profitable, and forward-thinking, especially in data storage and standardization (Laschitza & Undén, 2017). However, Enterprise Architecture investments and achieved values can be lost if important attributes in implementation are not identified (Laschitza & Undén, 2017). Enterprise Architecture methodologies need to evolve to ensure successful implementation in future projects (Laschitza & Undén, 2017).

Enterprise architecture does not have a single model because it is a multidimensional and complex discipline that requires a holistic approach to managing the organization's information technology (IT) infrastructure, business processes, and systems. EA involves creating a blueprint or a set of blueprints that guide the development, deployment, and management of an organization's IT infrastructure and applications. This blueprint or set of blueprints represents a complex system that requires the integration of various architectural models,

each of which addresses a different aspect of the organization. For example, an organization's Enterprise Architecture might include the following architectural models: Business Architecture: This model defines the organization's strategy, goals, and objectives, and how they relate to its business processes and activities. Information Architecture: This model defines the organization's data structures, data models, and data flows, and how they support the business processes and activities. Application Architecture: This model defines the organization's software applications, their functionality, and how they are integrated with other applications. Technology Architecture: This model defines the organization's IT infrastructure, including hardware, software, and networking components, and how they support the application and data architectures (ChatGPT, 2023).

Each of these models is important for managing the organization's IT infrastructure and applications, but they all serve different purposes and require different perspectives, skills, and tools to develop and maintain. Therefore, Enterprise Architecture does not have a single model, but rather a set of interrelated models that together provide a comprehensive view of the organization's IT infrastructure and applications. It is critical to ensure these methodologies are implemented effectively and successfully (ChatGPT, 2023)

There is a cost associated with implementing Enterprise Architecture and without proper planning the cost of implementation can extend over the long term and become a financial and resource burden on the organization (Reselman, 2021). Unfortunately, there are examples of Enterprise Architecture

implementation failure in the practical world (Laschitza & Undén, 2017). There was, however, an empirical study that introduced a general Enterprise Architecture visualization procedure using ArchiMate that was feasible to restore the Enterprise Architecture scenario (Zhi & Zhou, 2021). Different organizations have vastly different business needs, and therefore different methodologies have been developed to address those needs (Rouhani et al., 2013).

In Enterprise Architecture Implementation Methodology there are five methodologies currently developed. These methodologies include Enterprise Architecture Planning (EAP), The Open Group Architecture Framework (TOGAF), Department of Defense Architecture Framework (DoDAF), Gartner, and Federal Enterprise Architecture (FEA). EAP focuses on developing and managing the development process for alignment. TOGAF is an iterative process to develop a framework. DoDAF is a holistic approach designed for Department of Defense agencies. Gartner brings business owners, information specialists, and technology implementers together under one vision. FEA is designed specifically for government agencies. There are no current Enterprise Architecture Implementation Methodologies that cover the demands of all Enterprise Architecture implementations (Rouhani et al., 2013).

Among the available EA methodologies, The Open Group Architecture Framework (TOGAF) is scored as the most useful across concepts, modeling, and process (Rouhani et al., 2013). Different methodologies have evolved, and Enterprise Architecture needs arose in the areas of maintenance, business requirements, and continuing the process. There is a need to identify the

attributes that will provide solutions to those three areas and our study was needed to predict the effective attributes within those frameworks and how they can assist in successful implementations. This culminating experience project study will contribute to our understanding of EAP by identifying the effective attributes within those frameworks in the healthcare setting and how they contribute to successful EAP implementations (Rouhani et al., 2013).

There is a need to study Enterprise Architecture frameworks and the attributes within those frameworks to compare academic work to current, practical work, to help design successful implementations with the appropriate attributes (Gampfer et al., 2018). The data from the empirical study by Cameron and McMillan (2013), focused on the effective frameworks being used in 2013. That study stopped short of identifying attributes within those frameworks that would be effective for organizations (Cameron & McMillan, 2013). The study by Gampfer et al. (2018), used academic literature to predict future attributes within Enterprise Architecture. The data from these two studies can be used to compare against current, practical work, to accurately predict trends so a healthcare organization can design successful implementations with the appropriate attributes (Gampfer et al., 2018).

Successful implementations ensure the time and resources used by an organization to develop Enterprise Architecture views will benefit them going forward by achieving their business goals with improved business processes. By using trending and effective attributes within current Enterprise Architecture frameworks, data integration and standardization can be achieved with new tools

while improving business processes. These attributes can be identified by studying recent case studies with qualitative data (Cameron & McMillan, 2013).

