Czech University of Life Sciences Prague

Faculty of Economics and Management

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Diploma Thesis

Using Enterprise Architecture in a business company

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

DIPLOMA THESIS ASSIGNMENT

Roman Teslia

Economics and Management

Thesis title

Using Enterprise Architecture in a business company

Objectives of thesis

The main objective of the thesis is to apply Enterprise Architecture to a business company.

The partial objectives are such as following:

1) To make a comprehensive literature review on the current trends of using Enterprise Architecture for business companies;

2) To conduct a analysis of the current state of a selected business company;

3) To propose a change to the Enterprise Architecture of the company and assess the proposed change;

4) To formulate recommendations and conclusion.

Methodology

Methodology of the thesis is based on study and analysis of information resources. The findings will be used for proposing and implementing changes to the Enterprise Architecture of the company. The practical part will be based on the requirement analysis and ADM which is part of TOGAF. The Enterprise Architecture will be designed with the use of Archi modelling tool. The proposed change will be assessed by the Cost Benefit Analysis and ROI. Final recommendations and conclusion will be formulated as a synthesis of findings in the theoretical and practical part.

The proposed extent of the thesis

60 – 80 pages

Keywords

Enterprise Architecture, business company, information system, company management, web development, e-commerce

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Recommended information sources

Harrison, R., 2018. Togaf (r) 9 Foundation Study Guide. Van Haren.
Judah Phillips, 2016. Ecommerce Analytics: Analyze and Improve the Impact of Your Digital Strategy
Lankhorst, M., et al. 2018. Enterprise Architecture at Work: Modelling, Communication and Analysis (The Enterprise Engineering Series). Fourth edition. Springer. ISBN 978-3-662-53932-3
The Open Group, 2018. ArchiMate 3.0.1. Specification. www.publications.opengroup.org
The Open Group, 2018. The TOGAF Standard, Version 9.2. www.publications.opengroup.org

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Declaration

I declare that I have worked on my diploma thesis titled "Using Enterprise Architecture in a business company" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 22. 10. 2018 _____

Acknowledgement

I would like to thank Ing. Miloš Ulman, Ing. Bohuslava Boučková, Prof. Eamon Lenihan, Ing. Marek Pícka and all other persons, for their advice and support during my work on this thesis.

Using Enterprise Architecture in a business company

Abstract

Enterprise architecture (EA) is a well-defined practice for conducting enterprise analysis, design, planning, and implementation, using a holistic approach at all times, for the successful development and execution of strategy. Enterprise architecture applies architecture principles and practices to guide organizations through the business process, data & information, and technology changes necessary to execute their strategies.

EuroCool LLC is the selected company, which wants to utilize these practices in the variety of sales processes. The aspects of identifying, motivating, and achieving these practices, which includes the effort to understand the strategic intent of building a new enterprise architecture and then having to learn and adjust to new business processes, supporting technologies, new infrastructures and partner relationships, hiring and training, and anything else which is important to work in alignment, in order to achieve better business performance.

Proposed changes in enterprise architecture of the company have in consideration the preliminary analysis of business organization, the current state model, the future state model, evaluation of an economic effect on a business company and are targeted to improve business performance and enhance the economic growth.

Keywords: Enterprise Architecture, Business Company, information system, company management, business strategy, BPMN, web development, e-commerce, ArchiMate, Archi.

Table of content

List of pictures

List of tables

List of abbreviations

Enterprise Architecture – EA

Architecture Development Method – ADM

The Open Group Architecture Framework – TOGAF

Factor Analysis of Information Risk – FAIR

Unified Modelling Language – UML

Business Process Modelling and Notation – BPMN

Cost-Benefit analysis – CBA

Return on investment – ROI

1 Introduction

Every business company, no matter the size, history or industry have some type of organization structure in place. At the same time, their competitors can invest some more time to build an enterprise architecture in order to increase effectiveness, efficiency, agility, and durability of their operation with a goal to maintain the competitiveness of their business.

Usually, the large companies create and operate enterprise architecture, linking the business mission, strategy, and processes of an organization to its technological strategy. Although, in case of small companies, the business goal might be written in just a single document and the amount of organisation's technology goes down to founder's laptop and his/her mobile phone. To put in comparison, larger companies have their organisation structure that covers all aspects of the business strategy as well as a full stack of technology including infrastructure, data and thousands of deployed applications.

Those companies are using various domain architectures such as organization, products, business process, application, information, and technical architectures. In each of these architectural domains, specific concepts are defined, which are modelling and visualizing their internal coherence. These specific models and visualizations simplify communication, discussion and analysis within the domain. In transformation processes, many models are produced in several stages, while each individual model deals with the same domain. It takes a lot of time and money to produce models during one stage of the transformation processes. Increasing coherence between models would, for example, enable the re-use of investments made in models earlier on in a transformation process.

It is often the case that models must be re-drawn or even re-modelled from one stage of the transformation process, such as a BPMN model, to some other languages at a later stage of the transformation process. This leads to unfavourable situations such as enormous costs and delays. An alternative to this problem is to create a coherent modelling landscape, which underlines the integration of modelling concepts at different levels. This prevents unnecessary delays and costs during transformation processes.

The ArchiMate language is uniquely designed specifically for Enterprise Architecture. It primarily illustrates the Business and Application core layers of the ArchiMate language.

The relevance of this work is the need to develop an enterprise architecture, a conceptual blueprint that defines the structure and operation of an organization of EuroCool LLC, for support of their business. In connection with the constant expansion of the company, and the

increasing demand for its range of products, it is necessary to closely monitor strategy, development their comments and suggestions. The company needs to automate this process, as the increasing flow of requests requires comprehensive analysis and response decisions.

2 Objectives and Methodology

2.1 Objectives

The main objective of the thesis is to apply Enterprise Architecture to a business company. The partial objectives are such as following. Firstly, an analysis of the current state of a selected business company will be conducted. Secondly, changes to the Enterprise Architecture will be identified and proposed. The presented research will try to prove a hypothesis: "*The improvements in Enterprise Architecture can lead to a positive economic effect in a business company.*" Thirdly, based on the proposal of the changes to the enterprise architecture, chosen economic effects will be evaluated. Finally, recommendations and conclusion will be formulated.

2.2 Methodology

Methodology of the thesis is based on study and analysis of information resources. Thus, a comprehensive literature review on the current trends of using Enterprise Architecture for business companies. The findings will be used for proposing and implementing changes to the Enterprise Architecture of the company. The practical part will consist of a requirement analysis and ADM which is part of The Open Group Architecture Framework, or shortly TOGAF. The Enterprise Architecture will be designed with the use of Archi modelling tool. Archi is a free and open-source visual-modelling and design tool for creating ArchiMate models and modelling sketches.

Main methodological tool is ArchiMate – is an open and independent enterprise architecture modelling language to support the description, analysis and visualization of architecture within and across business domains in an unambiguous way.

An Archi software supports the ArchiMate 3.0 modelling language, a technical standard from The Open Group. Archi software provides an open source reference implementation of ArchiMate language. It also has many plugins, such as a Database Plugin that allows to store the ArchiMate models in a central repository (database). Also, a Form Plugin: add the ability to show and update elements and relationships properties in a form. And a Script plugin that automates some actions.

Economic evaluation which refers to various methods to determine the value of a project. It involves quantifying marginal economic impacts (benefits and costs) to determine net benefits or net value (benefits minus costs).

One of the most common economic evaluation methods is Cost-Benefit analysis, which uses monetized (measured in monetary units) values to compare total incremental benefits with total incremental costs. The results can be presented as a ratio, with benefits divided by costs (which is why it is often called Benefit/Cost or B/C analysis). Net Benefit is defined as the sum of all benefits minus the sum of all costs, which provides an absolute measure of benefits (total dollars), rather than the relative measures provided by B/C Ratio.

Return on investment, or ROI, a profitability measure that evaluates the performance of a business by dividing net profit by net worth. It is the most common profitability ratio. There are several ways to determine ROI, but the most frequently used method is to divide net profit by total assets.

3 Literature Review

3.1 Definition of Business strategy

The strategy has to do with how a company chooses what activities it performs. It also has to do with how and where the administration decides to participate in those activities. Success happens when that strategy generates a sustainable benefit, higher than the industry average. (Magretta)

There are three generic strategies for competitive advantage:

Cost leadership – Become the lowest cost competitor. Most industries only have a cost leader. And this leadership is usually achieved through economies of scale, technology, or perhaps a unique access to raw materials. A business is successful if its costs are lower than its competitors and can charge average industry prices. But if that company sacrifices quality, it can find itself in a spiral of death that reduces costs. This strategy is difficult if competitors also pursue it. In that case, this strategy could start the industry in a spiral of death that reduces costs.

Differentiation – Develop products or services that provide superior value. This strategy costs more, so the company should be able to charge more than competitors to obtain a profit above the industry average. To offset these higher costs, the company may need to reduce costs in less critical and non-core areas. Unlike the low-cost strategy, many competitors in an industry could follow this strategy.

Focus – Target a specific segment of the industry, ignoring the rest. Usually, an area of focus is where competitors are weak.

A company should not follow more than one strategy or it will "stuck in the middle". There are rare cases in which cost and differentiation strategies can work together. For example, if competing companies are mismanaged or if a company has a major innovation. But a company should not try a dual strategy until it has mastered a strategy. (Porter, 2008)

To decide on a strategy that generates a long-term benefit above the industry average, companies must take into account the forces analysis of Porter.

Porter's Five Forces is a business analysis model that helps to explain why different industries are able to sustain different levels of profitability. The model was originally published in Michael Porter's book, "Competitive Strategy: Techniques for Analysing Industries and

Competitors" in 1980. The model is widely used to analyse the industry structure of a company as well as its corporate strategy.

Figure 1 Porter's Five Forces model, adapted from: (Porter, 2008)

Porter identified five undeniable forces that play a part in shaping every market and industry in the world. The forces are frequently used to measure competition intensity, attractiveness and profitability of an industry or market. These forces are:

Competition in the Industry

The importance of this force is the number of competitors and their ability to threaten a company. The larger the number of competitors, along with the number of equivalent products and services they offer, the lesser the power of a company. Suppliers and buyers seek out a company's competition if they are unable to receive a suitable deal. When competitive rivalry is low, a company has greater power to do what it wants to do to achieve higher sales and profits.

Potential of New Entrants into an Industry

A company's power is also affected by the force of new entrants into its market. The less time and money it costs for a competitor to enter a company's market and be an effective competitor, the more a company's position may be significantly weakened. An industry with strong barriers to entry is an attractive feature for companies that would prefer to operate in a space with fewer competitors.

Power of Suppliers

This force addresses how easily suppliers can drive up the price of goods and services. It is affected by the number of suppliers of key aspects of a good or service, how unique these aspects are, and how much it would cost a company to switch from one supplier to another. The fewer the number of suppliers, and the more a company depends upon a supplier, the more power a supplier holds.

Power of customers (Buyers)

This specifically deals with the ability customers have to drive prices down. It is affected by how many buyers or customers a company has, how significant each customer is, and how much it would cost a customer to switch from one company to another. The smaller and more powerful a client base, the more power it holds.

Threat of Substitutes

Competitor substitutes that can be used in place of a company's products or services pose a threat. For example, if customers rely on a company to provide a tool or service that can be substituted with another tool or service or by performing the task manually, and if this substitution is fairly easy and of low cost, a company's power can be weakened.

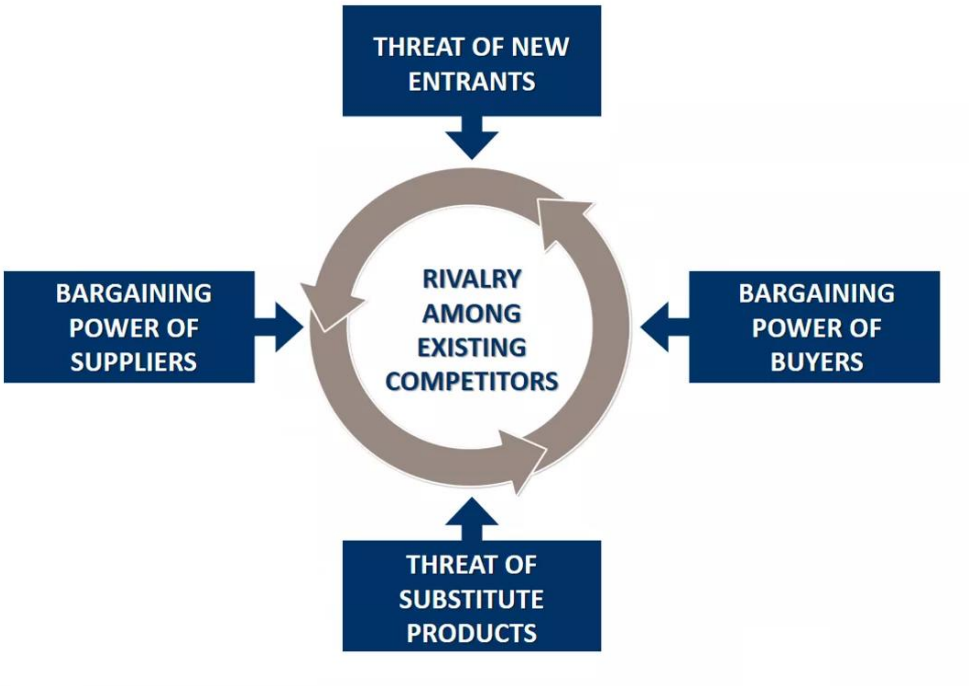

Figure 1.1 How Porter's five Forces model works, adapted from (Porter, 2008)

This model describes the profitability of an industry and which part of it is the most profitable. To be successful, a company must relentlessly pursue the strategy it chooses; Even when some

doubt that the strategy can succeed. In fact, true success occurs when a management team adheres to that strategy for longer than its competitors. (Porter, 2008)

It is necessary to understand the goals and objectives of the business, the direction and prospects of its development. Also, the maximum involvement of the business in the automation process and its willingness to work together are necessary.

It is necessary to take into account such an important factor as the state of business processes intended for automation: their maturity, sustainability, and manageability In addition, it is necessary to take into account the principles of company management, the distribution of management functions, a centralized and / or decentralized approach.

In addition, should not forget about the general state of automation and automated processes, perceptions and attitudes towards automation by users and businesses.

