Minimum viable Enterprise Architecture

Tailoring TOGAF to suit small company needs.

HAMK
HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

Bachelor thesis

Degree Programme in Business Information Technology
or Computer Applications
Hämeenlinna University Centre
Spring, 2021

Joni Turunen

TIIVISTELMÄ

Tässä opinnäytetyössä tutkittiin pienen ohjelmistoyrityksen tarpeisiin kokonaisarkkitehtuurin (KA) sovittamista. Työn tarkoitus oli selvittää onko KA yleisesti kannattava työkalu alle 50 henkilön ohjelmistoyritykselle, miten DevOps-periaatteiden ja käytäntöjen soveltaminen vaikuttaa KA:han ja miten The Open Group Framework (lyhyemmin TOGAF) -standardin KA-viitekehys on sovellettavissa pienen yrityksen tarpeisiin.

Työn tueksi suoritettiin TOGAF Foundation 9.2 -sertifiointi tietopohjan lujittamiseksi. Tämän lisäksi tutustuttiin Bisnesteknologiamalliin (BT-malli) sekä lähinnä opetuskäyttöön sovitettuun yksinkertaistettuun Simple Enterprise Architecture (SEA) -kokonaisarkkitehtuuriviitekehykseen. Opinnäytetyö on teoriapohjainen joka tuotti tietoa TOGAF-viitekehtyksen räätälöintiä ja käyttöönottoa varten. Tutkimusaineistoa kerättiin case-yrityksessä tehdyillä teemahaastatteluilla.

Opinnäytetyön tuloksena case-yritykselle syntyi tietoa tavoiteltavista KA-tuotoksista, ehdotelma KA-työn prosessista ja yrityksen kyvykkyyksistä sekä yleisesti huomion arvoista tietoa KA-työn toteuttamiseen. Opinnäytetyö koettiin hyödylliseksi ja se osin täytti TOGAF-standardin mukaisen KA-prosessin ensimmäisen preliminäärivaiheen, jonka tarkoituksena on muun muassa tuottaa räätälöity versio TOGAF-viitekehtyksestä. Opinnäytetyön johtopäätöksenä voidaan todeta KA:n olevan tavoittelemisen arvoinen asia, jolla on positiivinen vaikutus yrityksen toimintaan.

Avainsanat	TOGAF, Kokonaisarkkitehtuuri, muutos, johtaminen, viitekehys
Sivut	59 sivua ja liitteitä 9 sivua

HAMK
HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

Degree Programme in Business Information Technology	**Abstract**
Hämeenlinna University Centre	

Author	Joni Turunen	Year 2021
Subject	Minimum viable Enterprise Architecture – Tailoring TOGAF to suit small company needs.	
Supervisors	Lasse Seppänen	

ABSTRACT

This thesis studied if and how to implement Enterprise Architecture (EA) for the needs of a small software company. This work aimed to determine whether EA is a generally viable tool for a software company with less than 50 employees and how DevOps principles and practices affect enterprise architecture and if The Open Group Framework (TOGAF) applies to small business needs.

The thesis is theory-based and provided information for tailoring and implementing the TOGAF framework for the company needs. The research material was collected through thematic interviews conducted in the case company. TOGAF Foundation 9.2 certification was acquired to strengthen the knowledge base. Other EA frameworks and digital transformation, in general, were also studied.

As a result of the thesis, the case company gained information about the desired EA deliverables, a suggestion for the EA work process and a review of the case company's capabilities concerning EA. The thesis provided information about how to implement EA work. The thesis was considered valuable, and it partly fulfilled the first preliminary stage of the EA process according to the TOGAF standard, the purpose of which is to produce a customised version of the TOGAF reference framework. The thesis concludes that EA is worth pursuing and that it positively affects the company's operations.

Keywords	TOGAF, Enterprise Architecture, change, management, framework
Pages	59 pages and appendices 9 pages

Glossary

Holistic	All levels, elements, and groups are included in one architecture
Enterprise	A large, complex organisation, similar parts of several organisations
EA	Enterprise Architecture
EAF	Enterprise Architecture Framework (EAF) is a set of principles, methods, and practices to develop, design and manage EA.
EAM	Enterprise Architecture Management (EAM) is the practice of enabling Business Value in the organisation via EA. EAM can be done using EA Framework.
TOGAF	The Open Group Architecture Framework (TOGAF) is a standardised EA Framework for implementing EA
Zachman	Name of the founder of Standardised Zachman EA Framework
Stakeholder	An individual, team, organisation, or class thereof, having an interest in a system.
DevOps	Set of practices that aim to combine Development and Operations teams
Value streams	The sequence of activities an organisation undertakes to deliver upon a customer request
Artefact	Items created to describe a system, solution, state of the enterprise. These can be diagrams, views, or other documentation.
Deliverable	Contractual or formal work products of an architecture project
Domain	A sub-part of a concept or method
Component	A sub-part of a product of service
Roadmap	Abstract plan describing what are the future goals and how they might be achieved.
ADM	Architecture Development Method
ATAM	Architecture Tradeoff Analysis Method is used as a risk-mitigation process in the software development life cycle as well as in some EAFs.
Quality attribute	Derived from the needs of the stakeholders to describe characteristics and properties of a system or architecture.
Utility tree	Used in ATAM to identify and prioritise quality attributes in order to evaluate designed architecture against stakeholder requirements.
Capability	In this thesis, the capability is referred to as the capability to implement EA.

ITAM	IT Asset Management (ITAM) provides an accurate account of technology asset lifecycle costs and risks to maximise the business value of technology strategy, architecture, funding, contractual and sourcing decisions.
ITSM	IT Service Management (ITSM) Tools enable IT operations organisations, specifically infrastructure and operations managers, to better support the production environments creating business value for the organisation.
ITIL	Information Technology Infrastructure Library (ITIL) is a set of practices for IT activities like ITSM and ITAM. ITIL drives IT services to align with business needs.
Business Ecosystem	
	A business ecosystem is the network of organisations—including suppliers, distributors, customers, competitors, government agencies, and so on—involved in the delivery of a specific product or service through both competition and cooperation.
ISO 9001	Standard providing criteria for a quality management system that has a strong customer focus, the motivation and implication of top management, the process a
ISO 27001	Standard providing criteria for an information security management system (ISMS).

Contents

Annexes

Figures and tables

1 Introduction

Change is necessary for any company, regardless of the industry. According to the Harvard Business Review, since the year 2000, 52 per cent of Fortune 500 companies have either gone bankrupt, been acquired, or ceased to exist due to a change in the operating environment caused by digitalisation. No company or industry appears to be immune to change. Managing change is crucial for business survival, but staying ahead of the learning curve can open new business opportunities and fields to operate in. (DXC Technology, 2017)

From the standpoint of a small software company, disruptive change mostly comes from outside of the company. Small or big, no company is safe from change. Enterprise Architecture (EA) is a set of practices and process that can help manage change needs that companies face. Managing change in a small software company requires information about the company. Enterprise Architecture provides a holistic view of the company's business, the information systems and processes that support it. Business management can leverage EA and use it to manage change, set goals, measure performance and implement a strategy. EA enables business management to make informed decisions about the company.

The client for the Thesis work is a small software company operating in Finland. Case company presents its mission to provide public administration with versatile and modern digital tools for producing and managing information. Its product-based operating model guarantees successful and on-time implementations as well as cost-effective solutions.

The Case company has been on its DevOps journey for few years, building towards more agile software development and rapid deployment methods. This agenda causes a constant need for change that requires governance, documentation and careful planning.

The case company has an information security management system (ISO 27001) and a quality management system (ISO 9001) in place and certified. The scope of this thesis does not include these systems since they are well documented and known topics in general and even so for the case company.

The thesis aims to generate an adaptive, lightweight, and agile, tailored version from The Open Group Architecture Framework (TOGAF) that suits the company needs and capabilities. With a

suitable framework, the enterprise architecture work can be started in the company. Producing a suitable EA framework for a less than 50 employee organisation is not restricted to TOGAF standard alone. Part of the Thesis aims to research other Enterprise Architecture Frameworks (EAF) to form a broad view of available practices and methods and learn what parts form the minimum viable architecture framework that offers the best value for small companies working with limited resources.

Research questions are as follows.

- What is the capability of the case company to manage enterprise architecture in general?
- How EA affects our organisations' strategy and the ability to implement it?
- What are the advantages or disadvantages of enterprise architecture for the case company implementing DevOps principles?
- What are the most relevant parts of EA frameworks the case company should include in its Enterprise Architecture?
- What are the costs and benefits of implementing EA for the case company?

2   Digital transformation and other sources of disruption

Businesses face change, from which a disruptive change can be fatal or provide an opportunity for the prepared. Disruptive change can result from technological innovation, market or trend change, or legislation. History has shown the power of disruptive innovation that sometimes becomes a crucial change to companies. Kodak is one of the most famous warning examples of disruptive change. Kodak based its business around film products and film photography. In 1975 Steven Sasson from Kodak invented the digital camera, but Kodak chose to suppress the new Technology to protect its main revenue stream, the film production. At the beginning of a new millennium, it became clear that digital photography would be the future of photography and filmmaking. Since 1999, Kodak has been losing its stock value from 80$ per share to its low point of 1.65$ per share in 2020. In 2012 Kodak was forced to file bankruptcy and sold most of its legacy industry and intellectual properties to emerge a much smaller company in 2013. In Kodak's story, the innovation that caused the disruptive change was found inside the company and could have been a great opportunity, competitive advantage for the upcoming digitalisation of photography and filmmaking. (Sinek, 2010)

In Kodak's case, the root causes are that they partly ignored the new rise of digital technologies because of focusing too much on the current success. Part of the failure comes from ignoring innovation, and when finally getting involved, they focused on generating more printing services when the industry was going towards social media platforms. The important lessons to learn from Kodak are subtle. Companies often see the disruptive change affecting the industry but fail to embrace the new business models the change opens up truly. Kodak failed to see the online photo sharing was the new business being created. Same time Kodak's competitor Fuji aggressively explored new opportunities creating new products. Fuji has grown massively since by broadening its business areas to healthcare, electronics operations and document solutions. Anthony encourages companies facing digital transformation to ask three questions: (1) What business are we in? (2) What new opportunities does the disruption open up? (3) What capabilities do we need to realise these opportunities? (Anthony, 2016)

Anthony warns organisation leaders to avoid answering the first questions with Technology or product answer (Anthony, 2016). Sinek describes that by answering with Technology or specific product to the question, the company narrows its scope. Fuji did not focus strictly on film products

but had a broader view. Amazon is another excellent example that did not focus on just selling books but became one of the biggest IT companies in the world. Besides Kodak, other examples of companies focusing on Technology, product, or being the best are Garmin and some book publishers that saw themselves in the book business rather than in the idea of spreading business. (Sinek, 2019)

The growth of digitalisation has increased the rate of change (Centric Digital, 2017) and affected the social and cultural aspects (Ho & Lee, 2015). The emergence of new technologies such as artificial intelligence, machine learning, automation, and work culture movements such as agile software development and DevOps practices can be opportunities or, if ignored long enough, complex challenges for today's organisations.

While the landscape for organisations is getting more complex and the rate of change is increasing, the organisations face demand for intelligence and mobility to solve their problems. Hierarchically structured organisations can be slow to react to changes. Silent and obscured information flows reduce mobility and require cumbersome ways to share information to become more transparent(Linders & Dubakov, 2015). Identifying these traits in an organisation can be critical to achieving a more agile organisation that is not hindered by its organisation structure. Flat organisation structures offer agility, responsiveness, and proactiveness via empowering the people and sharing the responsibilities. Traditional leader-follower models with hierarchical structures might need to change as the competition tightens. Digital transformation has introduced change requirements to leadership structures, work culture models, and technologies.

In the following chapters, these sources of change affecting organisations are viewed in more detail to understand how Enterprise Architecture (EA) could help the case company achieve a holistic view of its parts.

2.1   Flat leadership structures

According to Kruse (2013), leadership can be defined as a "process of social influence, which maximises the efforts of others, towards the achievement of a goal". Leadership can therefore be seen as a facilitator for the organisation.

Flat leadership structures elevate each employee's responsibility inside the organisation. In a flat organisation, there are little to no management levels between leaders and staff. Risk for generalisation and confusion is increased if the organisation fails to direct team goals and talents. Best outcomes are achieved when individuals are allowed and supported to pursue their passion projects aligned with organisations' business goals. (Graig, 2018)

A flat organisation is based on the leader-leader model, which is based on the idea of tuning the empowerment in people via ownership of their work and responsibilities. The leader-leader model requires that leadership facilitates competence for teams, gives control to people, offers clarity by making goals and intentions clear. Leadership is required to trust its team to deliver and courage to resist the urge to fall to the leader-follower model. (Marquet, 2015)

Simon Sinek resonates a lot with Marquet's idea of giving clarity by talking about the "Why?" in company culture as a driving force to motivate employees. Sinek encourages companies to answer why the company exists and why we work in the company. Sinek defines this as the Just-Cause for the employees and the customers. Just-Cause guides the company vision and decision making in an infinite mindset geared towards longevity and stability rather than short term success. (Sinek, 2019). Answering the why is at the core of the organisation identity, surrounded by the how and the what. (Figure 1) Sinek makes a point that the why is the reason what makes the customer buy and the employee commits to the company. (Sinek, 2005)

Figure 1 The Golden Circle (Chaffey, 2020)

The Golden Circle

WHAT

Every organization on the planet knows WHAT they do. These are products they sell or the services

HOW

Some organizations know HOW they do it. These are the things that make them special or set them apart from their competition.