Using the data from existing qualitative data and the shortcomings of existing Enterprise Architecture Implementation Methodologies, the next steps in the evolution of Enterprise Architecture trends in healthcare can be predicted. It is important to identify these trends to ensure future Enterprise Architecture work is developed and implemented effectively so healthcare organizations utilize the appropriate attributes within the correct framework. Knowing the trends of successful implementations will guide future healthcare organizations in developing effective Enterprise Architecture plans (Gampfer et al., 2018).

1.2 Problem Statement

To ensure successful implementation, effective solutions need to be used when developing the Enterprise Architecture frameworks. The trends and attributes that are most useful to healthcare organizations and can be utilized in the long term need to be identified and utilized within frameworks. The data exists to find these attributes and how they can be used going forward within frameworks to maximize the benefits of the healthcare organizations developing Enterprise Architecture views (Gampfer et al., 2018).

The data in previous studies stopped short of finding specific attributes that can be found in current successful Enterprise Architecture implementations. The study by Cameron and McMillan (2013), suggested future research on the attributes within the frameworks (Cameron & McMillan, 2013). The study also suggests further research in how these attributes contribute to the development

of hybrid frameworks (Cameron & McMillan, 2013). The predictive analysis study by Gampfer et al. (2018), suggested there is a mismatch between Enterprise Architecture in practice and in academics (Gampfer et al., 2018).

The purpose of this study is to determine which attributes within existing Enterprise Architecture frameworks are trending in recent, successful healthcare implementations. The aim of this study is to find how those attributes shape the current trends in Enterprise Architecture by studying the attributes being used currently within healthcare and in recent implementations. To uncover these attributes in practical work, this study used a trend analysis of current qualitative data of the healthcare industry and in recent implementations.

The research questions are:

- 1) What attributes within Enterprise Architecture were used in the healthcare industry?
- 2) What are the limitations of those attributes?
- 3) How can those attributes assist in successful Enterprise Architecture implementations?

1.3 Organization of The Study

Chapter 1 provided the background of the study, the problem statement, as well as the research question determining which attributes within existing Enterprise Architecture frameworks are trending in recent, successful implementations. Chapter 2 will provide the literature review. Chapter 3 will discuss the research methods used to answer the research questions. Chapter 4

will provide an analysis of the data and findings. Chapter 5 will consist of discussion, conclusion and areas for further study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Chapter Overview

This chapter addresses the trends already predicted within Enterprise Architecture and the additional research that will be done. The predictive analysis study by Gampfer et al. (2018), used academic literature to predict future trends of Enterprise Architecture. The study by Cameron and McMillan (2013), surveyed participants whose job roles included working with Enterprise Architecture frameworks. That study compared the choices of respondents between Enterprise Architecture frameworks. This chapter will review those predictions and explore the recommendations made by the study for future research.

2.2 What attributes were used within Enterprise Architecture in the healthcare industry?

The predictive analysis study by Gampfer et al. (2018), utilized text mining to identify existing literature relevant to predicting trends in Enterprise Architecture across all industries. 3799 records were found and 10% were randomly selected to be reviewed. The literature focused on Enterprise Architecture Modelling accounted for 30% of the studies in the early 90's but increased to 50% by 2015. The studies on Enterprise Architecture Understanding and Management accounted for 70% in the early 90's but decreased to 50% by 2015. SAS Content Categorization Studio was used to correlate existing literature into identifiable trends (Gampfer et al., 2018).

The identifiable trends found in the study by Gampfer et al. (2018) touched briefly on what Enterprise Architecture frameworks those attributes could be found within. The study by Cameron and McMillan (2013), reviewed the five major frameworks within Enterprise Architecture in more detail. Those included Zachman, the TOGAF Standard, FEAR, DoDAF, and Gartner. The goal of the study was to provide recommendations on criteria for organizations to select an appropriate framework. Important elements were identified from each framework that would assist organizations in selecting the correct framework to utilize (Cameron & McMillan, 2013).

These sources created a reference of information of identified trends and the details of the frameworks they exist within. The predictive analysis study by Gampfer et al. (2018), focused on attributes most often found in academic works (Gampfer et al., 2018). The study by Cameron and McMillan (2013), looked at providing guidance on frameworks that were most appropriate for organizations undergoing Enterprise Architecture (Cameron & McMillan, 2013). The identified trends from the literature review need to be compared against a specific case study within healthcare to provide practical case study context.