Thus, we can formulate a number of key aspects of linking between IT and business:

Recognition of information technology as an integral part of the enterprise;

Distribution of responsibility for the implementation of IT strategy between business and IT;

The objectives of the strategy should be based on the needs of the enterprise;

Close collaboration with business customers should be maintained;

Concentration is needed on priority objectives and strategic initiatives, rather than on meeting short-term “one-time” needs;

It is necessary to ensure the availability and adequacy of resources. At the same time, the volume of these resources should not exceed the size of the expected effect;

IT management needs to maintain informal relationships with executive management;

It is necessary to create a strategic management system for the implementation of IT strategy.

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To provide more insight into the different aspects that an enterprise architecture model may encompass, we will outline a number of well-known architecture frameworks, standards and approaches. Frameworks structure architecture description techniques by identifying and relating different architectural viewpoints and the modelling techniques associated with them. They do not provide the concepts for the actual modelling, although some frameworks are closely connected to a specific modelling language or set of languages. (Lankhorst, 2018)

3.1.1 Zachman Framework

Most architecture frameworks are quite precise in establishing what elements should be part of an enterprise architecture. However, to ensure the quality of the enterprise architecture during its life cycle the adoption of a certain framework is not sufficient. The relations between the different types of domains, views, or layers of the architecture must remain clear, and any change should be carried through methodically in all of them. For this purpose, a number of methods are available, which assist architects through all phases of the life cycle of architectures. (Lankhorst, 2018)

In the year of 1987, John Zachman introduced the first and best-known enterprise architecture framework, although back then it was called ‘Framework for Information Systems Architecture’. This framework as it applies to enterprises is simply a logical structure for classifying and organising the descriptive representations of an organisations that are significant to the management of the enterprise as well as to the development of the enterprise’s systems. (Lankhorst, 2018)

	What (Data)	How (Function)	Where (Locations)	Who (People)	When (Time)	Why (Motivation)
Scope {contextual} Planner	List of things important to the business	List of processes that the business performs	List of locations in which the business operatses	List of organizations important to the business	List of events/ cycles important to the business	List of business goals/strategies
Enterprise Model {conceptual} Business Owner	e.g. Semantic Model	e.g. Business Process Model	e.g. Business Logistics System	e.g. Workflow Model	e.g. Master Schedule	e.g. Business Plan
System Model {logical} Designer	e.g. Logical Data Model	e.g. Application Architecture	e.g. Distributed System Architecture	e.g. Human Interface Architecture	e.g. Process Structure	e.g. Business Rule Model
Technology Model {physical} Implementer	e.g. Physical Data Model	e.g. System Design	e.g. Technology Architecture	e.g. Presentation Architecture	e.g. Control Structure	e.g. Rule Design
Detailed Representation {out-of-context} Subcontractor	e.g. Data Definition	e.g. Program	e.g. Network Architecture	e.g. Security Architecture	e.g. Timing Definition	e.g. Rule Definition
Functioning System	e.g. Data	e.g. Function	e.g. Network	e.g. Organization	e.g. Schedule	e.g. Strategy

Figure 2 – Zachman Framework, source: http://www.enterpriseunifiedprocess.com

The framework in its most simple form depicts the design artefacts that constitute the intersection between the roles in the design process, that is, owner, designer and builder, and the product abstractions, that is, what (material) it is made of, how (process) it works and where (geometry) the components are relative to one another. Empirically, in the older disciplines, some other 'artefacts' were observable that were being used for scoping and for implementation purposes. These roles are somewhat arbitrarily labelled planner and subcontractor and are included in the framework graphic that is commonly exhibited. From the very inception of the framework, some other product abstractions were known to exist because it was obvious that in addition to what, how, and where, a complete description would necessarily have to include the remaining primitive interrogatives: who, when and why. These three additional interrogatives would be manifest as three additional columns of models that, in the case of enterprises, would depict: who does what work, when do things happen, and why are various choices made.

Advantages of the Zachman framework are that it is easy to understand, it addresses the enterprise as a whole, it is defined independently of tools or methodologies, and any issues can be mapped against it to understand where they fit. An important drawback is the large number

of cells, which is an obstacle for the practical applicability of the framework. Also, the relations between the different cells are not that well specified. Notwithstanding these drawbacks, Zachman is to be credited with providing the first comprehensive framework for enterprise architecture, and his work is still widely used.

3.1.2 The Open Group Architecture Framework

The Open Group Architecture Framework (TOGAF) originated as a generic framework and methodology for development of technical architectures, but evolved into an enterprise architecture framework and method. From version 8 onwards, TOGAF (The Open Group 2011) is dedicated to enterprise architectures. TOGAF has the following main components

- An Architecture Capability Framework, which addresses the organisation, processes, skills, roles, and responsibilities required to establish and operate an architecture function within an enterprise.
- The Architecture Development Method (ADM), which provides a 'way of working' for architects. The ADM is considered to be the core of TOGAF, and consists of a stepwise cyclic approach for the development of the overall enterprise architecture.
- The Architecture Content Framework, which considers an overall enterprise architecture as composed of four closely interrelated architectures: Business Architecture, Data Architecture, Application Architecture, and Technology (IT) Architecture.

The Enterprise Continuum, which comprises various reference models, such asthe Technical Reference Model, The Open Group's Standards Information Base (SIB), and The Building Blocks Information Base (BBIB). The idea behind the Enterprise Continuum is to illustrate how architectures are developed across a continuum ranging from foundational architectures, through common systems architectures and industry-specific architectures, to an enterprise's own individual architecture.

TOGAF is an enterprise architecture standard, ensuring consistency of standards, methods, and communication among enterprise architecture, so that it is possible to conduct enterprise architecture development in a better way, including:

- An iterative process model supported by best practices
- A re-usable set of existing architecture assets

- Methods and tools for the planning, development, implementation, and maintenance of an enterprise architecture

3.1.3 AllFusion Process Modeler

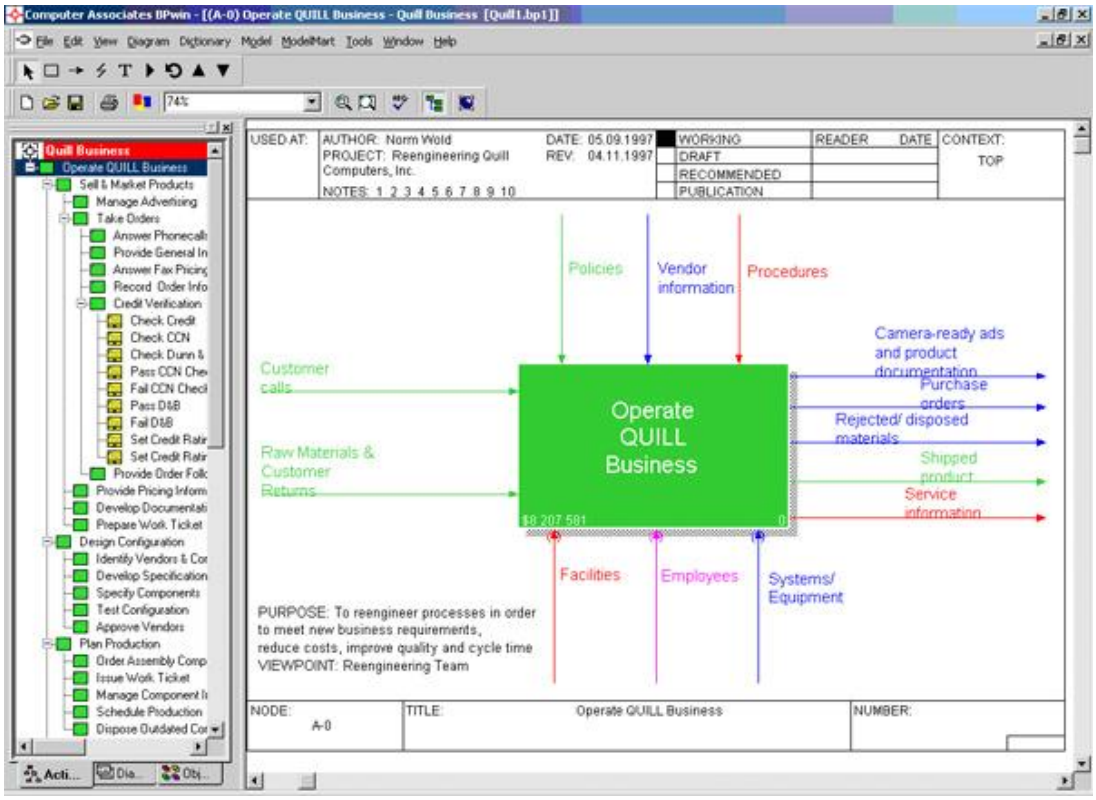


Figure 3.1 Example of a business process modelling – BPMN, source: https://supportcontent.ca.com/cadocs/0/e002771e.pdf

It is a tool for modelling, analysing, documenting and optimizing business processes. AllFusion Process Modeler can be used to graphically represent business processes. A graphically presented work flow, information exchange, workflow visualizes the business process model. Graphic presentation of this information allows to transfer the management of the organization of the complex craft in the field of engineering technology. AllFusion Process Modeler helps to clearly document important aspects of any business processes: the actions to be taken, the ways to implement and control, the resources required for this, as well as visualize the results obtained from these actions. AllFusion Process Modeler enhances the business efficiency of IT solutions, allowing analysts and model planners to align corporate initiatives and tasks with business requirements and information architecture and application design processes. Thus, a holistic picture of the enterprise's activity is formed: from workflows in small divisions to

complex organizational functions. AllFusion Process Modeler (BPwin) is effective in projects related to the description of the existing bases of enterprises, the reorganization of business processes, the introduction of corporate information systems.

One of key features of AllFusion Process Modeler is the decomposition diagrams which are used to break down an activity into more detailed and constituent parts.

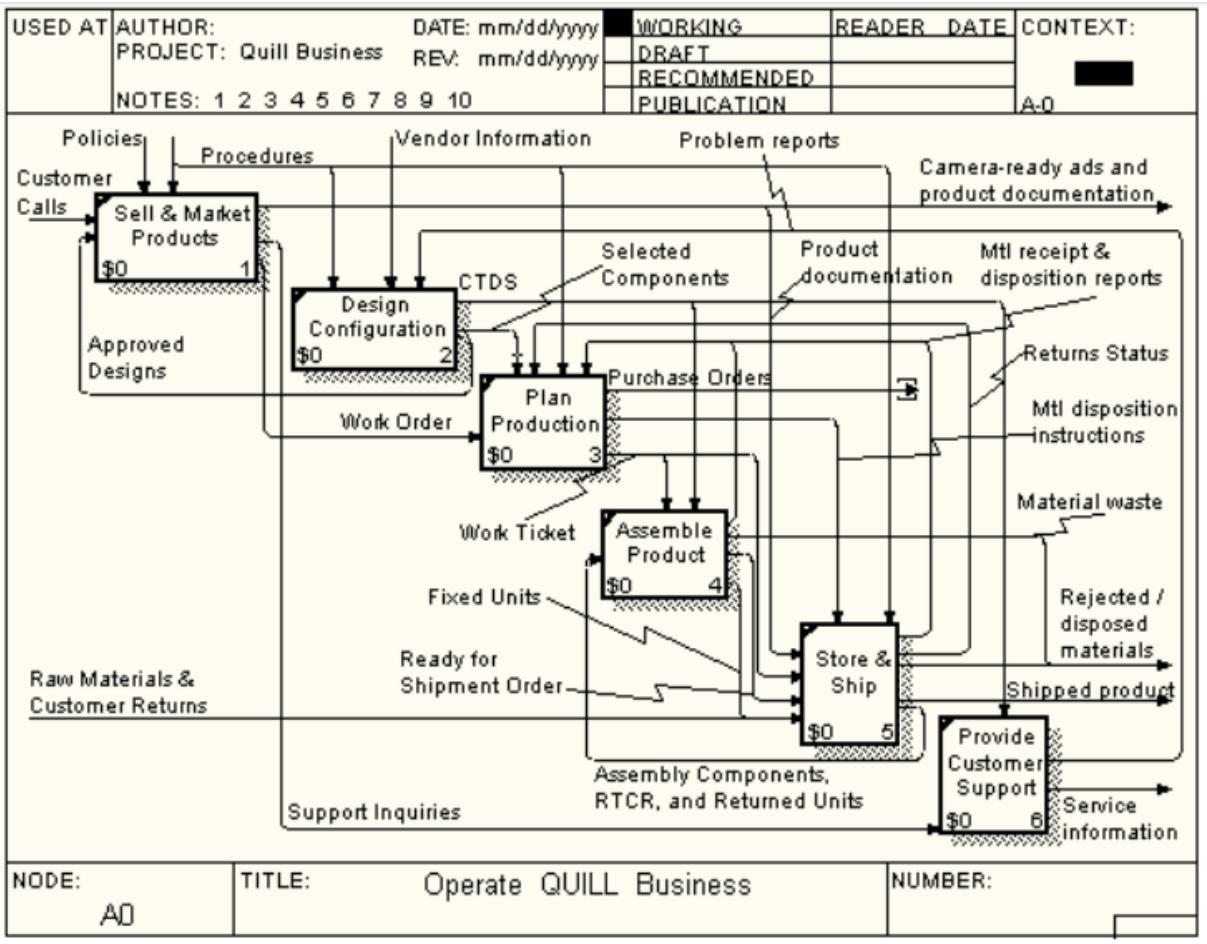


Figure 3.2 Example of a business decomposition modelling – BPMN, source: https://supportcontent.ca.com/cadocs/0/e002771e.pdf

Figure 3.2 represents decomposition example, the activities are being divided into smaller ones.

To see how selected business company operates, it can be decomposed into activities that it is doing. On a figure above, it was decomposed into activities such as Sell & Market Products, Design configuration, Plan Production, Assemble product, Store & Ship and Provide customer support. Each of these activities can also be decomposed into their constituent activities, in order to see more detailed picture. Although the methodologies may differ, the basic premise of decomposition is the same.

