

Strategic Deployment of EA Frameworks to Address ESG Challenges in Healthcare

Chia-Chi Wu
University of Melbourne
elxni0608@gmail.com

Yu-Wei Tang
University of Melbourne
a960097@gmail.com

Wan Kei Sze
University of Melbourne
szewankei@gmail.com

Cheuk Yin Hon
University of Melbourne
honcheukyin5@gmail.com

Pyae Phyo Swe
University of Melbourne
pyswe1999@gmail.com

Rod Dilnutt
University of Melbourne
rpdl@unimelb.edu.au

Abstract

As sustainability becomes increasingly essential, healthcare systems face unique challenges to integrate Environmental, Social, and Governance (ESG) concerns into operation and decisions. This necessitates a structured approach to align Information Technology (IT) capacities with ESG objectives to enhance operational sustainability, governance standards, and social responsibility within the sector.

This report examines the strategic integration of ESG factors into the healthcare industry through the application of Enterprise Architecture (EA) frameworks, specifically The Open Group Architecture Framework (TOGAF®¹) and the Gartner's Pace-layered Architecture TM².

The TOGAF framework supports systematic changes across business, data, application, and technology architectures, integrating ESG considerations by enhancing resource management, improving data quality, and ensuring effective governance. The Gartner's Pace-layered Architecture, on the other hand, offers a dynamic stratification of applications, promoting agile responses to changing market conditions and enabling innovation. This framework categorises applications into three layers by their unique management needs and rates of change.

Despite their potential, implementation encounters barriers such as resistance to change, high implementation costs, and the complexity of existing healthcare systems. Additionally, lack of real-life application of Pace-layered Architecture highlights the need for further studies and pilot projects to establish its effectiveness and scalability.

This report aims to provide healthcare organisations with insights on addressing ESG challenges with EA frameworks. By aligning IT infrastructure with ESG goals, healthcare organisations can effectively address the current challenges. Yet, a successful implementation necessitates robust change management strategies and comprehensive stakeholder involvement to overcome the inherent challenges, and eventually realise the benefits of ESG integration in healthcare organisations.

¹ TOGAF is a registered trademark of The Open Group.

² Gartner is a registered trademark of Gartner Inc and/or its affiliates.

1. Introduction

With sustainability gaining prominence, there has been a notable shift in integrating Environmental, Social, and Governance (ESG) factors into business operations. This poses challenges and the result is not satisfying, particularly in the healthcare industry. With its complex systems, the industry faces a unique set of ESG concerns (Pereno & Eriksson, 2020). In view of this, a guideline is needed to assist in addressing those factors. On the other hand, Enterprise Architecture (EA) provides a structured approach to facilitate the change processes by aligning ESG objectives and IT capacities. Through the course of this paper, EA frameworks, namely, The Open Group Architecture Framework (TOGAF) and the Gartner's Pace-layered Architecture will be explored to leverage EA to address the challenges regarding the integrating process.

2. Background

2.1. ESG in Healthcare

The healthcare industry faces increasing demands for sustainable performance and disclosure regarding ESG activities. Firstly, due to its high energy consumption and waste generation, the healthcare industry is often urged to develop strategies to reduce environmental costs, which includes proper management of medical wastes and preventing pollution from hazardous wastes (PWC, 2021; Bosco et al., 2024). Regarding social responsibility, it is argued that healthcare organisations should take action to improve workplace diversity and transparency (Leung & You, 2023). Further steps should also involve investing in technology to ensure cybersecurity for health and medical records and to optimise the quality of service (Bosco et al., 2024). Additionally, governance practices, including an effective and diverse board structure as well as ethical policies, are critical components of ESG contributions. In response to these pressures, regulators and government bodies have heightened expectations for healthcare organisations to ensure accountability in care delivery and sustainability (Leung & You, 2023).

The benefits for organisations implementing ESG activities have been discussed in several aspects, including better financial performance and alignment with regulatory standards (Chaudhry et al., 2023; Leung & You, 2023). Research has shown that ESG activities positively influence performance measures such as return on assets and help reduce operating expenses (Piechocka-Kałużna et al., 2021; Kalia & Aggarwal, 2023). The engagement and disclosure of ESG activities serve to demonstrate an organisation's commitment to aligning with stakeholder expectations (Kalia & Aggarwal, 2023), which helps increase credibility and transparency, thereby achieving better access to resources from the community and government. All these findings demonstrate the importance of embedding ESG considerations in business strategies for the healthcare industry to address sustainability requirements and meet stakeholder expectations.