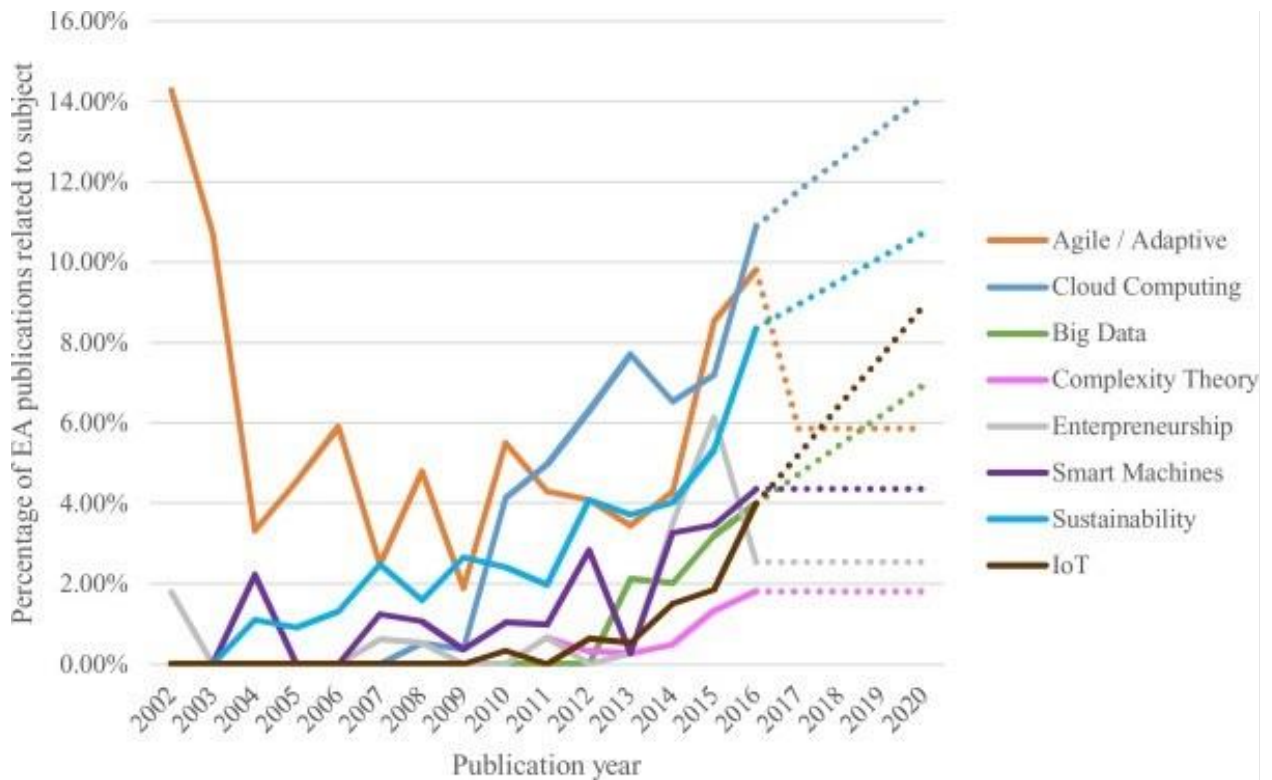
2.3 Identified Trends

The eight strongest trends that could be mapped to a subject were identified in the predictive analysis study by Gampfer et al. (2018). Those that appeared most frequently and could be mapped to a subject. These trends are modeled below in Table 1. The trends identified were as follows: The strongest trend identified is Cloud Computing. Adaptive or Agile Enterprise Architecture is

also identified as a strong trend and has been studied closely for the past 20 years. Sustainability as well as smart machines, the Internet of things, big data, entrepreneurship, and complexity theory were also identified as strong trends (Gampfer et al., 2018).

Table 1

Percentage of EA publications related to subject (Source: (Gampfer et al., 2018).



The study was the first comprehensive review of Enterprise Architecture academic knowledge in the last 35 years but was limited for two reasons. Not being analyzed against recent detailed, qualitative studies, and with the post-COVID-19 Pandemic work environment (Gampfer et al., 2018). More details were needed on currently existing Enterprise Architecture methodologies. The

study by Cameron and McMillan (2013), looked within current frameworks to identify trends.

The trends identified by Cameron and McMillan (2013), were related to how the frameworks were designed and not the attributes within the framework, as described in the previous paragraph. The respondents in the survey desired a clear, consistent, and structured framework. These trends are modeled below in Table 2. They overwhelmingly supported a hybrid framework, driven by the need for an Agile/Adaptive approach (Cameron & McMillan, 2013).

Table 2

EA Framework Approach (Source: (Cameron & McMillan, 2013).