System requirements for AllFusion Process Modeler:

- 32 or 64 bit dual core processor, 2 GHZ or higher
- Graphic adapter with a resolution of at least 800 x 600, 256 colours.
- 2 GB available hard drive space
- 2 GB RAM minimum; more is recommended for large models
- MS Windows operating system, versions XP Service Pack 3/Vista/ 2003 Server SP2/ 2008 Server SP2 Windows 7

3.1.4 CraftCase

Craft.CASE is a small, but yet very powerful Business process analysis tool. This tool can visualize or define business processes it is also possible to locate inefficiencies, performance deviations or errors.

With Craft.CASE it is relatively easy to build the business architecture. However, he tool works according to a complex and powerful method. Even though it may seem difficult, it is actually very simple to use.

Features:

- guidelines set according to the C.C. method
- process analysis categorization into interview, business and conceptual phases
- ability to set the user-defined properties to individual objects
- graphically visualize any object according to its values and properties
- performing process animations and simulations
- generating reports and specifying their content
- team collaboration
- advanced functions or functions not common in the field of BPA software are defined by users who can define and run their own scripts using our built-in programming language

Last but not least, another very important feature is the ability to simulate the process. Whether it is necessary to use it for model validation, verification, or just to present and visualize process progress, which depends on current needs, but if it is going to be used, Craft.CASE has this functionality. Many of the current business process analysis (BPA) tools that are available do not support simulations functionality.

System requirements of Craft.CASE software:

- 32 or 64 bit processor, minimum 300 MHz
- Graphic adapter with a resolution of at least 800 x 600, 256 colours. A graphic adapter supporting 3D, DirectX or OpenGL is not necessary.
- 80 MB of disk space
- MS Windows operating system, including versions ME/2000/XP/Windows 7/Vista, or Linux (x86/SPARC/PPC).

An example of a business process modelling in Craft.Case is presented in 8.1

3.2 Definition of Enterprise Architecture

Enterprise Architecture (EA) will interconnect business and IT together. It consists of a vision, principles and standards that lead to the acquisition and implementation of technology within the enterprise. (Okunieff, et al.)

The mission of Enterprise Architecture is to provide a process that sets common goals and coordinates the delivery of information technology services to government administrations that are responsible and cost-effective. (Transportation Research Board, 2011)

EA offers a model that links business goals with an IT strategy and creates a formal communication structure that supports a common vision.

The benefits of having a well-defined Enterprise Architecture are:

A more efficient business operation:

- Lower business operation costs
- More agile organization
- Business capabilities shared across the organization
- Lower change management costs
- More flexible workforce
- Improved business productivity

An Enterprise Architecture is typically developed because key people have concerns that need to be addressed by the business and IT systems within an organization. Such people are commonly referred to as the “stakeholders” of the Enterprise Architecture. The role of the architect is to address these concerns by identifying and refining the motivation and strategy

expressed by stakeholders, developing an architecture, and creating views of the architecture that show how it addresses and balances stakeholder concerns. Without an Enterprise Architecture, it is unlikely that all concerns and requirements are considered and addressed.

The ArchiMate Enterprise Architecture modelling language provides a uniform representation for diagrams that describe Enterprise Architectures. It includes concepts for specifying inter-related architectures, specific viewpoints for selected stakeholders, and language customization mechanisms. It offers an integrated architectural approach that describes and visualizes different architecture domains and their underlying relations and dependencies. Its language framework provides a structuring mechanism for architecture domains, layers, and aspects. It distinguishes between the model elements and their notation, to allow for varied, stakeholder-oriented depictions of architecture information. The language uses service-orientation to distinguish and relate the Business, Application, and Technology Layers of Enterprise Architectures, and uses realization relationships to relate concrete elements to more abstract elements across these layers.

Through Enterprise Architecture, in example state agencies are leading the way for the future of information technology. The success of this highly cooperative process depends on the participants' commitment to their goals and the guiding principles. (Transportation Research Board, 2011)

EA is a continuous, iterative process that ensures:

A shared vision of the future shared by stakeholders in business and information technology

Guidelines for selecting, creating and implementing solutions managed by business requirements

Support for government business through improved information exchange

A tool to control the growing complexity of technology by setting information technology standards across the enterprise

Ensuring policy makers that agencies create new systems and migrate old systems through a consistent process

Plan for integrating information and services at the design level across the borders of the agency. One of the central motivations for enterprise architecture in general is getting to grips with change. Architects and stakeholders want to take well-informed design decisions. To that end, they need to compare alternative designs, make trade-offs between aspects like cost,

quality, and performance, and know the impact of a change across all aspects of an architecture. Given the size and complexity of enterprise architectures, this is something that can no longer be done by hand and requires sophisticated analysis techniques. These analysis techniques do more than simply 'walk through a picture', but require well-defined semantic underpinnings and advanced analysis algorithms.

It is important to classify architecture analysis techniques according to different aspects. First, we make a distinction based on the types of analysis inputs and results: functional structural and dynamic properties and quantitative e.g., performance and costs.

Functional analysis is performed to gain insight into the functional aspects of an architecture. Among others, it is used to understand how a system that conforms to an architecture works, to find the impact of a change on an architecture, or to validate the correctness of an architecture.

Functional analysis techniques do not answer quantitative questions, like 'how quick' or 'how cheap'. These are typically questions addressed by the quantitative analysis techniques. Usually, architectural models do not provide sufficient information to perform detailed quantitative studies. In our view, an approach for quantitative analysis of enterprise architectures should make it possible to structure and relate quantitative results obtained with existing detailed analysis methods (e.g., queuing analysis or simulation).

Second, for both functional and quantitative analysis, we distinguish two main types of techniques: analytical techniques and simulation.

Basically, simulation can be seen as the 'execution' of a model. Functional simulation and animation are useful to illustrate the dynamic behaviour of a system. The aim of functional simulation is to gain insight into the properties and behaviour of an architecture. Architects can 'play' with the architecture and see how it works, feels, looks, can be adapted to certain changes, etc. Moreover, functional simulation can also play an important role in the communication between stakeholders, by giving them a better common understanding of the architecture. Interpretation problems, often stemming from the high level of abstraction of architectures, may come to light when using functional simulation. Quantitative simulation is used to make statistical statements about the quantitative measures of a system based on multiple simulation runs. It can be seen as performing 'measurements' in a model. Thus, quantitative simulation allows for a thorough examination of the performance measures in a specific situation.

Moreover, there are formal and analytical analysis techniques. In contrast to simulation, these are not of a statistical nature, but provide a unique, reproducible result. Analytical techniques

for quantitative analysis are typically more efficient than quantitative simulation, and therefore more suitable for providing the architect with a first indication of performance measures and bottlenecks in an architecture model. They are also useful when a comparison of a (large) number of alternatives is needed in so-called “what if” analysis.

Another issue to be addressed when using analysis techniques for enterprise architectures is whether to apply existing techniques, or to develop new ones. Buy or build? In the first case, two other questions are to be answered: which technique to choose from the available ones, and how to apply it? In the second case, the questions are for what problem a technique is developed, and how the development itself can be carried out.

3.2.1 Risk Analysis

In recent years, organisations have started to realise that the IT security challenges cannot be solved without dedicated security specialists. In facr, it should be incorporated as an integral Enterprise Risk and Security Management (ERSM) approaches. It is only natural to place ERSM in the context of enterprise architecture, for a comprehensive view that not only touches upon IT-related risks and security, but also at the social and business aspects. Therefore, it is not surprising that enterprise architecture frameworks such as TOGAF (The Open Group, 2011) are including information on risk and security and the security frameworks, such as SABSA (Sherwood, 2009) shows a remarkable similarity to the Zachman framework. Seen in this light, it also makes sense to use the ArchiMate language to model risk and security aspects as an integral part of an enterprise architecture and use such analysis techniques to assess vulnerabilities, threats and the ensuing risks. In a work published by The Open Group (The Open Group, 2018) it is shown how concepts found in recent risk and security standards and frameworks can be applied to ArchiMate concepts. Specific icons, different from the standard ArchiMate icons, are used to denote risk and security-specific specialisations of concepts. For the purpose of risk analysis, it is possible to assign risk-related attributes to these concepts. The Factor Analysis of Information Risk (FAIR) taxonomy (The Open Group, 2011) adopted by The Open Group provides a good starting point for this. If sufficiently accurate estimates of the input values are available, quantitative risk analysis provides the most reliable basis for risk-based decision-making. However, in practice, these estimates are often difficult to obtain. Therefore, FAIR proposes a risk assessment based on qualitative measures, e.g. threat capability ranging from very low to very high and risk ranging from low to critical.

A vulnerability scan of the transmission of payment data from a web shop to an online payment provider has shown that the encryption level of transmitted payment records is low (e.g. due to an outdated version of the used encryption protocol). This is classified as VL: 'high'. Also, the transmission channel using the public Internet is insecure, which is classified as a VL: 'medium'. These two vulnerabilities enable a man-in-the-middle attack, in which a cybercriminal may modify the data to make unauthorised payments, e.g. by changing the bank account number of the receiver. Assuming a cybercriminal with medium skills (TC: 'medium') and an average of multiple attempted attacks per week (TEF: 'high'), the expected value for LEF is 'high'. Finally, assuming that a potentially large sum of money may be lost (PLM: 'high'), the resulting risk factor RF is 'critical'.

Assuming that this risk is deemed unacceptable, a control objective can be defined to prevent unauthorised access to payment data. We can also attach a security profile to this control objective, specifying the security parameters that we require for payment data: confidentiality and integrity must be high (it should be prevented that unauthorised persons can view or modify the data), and the required level of availability is medium (payment data does not have to be available 24/7).

Based on the security profile of the control objective and the outcome of the risk analysis, specific requirements for control measures are required. For example, as a preventive control measure that helps to achieve the required levels of confidentiality and integrity, a stronger encryption protocol is needed (which can be realized by e.g. 256-bit encryption instead of 128-bit encryption), as well as a secure transmission channel (which can be realized by using a VPN solution). Incorporating the control strengths of these measures in the risk analysis, an estimate can be made of the effect of the control strengths on the residual risk. Further reduction of this risk may also require other measures, e.g. a reduction of the probable loss magnitude by limiting the maximum amount of money that can be transferred using this payment provider. Although the importance of enterprise architecture modelling has been recognized, hardly any attention has been paid to the analysis of its quantitative properties. Most existing approaches to performance evaluation focus on detailed models within a specific domain. We demonstrated the applicability of quantitative modelling and analysis techniques for the effective evaluation of design choices at the enterprise architectures level, in the context of ArchiMate models. We discerned a number of architecture viewpoints with corresponding performance measures, which can be used as criteria for the optimization or comparison of such designs. We introduced a new approach for the propagation of workload and performance measures through a layered

enterprise architecture model. This can be used as an analysis framework where existing methods for detailed performance analysis, based on, for example, queuing models, Petri nets or simulation, can be plugged in. The presented example illustrates the use of our top-down and bottom up technique to evaluate the performance of a document management system for the storage and retrieval of damage reports. Using a simple queuing formula for the response times, we showed that queuing times from the lower layers of the architecture accumulate in the higher layers, which may result in response times that are orders of magnitude greater than the local service times. (Lankhorst, 2018)

3.3 ArchiMate language and Archi modelling tool

ArchiMate is an open and independent enterprise architecture modelling language that explicitly supports the description, analysis, and visualization of an architecture within and between business domains.

ArchiMate is a technical standard from the Open Group and is based on the concepts of the IEEE 1471 standard. It is supported by various tool vendors and consulting firms. ArchiMate is also a registered trademark of The Open Group. The Open Group has a certification program for ArchiMate users, software and courses. ArchiMate distinguishes itself from other languages, such as Unified Modelling Language (UML) and business process modelling and notation (BPMN), using enterprise modelling capabilities. (The Open Group, 2018)

ArchiMate offers a common language for describing the construction and operation of business processes, organizational structures, information flows, IT systems and technical infrastructure. This is similar to an architectural drawing in a classic building, where architecture describes various aspects of building construction and use. This understanding helps various stakeholders design, evaluate, and communicate the implications of decisions and changes within and between these business domains.

The basic concepts and relations of the ArchiMate language can be viewed as a structure, the so-called ArchiMate architecture: it divides the corporate architecture into a business, application and technology level. Three aspects are considered in each layer: active elements that demonstrate behaviour (for example, process and function), internal structure, and elements that define the use or transmission of information.

One of the goals of the ArchiMate language is to define the relationship between concepts in different areas of architecture. Thus, the concepts of this language occupy the middle between

the detailed concepts that are used to model individual domains and BPMN, which is used to model business processes. ArchiMate is partly based on the IEEE 1471 standard. It was developed in the Netherlands by a project team from the Telematica Instituut in cooperation with several Dutch partners from government, industry and academia. Among the partners were Ordina, Radboud Universiteit Nijmegen and the Leiden Institute for Advanced Computer Science (LIACS) and the Centrum Wiskunde & Informatica (CWI). Later, tests were performed in organizations such as ABN AMRO, the Dutch Tax and Customs Administration and the ABP.

The development process lasted from July 2002 to December 2004 and occupied about 35 man-years and about 4 million euros. The development was funded by the Dutch government (the Dutch tax and customs administration) and business partners, including ABN AMRO and the ABP Pension Fund. TOGAF (The Open Group, 2011) identifies a large number of viewpoints as part of its content meta-model, subdivided in three main types of architectural artefact: matrices, catalogues and diagrams. Also, ArchiMate and TOGAF exhibit a very similar layered structure. This correspondence suggests a fairly easy mapping between TOGAF's views and the ArchiMate viewpoints. Although corresponding viewpoints from ArchiMate and TOGAF do not necessarily have identical coverage, we can see that many viewpoints from both methods address approximately the same issues.

Moreover, ArchiMate is not limited to a specific set of viewpoints and allows the definition of new viewpoints via the viewpoint mechanism described in the standard.

The most important disparity we observe between TOGAF and ArchiMate is that the ArchiMate viewpoints that deal with the relationships between architectural layers, such as the product and application usage viewpoints, are difficult to map onto TOGAF's diagrams, which are largely confined to a single architectural layer. Although TOGAF does support several matrices that provide such a correspondence between layers, such as the 'Application/Organization Matrix' or the 'Data Entity/Business Function Matrix' it does not provide graphical representations of these.

The ArchiMate language and its analysis techniques support pretty much all of TOGAF's diagrammatic views. Using ArchiMate as a description language together with TOGAF as a method for developing architectures provides the architect with two nicely complementary, open and vendor-independent methods. Since both are administered by The Open Group, further integration of TOGAF and ArchiMate can be expected.