2.2. Current Issues of ESG integration in Healthcare

As the healthcare industry is implementing ESG into its current operation, three major challenges are often raised. First, ESG in the healthcare industry is often criticised for its **absence of foreseeable goals and vision**, resulting in limited stakeholder engagement and ineffectiveness. Two of the six generic problems for corporate sustainability are lack of standardisation and credibility of information (Consolandi et al., 2020; Windolph, 2011). These two problems have led to low ESG knowledge and low stakeholder engagement, causing the healthcare industry to have a lower ESG score across the board (Hallez, 2022; Bernow et al., 2017). Additionally, Boiral (2013) stated 90 percent of ESG reports from corporations are found to have sections that are idealised or altered to meet their target, or emphasise only the positives, in turn neglecting the key issues. These reports are not represented realistically due to their low transparency. As a result, not many legitimate reports can be highlighted to become the healthcare industry's ESG goals. Moreover, the healthcare industry is struggling to find value in ESG, which also develops a low interest and low focus on the activities and attitudes towards ESG (Bernow et al., 2017).

Secondly, financial and human resources are critical to the success of the healthcare industry, and the **lack of resource management and control** hinders sustainability in the broader view (Chiu & Fong, 2023). As the healthcare industry becomes more competitive, many institutions focus on gaining more financial resources and support (Gerber, 2014). On the other hand, around one trillion US dollars are spent on administrative departments in the United States healthcare industry, accounting for a quarter of the entire spending in 2019 (Sahni et al., 2021). These unnecessary costs are caused by redundant processes and outdated human resource management (Yang & Lin, 2009). Human resource management can help healthcare organisations to provide quality healthcare service to patients and communities, while the current systems are unable to satisfy their needs (Kabene et al., 2006).

Lastly, is the **insufficient system design** of the healthcare industry, specifically, the **unorganised and mixed quality of data**. Due to the confidential nature of patients' data and to protect patient privacy, these data are mostly not shared among medical organisations (Kern et al., 2019; Wei et al., 2012). Issues such as polypharmacy, referring to misuse and excessive use of more than five medications (Varghese et al., 2023), are common for elderly aged over 60 (Hosseini et al., 2018). Not only does this damage the health condition of patients, but it also generates massive medical waste and financial costs (Sahni et al., 2021). The healthcare industry handles large amounts of complex data from patients, doctors, caregivers, etc, which are becoming more detailed with the innovation of technology (Carvalho et al., 2019; Gerber, 2014). The growing demand for data management is becoming a massive issue for the healthcare industry since traditional methods of recording data are becoming obsolete (Galetsi et al., 2020).

2.3. Role of EA in Enhancing ESG Initiatives

IEEE Computer Society (2000) coined the architecture in an organisation related to IT by the following definition: “Architecture is the fundamental organisation of a system embodied in its components, their relationships to each other, and to the environment, and the principle guiding its design and evolution” (p. 3). EA captures different processes and information within the company, which is essential in developing specific solutions that maximise the value (Jonkers et al., 2006). It concerns the integration of various systems used for diverse purposes to create a holistic view of the company's IT landscape (Lankhorst, 2004). Comprehending the current status of EA within the sector aids in formulating the strategies and blueprint to achieve the desired outcome (Jonkers et al., 2006; Lankhorst, 2004). In the context of ESG in the healthcare sector, due to the undergoing digital transformation, EA guides the integration of ESG modules in the current systems and operations, aims at renovating the architecture with ESG goals and ultimately stabilises the new process (Nayeem et al., 2023). In summary, EA is a framework driving the collaboration between systems and processes, aligning business and IT objectives and optimising IT infrastructure to cope with the overarching business strategies (Rouhani et al. 2015).

3. Enterprise Architecture Framework in Addressing ESG Issues in Healthcare

3.1. TOGAF

3.1.1. Introduction

TOGAF provides a framework for EA development, implementation, and maintenance, focusing on four domains within an organisation as defined by The Open Group (2018):

1. Business architecture: defines the business strategies, core functions, and governance process within the organisation.
2. Data architecture: defines the data structure supporting business functions and data management.
3. Application architecture: describes the required applications and their interactions to support the business process and data flow.

4. Technology architecture: describes the required IT infrastructures, devices, software components, and networks to support the business, data, and application operations.

The TOGAF Architecture development method (ADM) serves as the core of TOGAF, providing an iterative approach (Figure 1) with the basic structures including understanding the architecture context, architecture development in different domains, transition plan development, and architecture governance (The Open Group, 2018).