EA Framework Approach	Number of Responses	% of Participants
Hybrid framework	151	54%
Popular EA framework	72	26%
Original EA framework	26	9%
Consulting firm framework	14	5%

2.4 What are the limitations of those attributes?

Different Organizations have a variety of business needs and selecting an appropriate Enterprise Architecture framework can be challenging and complicated. Many attributes can be added to or taken from a particular framework, depending on the internal goals and business processes of the organization, and the limitations of those attributes. The practice of adding and deleting attributes from existing frameworks leads to the practice of using hybrid

frameworks to minimize the limitations of current attributes within established frameworks. This can be a viable solution, but more guidance is needed on how to effectively utilize hybrid frameworks (Cameron & McMillan, 2013).

2.5 How can those attributes assist in successful Enterprise Architecture implementations?

Theory can inform practice and vice versa. The predictive analysis study by Gampfer et al. (2018), identified attributes strictly through academic work and those attributes need confirming through case study review of recent implementations. This human intervention is needed to unclutter the results of the predictive clustering analysis. Through this method this study will confirm how currently used attributes can be effective in assisting with future successful implementations, especially within hybrid, Adaptive frameworks (Gampfer et al., 2018).

2.6 Further Research

The predictive analysis study by Gampfer et al. (2018), recommends further research in the areas of Developmental Operations, Design Thinking, Customer Journey Analytics, Web-Scale Application Architecture, Workforce Planning and Modelling, and IT/OT Architecture. The Gartner Hype Cycle, which provides a representation of how technologies and applications may be potentially relevant over time, is especially popular with practitioners. The predictive analysis from this study differed from the Gartner Hype Cycle, suggesting there is a mismatch between Enterprise Architecture in practice and in academics (Gampfer et al., 2018). Our case study trend analysis will find if

these trends appear within Enterprise Architecture in practice and whether new trends have occurred in healthcare.

The study by Cameron & McMillan (2013), suggested future research on the attributes within the frameworks. Attributes change quickly over time as business needs change. The study also suggests further research in how these attributes contribute to the development of the desired hybrid framework (Cameron & McMillan, 2013). Our case study trend analysis study looks further into the attributes currently being utilized in healthcare and in recent Enterprise Architecture Implementations.

CHAPTER THREE: RESEARCH METHODS

3.1 Chapter Overview

This chapter will review the research method utilized in this study. To ensure successful implementation, effective attributes need to be used when developing the Enterprise Architecture frameworks. The trend analysis research design will be used to find reoccurring patterns within existing case studies. This design was effective because Enterprise Architecture is always changing to meet the needs of the ever-changing business environment. This trend analysis will be applied to each of the research questions through the review of case studies.

3.2 What attributes within Enterprise Architecture were used in the healthcare industry?

The scope of this research question involves a trend analysis of existing qualitative data on attributes being used within Enterprise Architecture frameworks within the healthcare industry. Through the existing qualitative data case study, this project will predict future attributes and trends in Enterprise Architecture within healthcare. Predicted trends from the literature review will be proven or disproven.

Our study utilized trend analysis in a non-structured format to analyze case studies. The design is temporal as it studies qualitative data done over a specific period of time. This research design will study predicted trends from previous literature and cross-reference those predictions against the current practices from a case study in healthcare. Only secondary data was needed in this study as there was a sufficient case study available from within the

healthcare industry. This study reviewed and selected data available from Google Scholar and other peer-reviewed sources available online. The data that was selected was either recent, highly cited, or the only available data on a particular subject.

This study was limited in the sense that it did not have the means to collect additional data within the healthcare field. This trend analysis attempted to tie existing data together to create a more complete picture of Enterprise Architecture attributes in healthcare. In all circumstances, the best available data was selected and utilized to further research in the exploration of attributes and trends in Enterprise Architecture.

3.3 What are the limitations of those attributes?

This research question again utilized trend analysis in the structure described above to review case studies regarding the limitations of the attributes. Secondary, qualitative data, from Google Scholar and other peer-reviewed sources available online was plentiful, recent, and detailed. The best available data was selected and utilized to further research in the exploration of limitations of the attributes in Enterprise Architecture.

3.4 How can those attributes assist in successful Enterprise Architecture implementations?

This research question again utilized trend analysis in the structure described above to review case studies to find how those attributes can assist in successful Enterprise Architecture implementations. Based on the secondary data, suggestions were made for the improvement of Enterprise Architecture

development and implementation with the use of the attributes. There was limited Google Scholar or peer-reviewed data available on some relevant implementations, so older data was selected in some cases. This study was also limited in the sense that it did not have the means to collect additional data on recent implementations. This trend analysis attempted to connect attributes found in research question 1 and utilize them with in the suggestions from the recent implementation case studies. The best available data was selected and utilized to further research in the exploration of how attributes can assist in successful Enterprise Architecture implementations.