In 2008, the ownership and control of ArchiMate was transferred to the Open Group. Now it is managed by the ArchiMate Forum as part of The Open Group. In February 2009, the Open Group published ArchiMate 1.0 as the official technical standard. In January 2012, the ArchiMate 2.0 standard was established, and in 2013, the ArchiMate 2.1 standard was released.

In June 2016, the Open Group released version 3.0 of the ArchiMate specification. In version 3.0, extended support was added for functional-oriented strategic modelling, new objects representing physical resources (for modelling ingredients, equipment and transport resources used in the physical world), and a general model showing the types of entities and the relationships between them (Harrison, 2018).

ArchiMate is an integrated architectural approach that describes and visualizes various business domains and their relationships. The use of these integrated architectures helps interested parties in assessing the impact of design choices and changes. Figure 3.1 shows a variety of different layers, which ArchiMate is using.

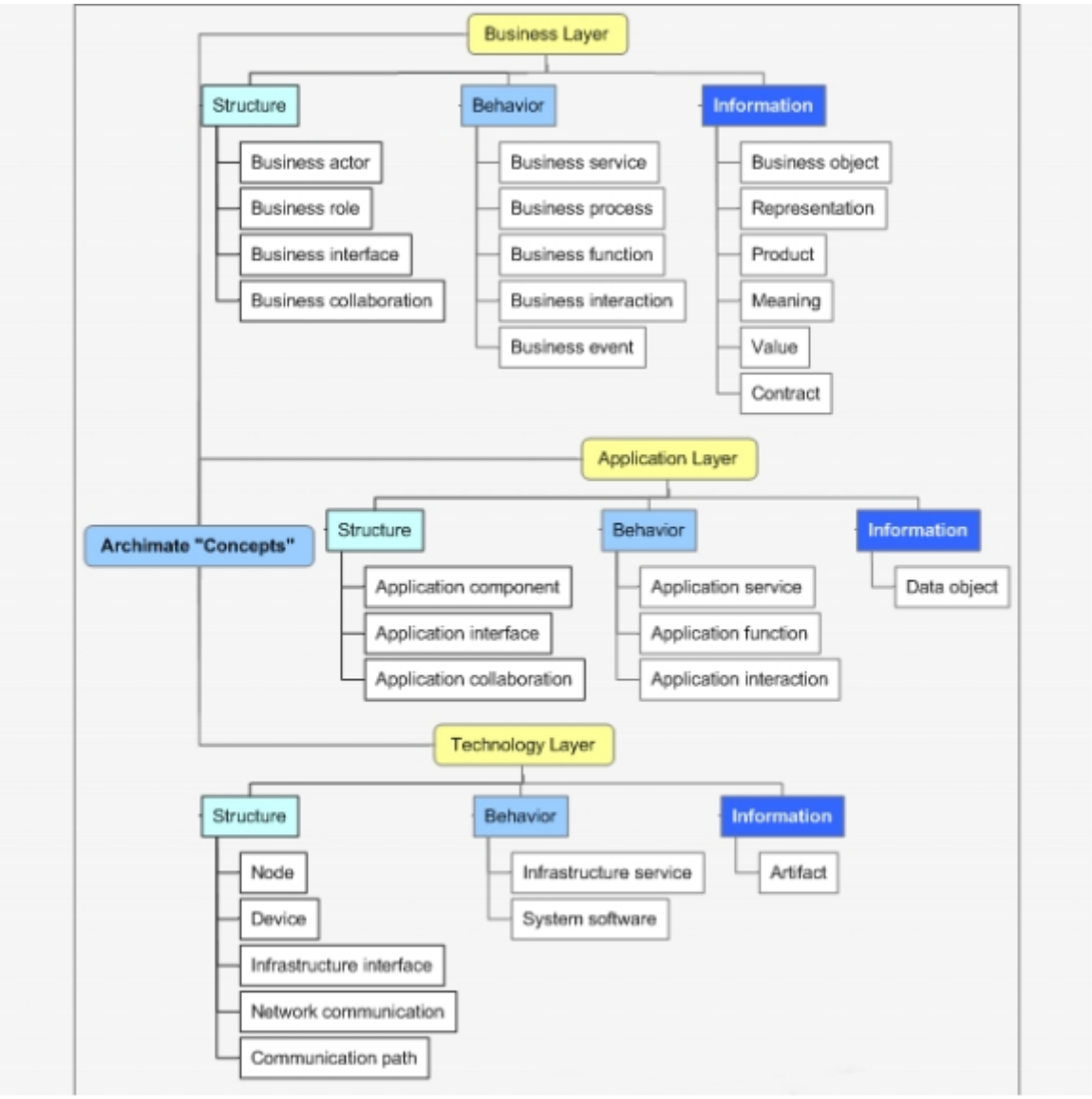


Figure 3.5 – Behavioural Layers of ArchiMate, source: http://sewiki.ru/ArchiMate

The Business layer of activity is mostly informative. People are looking for information here and they see Actors, roles and objects.

The Application level is the processing of information. The main principle is to form a new data from older data, which is different in both format and content. No one promises anything to anyone and does not give instructions, does not pursue any goals. The main task of the level is to ensure that the processed data is at the right time with the right people in the right way.

The level of hardware (or technology level) – there is no longer any data processing, but only storage and transfer of it. Of course, at this level, there are also specialized supporting software. The task of the level is to store the bytes addressed somehow, without going into their meaning,

send these bytes at the request of the programs, and also store the programs themselves and enable them to execute.

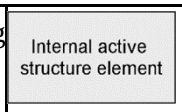
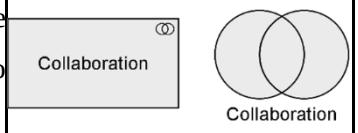
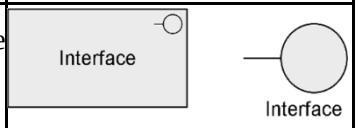
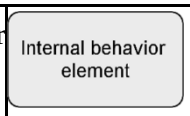
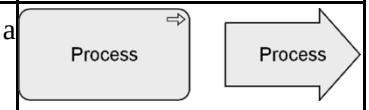
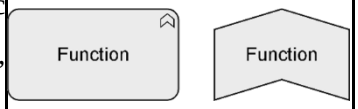
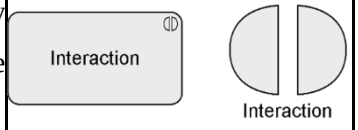
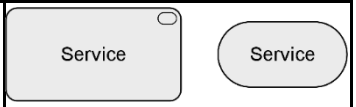
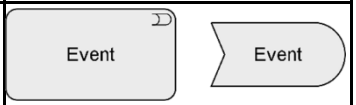
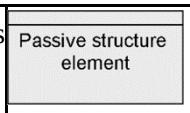
Element	Specializations	Definition	Notation
Active Structure			
Internal active structure element		An entity that is capable of performing behavior.	
	Collaboration	An aggregate of two or more active structure elements, working together to perform some collective behavior.	
Interface		A point of access where one or more services are exposed to the environment.	
Behavior			
Internal behavior element		A unit of activity performed by one or more active structure elements.	
	Process	A sequence of behaviors that achieves a specific outcome.	
	Function	A collection of behavior based on specific criteria, such as required resources, competences, or location.	
	Interaction	A unit of collective behavior performed by (a collaboration of) two or more structure elements.	
Service		An explicitly defined exposed behavior.	
Event		A state change.	
Passive Structure			
Passive structure element		An element on which behavior is performed.	

Table 3.1 – Core Elements of ArchiMate, source: http://pubs.opengroup.org/architecture/archimate3-doc/chap04.html

Table 3.1 gives an overview of the core elements, their definitions, and their default graphical notation. However, it should be mentioned, that most of these elements are abstract; they are not used in models but only their descendants in the different layers of the ArchiMate language.

A viewpoint-oriented approach to enterprise architecture modelling, in which architects and other stakeholders can define their own views of the architecture. In this approach views are specified by viewpoints, which define abstractions on the set of models representing the enterprise architecture, each aimed at a particular type of stakeholder and addressing a particular set of concerns. (Lankhorst, 2018)

In conclusion of this topic, the use of ArchiMate language, the difference between its elements, a review of the models, and its visualisation and manipulations have been described. This part of the research was made to learn more about selecting and using viewpoints and a number of viewpoints in the ArchiMate language that can be used by enterprise architects involved in the creation or improvement of business architecture. Finally, it is shown how TOGAF's views and ArchiMate's viewpoints match together.

An example of a business process modelling in Archi tool is presented in 8.2

3.4 Definition of Economic Methods and Indicators

CBA or Cost–benefit analysis is a socio-economic method for comparing the consequences of public measures. For example, in road construction, looking at different road routes and comparing the costs as well as the benefits for individuals and businesses. Moreover, the impact on environment and safety. Thus, a cost-benefit analysis can provide a decision base and inform the public debate.

Cost–benefit analysis is not about money. It is not about inputs or outputs either. It is about welfare. Money is central to financial analysis but only instrumental in the economic appraisal of projects and policies. Money is the common unit in which economists express the social costs and benefits of projects. Volume of drinking water, accidents avoided, time savings and energy and labour consumed are measured in different units and we need a common unit of measure to express all these heterogeneous items in a homogeneous flow. (Elgar, 2010)

Cost–benefit analysis is about the well-being of individuals affected by the project and not about the number of trips or visits. The change in welfare is what economists want to measure, and this is quite a challenging task because welfare cannot be measured. To solve this problem,

economists have found an alternative: to use money as an expression of welfare. I do not know how great the utility1 of a particular individual is when driving his car from A to B at a particular date and time, but if I am able to determine the amount of money to charge for this trip that makes him indifferent between driving or not, then interesting things can be said. Cost–benefit analysis is not about money but money helps. (Elgar, 2010)

Cost–benefit analysis conceived as a toolkit for the selection of projects and policies, in the general interest of the society, presupposes the existence of a social planner, a benevolent government that compares benefits and costs before the implementation of projects and policies.

The beneficial effects should be equal to what the population is willing to pay to achieve them. The cost of the measure should be equal to the best one could get rid of the money. If the monetary value of the utility is greater than the cost, the measure is economically profitable - the population is willing to pay what the measure costs. The effects typically occur at different times, and in the calculation of profitability, one must therefore take into consideration that people place more emphasis on effects that are happening now than effects coming in the future. This is called the present value method. In an overall assessment of profitability, one must also look at the uncertainty in the calculations and effects that cannot be valued by currency.

While calculating profitability, distribution effects are not usually seen, i. e. who will be the winners and losers of the measure. The project is considered profitable as long as the benefit exceeds the cost, regardless of who gets the benefit. One important reason is that it is difficult to agree on a mathematical way that represents how society weighs different interests against each other. One consequence of this is that socio-economic profitability does not automatically state that the measure is something society wants. It is not a decision-making rule, but a part of a decision-making basis. In Norway, the Ministry of Finance has decided that a separate analysis should be made which describes the distribution effects. The exclusion of distribution effects in the calculation has nevertheless been subject to a number of academic criticisms. Another criticism is that economically useful is not necessarily the right way to assess whether the measure is good or not.

Cost–benefit analysis compares the social benefits and cost in contrast with financial analysis, which uses revenues instead of social benefits and private costs instead of social costs. However, it is very important for the analyst to have a report that not only includes the economic return of the project but also the financial result or commercial feasibility of the project.

It is perfectly possible for a project or public policy to generate social benefits that exceed social costs and, at the same time, to present a negative financial result. Let us consider, for example, the case of a reforesting policy that reduces land erosion and delivers new space for recreation. Moreover, the responsible public agency obtains some revenues from charging for parking close to the recreation area. It is likely that this project presents a positive social NPV and a negative financial result. The analyst must present both results to the decision maker for two main reasons. (Elgar, 2010)

ROI (Return on investment) is a financial indicator that illustrates the level of profitability or loss of business, taking into account the amount of investment in this business. ROI is usually expressed as a percentage, less frequently as a fraction. This indicator may also have the following names: return on invested capital, return on investment, return, return of invested capital, rate of return. (Chen, 2018)

ROI is the ratio of the amount of profit or loss to the amount of the investment. The value of the profit can be interest income, profit / loss on accounting, profit / loss in administrative accounting or net profit / loss. The value of the investment sum may be assets, capital, the amount of the main operating debt and other investments expressed in cash.

ROI is a popular metric because of its versatility and simplicity. Moreover, ROI might be used as a rudimentary gauge of an investment's profitability. This could be the ROI on a stock investment, or the ROI a company expects on expanding. The calculation itself is not too complicated, and it is relatively easy to interpret for its wide range of applications. If an investment's ROI is net positive, it is probably worthwhile. But if other opportunities with higher ROIs are available, these signals can help investors eliminate or select the best options. Likewise, investors should avoid negative ROIs, which imply a net a loss. The Return on investment calculation is a straightforward one, and it can be calculated by the following method:

Return on Investment = Net income / Investment

In addition, ROI is intuitively easier to understand when expressed as a percentage instead of a ratio.

There are several other types of ROI that have been developed for particular purposes. Social media statistics ROI pinpoints the effectiveness of social media campaigns - for example how many clicks or likes are generated for a unit of effort. Similarly, marketing statistics ROI tries to identify the return attributable to advertising or marketing campaigns. So-called learning ROI

relates to amount of information learned and retained as return on education or skills training. As the world progresses and the economy changes, several other niche forms of ROI are sure to be developed in the future.

4 Practical Part

4.1 Introduction of a Business Company.

4.1.1 Background and History

EuroCool LLC is a trading company founded in 2007 and sells refrigerated containers, and since 2008 has expanded its regional network and has started selling in Krasnodar and Krasnodar Krai, Astrakhan and Astrakhan regions, Volgograd and Volgograd regions, in Elista and the Republic of Kalmykia. In 2010, work began on the development of the retail market: the first self-service store was opened. During this year, the company took a leading position in the south of Russia, after which the company began to move to other regions.

At the beginning of 2012, the reorganization was completed, as a result of which EuroCool LLC became the holding company of a group of companies engaged in retail trade through a network of stores. In April 2015, the company conducted a public sale of shares, most of the proceeds were aimed at developing the chain of stores and developing the format for hypermarkets under the same brand.