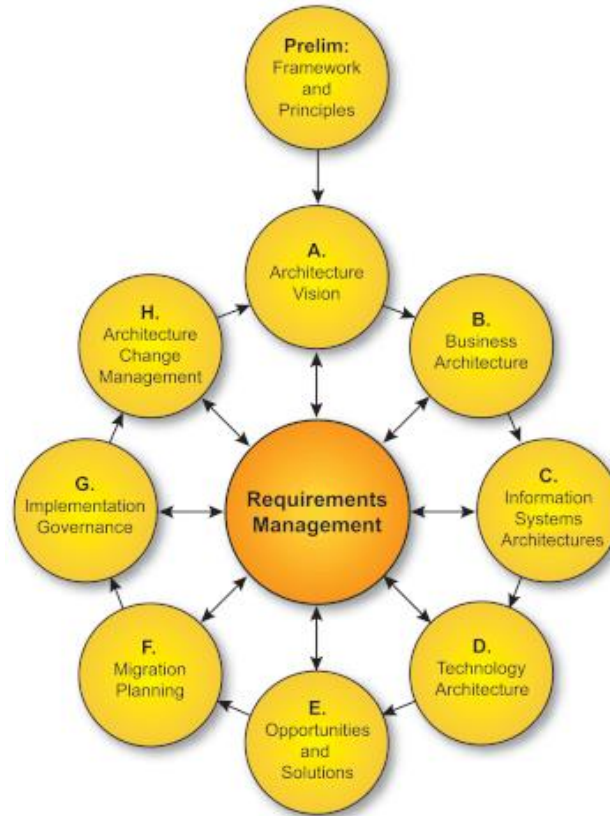


Figure 1: TOGAF ADM (The Open Group, 2018)

TOGAF ADM is widely recognized and adopted to strengthen business process, facilitate strategic planning to enhance IT capability and enhance decision-making for digital transformation in healthcare organisations (Capirossi & Rabier, 2013; Girsang & Abimanyu, 2021; Rahimi et al., 2023). This all demonstrates the framework's applicability and value. Overall, TOGAF provides a structured approach to develop enterprise-specific architectures that align with organisational needs and assist the organisation in identifying and outlining the opportunities to achieve the strategic goals (Amalia & Supriadi, 2017).

Expanding upon the introduction of TOGAF, the benefits of leveraging this framework are as follows: Firstly, TOGAF aims to enhance IT operational performance by providing comprehensive guidance for organisations to follow and assisting in continually managing across different EA layers iteratively. Additionally, it improves business-IT alignment by facilitating integration and interconnection within the EA system (Girsang & Abimanyu, 2021). On the other hand, TOGAF offers flexibility for organisations to customise the system for the most suitable use regarding business objectives and constraints (Kotusev, 2018).

3.1.2. Applying TOGAF to Address Issues

Establish Clear ESG Goals and Direction

TOGAF assists organisations in understanding the current context and baseline architecture, serving as a starting point for integrating ESG considerations into their core strategy (Kadi, 2022). By assessing how existing processes and functions support ESG consideration in EA layers, healthcare organisations can understand their ESG positions. Subsequently, the organisation shall define the desired outcomes, incorporating ESG considerations and goals in different architecture domains. This approach helps identify the opportunities aligning with ESG factors, such as waste management, enhancing service quality and prioritising focus areas, therefore embedding ESG factors into organisations' sustainability strategy (Zhong et al., 2023).

Additionally, TOGAF ADM helps ensure effective establishment and implementation of governance mechanisms (Rahimi et al., 2023). An accountable governance system, with sets of policies and practices facilitated by TOGAF, will ensure the alignment of EA with the organisation's objectives and stakeholder engagement (Rahimi et al., 2023). Overall, the structured approach will motivate stakeholders to achieve ESG goals by providing actionable maps with a clear EA framework (Bender et al., 2009).

Manage Resource Allocation

TOGAF ADM suggests architecture development shall start from the preliminary phase that emphasises the initial analysis of resource allocation including human, financial, time, hardware as well as software infrastructure (Girsang & Abimanyu, 2021). According to The Open Group (2018), each decision-making should consider practical assessment of resource and competency availability, and the expected value delivered by the chosen scope of work. This approach allows the organisation to understand the resource constraint and capability, prioritising the most impactful initiatives, achieving better resource management.

Furthermore, TOGAF provides a strategic architectural view of the organisation's current condition to identify opportunities for lower costs and guides the decision-making processes to avoid wasteful spending on incorrect or inefficient initiatives (Rahimi et al., 2023). This helps the healthcare organisation to allocate resources effectively, make informed decisions, and facilitate the incorporation of ESG to align business objectives despite constricted resources.