CHAPTER FOUR: DATA ANALYSIS AND FINDINGS

4.1 Case Studies

A Healthcare case study was chosen because the industry utilizes Cloud Computing and the Internet of Things in emerging ways (Masuda et al., 2021). Data centers case studies were reviewed for limitations as they are heavy users of Cloud Computing and the Internet of Things (Al Twaijiry, 2021). The case studies by Laschitza and Undén (2017), Aier and Schelp (2010), and Alzoubi and Gill (2022) were selected because they are the most recent, detailed, implementation studies available.

Case study 1 will answer research question 1. What attributes were used within Enterprise Architecture in the healthcare industry? Case study 2 will answer research question 2. What are the limitations of those attributes? Case studies 3-5 will answer research question 3. How can those attributes assist in successful Enterprise Architecture implementations?

4.2 Case 1: Healthcare

This section will focus specifically on the ability of Enterprise Architecture to fuel growth in the healthcare industry and what trends will fuel that growth. Opportunities for Enterprise Architecture to help the healthcare industry exist in improved patient care, generated revenue, and controlling costs. An Adaptive Integrated Digital Architecture Framework (AIDAF) is most appropriate for the healthcare industry where three trends, Internet of Things, Cloud Computing, and Agile/Adaptive, are clearly seen (Masuda et al., 2021).

The Internet of Things Enterprise Architecture solution is already being utilized in the healthcare industry but is not being holistically understood within Enterprise Architecture management. The Internet of Things can distribute healthcare applications, potentially reducing costs when paired with behavioral changes of stakeholders. Costs are only reduced when stakeholders make the necessary changes in their actions to embrace the use of the applications (Masuda et al., 2021).

Within the physical healthcare setting those stakeholders can access medical, diagnostic, and imaging sensor devices through wireless technologies. Smartphones and tablets play a key role in leveraging healthcare applications. Wearable healthcare systems can track and upload data to the cloud. These devices play a key role in improving overall care and patient outcomes by allowing caregivers to track patient status in real time. (Masuda et al., 2021).

Cloud Computing has emerged as a leading Enterprise Architecture solution when dealing with big data. The healthcare industry has embraced the cloud as an opportunity to store and secure a large amount of data including electronic health records. With Cloud Computing, the healthcare industry can identify Enterprise Architecture solutions that move from descriptive to predictive to prescriptive, improving patient care (Masuda et al., 2021).

Utilizing big data through Cloud Computing allows for Enterprise Architecture solutions that contribute to evidence-based medicine and patient profile analysis. To successfully utilize Cloud Computing, the Enterprise

Architecture frameworks will need to be adaptive. Companies that utilize the Open Group Architecture Framework (TOGAF) or the Federal Enterprise Architecture Framework (FEAF) can adopt a hybrid, adaptive framework and support Cloud Computing in an Agile way (Masuda et al., 2021).

Traditional software development processes have been done in a linear fashion and are not effective in Agile and Adaptive environments like healthcare. Due to the ever-changing situation of the patient in healthcare, the process of linear development is not sustainable in healthcare Enterprise Architecture solutions. Agile methods work iteratively and incrementally by contacting the patient throughout the process. The solution is developed incrementally with all stakeholders (Masuda et al., 2021).

Within an Agile framework, the number of patient interactions can be carried out flexibly and effectively in real time, and in increased numbers. In Agile solutions, the interactions are more important than the processes or tools. The functionality of the software solutions is the most important item when developing the Agile Enterprise Architecture frameworks to ensure quality patient care is maintained. Responding appropriately to change is more important than following plans or specific frameworks (Masuda et al., 2021).

No existing frameworks can adequately fill the Adaptive and Agile needs of the healthcare industry. This industry would require hybrid solutions, which supports the survey results from the study by Gampfer et al. (2018). This trend analysis has reviewed Cloud Computing, the Internet of Things, and Agile/Adaptive frameworks and how they positively impact the leaders in the

technology and healthcare space, but those trends have limitations as well (Cameron & McMillan, 2013).

4.3 Case 2: Data Centers

This study has identified Cloud Computing and the Internet of Things as the two most impactful trends currently in Enterprise Architecture when considering the healthcare industry. This study has thus far outlined the positives and reasons why Cloud Computing and the Internet of Things are being used extensively. This section will review the limitations of those trends within data centers.

The possible uses of Cloud Computing for an organization are almost endless, but the organization must scale their resources to support the use of the cloud, or they will lose control of their business processes. Cloud outages are a common concern and reality of those using Cloud Computing. There are a variety of reasons why a cloud provider may lose service including power outages, human error, cyber-attacks, network issues, or problems with the cloud infrastructure. Having reliable backup plans is vital for the organization to navigate these outages (Al Twaijiry, 2021).