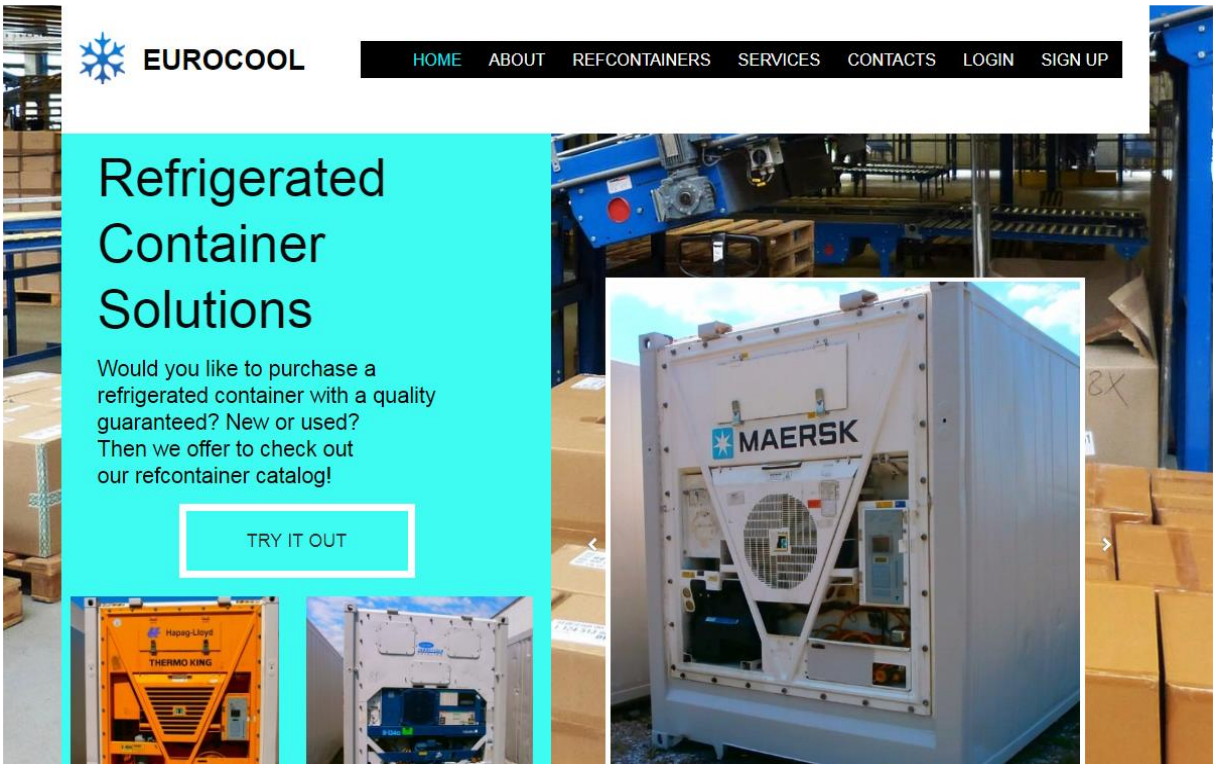


Figure 4.1 website of EuroCool LLC, source: http://eurocool.uphero.com/

The year of 2017 is a significant year in the history of the company. Management decides to reorganize the retail business. It was decided to develop a business and offer its services in other regions, in the summer of 2017 a second trading platform in the Republic of Crimea will be opened. It is still under development. At the moment, the territory is being selected and a package of documents is being prepared for opening.

According to unaudited data, the net revenue of EuroCool LLC as of December 31th, 2018 was about 8,370,000 US Dollars.

The company does not use franchising, it completely independently manages its outlets, which allows it to set and maintain uniform quality standards throughout the network. As of December 31th, 2018, the company has 32 branches, in which there are more than 300 employees.

4.1.2 Organizational Structure

Through the use of regional distribution points EuroCool LLC has managed to establish an effective logistics system. The company has 5 own distribution points, which account for about 85% of the total turnover. The organization has its own fleet of 432 cars, which allows reducing transport costs and almost completely eliminating losses during transportation. As of December 31, 2018, the assortment of EuroCool LLC consisted of about 21 types of goods. An automated inventory management system has been introduced into the companies, thereby increasing their turnover. EuroCool LLC is the owner of the largest network of refrigerated containers in the south of Russia in terms of the number of stores and the territory of their coverage, which allows for purchases under special conditions.

The main activity of the company is:

- Execution of retail trade in non-food goods;
- organization of wholesale trade, intermediary and commercial activities;
- the organization of direct relations with enterprises-suppliers of goods;
- the provision of services for the direct maintenance of goods;
- participation in exhibitions, auctions and other events.

Much attention is paid to cooperation with local manufacturers and suppliers, which allows the organization to quickly solve the issues of providing store chains with refrigerated containers. In example, as of March 31, 2018, 57 retail spaces were opened. The trading area varies from 2000-12500 sq. Meters. The range includes a large number of items of goods, of which about 76% on average are large refrigerated containers up to 40 feet.

More than 300 employees, who by their work provide clients with the opportunity to purchase high-quality refrigeration equipment at affordable prices. Thus, the latest methods and technologies in the field of product distribution, sales, finance and personnel policy, allowing to effectively manage the company and reduce the price of goods for customers. The network of service centers throughout the European part of Russia, receiving goods from customers and preparing it for shipment is already in working condition.

Limited Liability Company EuroCool is a legal entity, it has its own seal, stamps, forms with its name, trademark (service mark), main and additional accounts in banks. The purpose of the creation of EuroCool LLC is the implementation of economic activities aimed at making a profit.

EuroCool LLC carries out its activities in accordance with the legislation of the Russian Federation and the rules of the organization.

The supreme governing body of the company is the board of directors. Its competencies include: making changes and additions to the company's charter or approval of a new edition of the charter; change of authorized capital; determination of the main activities of the organization, approval of its plans and reports on their implementation; resolving issues of the acquisition and disposal of the organization of securities issued by it, as well as the securities of other business entities; approval of reports and conclusions of the audit committee, distribution of profits and cover losses; making a decision on the termination of the company's activities and its reorganization, the solution of other issues in accordance with the company's charter.

The Board manages the EuroCool LLC in the period between the meetings of the founders.

The Directorate is the executive body of the company, is accountable on all matters of its activities to the meeting of the founders and operates within the limits of its powers, determined by the company's charter, decisions of the meetings of the founders and the board.

The Directorate includes the director, his deputies, the chief accountant, the legal consultant, and heads of departments.

At the location of the enterprise, complete documentation is maintained, including: constituent documents, as well as regulatory documents governing and regulating the organization’s work procedure; accounting documents; documents of the founders' meetings, etc.

4.1.3 Problem Analysis

The business performance of EuroCool LLC suffers from defects in its enterprise architecture which results in a disjointed approach to customer service and CRM. These defects are also reflected in the inadequate architecture of its applications and information. In particular, the personel of EuroCool has disparate views of the customer base across various departments.

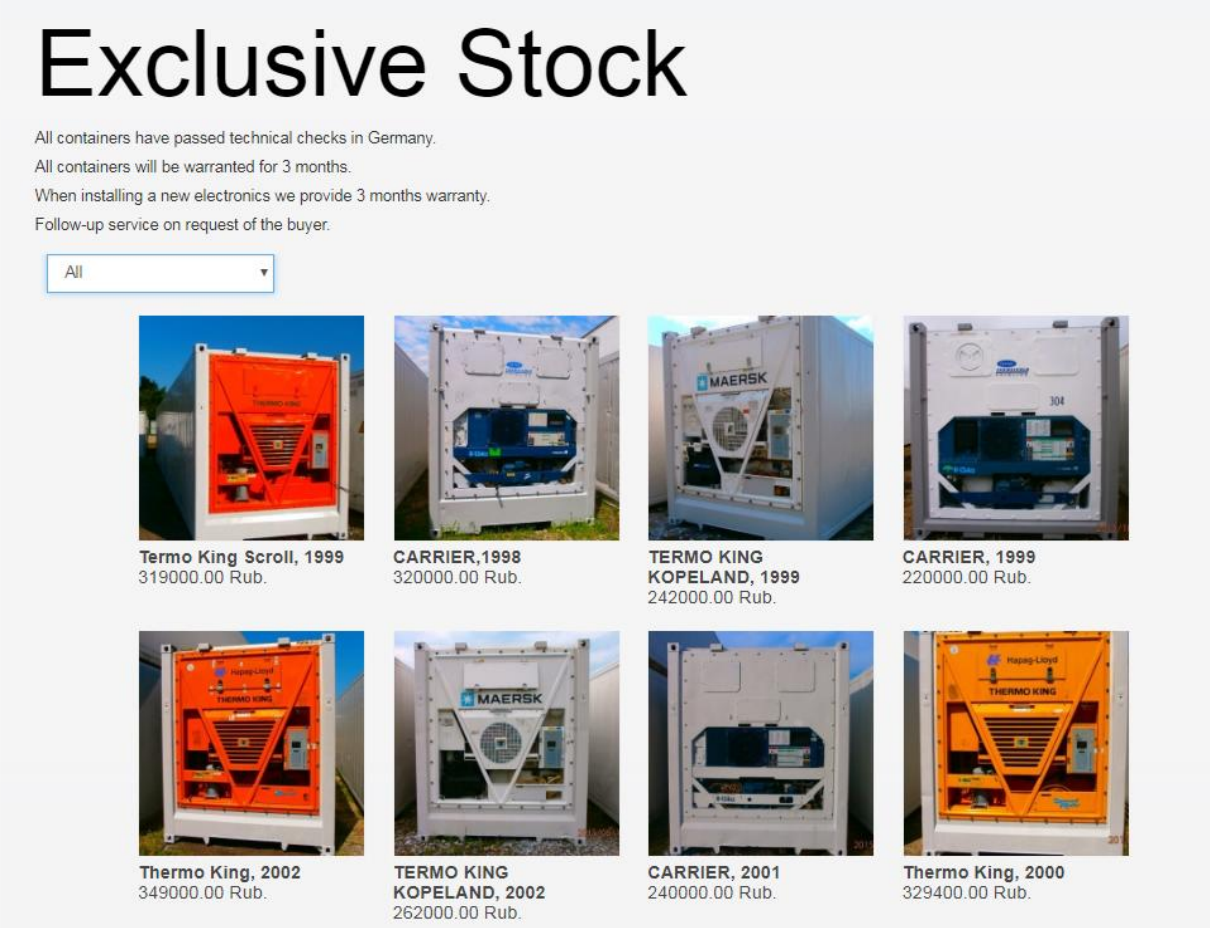


Figure 4.2 Refrigerated container catalog on website, source: http://eurocool.uphero.com/

The customer databases and applications of the different shops do not work together. In addition, the formats of customer master data vary across the company.

These two factors make it difficult to maintain consistent and accurate data. As a result, this decreases the quality of the customer experience, spends useful resources for redundant data collection and cleanup, and exposes EuroCool LLC to a variety of risks.

4.2 Building the Enterprise Architecture in the Archi tool

4.2.1 Preliminary Analysis of the Business Organization

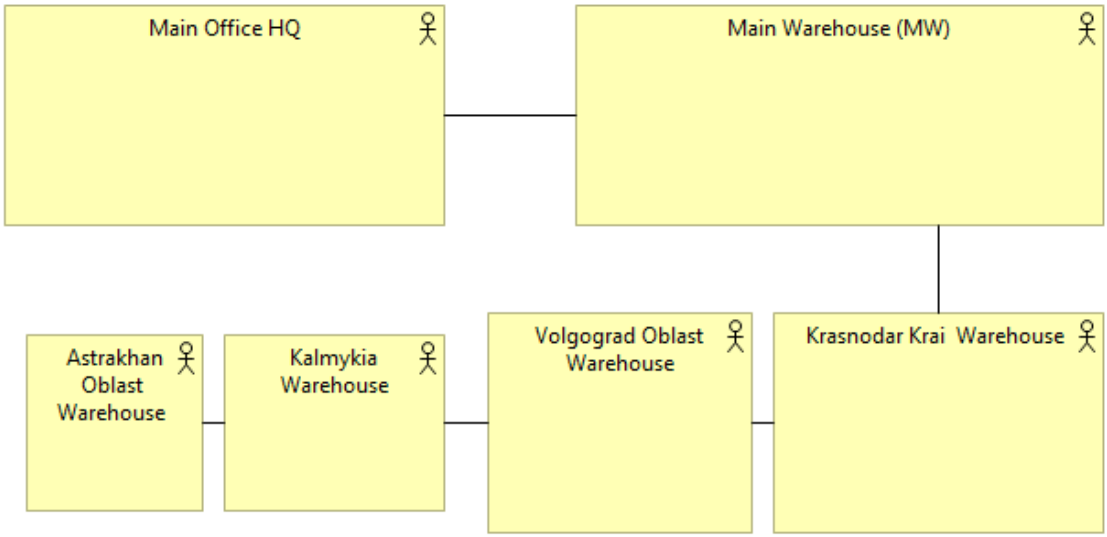


Figure 4.2.1 Organization view

The Figure 4.1 shows an organization view for the EuroCool LLC. The business entity consists of an office and five different warehouses, where the refrigerated containers are being stored for a closer proximity to the customers from different areas.