WHY

Very few organizations know WHY they do what they do. WHY is not about making money. That's a result. WHY is a purpose, cause or belief. It's the very reason your organization exists.

WHY

HOW

WHAT
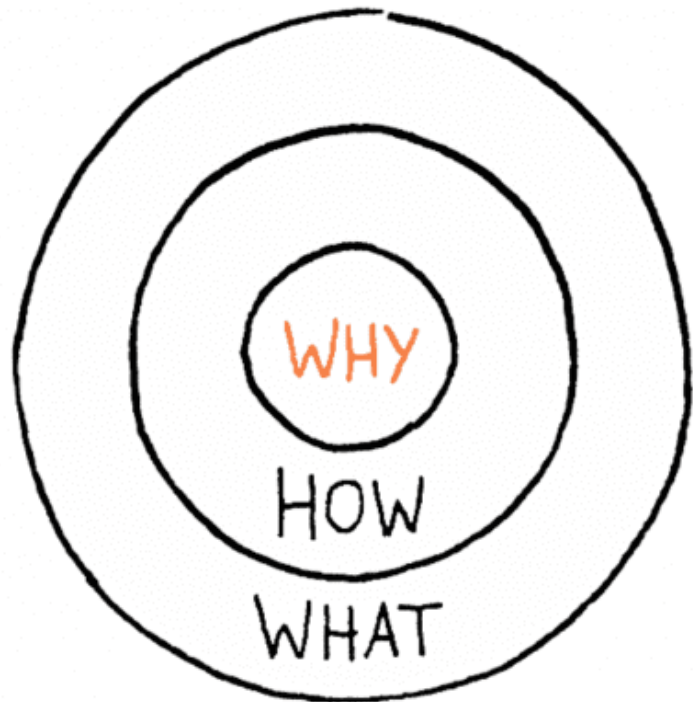
In the leader-leader model, the role of leadership is to act as a facilitator. In a flat organisation leadership structure, the information about capabilities and company parts is essential to manage teams aligned with business goals. EA can enable leadership by offering this information.

2.2   DevOps, the new business requirement

DevOps term was coined in 2009 by Patrick Debois after watching O'Reilly Velocity Conference where John Allspaw and Paul Hammond gave the seminal "10 Deploys per Day: Dev and Ops Cooperation at Flickr" presentation. DevOps and its resulting technical, architectural, and cultural practices are a combination of several philosophical and management movements. DevOps' core is the idea of breaking up team boundaries and silos between developers (Dev) and operations (Ops) teams to provide better value for the customer. DevOps foundations are being derived from Lean, the Theory of Constraints, and the Toyota Kata movement. DevOps is also seen as the logical continuation of the Agile software journey. (Kim et al., 2016)

The lean movement principles are adopted from manufacturing to software development. Focus is on creating value for the customer, enfolding scientific thinking, confirming quality at the source, leading with humility, and respecting all individuals (Kim et al., 2016). These ideas are bundled within the DevOps, and other methodologies and practices like Theory of Constraints used to manage any systems to increase the flow of work and, therefore, the business value generated (Goldratt & Cox, 2014).

DevOps term itself has been altered to include information security, network operations and even business and sales teams. This has formed new abbreviations like DevSecOps and DevSecNetOps, usually presented by companies operating in these fields. The profound idea behind them all is to work towards a common goal to improved customer value by working together in independent teams taking ownership of their work. Improved customer value results from optimising the value stream, improving deployment time, and reducing work size. DevOps, at its core, is about work culture, but case studies (Kim et al., 2016) show that new technological competencies and technologies might be required to achieve some of the benefits.

Sometimes the technological change that requires new capabilities and talent is in the spotlight. It is easy to forget why the new tech is required (Little, 2019). The new Technology is not an absolute value but is intended to provide a better experience and value for the customer. Figure 2 shows the iterative infinite loop of DevOps. The left side of the loop is part of traditional developer team tasks, and the right side shows the traditional tasks of the operations team.

Figure 2 DevOps Lifecycle/Feedback loop (Little, 2019)
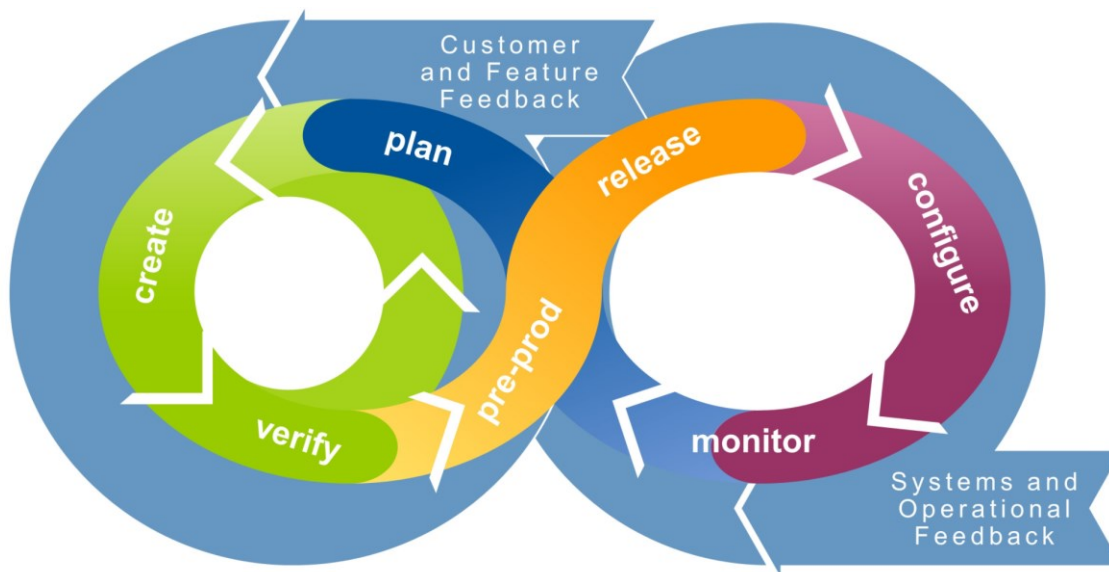
DevOps is changing the landscape fast. In 2020 DevOps was stated as an industry standard rather than just a competitive advantage (Klemetti, 2020). Eficode predicts in its yearly DevOps trends that in 2021, cloud and SaaS consumption will continue to increase while 83% of companies lack the talent to achieve smooth digital transformation (Mäkelä & Abildskov, 2021).

In IT organisations, a GitOps movement has followed DevOps and embraces change even further. GitOps utilises DevOps best practices and applies them to infrastructure automation. GitOps utilises infrastructure as a code (IaC) approach for provisioning cloud-native application platforms such as Kubernetes for use in software development and production use. Environments are described in code and stored in version control to be used when needed. This allows rapid infrastructure deployment to one or several different cloud platform vendors preventing vendor locking with a specific cloud provider. The idea is to save cost, make infrastructure agile, allow change of cloud providers, increased disaster recovery capabilities and provide infrastructure when it is needed. Infrastructure can be scaled up or down and provisioned only when there is a need for it. Infrastructure as code changes can be triggered via version control events like code merge or pull request actions generated when a developer introduces new code to version control. Automated software testing or build processes may be triggered as part of the code changes requiring temporary scale or provisioning of infrastructure.

GitOps increases the rate of change in organisations information systems, and the very nature of our infrastructure is seen. GitOps aims for an uneventful change cycle where change is seen as a good or even "boring" event rather than rare a high-risk. (Goossens, 2021)

As can be seen, DevOps and GitOps practices introduce a disruptive change to organisations and are becoming essential and less optional as businesses evolve their approach to its methodologies. Impacts of DevOps need to be identified, documented, and communicated inside the organisation to provide a holistic view of all the parts associated with it and the relations to others.

2.3   New technologies and complexity in systems

Complexity is a fundamental issue, and it is shared by business and IT. The best solution for complex problems is not to add more complexity but simplify. (Sessions, 2008)

The rise in the number of information systems, fragmentation of systems architectures, and the expansion in the number of integrations between systems cause more dependence, increasing the difficulty and complexity of perceiving the whole. This is observable in the case company's IT infrastructure. Cloud-based infrastructure and services can cause an increase in complexity and add new layers of abstraction (Linthicum, 2019). Interdependencies between systems, hierarchies and traceability of changes become difficult. Cleaning the system-landscape and reducing complexity should be pursued. (Akella et al., 2009)

New technologies open up new business fields. Such technologies might be Automation, Deep Learning, Artificial Intelligence (AI) and Machine Learning (ML) (Pollard et al., 2018). 5G telecommunication networks are readily available and opening huge markets that can change the way digital services are consumed and used. (Mäkelä & Abildskov, 2021)

The year 2020 introduced a global pandemic, COVID-19. This marked a turning point in how we approach remote work and challenged IT leadership to adapt to the new situation—this accelerated digital transformation for the company. Also, a new trend for softer values and a shift in leadership style to coaching and mentoring was seen. (Gartner, 2021)

3   Enterprise Architecture

The term architecture has several definitions and confusion around it when viewed in the context of information technology. Architecture term is adopted from construction to software development. In construction, the architecture term is defined by the Britannica encyclopedia as "the art and technique of designing and building". As software development and information systems have adopted the term, the definition has retained its original characteristics. Architecture regarding software and information systems development is defined in ANSI/IEEE 1471-2000 standard as "the fundamental organisation of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution". A similar definition is found in ISO/IEC/IEEE 42010:2011, which defines "architecture" as "[t]he fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution." (ISO/IEC JTC 1/SC 7, 2017)

Renowned software developer Martin Fowler makes a case in his keynote at OSCON 2015 that architecture is "the important stuff". By "the important stuff", Fowler means all the things that need to be communicated and known among the expert developers and architects collaborating on a joint project or product. Architecture is the consensus of all the essential things documented in an abstract detail that is easy and fast to communicate. (Fowler, 2015)

Enterprise Architecture has even more definitions and interpretations. Using a search engine to find the definition term Enterprise Architecture returns approximately 377 million results. The quality of these definitions varies greatly. Confusion around the term usually is that Enterprise Architecture is seen as IT-architecture, which is not the case. (Holcman, 2020)

Bernard explains that the core of Enterprise Architecture is a strategy and business-driven ongoing activity that supports management planning and decision-making (Figure 3). This is achieved by providing coordinated views of an entire organisation. (Bernard, 2020)

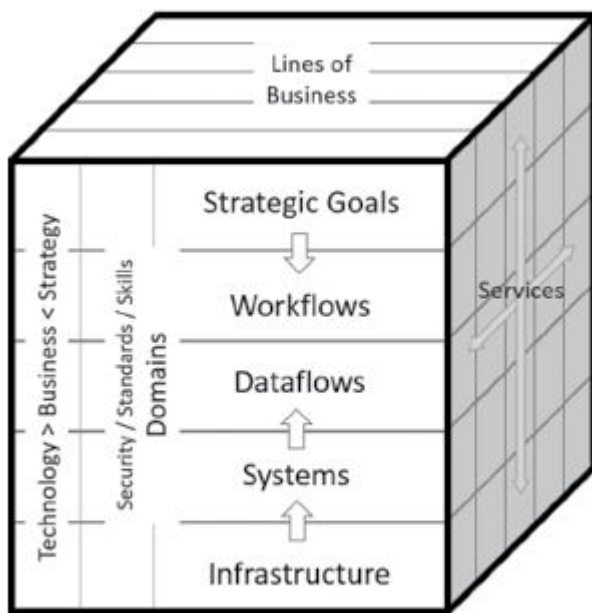Figure 3 Fundamental aspects of an organisation (Bernard, 2020)

Figure 1-5: The EA6 Framework

EA work will result in deliverables and artefacts that represent the organisation and its parts from different viewpoints: Holistic, top-down view of the organisation provides an abstract overview for the organisation leadership to aid in their strategic decisions. Detailed views guide the implementation of the architecture work planned. (TOGAF, 2018)

Deliverables and artefacts produced by the EA work may be referred to with different terminology depending on what EA Framework is used to implement EA in the organisation. (TOGAF, 2018)

In summary, EA is a tool to share the consensus between all the stakeholders. Samuel Hoclman (2020) summed up this idea in the following words: "If you do not write these things down, it does not mean they are not there; it means that you are guesses about these things."

3.1   TOGAF standard

The Open Group Architecture Framework (TOGAF) standard is a high-level enterprise architecture methodology and framework that helps organisations define business goals and align information technology with them. TOGAF standard defines EA as follows: "An EA [defines] a strategic context for the evolution of the IT system in response to the constantly changing needs of the business environment." (TOGAF, 2018)

TOGAF is designed to be suitable for a plethora of organisation sizes and types. Thus, in its preliminary phase, the TOGAF is tailored to suit the specific company needs and include other frameworks and best practices. (TOGAF, 2018)

TOGAF standard considers the enterprise as a system and endeavours to balance terminology drawn from relevant standards and commonly accepted terminology familiar TOGAF readership. TOGAF defines a second meaning depending on the context to the ISO/IEC/IEEE 42010:2011 terminology to promote this: "The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time" (TOGAF, 2018).