Organizations may adapt their services to fit the capabilities of the cloud provider, but this can lead to vendor lock-in. Switching vendors may become financially impossible or lead to detrimental outcomes for the organization. One of those detrimental outcomes may be poor cloud security. If an organization's data is not protected properly, the adverse outcomes could be financial loss, customer loss, and possibly the end of the organization. The organization must

have confidence they have the most ideal cloud vendor, and their operation is secure. The more devices used within the cloud setting, the more potential security risks are created (Al Twaijiry, 2021).

The Internet of Things can bring a large number of devices together to achieve common goals, such as improved patient care in health care. There are limitations, however, when adopting a large volume of new devices at the same time. This section will review some of those challenges in the healthcare landscape (Masuda et al., 2021).

Wearable devices can send real-time data on a patient's health to their data center. Many of these devices require technology experts to be used properly, especially when working with older patients. A healthcare organization must use their resources and technology experts to maintain the wearables for them to be a usable addition. These wearable devices also require a lot of power, and many operate on batteries. The power resources must be available, and batteries must be maintained, as a low battery can lead to incorrect data and an adverse effect on patient care (Raza et al., 2021).

The amount of data collected using the Internet of Things will increase, but how that data is utilized is a challenge for any organization. Within healthcare, that data must reach the correct people in a timely manner for decisions to be made. There are also limitations in how accurate the data being relayed is and the organization must know when a physical exam is necessary in a situation to verify data. Cloud Computing and the Internet of Things do have limitations but

are still vital in the successful implementation of Enterprise Architecture methodologies (Raza et al., 2021).

4.4 Case 3: Global Manufacturing

The case study by Laschitza and Undén (2017), reviewed an Enterprise Architecture implementation done at a Global Manufacturing company in 2018. Both Cloud Computing and the Internet of Things are critical components of a successful Enterprise Architecture implementation. They both play a key role in communication in the implementation (Laschitza & Undén, 2017).

Communication plays an important role in successful Enterprise Architecture implementation. Programs such as Microsoft Teams or Slack can be implemented as part of the Enterprise Architecture methodology and ensure proper communication is achieved. Cloud Computing and the Internet of Things can also encourage employees to become more knowledgeable in the Enterprise Architecture implementation process (Laschitza & Undén, 2017).

Data that can be easily accessed by employees on a cloud can educate employees on the process and the previously mentioned communication devices like Microsoft Teams and Slack can relay information as well. Knowledge and communication can reinforce the idea that there is formal power in the implementation process. Formal power from the lead stakeholders down to the employees helps ensure Enterprise Architecture rules, standards, and quality are kept (Laschitza & Undén, 2017).

4.5 Case 4: 6 Implementations

The qualitative study by Aier and Schelp (2010), studied six different Enterprise Architecture implementations. This section will review the use of Cloud Computing and the Internet of Things in those implementations. They are both critical to successful Enterprise Architecture implementations (Aier & Schelp, 2010).

Training and education were identified as important tools for the successful Enterprise Architecture implementation of the six companies. Many organizations will store their training on cloud-based software programs. The training can be taken in-person, on a computer, or through programs like Zoom or Microsoft Teams. Communication once again rose to the top of things needed for successful Enterprise Architecture implementation (Aier & Schelp, 2010).

As discussed in the previous section, Cloud Computing and the Internet of Things offer various solutions to improve communication. Training, education, and communication reduces barriers and improves implementation success. Access to data on a cloud that is distributed through the Internet of Things is a successful strategy to achieve these goals. Cloud Computing and the Internet of Things pair together very well to support successful Enterprise Architecture implementations (Aier & Schelp, 2010).

4.6 Case 5: Software Development

The study by Alzoubi and Gill (2022), reviewed a practical case of implementing Agile Enterprise Architecture. Definition, communication, views, availability, involvement of stakeholders, assistance to technical teams, and

feedback were identified as key tools for successful implementation. More specifically, sharing, communicating, and training should be paid attention to the most (Alzoubi & Gill, 2022).

As discussed in the previous implementation case studies, training and communication were key concepts in successful implementation, especially Agile developments, like the ones used in healthcare. This study suggests a team-oriented approach to address communication and training. As discussed previously, Cloud Computing and the Internet of Things offer a variety of options for team-oriented solutions such as Microsoft Azure paired with Microsoft Teams (Alzoubi & Gill, 2022).