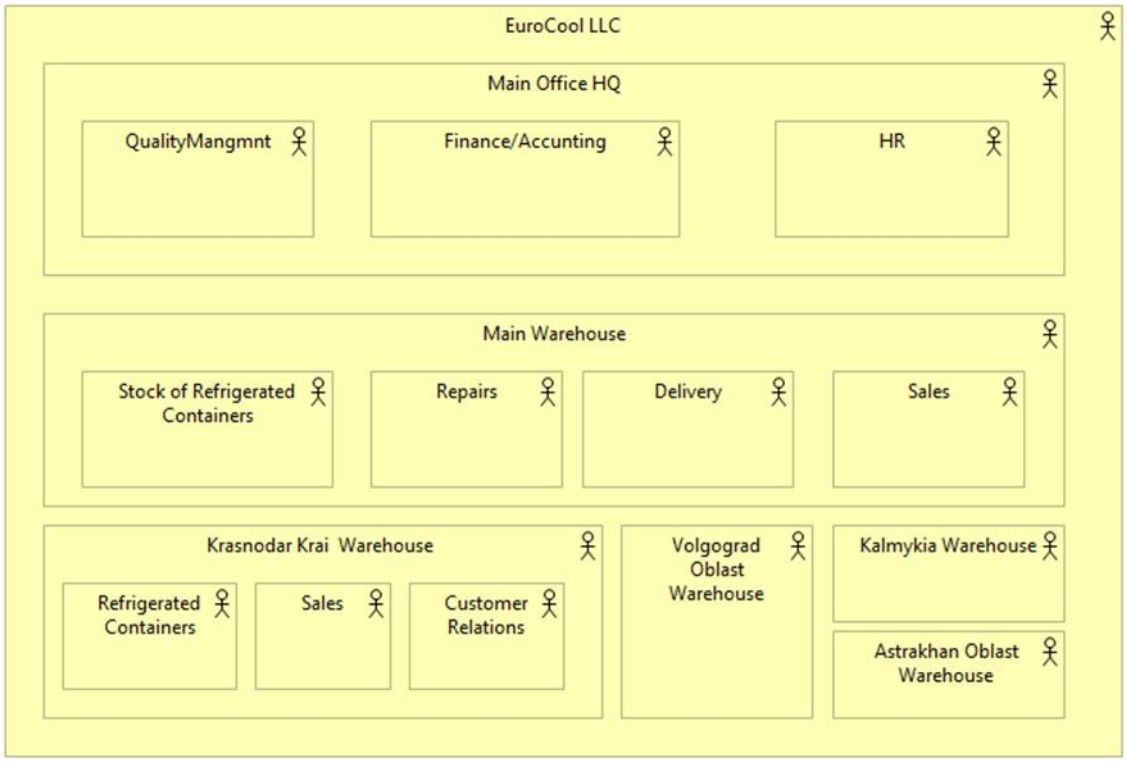


Figure 4.2.2 Organization Decomposition (Nested)

The Figure 4.2 presents an organization decomposition look of the EuroCool LLC. The Main Office HQ (Headquarters) consists of specialists, leading different sectors: Quality Management, Finance & Accounting and Human Resources. The Main Warehouse entity consists of four actors: a stock of refrigerated containers, sales division and also two service divisions – repairs and delivery.

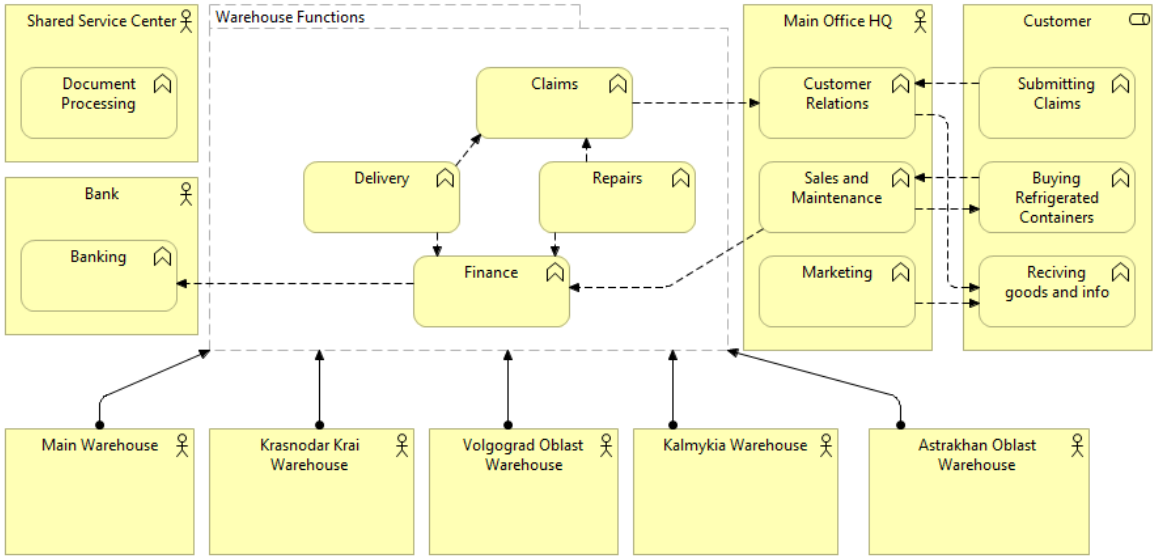


Figure 4.2.3 Business Function view

The Figure 4.3 describes how business functions of EuroCool LLC are working. The Main Office HQ works with Customers in three different areas: Customer Relations, Sales and Maintenance and Marketing. In the same fashion, Customers are Submitting Claims, Buying Refrigerated Containers and Receiving their goods and information.

A variety of five warehouses are shown in the bottom of figure. They are assigned with similar functions, therefore as shown on a figure, their functions are joined into one group. That group consists of Claims, Delivery, Repairs and Finance. This business functions are connected with Main Office HQ. In addition, there is a Shared Service Center which does document processing function and a Bank which works with finances of the company.

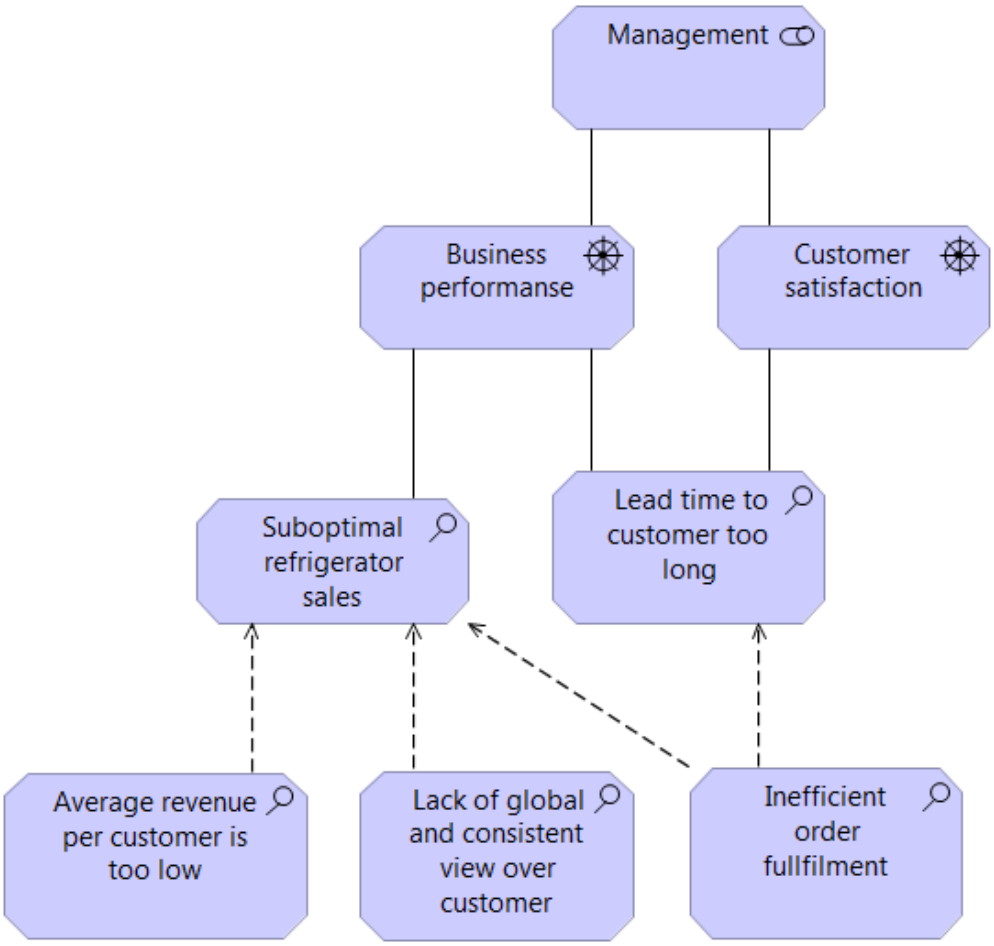


Figure 4.2.4 ArchiMate Motivation view, describing the overall challenges, facing EuroCool LLC

Figure 4.4 shows motivation view, the drivers and assessments of EuroCool LLC. As it shown on a figure above, two main drivers are the Business performance and Customer satisfaction. Also, there is a variety of assessments, regarding those drivers, that are influencing each other, which is described by the arrows

4.2.2 Conceptual diagram

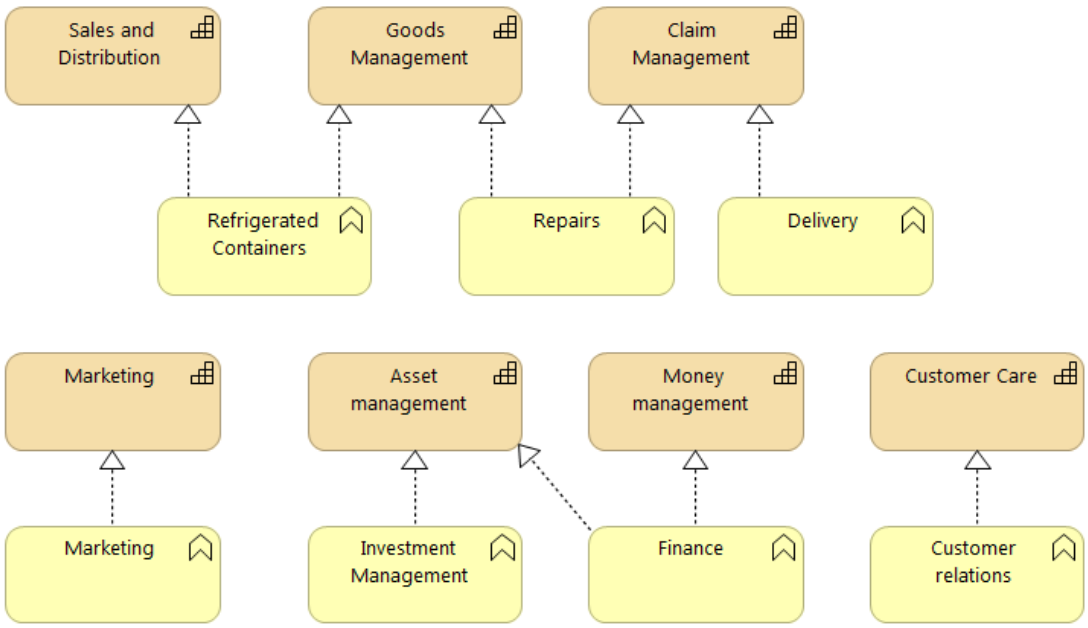


Figure 4.2.5 Conceptual Diagram

Figure 4.5 shows relationships between Strategic Level (Orange) and Business Level (Yellow).

First row of diagram presents the capabilities of sales and distribution, and also the goods and claims management. Second row shows the business functions that are connected to the level above. Those include refrigerated containers, repairs and delivery. Third row contains another strategic level with such capabilities as marketing, assets management, money management and customer care. Last row represents the business functions of marketing, investment management, finance, customer relations and how they are connected to the third level above.

4.2.3 AS IS - view of the sales process (Current State)

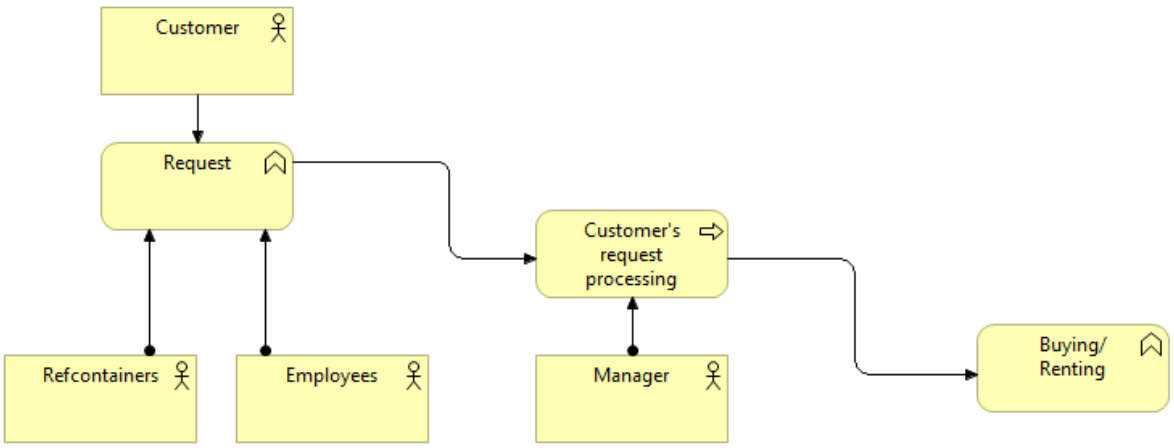


Figure 4.2.6 Current State of Enterprise Architecture – Archi

Figure 4.6 shows the current state of Enterprise Architecture at EuroCool LLC leaves much to be desired and contains only the business level. Customers are requesting refrigerated containers then employees are assigned to proceed this customer's request further to the manager, who will then transform it to buying or renting.