TOGAF consist of four main architecture domains; Business, Applications, Data and Technology (BDAT). At the core of the TOGAF standard is the Architecture Development Method (ADM). ADM cycle and phases involved in the architecture work and the key architecture domains referred to in TOGAF documentation as BDAT (business, data, application, Technology) are described in detail in the upcoming chapters. (TOGAF, 2018)

3.1.1   Business Architecture

Business Architecture defines the business strategy, governance models, organisation, and key processes. Business Architecture works as a driver for the EA process defining business goals for later Architecture Domains to pursue. Business Architecture answers the following questions: What do we do, and what is the company's purpose? (TOGAF, 2018)

3.1.2   Data Architecture

Data Architecture defines an organisation's physical and logical data repositories, data contents and data models, and related management models. Data strategy is defined, and data sources and types are documented. Data Architecture answers the following questions: How is information managed, and how does information affect the organisation and decision making? (TOGAF, 2018)

3.1.3   Applications Architecture

The Applications Architecture defines the action plans and definitions for the required systems, the interdependencies between the systems, and the interfaces and services provided by the systems to the core business processes. Application Architecture answers the following questions: How do those applications enable the fundamental purpose of the business to be realised? (TOGAF, 2018)

3.1.4   Technology Architecture

Technology Architecture defines the software, hardware, and data networks used to support core business processes. The technical architecture also takes a stand on, for example, selected operating systems and different platforms for providing services (different forms of providing cloud services). Technology Architecture describes the physical parts of organisations IT infrastructure and devices. Technology Architecture answers the questions: What is in use, and what impact they have on the business process? (TOGAF, 2018)

3.1.5   Architecture Development Method (ADM) cycle

At the core of the TOGAF standard is the Architecture Development Method (ADM). ADM consists of several phases described in Figure 4. ADM is a tested and proven method for developing IT architecture that meets an organisation's business requirements and needs. (TOGAF, 2018)

Figure 4 ADM phases diagram (TOGAF, 2018)
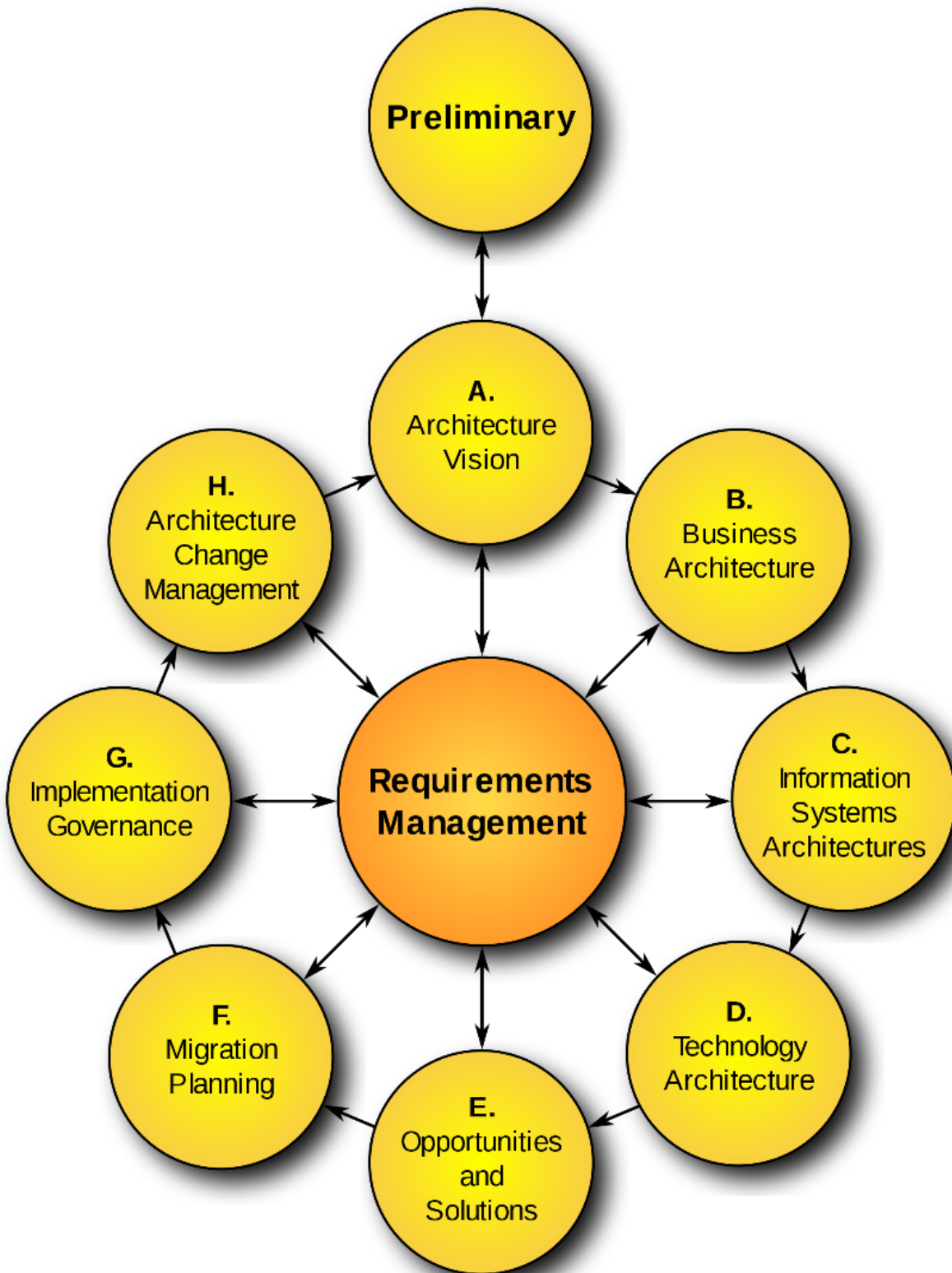
The preliminary phase is used at the start to tailor the TOGAF to fit the company needs. The

preliminary phase also defines the desired level of architecture, architecture capability and

principles. Principles can be abstract organisations values that guide each architecture levels decision making. An example of such a principle might be, "We avoid vendor-locking and prefer OpenSource solutions when possible". The preliminary phase includes but is not limited to the following steps: (1) scope the enterprise organisations impacted; (2) identify and establish architecture principles; (3) tailor TOGAF and possible other frameworks to suit organisation needs. (TOGAF, 2018)

The preliminary phase includes but is not limited to the following steps: (1) scope the enterprise organisations impacted; (2) identify and establish architecture principles; (3) tailor TOGAF and possible other frameworks to suit organisation needs. (TOGAF, 2018)

In **Architecture Vision, Phase A,** the goal is to develop a high-level vision of the desired business value to be delivered. The purpose is to obtain approval for a statement of architecture work. Phase A outputs include the draft architecture definition versions (version 0.1) for baseline and target BDAT documents. Phase A includes but is not limited to the following steps: (1) Identify stakeholders, concerns, and business requirements; (2) confirm business goals, (3) drivers and constraints; (4) evaluate capabilities and define scope; (5) develop architecture vision; (6) assess readiness for transformation; (7) identify transformation risks and mitigation activities. (TOGAF, 2018)

Phases B to D are for developing each of the individual architecture domains (BDAT). Architectural baseline and target descriptions, gap analyses and candidate roadmap components are created. These phases refine draft documents from phase A and produce architectural artefacts divided into diagrams, catalogues and matrices. In technology architecture phase D, new business opportunities are looked for using emerging technologies. Steps in these phases include: (1) selecting reference models, viewpoints and tools; (2) developing baseline and target architecture descriptions; (3) performing gap analysis; (4) defining candidate roadmap components; (5) resolving impacts across the architecture landscape; (6) conducting formal stakeholder reviews; (7) finalising developed architecture in question and (8) creating architecture definition documents. (TOGAF, 2018)

The purpose of **Phase E** is about opportunities and solutions. The phase aims to identify if transition architectures are required, defines solution blocks (SBBs), and generates the initial

architecture roadmap. The main steps in phase E include (1) determining key change attributes and business constraints; (2) review and consolidate gap analyses from phase B to D; (3) refine and validate dependencies; (4) confirm readiness and risk for business transformation and (5) create the architecture roadmap and implementation and migration plans. (TOGAF, 2018)

Phase F focuses on migration planning. Phase F purpose is as follows: (1) ensure business value and cost of architectural work packages is understood; (2) ensure the migration plan is aligned with an enterprise approach to change; (3) finalise the architecture roadmap and migration plan. Phase F steps include: (1) assign business value to each work package; (2) prioritise the migration projects; (3) estimate resource requirements and project timings; and (4) document the lessons learned. (TOGAF, 2018)

Phase G is about architecture governance to ensure conformance. In other words, Phase G is about ensuring that the architecture definitions are implemented correctly. Architecture Compliance is a set of different definitions to describe how the implementation matches architecture definitions. Implemented architecture can range between irrelevant, definitions and implementations are not equal to fully conformant where implementation is equal to definitions. Steps in Phase G include: (1) Confirm scope and priorities for implementation, (2) Identify resources and skills for the deployment/implementation, (3) perform EA compliance reviews. Phase G produces mentionable output called Architecture Contract, a joint agreement between development partners and sponsors (usually executive) about the deliverables, quality, and fitness-for-purpose of an architecture. (TOGAF, 2018)

Phase H is the final phase of the ADM cycle, and it is called the Architecture Change Management -phase. The purpose of this phase is to main architecture capability, execute architecture governance and maintain architecture lifecycle. This phase is the state where the EA work is waiting and on hold, and here it is decided if the next cycle should be started. Steps included are: (1) Manage risks; (2) deploy monitoring tools and provide analysis for architecture change management; (3) develop change requirements to meet performance targets; (4) manage governance process. Minor change requests can be handled in Phase H, but significant changes will be evaluated, and a new ADM cycle is started. (TOGAF, 2018)

The requirements management phase is in the centre of the ADM cycle tied to all phases. The requirements management phase is a continuous process of handling change during any phase of the ADM process. It is crucial to managing change at any time for the ADM to succeed. This phase aims to manage change while the ADM cycle is in progress, ensure the process is sustained through all phases, and provide the requirements to each ADM phase. There are no specific steps involved in this phase since it is tied to all phases and is continuous. (TOGAF, 2018)

3.1.6   Key elements for successfully implementing TOGAF

A cross-organisational Architecture Board means that the architects are and the whole organisation throughout different teams are involved. This will link people together and to "buy-in" to the architecture work and follow through with it. (TOGAF, 2018)

A comprehensive set of Architecture Principles is a good set of principles that will make it easier to make decisions on lower levels. It allows rejecting upcoming things based on the principles. (TOGAF, 2018)

An Architecture Compliance Strategy is its own process in the ADM-cycle of the TOGAF-standard, Phase G. Architecture compliance means the monitoring of the architecture work passed on to the development and project teams. Ability to monitor the decisions made while implementing the architecture design. The compliance process has a classification for how architecture implementation matches the architecture definition, and it is used to evaluate how well the architectural design has been implemented. (TOGAF, 2018)

3.1.7   Deliverables, Artefacts and Repository

A deliverable is an architectural work product that is contractually specified and formally reviewed, agreed and signed off by the stakeholders. Architectural work consists of artefacts or building blocks (Figure 5). Artefacts can be catalogues, matrices or diagrams created to describe a particular part of an architecture domain. These artefacts are designed to be re-usable and stored in an Architecture Repository for ease of access. Architecture Repository is created at the start of EA work and chosen as the location for all the different classes of architectural output at different levels of abstraction, created by the ADM. (TOGAF, 2018)

Figure 5 Relationship between deliverables (TOGAF, 2018)
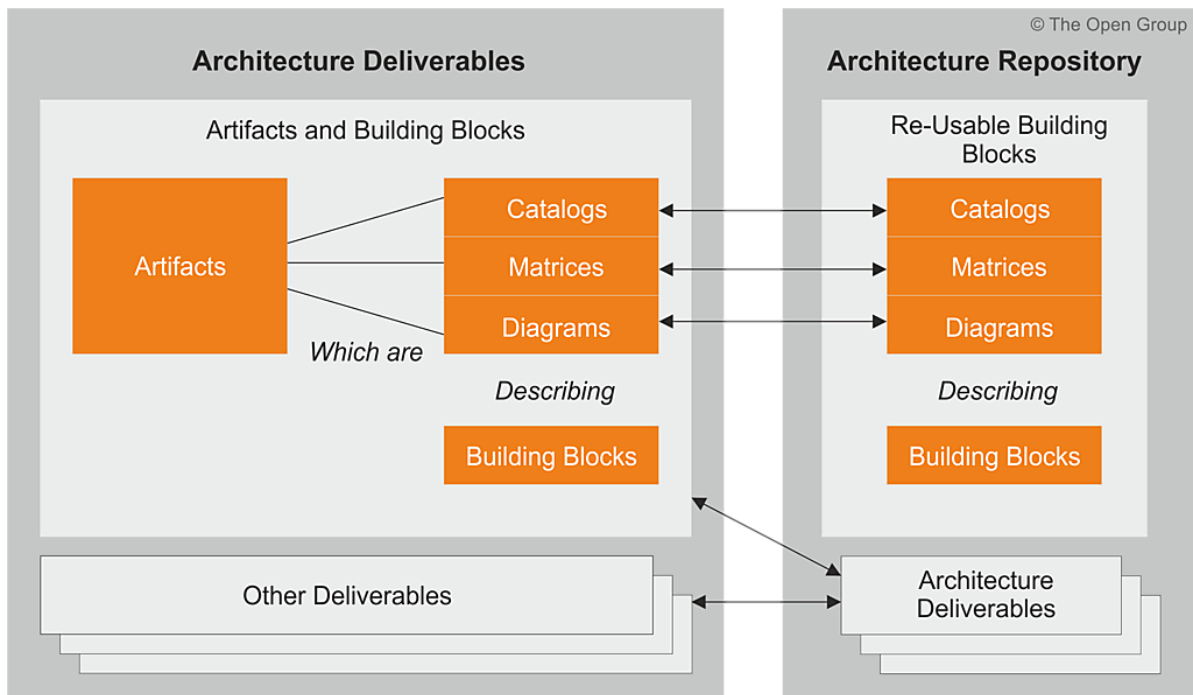
Architecture deliverables are typically consumed and produced during the different phases of the TOGAF ADM cycle. TOGAF standard introduces a set of deliverables and artefacts for each phase of the ADM cycle used as inputs for the phase or generated as outputs from the phase and then carried over to the next phase. Most of these deliverables are versioned throughout the phases. At the end of the ADM cycle, they reach their final 1.0 version. (TOGAF, 2018)