Strengthen System Design and Data Management

Architecture Building Blocks (ABBs) provide reusable architectural elements to meet business needs across organisations, ensuring the consistency and reusability in architecture development (The Open Group, 2018). Using the TOGAF ADM, organisations could document their existing information architecture, including data entities, flows, management, and their relationships, consequently developing a future state blueprint to align with organisational goals. The gap analysis helps mapping out the solution opportunities and prioritise efforts to address the issues (The Open Group, 2018; Kadi, 2022). In this way, organisations could gain an understanding of the areas for improvement in system design, enhance the data quality and interoperability, and further drive progress to translate ESG strategy into operations.

Effective governance and change management are crucial for aligning architectural elements with organisational objectives and standards throughout the development lifecycle (Capirossi & Rabier, 2013). TOGAF suggests establishing formal governance mechanisms to validate, review, and manage the architecture artefacts, documents, and supporting information (The Open Group, 2018). Furthermore, continually managing environmental changes and adapting plans could ensure the systems and data are managed to support ESG initiatives. This iterative TOGAF ADM process will enable healthcare organisations to leverage the enhanced data quality and IT capability as drivers for ESG integration.

3.1.3. Real-Life Application of TOGAF

Queensland Health's "Enterprise Architecture Vision 2026" presents the potential benefits of adopting TOGAF methodologies to integrate ESG in healthcare, although TOGAF is not explicitly mentioned. The organisation has established clear visions with different ESG aspects, including enhancing customer

experience through digital care delivery, leveraging technology for data capture and decision support, and improving clinician experience such as workflow optimization and waste reduction (Queensland Health, 2021).

Its digital architecture is developed across five domains including Security, Business, Information, Application, and Technology, aligning with the Queensland Government Enterprise Architecture (QGEA) Framework, which is similar to what TOGAF has suggested (Queensland Health, 2021). Following TOGAF allows it to systematically examine the legacy information system and technology infrastructure to make strategic decisions on replacing, upgrading, retiring or adopting additional services. Queensland Health has also recognised the importance of effective governance to the success of EA vision and digital investment, identifying key areas and policies for adherence. Leveraging TOGAF could enhance governance to manage and monitor the initiatives, ensuring continuous alignment with industry standards.

3.2. Gartner’s Pace-layered Architecture

3.2.1. Introduction

The Gartner’s Pace-layered Application Strategy is designed to categorise applications based on their change frequency and business differentiation role within an organisation (Maoz, 2015). This model stratifies enterprise applications into three distinct layers, each with unique management and governance styles, facilitating a more dynamic IT architecture that aligns with business strategies and technological advancements.

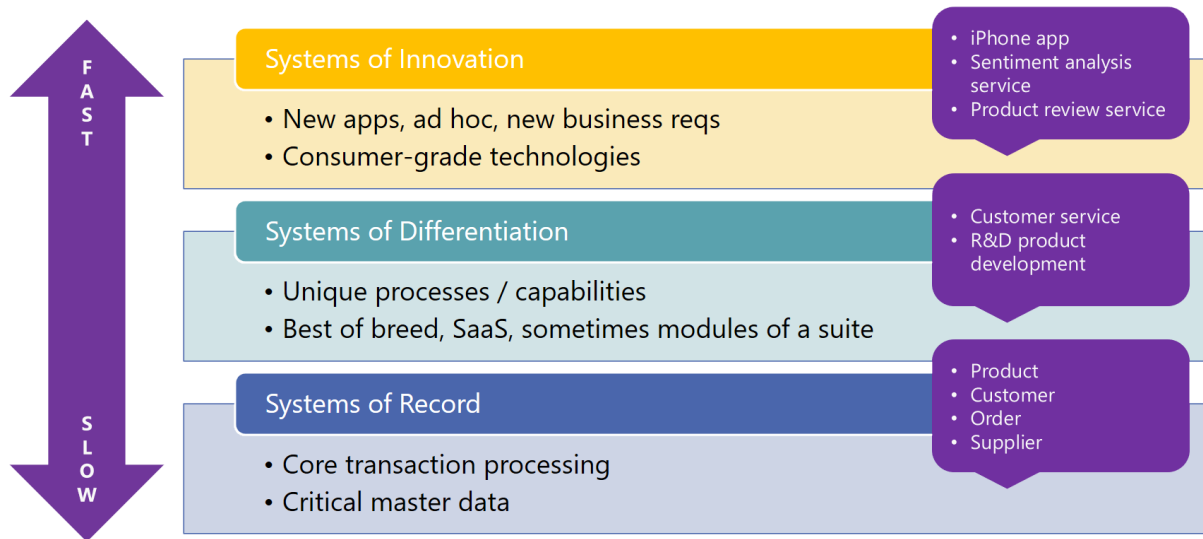


Figure 2: A Pace-Layered Integration Architecture (Toomey, 2018)