CHAPTER FIVE: DISCUSSION

5.1 What attributes within Enterprise Architecture were used in the healthcare industry?

Through the review of academic work, several Enterprise Architecture attributes were identified within healthcare. There was a question as to whether there was a gap in the trends in academic work and practical work, and this trend analysis did further research to disprove that gap in the healthcare industry. The two most important attributes identified in practical work in healthcare were Cloud Computing and the Internet of Things. Practical work has changed dramatically since the COVID-19 Pandemic and the growth of remote work. Cloud Computing is being heavily utilized in the healthcare industry, especially after the COVID-19 Pandemic.

5.2 What are the limitations of those attributes?

Cloud Computing and the Internet of Things both require significant resources from the organization to be utilized effectively. Both are valuable attributes when developing Enterprise Architecture frameworks but do still have some limitations. These limitations can include things like cloud outages, vendor lock-in, poor security, and lack of resources to support tools.

5.3 How can those attributes assist in successful Enterprise Architecture implementations?

Successful Enterprise Architecture implementation centers around communication, knowledge, and training. Cloud Computing and the Internet of Things offer a variety of solutions in this space to assist in healthcare business

processes. That can specifically include methods to deliver efficient communication, store a knowledge base, and administer training.

CONCLUSION

5.4 What attributes within Enterprise Architecture were used in the healthcare industry?

Cloud Computing is being heavily utilized in the healthcare industry, especially after the COVID-19 Pandemic. The Internet of Things pairs well with Cloud Computing as many devices utilize a cloud infrastructure. Healthcare organizations are finding ways to successfully leverage Cloud Computing and the Internet of Things to develop successful Enterprise Architecture plans. The most appropriate Enterprise Architecture framework for the healthcare setting is an Adaptive, hybrid framework. This framework can add and subtract appropriate attributes to assist with solutions for business processes and ensure a successful implementation.

5.5 What are the limitations of those attributes?

Regardless of the limitations of Cloud Computing and the Internet of Things, they are still vital to the successful implementation of Enterprise Architecture methodologies. Healthcare organizations must provide the necessary staffing and resources to support their Cloud Computing and Internet of Things tools. If these tools are properly supported the limitations of the attributes will be limited.

5.6 How can those attributes assist in successful Enterprise Architecture implementations?

Cloud Computing and the Internet of Things offer a wide variety of solutions to deliver successful communication, knowledge, and training like Microsoft Azure paired with Microsoft Teams. Team-oriented approaches to address communication and training, with the use of Cloud Computing and the Internet of Things, will lead to a unified approach to improve business processes through Enterprise Architecture in healthcare. The ability of Cloud Computing and the Internet of Things to support the team-oriented approach can assist in business processes to deliver efficient communication, store a knowledge base, and administer training.

FURTHER STUDY

Trend analysis does have some limitations, as it identifies trends, but it can be limited in showing the cause of those trends. This study was able to find data to uncover some of the causes of Cloud Computing and the Internet of Things emerging as trends, but further research is recommended in post-COVID-19 Enterprise Architecture implementations. This data would be useful to find if these trends continue to grow or if the landscape is reverting to pre-pandemic conditions.

Areas for further study include: (a), investigating healthcare organizations now that the surge of COVID-19 patients has subsided, and (b), monitoring changes in Enterprise Architecture frameworks overtime.

APPENDIX

HEALTHCARE CASE STUDY

ATTRIBUTE COMPARISON BY COUNTRY

Table 3

Attribute Comparison By Country (Source: (Masuda et al., 2021).

Country	Cloud Computing	Internet of Things
Australia	Being Utilized	Being Utilized
China	Being Utilized	Being Utilized
Germany	Being Utilized	Being Utilized
Japan	Being Utilized	Being Utilized
Jamaica (Carnegie Mellon University and Brandeis University)	Proposed Pilot Program	Proposed Pilot Program
USA	Being Utilized	Being Utilized

REFERENCE

- Aier, S., Schelp, J. (2010). A Reassessment of Enterprise Architecture Implementation. In: Dan, A., Gittler, F., Toumani, F. (eds) Service-Oriented Computing. ICSOC/ServiceWave 2009 Workshops. ServiceWave ICSOC 2009 2009. Lecture Notes in Computer Science, vol 6275. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-16132-2_4
- Al Twaijiry, A. (2021, November 15). Cloud computing present limitations and future trends. ScienceOpen. Retrieved February 24, 2023, from <https://www.scienceopen.com/hosted-document?doi=10.14293%2FS2199-1006.1.SOR-.PPEYYII.v1>
- Alzoubi, Y. I., & Gill, A. Q. (2022, February 18). Can Agile Enterprise Architecture be implemented successfully in Distributed Agile Development? empirical findings - global journal of flexible systems management. SpringerLink. Retrieved April 6, 2023, from <https://link.springer.com/article/10.1007/s40171-022-00298-w#Sec26>
- Buckl, S., Ernst, A. M., Matthes, F., & Schweda, C. M. (2009). Visual roadmaps for managed Enterprise Architecture Evolution. Retrieved February 5, 2023, from <https://ieeexplore.ieee.org/abstract/document/5286642/>
- Cameron, B. H., & McMillan, E. (2013, February). Analyzing the Current Trends in Enterprise Architecture Frameworks. Retrieved March 9, 2023, from <https://eapad.dk/wp-content/uploads/2014/11/2012-4.pdf>