3.1.8 Content Metamodel

TOGAF Content Metamodel defines all the building blocks that may exist within architecture. The Content Metamodel Overview (Figure 6) forms a holistic view of all the ADM cycle phases and architecture domains within them. (TOGAF, 2018)

Figure 6 Content Metamodel Overview (TOGAF, 2018)
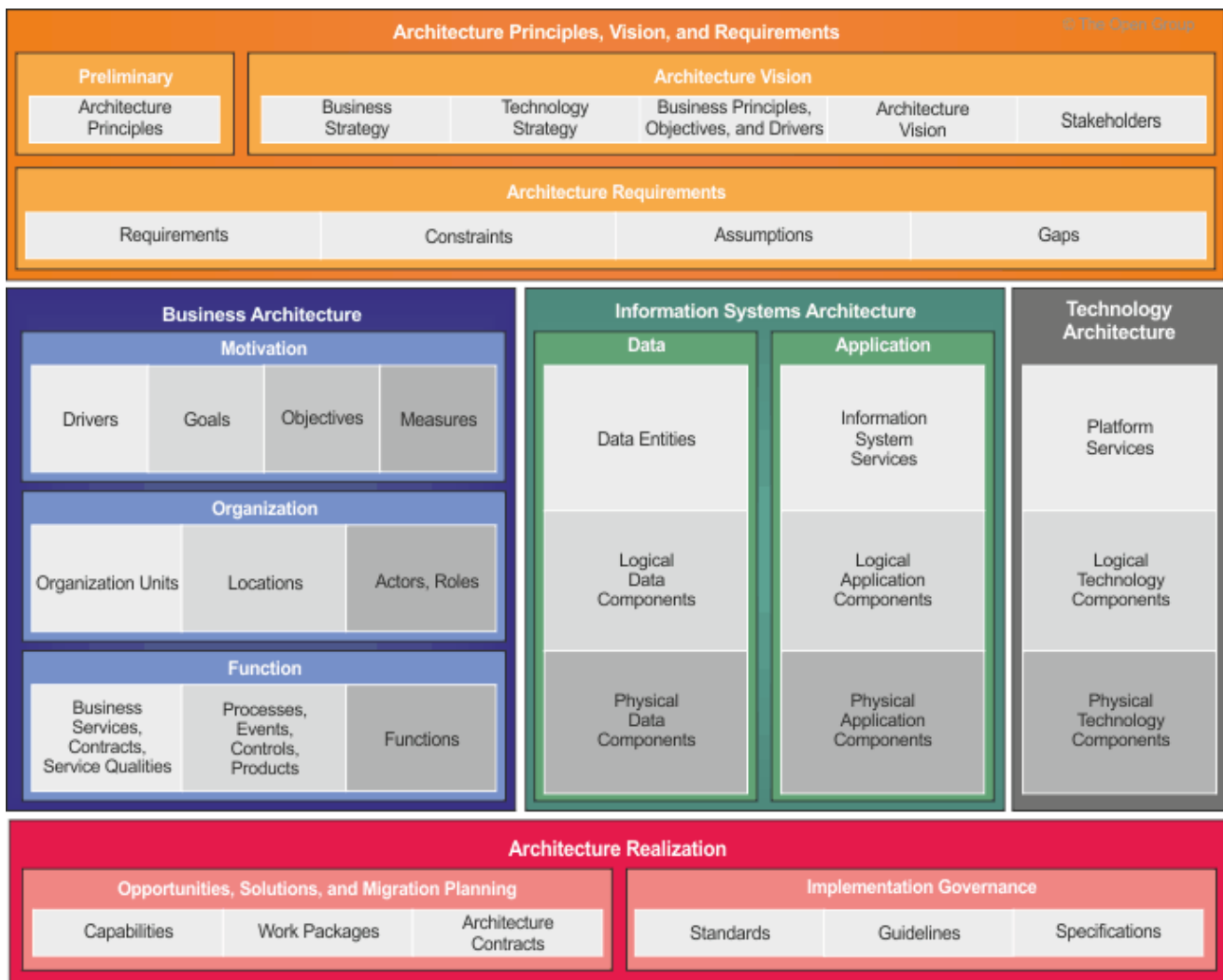
3.1.9 Tailoring TOGAF for organisation

It is necessary to tailor TOGAF Standard to fit the organisation's needs in the preliminary phase of ADM. TOGAF can be used with other frameworks and best practices by adopting elements from them. Two critical elements of any Enterprise Architecture Framework (EAF) are the definition of deliverables the architecting should produce and a description of the method by which this should be done. (TOGAF, 2018)

When merging EA with several methods, best practices, and frameworks, it is necessary to perform current state analysis to identify the organisation's actual needs. EA offers foundations for knowledge and change management on which the other methodologies can be implemented

on. Knowledge of these foundations and additional practices needs to be strong to be successful. (Moscoso-Zea et al., 2019)

3.2 JHS-179 for Finnish public administration

JHS-recommendations are a set of public administration recommendations (JHS) that describe a set of best practices and principles for Finnish public administration organisations. JHS-recommendations were prepared between the years 1992-2019 in cooperation between the state and municipalities. The recommendations were approved by the public administration information management advisory board, JUHTA. The JHS-system was abolished in 2020 when its legal basis expired and was replaced by the Information Management Act. JHS-179 is a recommendation that defines a tailored EA model based on the TOGAF standard version 9.1. JHS-179 is aimed at Finnish public administration organisations and companies working closely with the public sector. JHS-179 based EA model was the recommendation for government-funded organisations since 2011. After the Information Management Act was introduced, information management units are now required to produce more specified planning, description and information security obligations based on the information management model. (JUHTA Julkisen hallinnon tietohallinnon neuvottelukunta, 2017)
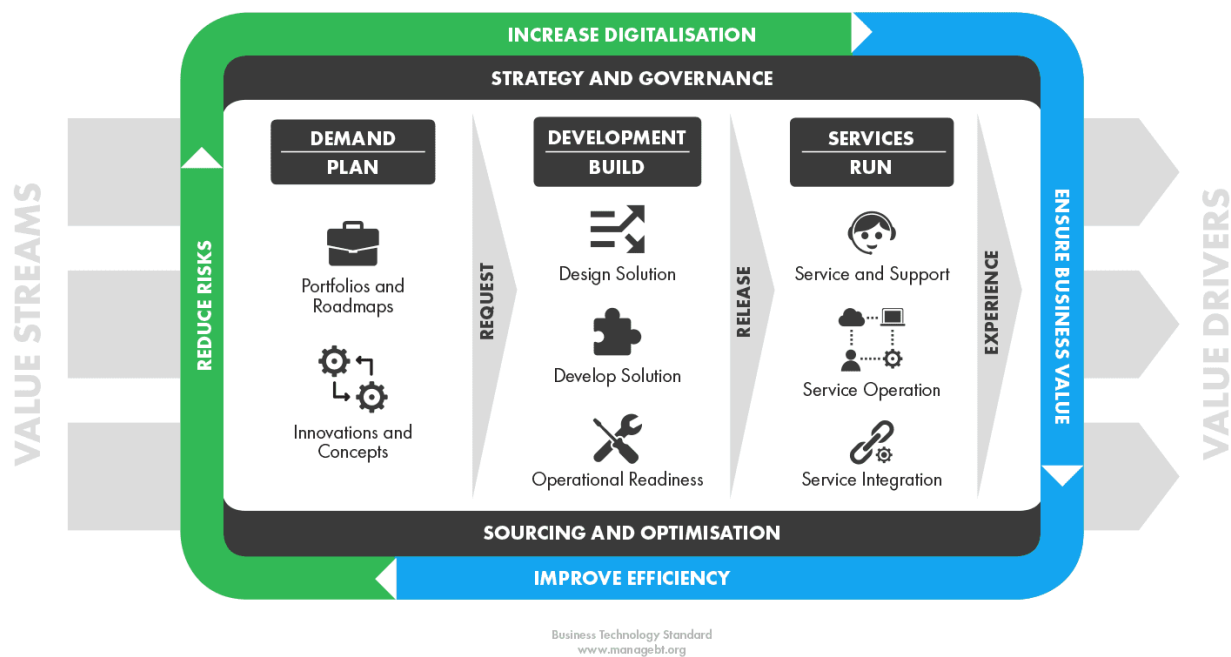
3.3 Business Technology Standard

Business Technology Standard (BT Standard) is a business-oriented holistic management model for organisations that are based on ITIL and TOGAF. The BT Standard has been developed for the past ten years and is widely used in Nordic countries. The BT Standard supports various organisation models, sizes and types and supports organisations using pure agile methodologies. Organisations using project-based development and process-driven service management can use BT Standard to develop their methodologies towards agile and DevOps style development practices. Business Technology Forum is a non-profit community that freely offers the BT Standard as an open source for others to benefit from an information technology society. The BT Standard is compliant with best practices such as DevOps, SAFe, ITIL and IT4IT. The BT Standard consists of three models for digitalisation management. These models and few unique elements addressing the current challenges organisations face are presented below this chapter. The BT Standard operating model

defines how business value can be created with information technology management. (Business Technology Forum, 2019)

3.3.1 Operating model

The operating model has three disciplines building value for business: demand, development and services complemented by two additional management-focused disciplines: strategy and governance and sourcing and optimisation. The operating model consists of value stream planning, building and operating supported by shared strategy, governance, sourcing and optimisation. Value streams have end-to-end goals to create value for the business via the operating model (Figure 7). (Business Technology Forum, 2019)

Figure 7 BT Standard operating model (Business Technology Forum, 2019)

The Business Technology Standard offers a capability model that defines five management areas and 28 capabilities associated with them in a framework. (Business Technology Forum, 2019)

3.3.2 Capability model

The framework is divided into four sections represented in horizontal management areas (strategy and governance, sourcing and optimisation, development and services) and in one vertical demand discipline intersecting with the management areas as seen in Figure 8. Capability models form a solid foundation for self-assessment and for holistically identifying organisational weaknesses and strengths. (Business Technology Forum, 2019)

Figure 8 BT standard capability model (Business Technology Forum, 2019)

3.3.3 Roles and responsibilities model

The BT Standard defines 64 standardised roles. Roles have responsibilities and contribution on capabilities related to them. Roles have been divided into five career identities, each defining passion, mission, and critical metrics. The Business Technology Standard promotes a low hierarchy model with three levels: expert, lead, and officer. Many of the roles work in one-to-one relationships, and one person may have several roles; therefore, the model can be applied in different size organisations. The Business Technology Standard breaks traditional organisational silos by defining cooperative teams and steering groups and using the same role names for enterprise and digital development. (Business Technology Forum, 2019)

Figure 9 BT Standard roles and responsibilities model (Business Technology Forum, 2019)