1. Systems of Record are stable, core systems that support day-to-day operations, and do not have frequent changes. Due to their critical nature, Systems of Record demand rigorous control to ensure consistent and reliable operations of core business functions (Maoz, 2015; Toomey, 2018).
2. Systems of Differentiation consist of applications that enable organisations to establish competitive advantages by supporting unique company processes or capabilities that distinguish them from competitors. Such systems are tailored to specific business needs and require a balance of agility and control to refine or extend core applications (Maoz, 2015; Toomey, 2018).
3. Systems of Innovation are the most dynamic layer within the architecture and encourage experimentation with the rapid development of new applications that can address emerging business opportunities or technological advancements. They are characterised by a high degree of flexibility aligned with minimal governance, thereby enabling organisations to quickly test and

iterate on new ideas without the constraints typically imposed by more traditional IT projects and systems (Toomey, 2018).

The Gartner research indicates a fundamental disconnect between management's pursuit of user-friendly applications and IT's goal of standardised and secure enterprise systems (Genovese, 2012). While management aims for quick solutions to organisational problems and fast responses to market opportunities, IT prioritises system integration, data security enhancement, and cost minimisation (Njanka et al., 2021). Therefore, the Pace Layered application strategy emerges as a solution to resolve this misalignment caused by conflicting objectives between business and IT (Genovese, 2012).

However, according to The Gartner research (Genovese, 2012), many organisations encounter challenges due to a lack of methodologies for classifying applications that are fundamentally different in their use, resulting in problematic application portfolio management. The successful adoption of The Gartner Pace Layered framework enables them to address this challenge by precisely categorising applications based on their characteristics. This allows organisations to prioritise IT investment effectively, bringing significant value to organisations by aligning IT strategies with business objectives, and further supporting innovation and differentiation in business processes (Gellweiler, 2022).

3.2.2. Applying Pace-Layered to Address Issues

Improve Data Quality in Systems of Record

This layer pertains to core applications that support fundamental operations, including adopting ESG in decision-making. The electronic health record (EHR) contains all patient-related data for the healthcare sector, supporting evidence-based decisions and outcome reporting (Seymour et al., 2012). The ongoing digital transformation process in healthcare, including wearable technology, is used to capture data (Stoumpos et al., 2023). Sepetis et al. (2024) have noted that current systems suffer from a lack of harmonisation and are inconsistent in terms of data format and transmission, highlighting a need for better solutions to manage and analyse data considering ESG factors.

The fundamental issue identified here is the poor data quality, which, as mentioned, is exacerbated by a lack of standardisation for further analysis and operational use. This core business system provides data for decision-making, including factors related to ESG (Seymour et al., 2012). Therefore, there is a need to enhance data quality by standardising the format, unifying the language, and implementing interoperability between systems to create a cohesive environment for data transmission (Sepetis et al., 2024). This enables the capture of all ESG-related information within their core business system, the EHR, to be utilised for further analysis. Consequently, health facilities can integrate ESG modules into their core functions, laying a foundation for incorporating ESG into EA (Nayeem et al., 2023).

Applying the pace-layered framework ensures the data stability in the organisation's system of record during system changes or upgrades, facilitating the gradual integration of ESG factors into the EHR while minimising the risk of data disruption. Overall, this approach prioritises enhancing data quality and integrity to improve ESG-informed decision-making processes.

Enhance Efficiency in Systems of Differentiation

This level highlights the software that provides unique opportunities to the business. Healthcare's supply chain is undergoing a digital transformation to cater to medical-related flow (Beaulieu and Bentahar, 2021). Greening the manufacturing practices cannot be generalised due to bureaucratic processes and resistance from upper management (Ageron et al., 2018). Telemedicine and remote patient monitoring experienced a burst during COVID-19. For this purpose, medical facilities install different systems to ensure equipment works around the clock. The resulting effect on ESG is tremendous: it extends the reach of healthcare to more patients, reduces the volume of medical waste and increases the number of consultations (Sharno & Bokov, 2024).

To address this, it is recommended that advanced analytics and automation technologies be integrated to streamline supply chain processes and enhance resource management. This approach can help mitigate the bureaucratic challenges noted by Ageron et al. (2018) and align technological upgrades with strategic business outcomes, improving operational efficiency, ESG performance, and ultimately, increasing control in resource management (Toomey, 2018).

Leveraging differentiation within the system as identified by the paced-layered framework enables us to address current challenges while also exploring opportunities for innovation that foster more sustainable practices in healthcare. The iterative refinement of this layer could determine the competitive advantages of an organisation within the industry.