4.2.4 TO BE – Improvements for the sales process (Future State)

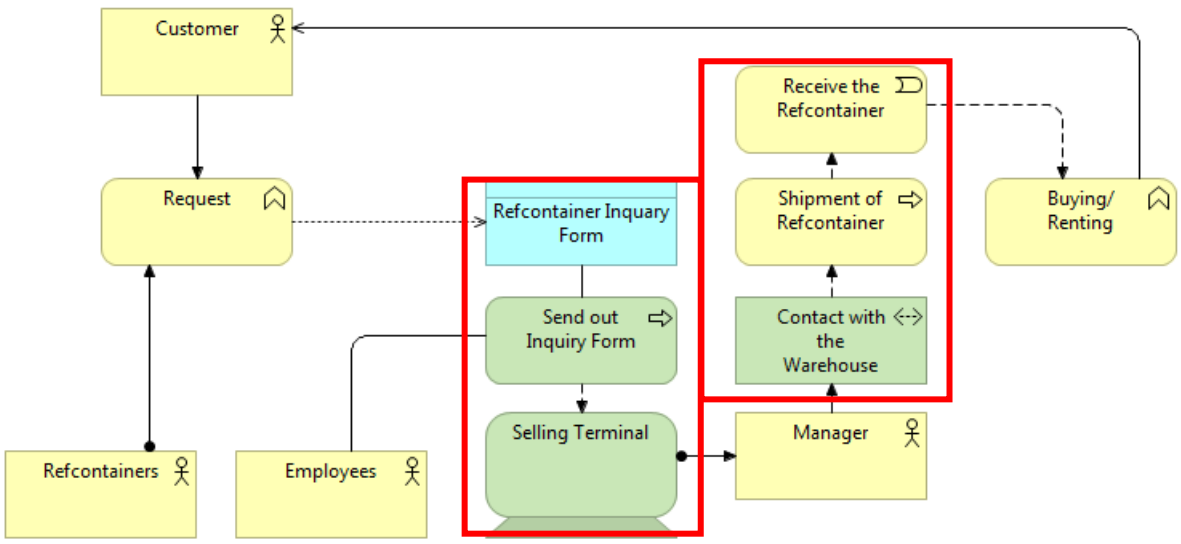


Figure 4.2.7 Future State of Enterprise Architecture – Archi

Figure 4.7 shows the future state of Enterprise Architecture at EuroCool LLC, in addition to business level, it has additional application and technological levels. Customers are requesting refrigerated containers, then this request is assessing into an inquiry form which gets to the process of sending out inquiry form allocated to the employees. A new technological device called “Selling Terminal” is being introduced, it is assigned to manager in order to help with all the requests from customers. Then manager is contacting one of the warehouses, after that refrigerated container gets shipped and manager need to receive it. At last, business function of buying/renting serves the customer.

4.3 Evaluation of an economic effect on a business company

4.3.1 Cost–benefit analysis

Currently, the project is being carried out according to requirements of the company, but the algorithms and methods currently used are implemented with the possibility of their further changes to the various interests of an organization, thus the project has some opportunities for modification or changes in future.

It has been decided by the board of directors at EuroCool LLC, that most sustainable duration for the project will be five months, divided into five stages.

The costs part of building an new enterprise architecture includes non-recurring and recurring costs.

- Non-recurring costs are the fixed one-time expenses. A company does not expect non-recurring costs to continue over time.
- Recurring costs typically illustrate multiple spendings or continuous costs.

Cost-Benefit Analysis						EuroCool LLC
Enterprise Archetecture Upgrade						
Part A: Costs	**Month 1**	**Month 2**	**Month 3**	**Month 4**	**Month 5**	**Total**
Non-Recurring Costs	Intiate	Define	Develop	Deploy	Optimize	
Hardware	$ 1,565.00	$ -	$ -	$ -	$ -	$ 1,565.00
Servers	$ 2,565.00	$ -	$ -	$ -	$ -	$ 2,565.00
Software maintenance and upgrades	$ 450.00	$ -	$ -	$ -	$ -	$ 450.00
Telecommunication equipment	$ -	$ 150.00	$ -	$ -	$ -	$ 150.00
Computer room upgrades	$ -	$ 300.00	$ -	$ -	$ -	$ 300.00
Furniture and fixtures	$ -	$ 150.00	$ -	$ -	$ -	$ 150.00
Planning (upon approval)	$ -	$ 200.00	$ -	$ -	$ -	$ 200.00
Procurement	$ -	$ 550.00	$ -	$ -	$ -	$ 550.00
Infrastructure Upgrade	$ -	$ -	$ 100.00	$ -	$ -	$ 100.00
Training of employees (pre-implement	$ -	$ -	$ -	$ 300.00	$ -	$ 300.00
Post implementation reviews	$ -	$ -	$ -	$ -	$ 400.00	$ 400.00
Other Expences	$ -	$ -	$ -	$ -	$ 150.00	$ 150.00
Total Non-Recurring Costs	$ 4,580.00	$ 1,350.00	$ 100.00	$ 300.00	$ 550.00	$ 6,730.00

Table 4.1 Cost-Benefit Analysis – Non-Recurring Costs

Table 4.1 shows non-recurring costs of enterprise architecture upgrade project, the project has been separated into 5 stages:

- Initiation stage has he initial costs for buying hardware, servers, and associated basic software for it to work. This stage will cost $4,580, but it has only the essential spending.
- Define stage expands our first investments in the way of further upgrades for the infrastructure which will include telecommunication equipment, computer room upgrades, furniture and fixtures, planning and procurement. This stage is second most expensive, and it will cost $1,350
- Development stage does not have much cost in non-recurring part, only the infrastructure upgrade which expected to be about $100, other costs on this stage are recurring.
- Deployment stage has only the initial training of employees, which will cost about $300, other costs on this stage are recurring.
- Optimization stage will include spending on post implementation reviews and other expenses if it is going to be necessary.

Recurring Costs	Intiate	Define	Develop	Deploy	Optimize	
Hardware	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 250.00
Software maintenance and upgrades	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 250.00
Computer supplies	$ 30.00	$ 50.00	$ 100.00	$ 50.00	$ 50.00	$ 280.00
Computer room upgrades	$ -	$ 100.00	$ -	$ -	$ 100.00	$ 200.00
Telecommunication equipment	$ -	$ 100.00	$ -	$ -	$ 100.00	$ 200.00
Furniture and fixtures	$ -	$ 250.00	$ -	$ -	$ 100.00	$ 350.00
Enterprise Archetect Salary	$ -	$ -	$ 1,750.00	$ 1,580.00	$ 1,580.00	$ 4,910.00
Project organizational/support costs	$ 100.00	$ 400.00	$ 200.00	$ 200.00	$ 200.00	$ 1,100.00
Ongoing Additional Labour	$ 50.00	$ -	$ -	$ -	$ 100.00	$ 150.00
IT staff costs (incl. benefits)	$ -	$ 200.00	$ 200.00	$ -	$ 200.00	$ 600.00
Infrastructure Upgrade	$ -	$ -	$ 200.00	$ 200.00	$ 200.00	$ 600.00
Management	$ 400.00	$ 400.00	$ 400.00	$ 400.00	$ 400.00	$ 2,000.00
Staff training	$ 100.00	$ -	$ -	$ 100.00	$ 200.00	$ 400.00
Office leases	$ 455.00	$ 455.00	$ 455.00	$ 455.00	$ 455.00	$ 2,275.00
Other Expenses	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 250.00
Total Recurring Costs	$ 1,285.00	$ 2,105.00	$ 3,455.00	$ 3,135.00	$ 3,835.00	$ 13,815.00

Total Costs	$ 5,865.00	$ 3,455.00	$ 3,555.00	$ 3,435.00	$ 4,385.00	$ 20,545.00

Table 4.2 Cost-Benefit Analysis – Recurring Costs and Total Costs

Table 4.2 shows recurring costs for the 5 months of enterprise architecture upgrade project. This part of costs can be best described in a bit different fashion, other than the non-recurring costs part.

- Hardware requires electricity, which is planned to cost about $50 per month on all stages;
- Software maintenance and upgrades can be described by paying for license of selected basic software. This is expected to cost about $50 on all stages;
- Computer supplies: initial purchase will cost about $30 for all the cables of various kinds. Then on definition stage and on the development stage there is a cost of $50 for each stage for the spare replacement parts on a variety of computer items;
- Computer room upgrades will require about $100 before the development starts and on the optimization stage;
- Telecommunication equipment includes cost of $100 on necessary equipment before the development stage and additional $100 in the optimization stage;
- Furniture and fixtures spending of $250 is postponed on a second month to balance out the initial non-recurring costs. There is a possibility of additional $100 spending at the last stage of architecture optimization;
- Enterprise Architect starts working and getting his salary from the development stage till the end of the project. During the development stage the salary is about $1,750, but the base salary is capped at $1,580;

- Project organizational/support costing $100 initially, it is expected to increase to $400 prior the development stage, and after that decrease to $200 on every further stage;
- Ongoing Additional Labor may be required at the start on project, it is expected to be about $50 and $100 at the end of the project;
- IT staff costs (incl. benefits) will be around $200 and are expected to be paid for the employees of IT-department prior and during the development stage and also on the optimization stage
- Infrastructure upgrade is a cost required for the business company to adjust to new enterprise architecture. It requires $200 each month starting from the development stage;
- Management cost is a salary for the project manager during all the stages, it is planned to be about $400 each month;
- Staff training cost includes initial training which costs $100, then on deployment and optimization stages $100 and $200 respectively;
- Office leases is a recurring cost of $455 each month for the rent payments of the commercial real estate;
- Other Expenses might be required at all stages of the project and expected to be about $50 each month.

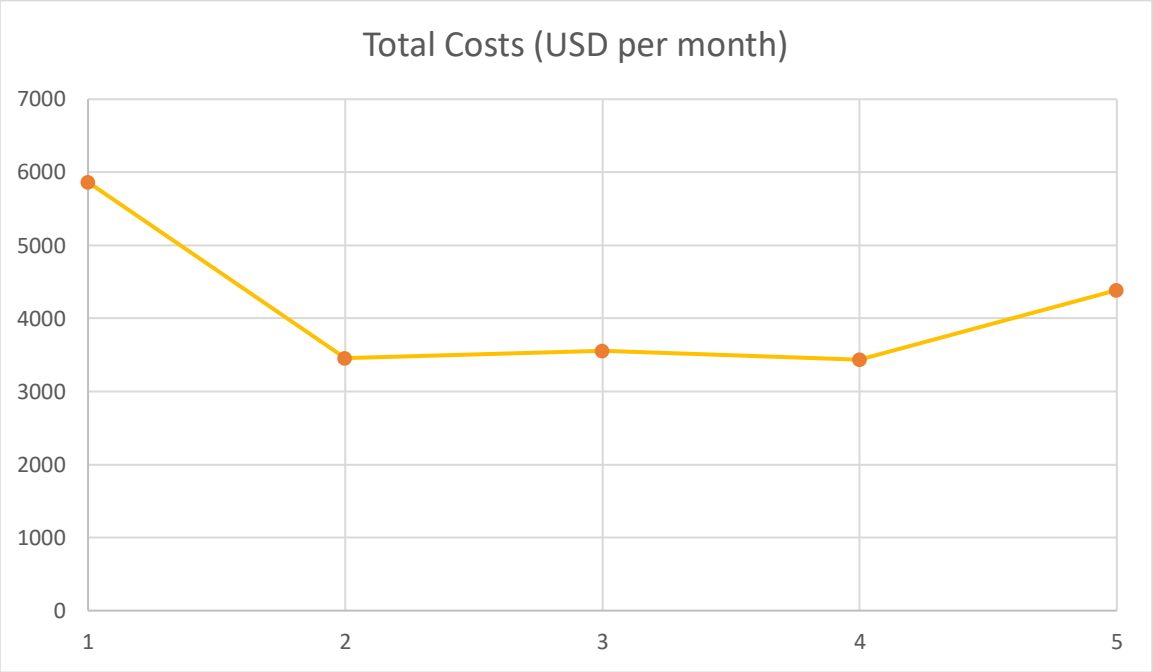


Figure 4.3.1 Cost-Benefit Analysis – Total Costs

Graph 4.1 shows that total costs tend to spend roughly the same amount on each stage, but there are bigger investments on initial and final stages. X-axis shows number of the month and Y-axis represents the amount of USD per month.

The benefits part of building a new enterprise architecture includes: revenues, cost savings, cost avoidance and other benefits.

- Revenues – the company's profits during the implementation of the project;
- Cost Savings – the funds saved during the implementation of the project;
- Cost Avoidance – are the benefits from the use of new enterprise architecture;
- Other benefits – include reduced costs on staff and equipment

Part B: BENEFITS	Month 1	Month 2	Month 3	Month 4	Month 5	Total
Revenues						
Refcontainers Sales	2500	2500	2500	5000	7500	$ 20,000.00
Refcontainers Rent	1000	1000	1000	2000	2500	$ 7,500.00
Refcontainer Repairs	1520	1520	1520	1520	1520	$ 7,600.00
Delivery services	850	850	850	850	850	$ 4,250.00
Total Revenues	$ 5,870.00	$ 5,870.00	$ 5,870.00	$ 9,370.00	$ 12,370.00	$ 39,350.00

Table 4.3 Cost-Benefit Analysis – Revenues

Table 4.3 shows expected revenues during the enterprise architecture upgrade project.

- During the initiation, definition and development stages revenues are expected to be the same;
- After deployment and optimization stages, revenues for sales and rent are expected to grow.

Cost Savings						
Decreased cost of services provided	0	0	0	200	400	$ 600.00
Savings from Business process improvements	0	0	0	100	200	$ 300.00
Productivity gains	0	0	0	100	200	$ 300.00
Savings from structural changes	0	100	150	150	300	$ 700.00
Savings from optimized information	0	200	0	100	200	$ 500.00
Decreased information publishing cost	0	400	0	200	400	$ 1,000.00
Reduced staffing cost (incl. overtime)	0	0	0	200	400	$ 600.00
Reduced staff turnover costs	0	0	0	200	400	$ 600.00
Total Cost Savings	$ -	$ 700.00	$ 150.00	$ 1,250.00	$ 2,500.00	$ 4,600.00

Table 4.4 Cost-Benefit Analysis – Cost Savings

Table 4.4 shows costs savings during the enterprise architecture upgrade project.

- At the initiation stage, none of the cost savings are expected;
- At the definition stage expected cost savings are savings from structural changes, savings from optimized information and decreased information publishing cost;

- Development stage involves cost savings from the structural staff reassignment;
- Deployment stage has all the cost savings which can be seen in the table above;
- After the Optimization stage cost savings expected to be double the amount, compared to the previous stage.

Cost Avoidance						
Selling terminal	0	0	0	1000	2000	$ 3,000.00
Sending Inquiry Form	0	0	0	500	1000	$ 1,500.00
Refcontainer Inquiry Form	0	0	0	250	500	$ 750.00
Total Cost Avoidance	$ -	$ -	$ -	$ 1,750.00	$ 3,500.00	$ 5,250.00

Other Benefits						
Reduced cost of staff	0	600	0	1200	2400	$ 4,200.00
Reduced cost of equipment	0	800	0	0	800	$ 1,600.00
Total Other Benefits	$ -	$ 1,400.00	$ -	$ 1,200.00	$ 3,200.00	$ 5,800.00

Total Benefits	$ 5,870.00	$ 7,970.00	$ 6,020.00	$ 13,570.00	$ 21,570.00	$ 55,000.00

Table 4.5 Cost-Benefit Analysis – Cost Avoidance, Other Benefits and Total Benefits.