Business Technology Standard
www.managebt.org
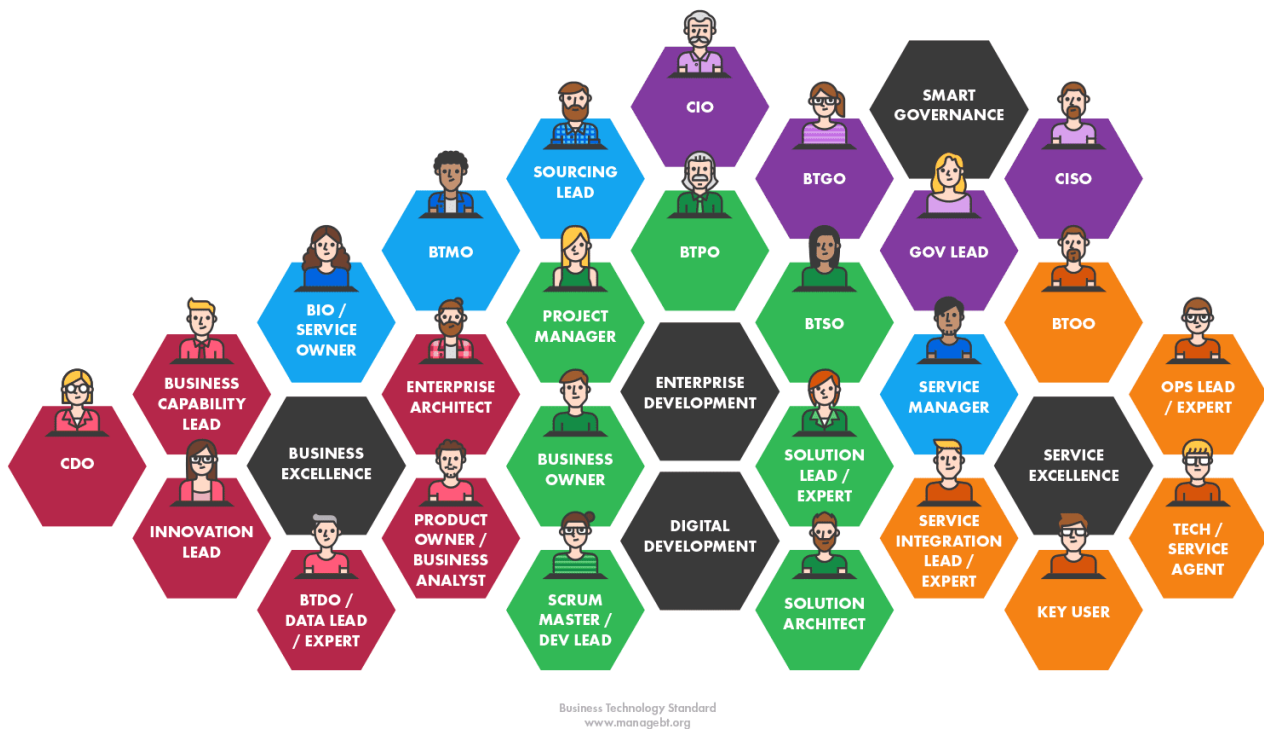
3.3.4 Enterprise Architecture

EA in the Business Technology Standard is part of demand discipline. The Business Technology Standard states that traditional monolithic EA is not ideal for digital development in fast development sprints and incremental progress-based planning introduced by digitalisation. The Business Technology Standard introduces a centric capability planning approach (Figure 10) that places the business ecosystem in a central role. It should be noted that BT standards definition for the capability term in this instance is the capability of the business to achieve long-term strategic goals. (Business Technology Forum, 2019)

Figure 10 EA centric capability planning (Business Technology Forum, 2019)
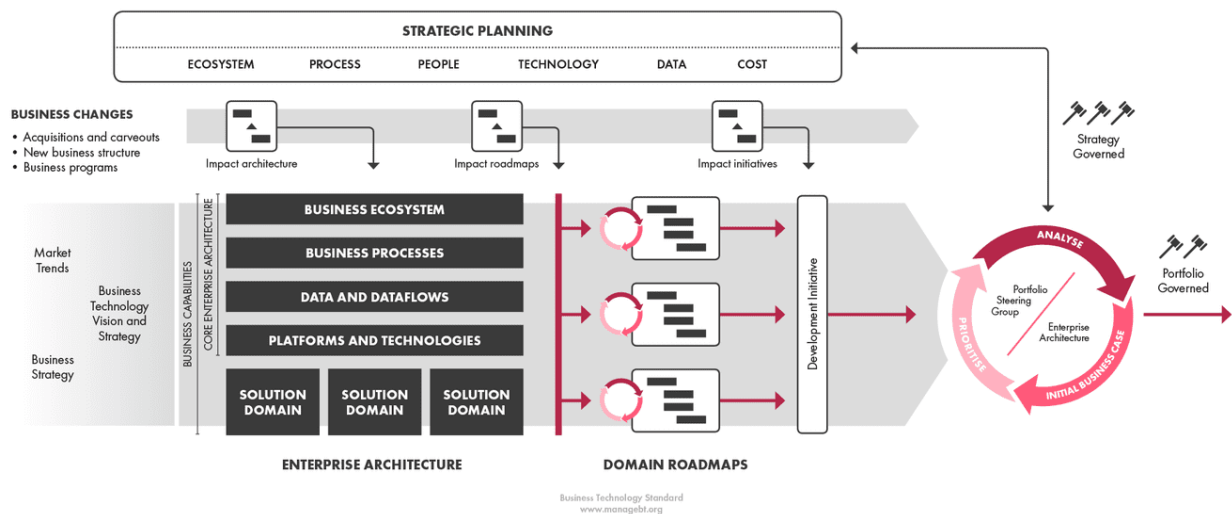
The modular nature of the approach creates possibilities to use more agile architecture development methods for different business areas. The model is compliant with the TOGAF and encompasses the four architectural aspects of it (BDAT). (Business Technology Forum, 2019)

## 3.4 Simple Enterprise Architecture (SEA) framework

Simple Enterprise Architecture (SEA) eases the definition of Enterprise Architecture primarily for educational purposes. SEA builds on top of the most notable Enterprise Architecture Frameworks (EAF), like TOGAF and Zachman frameworks, by integrating methods and components from several different EAFs. SEA provides concrete proof of the alignment between organisations IT decisions and the business goals with its practices. Popular EAFs can be intimidating and abstract, while SEA is a practical EAF that guides the analysts and architects to define enterprise architecture. SEA is based on the four architecture domains found in TOGAF and others alike and shares the view of building on architecture domains in three levels, as seen in Figure 11. Business Architecture sets the goals and defines processes that orient the decision making in the underlying two layers. Information Systems Architecture defines the information systems that support the Business Architecture goals and processes. Technical Architecture consists of the technical infrastructure that supports the information systems. (Giachetti et al., 2018)

Figure 11 Architectural levels (Giachetti et al., 2018)
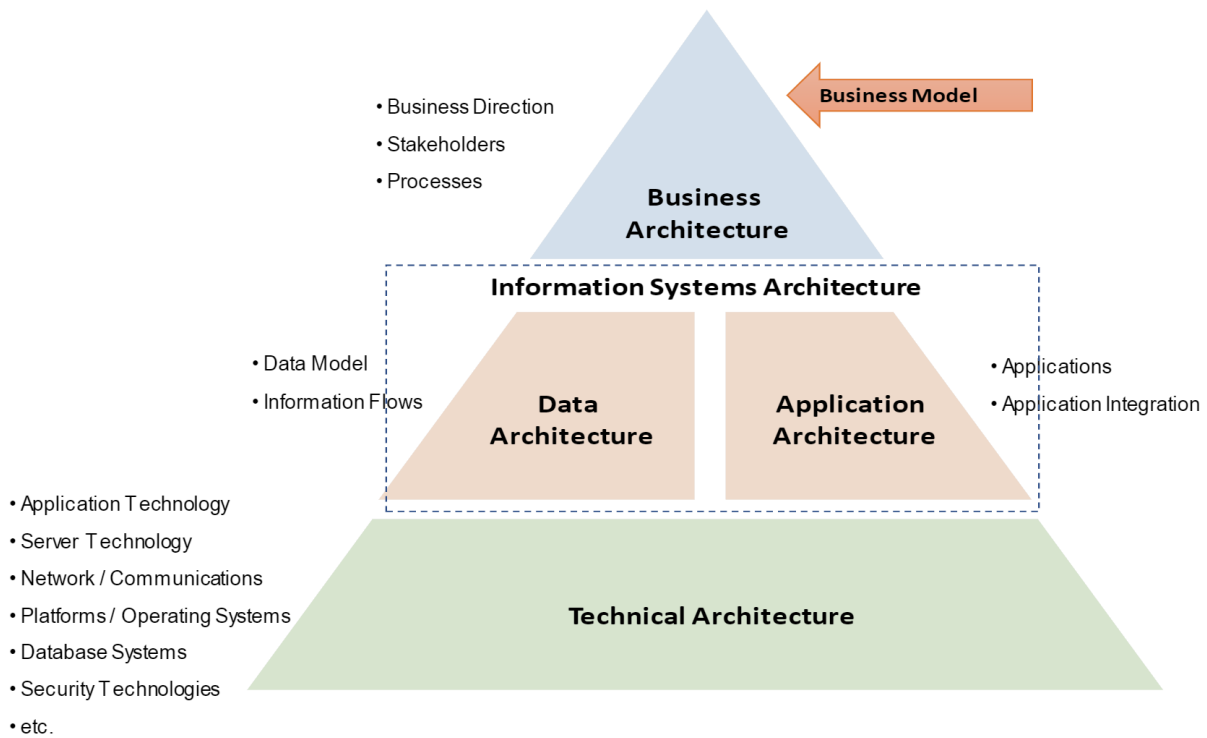
To guideline and align these architecture levels, quality attributes are used as architectural drivers for Information Systems and Technical Architecture level decision making. SEA applies Attribute Driven Design (ADD), utility tree and Architecture Tradeoff Analysis Method (ATAM) to refine the first version of the pyramids lower-level architecture designs. This way, EA will be aligned to these architectural drivers. (Giachetti et al., 2018)

Figure 12 Elements of SEA framework (Giachetti et al., 2018)
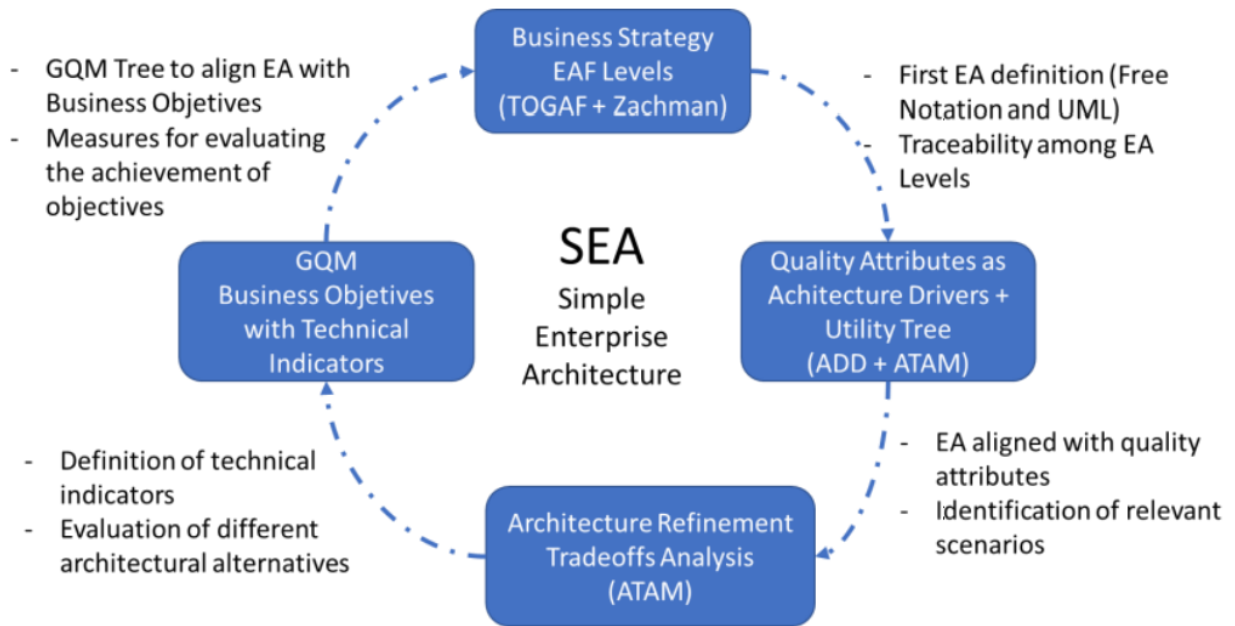
SEA forms an iterative process (Figure 12) with the mentioned method complementing the cycle with the GQM (goals, questions, metrics) approach, which generates measures to evaluate technical decisions with the business goals. Conceptual level goals are the drivers for EA, questions are operational and evaluate the goals. Metrics are the quantitative level measures that can evaluate the questions. SEA recommends the GQM approach to be used in a hybrid manner between top-down and bottom-up. (Giachetti et al., 2018)

Figure 13 GQM for measures aligned with objectives (Giachetti et al., 2018)
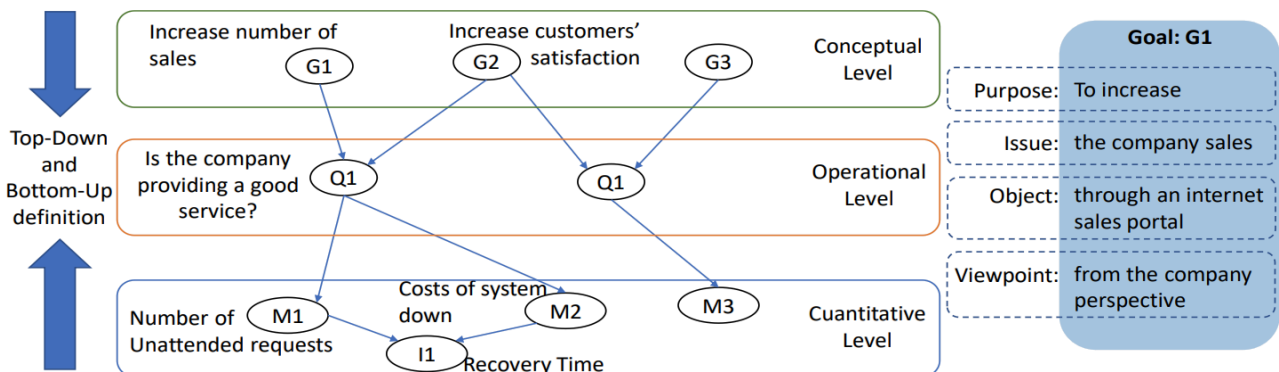
4 Aim and purpose of the thesis

This year marks 30 years since the case company was founded. The case company has operated on the line of moderate growth and today offers more than 40 jobs. This year, the company's management is also undergoing changes. Since its inception, the CEO has been in office and has moved to become chairman of the board. As the new CEO took office, changes have also taken place in the management team. With the changes, the aim is to support continuous moderate growth and, as the company grows, to improve the communication of strategy and vision within the organisation, bringing clarity and the business goals close to everyone.