Increase Market Responsiveness in Systems of Innovation

This layer comprises emerging technologies that disrupt the current business model and create new opportunities. Big Data analysis enhances operational efficiency and profitability through ESG management, yet it is not widely adopted (Pesqueira & Sousa, 2024). Although there is a recognised positive correlation between ESG and financial returns, the complexity of services and high implementation costs make it challenging to integrate ESG into system designs (Pereno & Eriksson, 2020).

To approach this, leveraging partnerships with tech innovators can provide access to cost-effective and scalable solutions. Businesses may define visions and goals related to ESG through different initiatives. Collaborative projects can explore innovative ways to integrate ESG factors more deeply into business models, enhancing organisational agility and responsiveness to market changes (Jonnagaddala et al., 2020).

This layer facilitates organisations' rapid capture of market opportunities through the integration of new technologies or ideas, minimising disruption and maximising efficiency. By overcoming constraints from other layers, it can bring significant benefits to organisations.

Facilitate System Communications in Message Bus

The message bus facilitates interconnection between the three layers. However, the lack of standardisation in data formats and fragmented systems hinder data sharing within organisations (Sepetis et al., 2024). As a result, information cannot be transmitted promptly to make informed ESG decisions.

To resolve this, implementing a robust integration architecture with standardised communication protocols across systems can significantly improve the data quality captured by the business, enhance internal data flows and support more informed decision-making processes. This approach can address the integration challenges and support better alignment of IT infrastructure with organisational ESG goals (Toomey, 2018).

4. Conclusion and Limitations

This report has explored the integration of ESG factors within the healthcare industry through EA frameworks like TOGAF and Gartner's Pace-layered Architecture. These frameworks help align IT infrastructure with ESG objectives, addressing sustainability, governance, and social responsibility challenges inherent in healthcare systems. While TOGAF provides a comprehensive methodology for systematic changes, the Pace-layered approach categorises applications to enhance responsiveness and innovation. However, applying these frameworks faces significant barriers, such as system complexity, resource constraints, and resistance to change. Moreover, there is a notable deficiency in empirical research regarding the real-life application of the Pace-layered Architecture in healthcare, indicating a need for further studies. Addressing these challenges requires effective change management and broader stakeholder engagement to ensure that integrating ESG factors leads to substantive improvements in healthcare sustainability and quality.

5. References

- Ageron, B., Benzidia, S., & Bourlakis, M. (2018). Healthcare logistics and supply chain—issues and future challenges. In *Supply Chain Forum: An International Journal*, 19(1), 1-3.
- Amalia, E., & Supriadi, H. (2017). Development of enterprise architecture in university using TOGAF as framework. *AIP Conference Proceedings*, 1855(1). <https://doi.org/10.1063/1.4985527>
- Beaulieu, M., & Bentahar, O. (2021). Digitalization of the healthcare supply chain: A roadmap to generate benefits and effectively support healthcare delivery. *Technological forecasting and social change*, 167, 120717.
- Bender, G., Matthes, F., & Buckl, S. (2009). Designing a Stakeholder-Specific Enterprise Architecture Management based on Patterns Entwicklung eines Stakeholder-spezifischen Enterprise-Architecture Managements basierend auf Patterns. <https://www.matthes.in.tum.de/file/1wd4rqwft5eg1/sebis-Public-Website/-/Be09/Be09%20-%20DesigningAStakeholderSpecificEnterpriseArchitectureManagementBasedOnPatterns.pdf>
- Bernow, S., Klempner, B., & Magnin, C. (2017). *From 'why' to 'why not': Sustainable investing as the new normal*. McKinsey & Company. <https://www.mckinsey.com/industries/private-equity-and-principal-investors/our-insights/from-why-to-why-not-sustainable-investing-as-the-new-normal>
- Boiral, O. (2013). Sustainability reports as simulacra? A counter-account of A and A+ GRI reports. *Accounting, Auditing & Accountability Journal*, 26(7), 1036-1071.
- Bosco, F., Di Gerio, C., Fiorani, G., & Stola, G. (2024). How to manage sustainability in healthcare organizations? A processing map to include the ESG strategy. *Journal of Public Budgeting, Accounting & Financial Management*.
- Capirossi, J., & Rabier, P. (2013). An Enterprise Architecture and Data Quality Framework. *Advances in Intelligent Systems and Computing*, 205, 67–79. https://link.springer.com/chapter/10.1007/978-3-642-37317-6_7
- Carvalho, J. V., Rocha, Á., Vasconcelos, J., & Abreu, A. (2019). A health data analytics maturity model for hospitals information systems. *International Journal of Information Management*, 46, 278-285.
- Chaudhry, S. M., Chen, X. H., Ahmed, R., & Nasir, M. A. (2023). Risk modelling of ESG (environmental, social, and governance), healthcare, and financial sectors. *Risk Analysis*.
- Chiu, W. K., & Fong, B. Y. F. (2023). New Paradigms in the Business of Healthcare. In *Environmental, Social and Governance and Sustainable Development in Healthcare*, 65-78.
- Consolandi, C., Phadke, H., Hawley, J., & Eccles, R. G. (2020). Material ESG outcomes and SDG externalities: Evaluating the health care sector's contribution to the SDGs. *Organization & Environment*, 33(4), 511-533.
- Galetsis, P., Katsaliaki, K., & Kumar, S. (2020). Big data analytics in health sector: Theoretical framework, techniques and prospects. *International Journal of Information Management*, 50, 206-216.
- Gellweiler, C. (2022). IT architects and IT-business alignment: a theoretical review. *Procedia Computer Science*, 196(10), 13–20. <https://doi.org/10.1016/j.procs.2021.11.067>
- Genovese, Y. (2012). *Accelerating Innovation by Adopting a Pace-Layered Application Strategy*. Gartner. <https://www.gartner.com/en/documents/1890915>
- Gerber, N. (2014). Transferring industry approaches to resource management for FM in hospitals : a theoretical reflection. *International Journal of Facility Management*, 5(2). <https://doi.org/10.21256/zhaw-3461>