- ChatGPT. (2023, April 15). What is Enterprise Architecture? Retrieved from <https://chat.openai.com/>.
- Darvish Rouhani, B., Nazri Mahrin, M., Nikpay, F., & Nikfard, P. (2013). A comparison enterprise architecture implementation methodologies ... Retrieved February 3, 2023, from <https://ieeexplore.ieee.org/document/6702772/>
- Dignan, L. (2021, December 22). Top cloud providers: AWS, Microsoft Azure, and Google Cloud, hybrid, SAAS players. ZDNET. Retrieved February 14, 2023, from <https://www.zdnet.com/article/the-top-cloud-providers-of-2021-aws-microsoft-azure-google-cloud-hybrid-saas/>
- Gampfer, F., Jürgens, A., Müller, M., & Buchkremer, R. (2018, May 9). Past, current and future trends in Enterprise Architecture-A View beyond the Horizon. Computers in Industry. Retrieved February 4, 2023, from https://www.sciencedirect.com/science/article/pii/S0166361517306723?casa_token=F6WRhGvFQjcAAAAA%3APmtZurY4XxTYHvhs_RICY42GAM-sUnrX-sopx8kcAosE7XQbJ2spBiZEznAbTmavedckReoEYuzh
- Laschitza, J., & Undén, M. (2017, September 15). Enterprise architecture implementation a qualitative study in opportunities and obstacles of EA Implementation. Home. Retrieved January 31, 2023, from <https://gupea.ub.gu.se/handle/2077/53749>
- Masuda, Y., Zimmermann, A., Shepard, D. S., Schmidt, R., & Shirasaka, S. (2021, December 1). An adaptive enterprise architecture design for a

digital ... - IEEE xplore. Retrieved February 14, 2023, from

<https://ieeexplore.ieee.org/abstract/document/9626251/>

Raza, M., Singh, N., Khalid, M., Khan, S., Awais, M., Usman Hadi, M., & Imran, M. (2021, September 27). Challenges and limitations of internet of things

enabled ... - IEEE xplore. Retrieved February 24, 2023, from

<https://ieeexplore.ieee.org/document/9548974/>

Reselman, B. (2021, April 7). 5 steps an enterprise architect can take to address adoption costs. Enable Architect. Retrieved March 28, 2023, from

<https://www.redhat.com/architect/adoption-costs>

Zhi, Q., & Zhou, Z. (2021, May 2). Empirically Modeling Enterprise Architecture using archimate. Retrieved February 9, 2023, from

[https://www.researchgate.net/profile/Qiang-](https://www.researchgate.net/profile/Qiang-Zhi4/publication/357487303_Empirically_Modeling_Enterprise_Architecture_Using_ArchiMate/links/621dbf81b1bace0083a48291/Empirically-Modeling-Enterprise-Architecture-Using-ArchiMate.pdf?origin=journalDetail)

[Zhi4/publication/357487303_Empirically_Modeling_Enterprise_Architecture_Using_ArchiMate/links/621dbf81b1bace0083a48291/Empirically-](https://www.researchgate.net/profile/Qiang-Zhi4/publication/357487303_Empirically_Modeling_Enterprise_Architecture_Using_ArchiMate/links/621dbf81b1bace0083a48291/Empirically-Modeling-Enterprise-Architecture-Using-ArchiMate.pdf?origin=journalDetail)

[Modeling-Enterprise-Architecture-Using-](https://www.researchgate.net/profile/Qiang-Zhi4/publication/357487303_Empirically_Modeling_Enterprise_Architecture_Using_ArchiMate/links/621dbf81b1bace0083a48291/Empirically-Modeling-Enterprise-Architecture-Using-ArchiMate.pdf?origin=journalDetail)

[ArchiMate.pdf?origin=journalDetail](https://www.researchgate.net/profile/Qiang-Zhi4/publication/357487303_Empirically_Modeling_Enterprise_Architecture_Using_ArchiMate/links/621dbf81b1bace0083a48291/Empirically-Modeling-Enterprise-Architecture-Using-ArchiMate.pdf?origin=journalDetail)