In 2019, the company resolutely started to pursue DevOps operating models, which include increased automated testing, the utilisation of container-based solutions and cloud services, and the introduction of the latest tools to development, operations, and project teams. Partly for this reason, and due to changes in the operating environment, the number and complexity of companies' internal systems have increased. Also, the software products the case company produces have increased both in numbers and in configuration lines. A new layer of abstractions is being applied to information systems, especially on the cloud platform, to form cloud-native solutions.

Growth and change in operating methods and the constantly evolving technologies such as machine learning and artificial intelligence shape our business ecosystem and bring challenges that the company wants to meet. To prepare for these challenges, the company wants to bring the benefits of the Enterprise Architecture into the management system, considering the available resources, and produce a lightweight EA that supports agile operating methods.

In the case company, EA can leverage and complement the existing management systems (ISO 9001, ISO 27001). The scope is to find what and how additional deliverables should be produced.

4.1 Research Methods

The research for this thesis was carried out as qualitative research in which phenomena, standards, methods and best practices related to the topic were studied via available research data, literature and conference speeches. The knowledge base and competence on Enterprise

Architecture Frameworks was strengthened by completing The Open Group Certified: TOGAF 9 Foundation certification. This allowed the researcher to profoundly understand the standard that is tailored for the case company.

Thematic interviews were conducted to collect data about the case company for the thesis. Interviews provided insight into silent knowledge inside the case company. The interviews were attended by the case company's management and experts, a total of six people.

4.2 Thematic interview as a qualitative research method

Thematic interviews do not follow specific patterns or pre-prepared questionnaires. The interviewer has prepared themes and subject matter which guides the conversation. This makes the thematic interview a free-form and flexible method to freely formulate questions on these themes (Finnish Social Science Data Archive (FSD), 2021). It is necessary to take note that the themes set in advance by the researcher might not be the same, that after analysing prove to be essential. (Hirsijärvi & Hurme, 2008)

The themes used in the interviews were the organisation's ability to implement EA, the achievable benefits of implementing EA, the challenges related to EA and the expected effects on costs. Six interviews were held and recorded. The interviews had a formal and fixed introductory section for all the interviewees about the topic describing the basic concepts of EA. This introduction part was approximately twenty minutes long and included terminology, the basic concepts, including ADM and deliverables, and EA's goals in general.

The interview theme list used in the thesis was loosely structured (Annexe 2), as is the case for thematic interviews. Interview themes were derived from the research questions. Under each theme, a set of questions supporting the course of the discussion were produced. These questions were used to inspire the interview and guide through the topics lightly. This is allowed in thematical interviews and helps to facilitate the conversation. (Hirsijärvi & Hurme, 2008)

Table 1 Relationship between interview themes and research questions

Research questions	Theme	Supporting questionnaire
What is the capability of the case company to manage enterprise architecture in general?	Capabilities	How familiar are you with the concept of total architecture already? How can the organization be committed to NEA work? How is it worth pursuing in a small company? What ability do you feel a successful NEA job requires from the organization?
How EA affects our organisations' strategy and the ability to implement it? What are the most relevant parts of EA frameworks the case company should include in its Enterprise Architecture?	Possibilities	What problems could EA solve in the case company? Where else should EA be used for and why?
What are the advantages or disadvantages of enterprise architecture for the case company implementing DevOps principles?	Challenges	What criteria do you think should be used to assess how successful the EA work has been? What things do you think will increase the success or failure of the EA?
What are the costs and benefits of implementing EA for the case company?	Resources	What kind of financial investments do you feel implementing EA requires? What kind of financial benefits do you feel you will receive from EA?

Interviews were conducted in Finnish, which is the native language of participants. The interviews were recorded and transcribed into text format after the interviews. The interview transcriptions were analysed, and main points were sought out and categorised under each of the themes to form a synopsis (Annexe 3, analysis).

5   Research findings

The results of the study are presented in this section and are divided into findings of the information obtained from the interviews as well as the information obtained from the literature research of the existing information.

5.1   Interview findings

Thematic interviews showed that the EA is, in principle, familiar to most interviewees. Only a few had practical experience working with EA before. All interviewees felt that EA is a desirable goal within the company and provides several benefits worth the effort. Reasons and benefits for this varied. There was an indication that the operational level is hoping the EA would provide more information, clarity and guidance for the daily work. The management side saw more benefits in increasing the usefulness of the resources at hand and improving efficiency. Management also felt that EA could be a valuable tool to identify upcoming changes in the business ecosystem, including customer trends and rising technologies. Management also felt that the **ownership of the work throughout the organisation is a desirable goal**. Opinions about generating accurate process diagrams aiming to give clarity to the operational level varied but, in general, were seen as valuable. One of the interviewees stated that "After all, professionalism itself is about identifying exceptions. Robots could do all our work if our work did not have these exceptions". The clarity to the company might mean stating the company's vision and answering the "Why" question Sinek introduced in the Golden Circle (Figure 1) rather than micro-managing processes. The **clarity, in general, is very subjective and hard to measure concept** and should be approached with the idea that there might never be enough clarity to satisfy everyone. Clarity proved to be an inductive finding that was seen as an essential benefit EA could offer.

Thematic interviews indicated that the capabilities within the company were scarce and mainly focused on a couple of people. The recurring theme was **the concern that the workload would be disproportionate to resources**. This finding was partly due to interviewees not having a good understanding of existing management systems. Interviewees who had experience with the existing systems, such as quality management system, had confidence that **the organisation has the capabilities required for EA**. This leads to the conclusion that the EA concept, terminology, and deliverables might be detached from current management systems in the minds of some

interviewees. **Practical examples and finished available work from existing management systems should be utilised** to implement EA in the case company successfully. This will help in forming a mentally easier and more motivational path for people involved in EA work.

Another concept that formed through the interviews was the idea to use evolution steps. Implementing evolution steps for the EA work was considered an aid to alleviate workload at the beginning. Using these steps of the EA could help the case company start and finish the EA work, but **the EA could grow later as the capabilities grew with each ADM cycle**. When asked about the contents of the first tailored EA framework, the word 'light' was used. One of the interviewees pointed out that light and agile is good as long as it is not synonymous for flimsy or slight. EA needs to be robust, solid and in touch with the practical side of things. **It is essential to do things ascending**. Goals may be ambitious but proportionate to abilities and capabilities. Lightweight so that the notion of the work is not overwhelming. The risk of introducing too much hard work to the organisation not capable enough could be mitigated with a good set of draft deliverables describing what questions the document should answer.

According to interviews, **the most viable architecture deliverables include the current state analysis** and an abstract vision of the future state. When the future state is described with a roadmap, the EA needs to implement that plan in order for the EA to be successful and seen as worth the effort it requires.

Interviewees were split about the methods how the implementation should be communicated. Getting people involved requires consistent communication about the intent and where the work is available for preview. Most importantly, why the work is essential and how it affects the individuals and the organisation as a whole. Operational level details need to be thought in the teams working with the specific process or system. Some systems might need an evaluation of their current state from outside of the core user group who might be incensed to support the status quo and avoid uncomfortable side effects of changing an old system although, it might be in the best interest of the company. When planning the EA work and planning the possible new system migrations and projects that the EA work introduces, **it is essential to recognise the work amount and resources needed for completion**. Estimates are needed to avoid situations where the EA is in a competitive position with the core business processes.

ADM cycles were discussed and how they should be triggered. Some thought that a yearly or quarterly ADM cycle would be beneficial, while others thought triggers should be defined that could start the EA work. Yearly ADM cycles with a specific focus on some parts of the company could be efficient way at the start of the EA until the capabilities grow. Focusing on different areas would produce high-quality EA while not entirely disregarding other parts needing attention. After the current state analyses for each architecture domain are high quality, it becomes easier to focus on specific parts of EA in each iteration to provide value to the company. **A good foundation for EA guarantees a better ability in the future to focus on organisational development instead of EA itself**.

Using certification systems like ISO 9001 or ISO 27001 works as a great driver inside the company. Such drivers have a quality improving effect that pushes the work to reach more than it would have achieved alone. An outside view can give new insights to EA when pushed further with external certification or review. Using an outside consultation is something that might be useful after we have made the EA look our own.

The case company should also encourage people to ask questions to understand and learn, not just be told what to do. One of the interviewees made a notion that: "No standard or framework can be documentation for professionalism. With implementing EA, we will not be giving anyone [in the organisation] a guide on how to do their job". **EA can help achieve work cultural goals by documenting the principles and visions the company has.**

5.2   Findings of theoretical material

Research of available knowledge was divided into sources of disruption and enterprise architecture frameworks.

Sources of disruption would have been an interesting thesis topic on its own. The scope of this thesis only scratched the surface of change management and focused on the leader-leader model, which moves away from micromanagement to more delegated leadership where the ownership of work is valued. This resonated with the interviewees as well. The research identified that digital transformation introduces disruptive change via rising complexity and added layers of abstraction caused by new technologies such as container technologies, artificial intelligence, and others.

DevOps, GitOps and agile software development methods introduce change at a fast pace to organisations. Work culture is also in change via these practices. EA provides a framework for these agile methods and practices to be agile in. EA can also align the work culture change to match business objectives like it is designed to match information management to business goals.

EA itself might have been a buzzword in the early 2000s. With the rise of new agile methodologies, it might have been seen as a bureaucratic and slow structure. However, it can be formed into a robust but lightweight framework that offers a permeable view to an organisation while not hindering it.

Research on different enterprise architecture framework was focused on TOGAF, while others were explored in general. TOGAF is a massive standard and requires much pruning for the case company needs. In this thesis, only the main parts of TOGAF were introduced. By studying other EAFs thesis was able to offer a broader view that will help in the long run. Additional EAF elements should be implemented at a later stage of EA work in the case company.

An organisation needs to have a consensus, an understanding of the company and its parts to make decisive decisions. Enterprise Architecture is the outcome of that consensus that helps the executive team steer the company towards its targets.

6   Results and Conclusion

For the case company with less than 50 employees, the resources and capability of implementing Enterprise Architecture are understandably lower than what the TOGAF standard is initially planned for. For this reason, it is required to evaluate the most important parts of the EA framework that offer the most significant benefits considering our capabilities. While tailoring the Enterprise Architecture Framework (EAF) to suit the case company, it should aim to be the minimum viable framework that is lightweight and supports the agile goals within the case company but has a solid practical association. After several ADM cycles, as the EA in the case company evolves, more deliverables and depth can be added to EA forming new evolutions of the EA and the tailored EAF. If the initial tailored EAF tries to be the best possible model for the case company with large amounts of deliverables and work, it will have a very high risk of failing. In this case, it would take too much time to finish the ADM cycle for it to have a good effect. Too large EA is a slow one that has a risk of being outdated and therefore does not offer the benefits it initially had been set to reach for.

The case company has a low capability at the start of the first ADM cycle. However, the capability is expected to grow with each iteration of the ADM cycle over the coming years. This allows us to create a baseline and target analysis for the whole case company's tailored EAF and set evolution steps for the desired EAF target state. These steps are not part of the thesis and should be considered in an agile manner as the knowledge in the case company grows.

The thesis started to search how the strategy could be implemented better with EA. During the research, it was clear that the strategy itself could be seen as a development target as well. Implementing strategy in an organisation should start from motivating people to see the benefits and sparking the desire to improve in each individual. In a flat organisation structure, the emancipation of employees requires intent and ownership of work in individuals, focusing on improving efficiency with practical examples and offering a just-cause that answers the big question of why we work, why we do things the way we do.

6.1   Tailored framework

Part of this thesis is to prepare for the upcoming ADM cycle. This part of the EA work is done usually in the preliminary phase of the TOGAF standard. As described in the previous chapters, the need is to create the minimum viable architecture framework that includes only the most essential parts of big frameworks identified throughout this thesis.

Enterprise Architecture is the consensus of the company that is required to do work efficiently. This is the reason for the EA to exist in the first place. TOGAF standard has been chosen as the EA framework for the case company since it is compatible with JHS-179. JHS-179 is relevant to the case company since the company works closely with public administration organisations. Understanding the JHS-179 is considered an advantage, but tailoring TOGAF was seen as more worth pursuing. The case company wants to produce comparable and understandable documentation of its organisation to be reviewed by the clientele from the public administration sector.

It can be expanded with other principles and methods from other frameworks such as the BT Standard and other methodologies.