- Girsang, A. S., & Abimanyu, A. (2021). Development of an Enterprise Architecture for Healthcare using TOGAF ADM. *Emerging Science Journal*, 5(3), 305–321. <https://doi.org/10.28991/esj-2021-01278>
- Hallez, E. (2022). *Weatherbie Capital Q&A: Engaging smaller companies*. PA future. <https://future.portfolio-adviser.com/weatherbie-capital-qa-engaging-smaller-companies/>
- Hosseini, S. R., Zabihi, A., Jafarian Amiri, S. R., & Bijani, A. (2018). Polypharmacy among the Elderly. *Journal of mid-life health*, 9(2), 97–103. https://doi.org/10.4103/jmh.JMH_87_17
- IEEE Computer Society. (2000). IEEE Recommended Practice for Architectural Description of Software Intensive Systems. IEEE Standard 1471-2000.
- Jonkers, H., Lankhorst, M. M., Ter Doest, H. W., Arbab, F., Bosma, H., & Wieringa, R. J. (2006). Enterprise architecture: Management tool and blueprint for the organisation. *Information systems frontiers*, 8(2), 63.
- Kabene, S. M., Orchard, C., Howard, J. M., Soriano, M. A., & Leduc, R. (2006). The importance of human resources management in health care: a global context. *Human resources for health*, 4, 1-17.
- Kadi, R.E. (2022). *An enterprise architecture approach to ESG*. PWC. <https://www.pwc.com.au/digitalpulse/esg-enterprise-architecture.html>, accessed 4 May 2024.
- Kalia, D. & Aggarwal, D. (2023). Examining impact of ESG score on financial performance of healthcare companies. *Journal of Global Responsibility*, 14(1), 155-176.
- Kern, L. M., Safford, M. M., Slavin, M. J., Makovkina, E., Fudl, A., Carrillo, J. E., & Abramson, E. L. (2019). Patients' and Providers' Views on Causes and Consequences of Healthcare Fragmentation in the Ambulatory Setting: a Qualitative Study. *Journal of general internal medicine*, 34(6), 899–907. <https://doi.org/10.1007/s11606-019-04859-1>
- Kotusev, S. (2018). TOGAF-based Enterprise Architecture Practice: An Exploratory Case Study. *Communications of the Association for Information Systems*, 43(20), 321–359. <https://doi.org/10.17705/1cais.04320>
- Lankhorst, M. M. (2004). Enterprise architecture modelling—the issue of integration. *Advanced Engineering Informatics*, 18(4), 205-216.
- Leung, T.C.H. & You, C.S.X. (2023). ESG Application in Sustainable Development of the Healthcare Industry. In *Environmental, Social and Governance and Sustainable Development in Healthcare*, 47-64.
- Lussem, J. & Harrach, H. (2013). How to make data migration processes more efficient by using TOGAF: Best practice data migration approach applied to SAP Financial Services-Policy Management. *ACS International Conference on Computer Systems and Applications (AICCSA)*. <https://doi.org/10.1109/aiccsa.2013.6616436>
- Maoz, M. (2015). Best Practices for Developing a Pace-Layered Application Strategy for CRM Customer Service. Gartner Inc.
- Nayeem, A.B.M., Dilnutt, R. & Bokil, Y. (2023). The Role of Enterprise Architecture in Ensuring ESG Factors for Sustainability.
- Njanka, S. Q., Sandula, G., & Colomo-Palacios, R. (2021). IT-Business Alignment: A Systematic Literature Review. *Procedia Computer Science*, 181, 333–340. <https://linkinghub.elsevier.com/retrieve/pii/S1877050921001940>
- Pereno, A., & Eriksson, D. (2020). A multi-stakeholder perspective on sustainable healthcare: From 2030 onwards. *Futures*, 122, 102605.
- Pesqueira, A., & Sousa, M. J. (2024). Exploring the role of big data analytics and dynamic capabilities in ESG programs within pharmaceuticals. *Software Quality Journal*, 1-34.