A new EA process model for the case company was created by tailoring the TOGAFs ADM cycle (Figure 4). This process model includes the TOGAF's Phase H as the continuous change management action. In the new model, an EA team evaluates the need to start the EA work and defines if there are requirements and capabilities for a new evolution of EAF to be created before starting the EA work (this is similar to the TOGAFs preliminary phase). When the EA work (in TOPGAF terms, the ADM cycle) starts, it includes TOGAF Phases from B to G. This process is designed to be run yearly or quarterly in tandem with other case company's timed processes or as an on-demand style process. Doing EA work with scarce resources encourages an annual static cycle, allowing time for observing the effects of created EA before implementing new changes. This main process evaluates the needs for the architecture changes each iteration, refines the architecture vision, and analyses the needs to evolve the tailored EAF by analysing case company capabilities.

Figure 14 Tailored EAF process for the case company
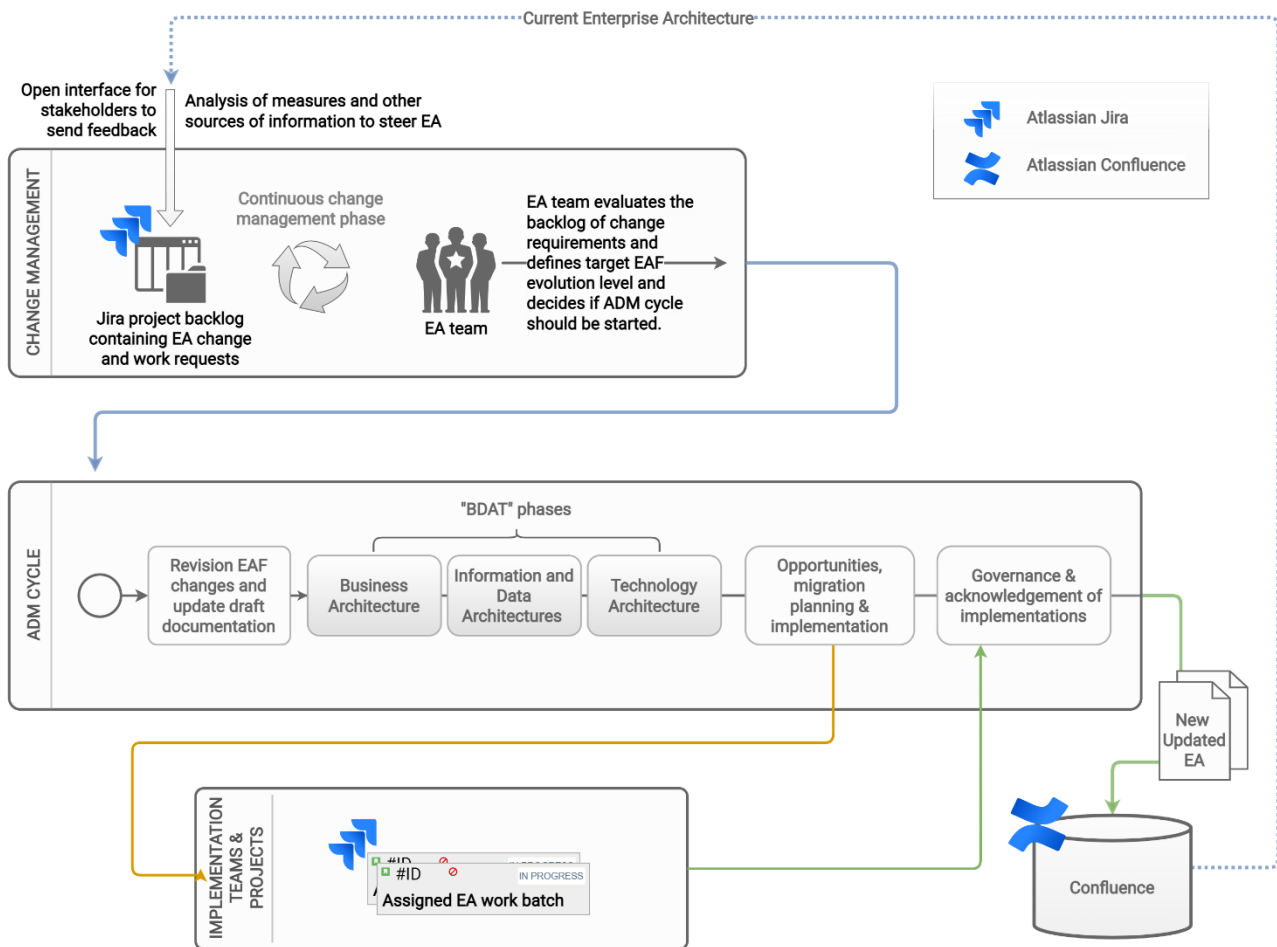
TOGAFs ADM cycle with several steps within each phase is too complex for the case company needs. ADM cycle phases have been combined to a simplified form. People working with EA in the case company are limited to only a few individuals, so the roles and capabilities across the EA are shared and sometimes focused on certain people and their capabilities. A joint project is created for all the architecture work to support the collaboration between architecture domains and different teams. This project is created in the Atlassian Jira platform used in the company. In the Jira project, incoming feedback and different work requests can be processed and worked. EA deliverables and products are worked on and saved in the Atlassian Confluence platform used for the company's documentation purposes. Each official approved EA version is then archived in the electronic archiving system used in the company from this platform. Atlassian platform with this electronic archiving system and partly with the case company's version control system form the architecture repository that holds the architecture deliverables. The information structure of this repository is not included in this thesis. That needs to be addressed as part of the EA work.

Deliverables to be used in case company are to be decided when the actual work starts. Draft versions of deliverables need to be created with sample questions guiding the document writer to produce proper documentation. During the research, the following key deliverables were identified: (1) current state descriptions of each of the architectural domains; (2) enterprise architecture framework current state description (evolution step); (3) target state for each architecture domain and the EAF; (4) gap analysis for the state differences; (5) roadmap and the implementation plan for architectural work; (6) a holistic information system map; (7) key systems used by business processes require detailed architecture view describing relations and dependencies; (8) process descriptions including how the processes relate to each other; (9) holistic view of the business processes; (10) company roadmap including the company principles, vision and strategy for the next five years. This list of ten items is the minimum architecture model that can be expanded. Descriptions of the current state include catalogues, diagrams and documentation about the specific architecture domain. Descriptions are set to identify what different parts of systems are present and how they interact with other systems and their business value.

Evolution steps for EA work were seen as a good approach in the thematic interviews. The conclusion from this finding was that the amount of work required would decrease as finished deliverables can work as an example for future EA work. Figure 15 shows EA work as a red line, decreasing slowly as new evolutions of EA are finished. Each evolution expands the tailored EAF and provides more deliverables. Contents of each step are colour-coded, showing that the fourth evolution level is not adding new contents to EAF; only the proportions might change. This is not relevant to document what parts of EA are from which evolution step but to visualise the possibility to review what changes were good and if they have been brought back.

While evolution steps might ease the workload and resources in work hours invested at the beginning, it must not stall to an abstract level. From the beginning, each evolution step needs to have a concrete and practical implementation to be valuable and urge the ownership of work.

Figure 15 EA evolution steps and predicted EA work
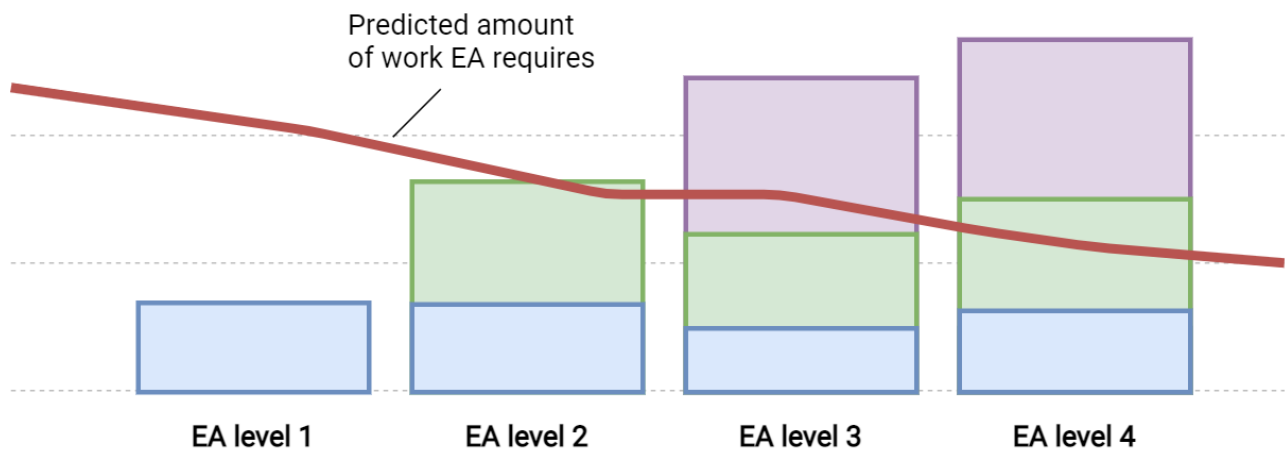
Some of the deliverables are present due to the case company having quality management (ISO 9001) and information security management (ISO 27001) systems in place. This overlapping and the annual certification process for re-certification could work as an incentive for the EA work as well.

EA work is tied to an architect role inside the case company. The architect leads work in coherence and cooperation with the rest of the organisation, forming the EA team. The required workload is assessed before starting the ADM cycle. The required work amount is approved by the Architecture Sponsors (executive team), and then the cycle can be started. The work required to implement the defined architecture is carried out in accordance with the company's internal project management process. Producing general EA deliverables (mainly documentation) is going to be embedded in practical work throughout the organisation. Therefore, EA deliverables should be generated and maintained as a by-product of the daily work. This produced documentation is revised and added to the EA through the ADM cycle.

6.2   Future of EA in the case company

Now that the foundation for the Enterprise Architecture is available, the first ADM cycle with the tailored version can start. In the future, the EA can be evaluated with the tailored EA work process (Figure 14 Tailored EAF process for the case company). The target EA evolution step can be adjusted as the capability and knowledge grow within the case company. Future work might include creating more measures, governance, and evaluation of implementation success. The

GQM of the SEA model (Figure 13) is very promising to generate new measures and align the business values with the IT systems. The success of EA should be validated via created measures in the value stream of the case company at a process level. This helps to steer the architecture in each ADM cycle. Other future additions might include parts of the BT Standard, especially the roles and responsibilities model (Figure 9), which might prove helpful later.

However, the first practical step is to form the architecture team that will produce the draft versions and decide the first deliverables for the first evolution of the case company's EAF. As it was found out in the studies of this thesis, the essential task for EA to succeed is to implement it with practicality in mind. After all, the current documents have been gathered and draft versions have been set, it is time to start documentation of the first EA.

It might be just the right time for the case company to start implementing EA; knowing that agility is crucial for our business in the future, we can take that into account as we develop our EA. Our EA work is shaped from the start by the knowledge of these relatively new methodologies such as DevOps and GitOps and new rising technologies, adding abstractions and complexity to our information systems.

7   Summary

A broader view of Enterprise Architecture Frameworks and a profound understanding of the TOGAF standard was acquired during the thesis. Research questions were answered in detail considering the capabilities the case company has for implementing EA for their needs. During the research, it became evident that implementing EA in the case company would be highly beneficial. The interviews revealed what risks might be associated with implementing the EA and what kind of resources and capabilities are required. Considering the research question about the advantages or disadvantages of EA for the case company implementing DevOps principles, there were no clear disadvantages other than applying too much governance with EA might complicate some DevOps practices. The advantages of implementing EA in the case company using DevOps were seen in the formal way of managing information systems, providing a good posture for future DevOps projects. DevOps without governance can lead to increased attack surfaces, unnecessary systems using capacity and increasing upkeep. EA was seen as a helpful tool to handle changes introduced by DevOps practices.

EA offers a new perspective for the management models in the organisation to empower their employees and encourage ownership of work. According to the research, these goals can be reached with communication, involvement in development projects and decisions of daily work.

Considering the costs of EA, they are mainly in the form of work hours required for the first iteration of EA. This first investment of work hours is crucial because it determines the direction of the future EA work. The payoff from the work investment can be expected after a couple of years from the first iterations.

The thesis can be seen as a TOGAF's preliminary phase where the capabilities and tailoring of the framework were done. During the thesis, I completed the TOGAF 9.2 Foundation certification via VUE Pearson. During that study, I learned most of the theory introduced in this thesis and more. This gave a solid foundation for implementing the EA work in the case company. Answering the research question about the essential parts of EAF that the company wants to include in the tailored EAF, we found via interviews the most valuable deliverables for our needs. These are described in chapter 6.1.

The most challenging task was to find practical examples of architecture work already done by other small companies. Lack of practical examples might be due to the fact that EA always requires an understanding of the 'enterprise' it describes. Practical examples might be hard to come up with that would suit the needs of the reader. Best practical use-case examples can be read from the book Introduction to Holistic Enterprise Architecture written by Scott A. Bernard.

In future, I believe we will be returning to look at what we could draw from the Business Technology Standard and the Simple Enterprise Architecture model as our EA continuous to evolve and grow.