Piechocka-Kaluźna, A., Tłuczak, A. & Łopatka, P. (2021). The impact of CSR/ESG reporting on the cost of capital: An example of US healthcare entities. *European Research Studies Journal*, 24 (Special 3).

PWC. (2021). *ESG for healthcare organisations: what's right for the world is good for business*. <https://www.pwc.com/us/en/industries/health-industries/library/assets/pwc-esg-health-insights-health-org.pdf>

Queensland Health. (2021). Enterprise architecture vision 2026. Retrieved from https://www.health.qld.gov.au/data/assets/pdf_file/0027/1118088/qh-enterprise-architecture-vision-2026.pdf

Rahimi, N. I. M., Yatya, S. M., & Bakar, N. A. A. (2023). Enterprise Architecture: Enabling Digital Transformation for Healthcare Organization. *Open International Journal of Informatics*, 11(1), 67-73.

Rouhani, B. D., Mahrin, M. N. R., Nikpay, F., Ahmad, R. B., & Nikfard, P. (2015). A systematic literature review on Enterprise Architecture Implementation Methodologies. *Information and Software Technology*, 62, 1-20.

Sahni, N. R., Mishra, P., Carrus, B., & Cutler, D. M. (2021). *Administrative simplification: How to save a quarter-trillion dollars in US healthcare*. McKinsey Center for US Health System Reform. <https://www.mckinsey.com/industries/healthcare/our-insights/administrative-simplification-how-to-save-a-quarter-trillion-dollars-in-us-healthcare>

Sepetis, A., Rizos, F., Pierrakos, G., Karanikas, H. & Schallmo, D. (2024). A Sustainable Model for Healthcare Systems: The Innovative Approach of ESG and Digital Transformation. *Healthcare*, 12(2), 156–156.

Seymour, T., Frantsvog, D., & Graeber, T. (2012). Electronic health records (EHR). *American Journal of Health Sciences (AJHS)*, 3(3), 201-210.

Sharno, O. I., & Bokov, Y. A. (2024). ESG-Screening of Remote Investment in Sustainable Development: The Environmental and Legal Dimension. In *Remote Investment Transactions in the Digital Age: Perception, Techniques, Law Regulation*, 73-83.

Stoumpos, A. I., Kitsios, F., & Talias, M. A. (2023). Digital transformation in healthcare: technology acceptance and its applications. *International journal of environmental research and public health*, 20(4), 3407.

The Open Group (2018). The TOGAF® Standard, Version 9.2. The Open Group <https://pubs.opengroup.org/architecture/togaf92-doc/arch/>, accessed 3 May 2024.

Toomey, D. (2018). *A Pace-Layered Integration Architecture*. Deloitte. <https://engineering.deloitte.com.au/articles/a-pace-layered-integration-architecture>

Varghese, D., Ishida, C., & Haseer Koya, H. (2023). Polypharmacy. In *StatPearls*. StatPearls Publishing.

Wei, W. Q., Leibson, C. L., Ransom, J. E., Kho, A. N., Caraballo, P. J., Chai, H. S., Yawn, B. P., Pacheco, J. A., & Chute, C. G. (2012). Impact of data fragmentation across healthcare centers on the accuracy of a high-throughput clinical phenotyping algorithm for specifying subjects with type 2 diabetes mellitus. *Journal of the American Medical Informatics Association*, 19(2), 219-224.

Windolph, S. E. (2011). Assessing corporate sustainability through ratings: challenges and their causes. *Journal of Environmental sustainability*, 1(1), 5.

Yang, C. C., & Lin, C. Y. Y. (2009). Does intellectual capital mediate the relationship between HRM and organizational performance? Perspective of a healthcare industry in Taiwan. *The International Journal of Human Resource Management*, 20(9), 1965-1984.

Zhong, Y., Zhao, H., & Yin, T. (2023). Resource bundling: How does enterprise digital transformation affect enterprise ESG development?. *Sustainability*, 15(2), 1319.