References

Akella, J., Buckow, H., & Rey, S. (2009). *IT architecture: Cutting costs and complexity | McKinsey*. McKinsey Digital. https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/it-architecture-cutting-costs-and-complexity

Anthony, S. D. (2016). *Kodak's Downfall Wasn't About Technology*. Harvard Business Review. https://hbr.org/2016/07/kodaks-downfall-wasnt-about-technology

Bernard, S. A. (2020). *Introduction to Holistic Enterprise Architecture*. AuthorHouse.

Business Technology Forum. (2019). *Business Technology Standard (4.0.1)*. https://www.managebt.org/content//uploads/Business-Technology-Standard.pdf

Centric Digital. (2017). *Digital Transformation and the Pace of Change | Centric Digital*. https://centricdigital.com/blog/digital-transformation/digital-transformation-and-the-pace-of-change/

Chaffey, D. (2020). Golden Circle model: Simon Sinek's theory of value proposition, start with why. In *Smart Insights* (pp. 1–3). https://www.smartinsights.com/digital-marketing-strategy/online-value-proposition/start-with-why-creating-a-value-proposition-with-the-golden-circle-model/

DXC Technology. (2017). Digital Transformation Is Racing Ahead and No Industry Is Immune - SPONSOR CONTENT FROM DXC TECHNOLOGY. *Harvard Business Review*, 2–5. https://hbr.org/sponsored/2017/07/digital-transformation-is-racing-ahead-and-no-industry-is-immune-2

Finnish Social Science Data Archive (FSD). (2021). *Research Methods Guidebook -*. https://www.fsd.tuni.fi/en/services/research-methods-web-resource/

Fowler, M. (2015). *(120) Making Architecture Matter - Martin Fowler Keynote - YouTube*. https://www.youtube.com/watch?v=DngAZyWMGR0

Gartner. (2021). *Top Priorities for IT: Leadership Vision for 2021*. 53. https://www.gartner.com/en/publications/2021-top-priorities-for-it-leadership-vision

Giachetti, G., Marín, B., & Serral, E. (2018). The Simple Enterprise Architecture Framework: Giving Alignment to IT Decisions. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *11158 LNCS*, 176–186. https://doi.org/10.1007/978-3-030-01391-2_23

Goldratt, E. M., & Cox, J. (2014). *The Goal - A process of ongoing improvement* (4th ed.). North River Press.

Goossens, K. (2021). *GitOps Lunch*. KubeCon & CloudNativeCon Europe 2021.

Graig, W. (2018). The Nature Of Leadership In A Flat Organization. *Forbes*. https://www.forbes.com/sites/williamcraig/2018/10/23/the-nature-of-leadership-in-a-flat-organization/?sh=5c040cf5fe19

Hirsijärvi, S., & Hurme, H. (2008). *Tutkimushaastattelu : Teemahaastattelun teoria ja käytäntö*. Gaudeamus Helsinki University Press. https://www.finna.fi/Record/jykdok.1063628?imgid=1

Ho, J. C., & Lee, C. S. (2015). A typology of technological change: Technological paradigm theory with validation and generalisation from case studies. *Technological Forecasting and Social Change*, *97*, 128–139. https://doi.org/10.1016/j.techfore.2014.05.015

Holcman, S. (2020). *Real Talk with Sam Holcman - Enterprise Architecture – The How-To Methodology*. https://realtalkwithsamholcman.podbean.com/e/enterprise-architecture-–-the-how-to-methodology/

ISO/IEC JTC 1/SC 7. (2017). *ISO - ISO/IEC/IEEE 42010:2011 - Systems and software engineering — Architecture description*. https://www.iso.org/standard/50508.html

JUHTA Julkisen hallinnon tietohallinnon neuvottelukunta. (2017). JHS 179 Kokonaisarkkitehtuurin suunnittelu ja kehittäminen. In *JHS-järjestelmän verkkopalvelu*. https://www.suomidigi.fi/ohjeet-ja-tuki/jhs-suositukset/jhs-179-kokonaisarkkitehtuurin-suunnittelu-ja-kehittaminen

Kim, G., Humble, J., Debois, P., Willis, J., & Allspaw, J. (2016). *DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations*.

Klemetti, M. (2020). *DevOps for* (p. 33). Eficode.

Kruse, K. (2013). *What is leadership?* Forbes.

> https://www.forbes.com/sites/kevinkruse/2013/04/09/what-is-
> leadership/?sh=13617e165b90

Linders, B., & Dubakov, M. (2015). Building Flat Organisations with Cross-functional Teams and Fewer Managers. *Infoq*. https://www.infoq.com/articles/flat-organizations-teams-managers/

Linthicum, D. (2019). *How to deal with cloud complexity | InfoWorld*. InfoWorld.

> https://www.infoworld.com/article/3409089/how-to-deal-with-cloud-complexity.html

Little, C. (2019). *The coming disruptions of the application release DevOps markets*.

> https://blogs.gartner.com/christopher-little/2019/07/03/coming-disruptions-application-
> release-devops-markets/

Mäkelä, K., & Abildskov, J. (2021). *DevOps trends for 2021*.

> https://www.eficode.com/guides/devops-trends-2021

Marquet, L. D. (2015). *Turn the Ship Around!*

Moscoso-Zea, O., Paredes-Gualtor, J., & Luján-Mora, S. (2019). Enterprise Architecture, an enabler of change and knowledge management. *Enfoque UTE*, *10*(1), 247–257.

> https://doi.org/10.29019/enfoqueute.v10n1.459

Pollard, M. O., Gurdasani, D., Mentzer, A. J., Porter, T., & Sandhu, M. S. (2018). Big Ideas 2021. *Human Molecular Genetics*, *27*(R2), R234–R241.

Sessions, R. (2008). *Simple Architectures for Complex Enterprises*. Microsoft Press.

Sinek, S. (2005). *Simon Sinek: How great leaders inspire action | TED Talk*. TED.

> https://www.ted.com/talks/simon_sinek_how_great_leaders_inspire_action?language=en

Sinek, S. (2010). *Re:Focus: Don't Protect Your Property*. Re: Focus -Blog.

> https://blog.startwithwhy.com/refocus/2010/09/dont-protect-your-property.html

Sinek, S. (2019). *Infinite game*. Portfolio.

TOGAF. (2018). The TOGAF® Standard, Version 9.2. *The Open Group*, 504.

Annexes

Annexe 1: Material management plan

The material management plan describes how the research material is handled during the research work and stored after the writing of the thesis.

The thesis utilises thematic interviews as a qualitative research method. Permission for the research in the case company is sought from the CEO of the case company. Interviewees are to be asked via Teams chat message individually if they would be willing to participate in the research. After getting approval for the interview, a Teams meeting is scheduled, and the interview description is sent with the meeting invitation. Interviewees accept the invitation in the Outlook email program or via Teams. Before beginning the introduction to the topic, consent is confirmed at the start of the interview verbally.

Interviews are held by using Microsoft Teams video conference program. The recording is done with the Open Broadcaster Software (OBS). Video files are saved on the laptops solid-state drive (SSD) in the user home directory under the Videos folder. Files are backed up to a separate SSD and to a USB flash drive.

Written material, including planning documentations and the transcriptions of the thematic interviews, are done in Microsoft Word and saved on the case companys' documenting platform and on the researchers' laptop in Docx format. Access control is used on the material to limit the access for the researcher only on the said platform. All written material, including work copies of the thesis, were also backed up on the separate SSD and on the USB flash drives. Transcriptions were written anonymised. All material is owned by the case company, the client of the thesis work, including the thesis.

The material is stored for one year after the thesis is published. After the time period, the material is destroyed.

Annexe 2: Structure for the thematic interviews

Introduction to the topic

The theme interview will begin with a short PowerPoint presentation on the backgrounds of the overall architecture. The presentation addresses the following issues.

The topic of the thesis is enterprise architecture (EA). EA is a change management and management tool that provides an overview of the company's areas. The overall architecture The KA is divided into four parts, which are business, information, system and Technology architecture.

Total architecture work includes a definition that identifies what the overall architecture wants to control. Numerous models and frameworks have been developed to manage the NEA, which provide methods for work management and define the outputs of the NEA work. Reference architectures and models generally divide the NEA into four architectural areas; business, information, systems and technology architecture. Their architectural areas provide a point of view on the significant and valuable areas to the company's operations, their interfaces, and the overall picture.

The purpose of the thesis is to study which outputs are the most important for the case company and how the overall architecture model will be formed in order to get the best benefit for the company's operations.

Capabilities

• How familiar are you with the concept of total architecture already?

• How can the organisation be committed to NEA work?

• How is it worth pursuing in a small company?

• What ability do you feel a successful NEA job requires from the organisation?

Benefits

• What problems could the NEA bring relief to?

• What else do you think the NEA should be used for?

Challenges

• What criteria do you think should be used to assess the success of EA work?

• What things do you think will increase the success or failure of the EA?

Resources

• What kind of financial investments do you feel the EA requires?

• What kind of financial benefits do you feel you will receive from EA?

Annexe 3: Thematic interview analysis

Here are the main themes and key points derived from the thematic interviews.

Capabilities (What capabilities we have or need for EA?)

- EA is, in principle, familiar to most interviewees. Few people had practical experience working with EA or parts of it.

- Much of the deliverables concerning processes and business architecture are already available and need only to be included in EA.

- Capabilities to implement EA are expected to grow with each ADM cycle

- To work within the EA team requires true passion and motivation with some holistic overview of the company.

- After the first iteration, the road is paved, and EA will be a more effortless process.

- Successful EA requires skills to identify activities and their relations.

- Using a certification program like ISO 9001 or an outside consultant can work as an incentive to drive EA after the first EA versions have been made.

- Leadership is supportive, and there is proof of capability in the form of existing management system development work.

- An incremental approach is the foundation of building capabilities.

- Process owners have a substantial role in EA work.

Benefits (What benefits EA would offer us?)

- The clarity to own work and surrounding activities is increased.

- Avoidance of duplication of work and unnecessary work is one significant benefit with real financial impacts.

- Deliver a holistic view of processes and how they interact (Value Stream mapping)

- A clear vision where we wish to lead our product line.

- Strategy and roadmap describe where the company is headed.

- Identifying needs in the organisation to improve value stream and specific processes.

- We gain information about the direction of our clientele and technology, in general, to prepare us for the changes ahead.

- Helps organisation to transform from being reactive to being proactive and identifying opportunities which enables us to evolve and gain an advantage.

- EA also shows what has been accomplished and can award by acknowledging that something great and good for the company was contributed and achieved.

- EA shares the same thinking as the existing management systems and is worth implementing.

Challenges (What challenges EA would offer us?)

- EA is a failure if it becomes an absolute value and is not in contact with the practice, and feels distant to employees.

- It is a failure not to have EA.

- The risk of failure is reduced by getting people involved in the work.

- The risk of failure is increased if the amount of work is overwhelming.

- The risk of failure is reduced with evolution steps where the EA size is scaled up as capabilities are growing.

- The risk of failure is reduced when the EA is recognised as essential and something we want to implement. This way, the EA work is authorised naturally.

- The first iteration of EA requires much work and may require effort from a single or just a few people to get the work going and show the benefits.

- While evaluating the current state, some users and admins of old systems may feel the need to support the status quo. They are motivated to keep the old systems in order not to have to learn new systems. This requires thought when these systems are analysed.

- Lack of motivation can make it challenging to adopt new operating models and systems.

- Lack of motivation needs addressing by showing the benefits that are achievable.

- There is always a need to clarify more. What is an acceptable level of ambiguity?

- There is a need for implementing ownership of work. How can this be helped via EA?

Resources (What resources EA would offer or require?)

- EA work requires an initial effort requiring much work from one person to get the work started. This will lower the risk of failure but requires resources from just one or a few people.

- None of the interviewees felt that the are other expenses required in EA than the work hours. Some findings of the EA could cause expenditures, but that should not be seen as a cost of EA rather an outcome of the findings that require cost to solve.

- Regarding resources, the EA can help communicate company goals, work ethics, and principles to clients and possible job seekers. This has value.

Other observations

- Some of the material EA could produce overlap with the quality handbook (ISO 9001)

- There may be inputs from different architecture domains to start the ADM cycle. The SaaS platform may only require a review every three years if the issue is considered in terms of procurement. It concludes that the ADM cycle may be light in some areas of architecture, while in others, the effort may be higher.

- Phase H is a problematic phase because it might feel too comfortable to stay there. The fear of launching a new ADM cycle is increased. This would suggest that the ADM cycle could be arranged yearly or quarterly to force the analysis. There is a saying in the case company, "You do not know what you do not know until you learn what about all the things you do not know". The idea behind it is that if we do not challenge ourselves to search and explore things, we are oblivious about the world. The first step of learning is to get a view of things there are to learn. EA process the ADM-cycle forces us to explore things and forces us to think, which will provoke

innovation and learning. There is a difference between "knowing" things and teaching things you know. Latter forces the teacher to learn the subject in more detail. EA requires us to communicate the things we think we know, and by that alone, it refines the understanding of things.

- Templates of the deliverables might help to lower the learning curve and guide the EA work to be more formalised. As time goes and we gain new knowledge via doing ADM cycles, capabilities of doing EA increase.

- The capability required is to take feedback fearlessly. When you have feedback from co-workers and employees, it should be embraced and not fought against.

- One of the interviewees pointed out that we have reached some great things together and should celebrate them. That thought was not pursued in the interview by the interviewer but lead to the idea of recognising the achievements from EA work.