Table 4.5 shows cost avoidances, other benefits and total benefits during the enterprise architecture upgrade project.

- Cost avoidance includes: selling terminal, sending inquiry form and refrigerated container inquiry form. As it is shown in the table, the benefits are expected to come after the deployment stage and planned to be $1000, $500 and $250 respectively.
- Other Benefits: after the definition stage, expected cost reduction on staff expected to be $600, after the deployment stage double the amount, after the optimization stage four times the amount. The cost reduction of equipment is expected after the Definition stage and optimization stage. IT is going to be $800 each time.

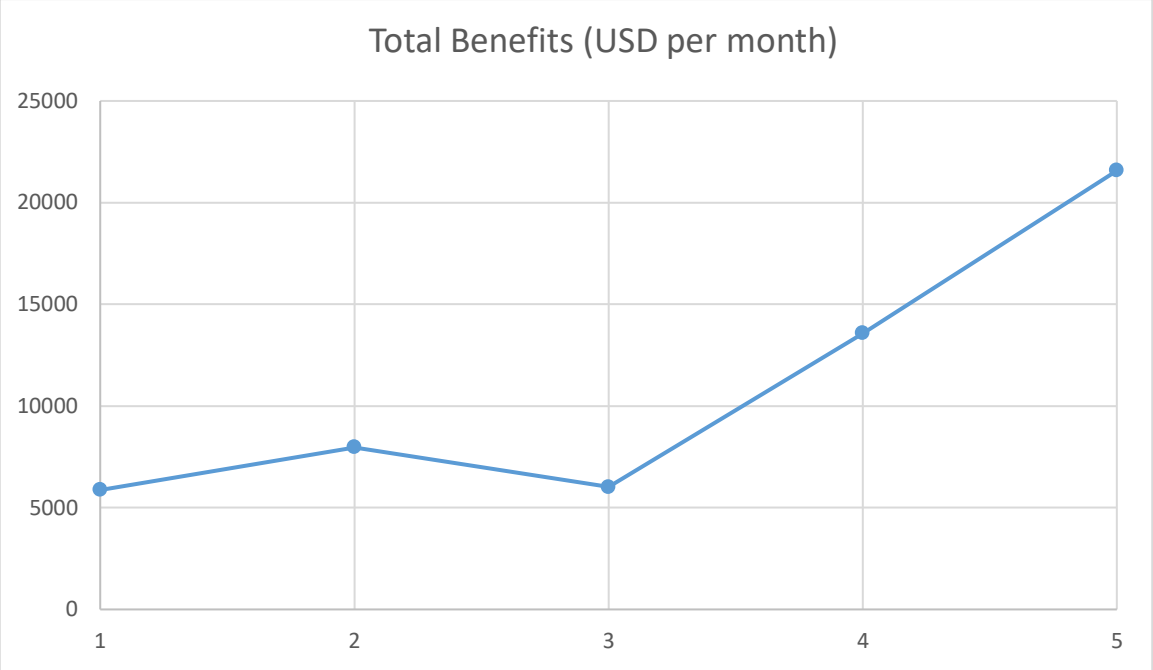


Figure 4.3.2 Cost-Benefit Analysis – Total Benefits

Graph 4.2 shows that total benefits are expected to grow on last two stages of the project. X-axis shows number of the moth and Y-axis represents the amount of USD per month.

Quantitative Analysis	Month 1	Month 2	Month 3	Month 4	Month 5	Total
BENEFITS						
Cost Savings	$ -	$ 700.00	$ 150.00	$ 1,250.00	$ 2,500.00	$ 4,600.00
Cost Avoidance	$ -	$ -	$ -	$ 1,750.00	$ 3,500.00	$ 5,250.00
Revenue	$ 5,870.00	$ 5,870.00	$ 5,870.00	$ 9,370.00	$ 12,370.00	$ 39,350.00
Other	$ -	$ 1,400.00	$ -	$ 1,200.00	$ 3,200.00	$ 5,800.00
Total Benefits	**$ 5,870.00**	**$ 7,970.00**	**$ 6,020.00**	**$ 13,570.00**	**$ 21,570.00**	**$ 55,000.00**
COSTS						
Non-Recurring	$ 4,580.00	$ 1,350.00	$ 100.00	$ 300.00	$ 550.00	$ 6,730.00
Recurring	$ 1,285.00	$ 2,105.00	$ 3,455.00	$ 3,135.00	$ 3,835.00	$ 13,815.00
Total Costs	**$ 5,865.00**	**$ 3,455.00**	**$ 3,555.00**	**$ 3,435.00**	**$ 4,385.00**	**$ 20,545.00**
Net Benefit (Cost)	**$ 5.00**	**$ 4,515.00**	**$ 2,465.00**	**$ 10,135.00**	**$ 17,185.00**	**$ 34,455.00**

Table 4.6 Cost-Benefit Analysis – Cost Avoidance and Other Benefits

Table 4.6 shows analysis summary, as presented on a table above, including non-recurring and recurring costs, benefits from cost saving, cost avoidance, revenue and others.

- During the first month the expected costs should be covered by the revenue of the company;
- On the Second month, first benefits are expected;

- Third month is the development stage, on which the benefits will decrease;
- Fourth month of deployment expected to be very profitable;
- Last month, the optimization stage expects to increase the benefits even more.

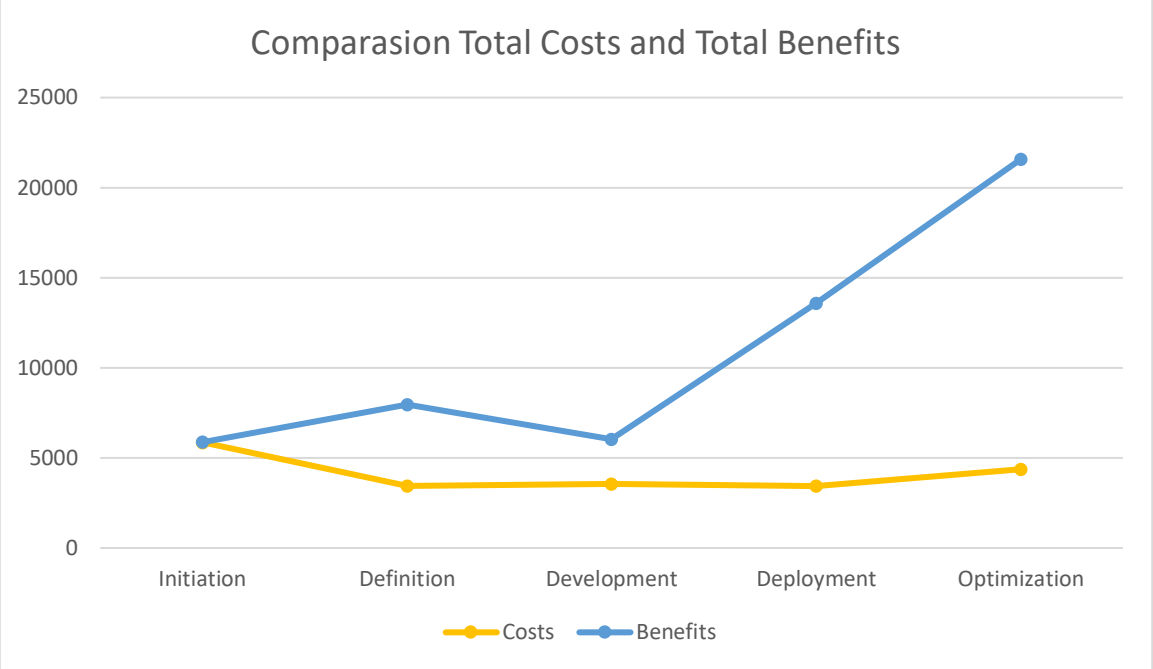


Figure 4.3.3 Cost-Benefit Analysis – Comparison between Total Costs and Total Benefits

Graph 4.2 shows comparison between total costs and total benefits. The space between lines represents the difference between them. X-axis shows the name of stage and Y-axis represents the amount of USD per stage.

Total benefits of project are $55,000 minus total costs of $20,545 gives the Net Benefit of $34,455.

4.3.2 Return on Investment Analysis

Return on Investment analysis consolidates the cost-benefit analysis and will be used to see the efficiency of the investments spent on the project.

For the return on investment analysis net income method is going to be used.

Cost-Benefit Analysis has all the necessary data to conduct return on investment analysis using this method.

- Original Investment is the total costs
- Net Income is the net benefit

Original Investment	$20,545.00
Net Income	$34,455.00
ROI	168%

Table 4.7 Return on Investment Analysis

Table 4.7 shows that after the implementation of the project major increase for the initial investments is expected. Total benefits are expected to fully cover total costs and gain an additional 168% profit, compared to the initial investment.

5 Results and Discussion

5.1 Summarization of Practical findings

The practical part describes various aspects of building an Enterprise architecture of EuroCool LLC, methods of organizing business for the sale and maintenance of refrigeration equipment. It is apparent, that architecture of sales process requires some improvements.

It is a well-known fact that if architecture is done because it is necessary to answer a specific question or need for the organization, that way, it is much easier to get much better data and results, and employees actually see the value of creating and maintaining an enterprise architecture for an organization.

Businesses organizations usually start implementing enterprise architecture by starting from top-bottom approach or the reverse. At first, building abstract layers from higher aspect, in example a Refrigerated container request function, which is on business level, then going down to refrigerated container inquiry form which is on an application level, going further, down to the process of sending out this inquiry form which is on technological level, then to the Selling Terminal, and digging down till Physical Architecture is modelled.

An architecture is only as good as the data that supports it, and the only way to keep that data current is to have the people who own it to keep the flow current. Employees and the manager won't do this unless they see some real value, which is why in proposed future state architecture, it has been decided to support them by introducing the selling terminal, which should help them to process customer’s requests.

5.2 Comparison between Practical findings and Literature review

In the event of comparing the practical part with the literature review, likewise, some differences can be noted. For example, whereas practical part describes the development of enterprise architecture, the literature review starts from describing the variety of business strategies. It would be a good idea to find business strategy that will supplement the new enterprise architecture. To decide which strategy EuroCool LLC should consider, it is necessary to analyse those business strategies and porter’s five powers model in addition.

Here are three generic strategies for competitive advantage:

- Cost leadership (the lowest costs competitor) the goods are too specific to implement such strategy
- Differentiation (develop products or services that provide superior value) the selected business company does not produce, it sells refrigerated containers that are produced by existing manufacturers.
- Focus (target a specific segment of the industry) this strategy should be selected and further improved. EuroCool LLC already targets a specific industry.

To decide on a strategy that generates a long-term benefit above the industry, selected company must also take into account the forces analysis of Porter (Porter, 2008):

- Competition in the Industry – bigger companies, who operate on a higher level, are trying to establish control of the regional market. EuroCool is rather unique in the regions where it operates;
- Potential of new players – can appear in case when bigger companies start to be interested in regions where EuroCool LLC operates;
- Power of Suppliers – suppliers are foreign, so they need representatives in the regions. EuroCool LLC works with them as an importer of refrigerated containers.
- Power of Customers is their ability to influence the price and demand of the refrigerated containers product and associated services is low
- Threat of Substitutes is pretty low because of high investment costs in the industry. Small players have to do extra work to keep up with big ones.

According to this data, it can be seen, that focus strategy works best with building a new enterprise architecture for refrigerated container sale process. Further step is to decide which framework will work best for the company.

Zachman's framework is the system for defining business architecture created by John Zachman at IBM in the late 1980s. Many people mistakenly call it a methodology, but Zachman does not define the methods of creating or using the content that it prescribes.

John Zachman describes specific models that are required to be created in order to fully describe anything in the company. The framework is usually presented as a matrix in which each line represents a regular view of a solution from a certain perspective and each column answers who, what, when, where, why and how about that perspective. According to Zachman (Zachman, 2008), each architectural material should only live in one cell of the matrix. The frame also defines architecture as complete only when all 36 cells in the matrix are filled out.

Zachman's framework is rather difficult to implement in EuroCool LLC therefore it is better to see the next one.

The Open Group Architecture Framework is used by a wide variety of business organizations and to improve their efficiency. It is one of the most prominent and most reliable standards of enterprise architecture. TOGAF can be used by business architects, IT architects, data architects, system architects and others. Professional enterprise architects who are using the TOGAF standards admire it for a higher industry credibility, job efficiency and career opportunities. TOGAF helps practitioners to avoid being locked in proprietary methods, use resources more efficiently and improve return investment. This framework should be recommended for EuroCool LLC to adapt. (The Open Group, 2018)

The Open Group Architecture Framework supplements and can be used together with other frameworks. While All Fusion Process Modeller and Craft.Case are used for business modelling, usually for a certain business processes, TOGAF was created especially for building an Enterprise architecture with an intent to see the whole overview of an organisation. EA follows several methodologies and techniques, which mainly summon artefacts, blueprints of all archetypal element in the universe. Most of the enterprises like big complex businesses rely on these methodologies to invest a change or investigate a problem.

To recap everything, the focus business strategy is recommended to be selected and enterprise architecture should be built with the use of the open group architecture framework.

6 Conclusion

To achieve the main objective of applying enterprise architecture to a business company, it is important to build enterprise architecture that has people and hardware in line and working together in an efficient, sustainable, and adaptable manner to bring positive and at the same time measurable results for the business organization. In example, it could be increase of sales amount, bigger market share, higher profit or any other positive economic effect.

Therefore, to get such results throughout this work, starting from analysing the literature resources, in order to find the best solutions and methods, it was necessary to get familiar with the EuroCool LLC, to know more details that have to be considered. Then, problem analysis was conducted, explaining what changes to the enterprise architecture are needed. Next, preliminary analysis of a selected business company, showing how it is structured and how it operates. Going further, the current state and the future state models were made, which is the main component for building an enterprise architecture. The presented research will try to prove a hypothesis: "The improvements in Enterprise Architecture can lead to a positive economic effect in a business company." In order to achieve that, based on the proposed changes to the enterprise architecture, chosen economic effects were evaluated, with use of Cost-Benefit analysis and Return on Investment method.

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8 Appendix

8.1 An Example of a business process modeling in Craft.Case

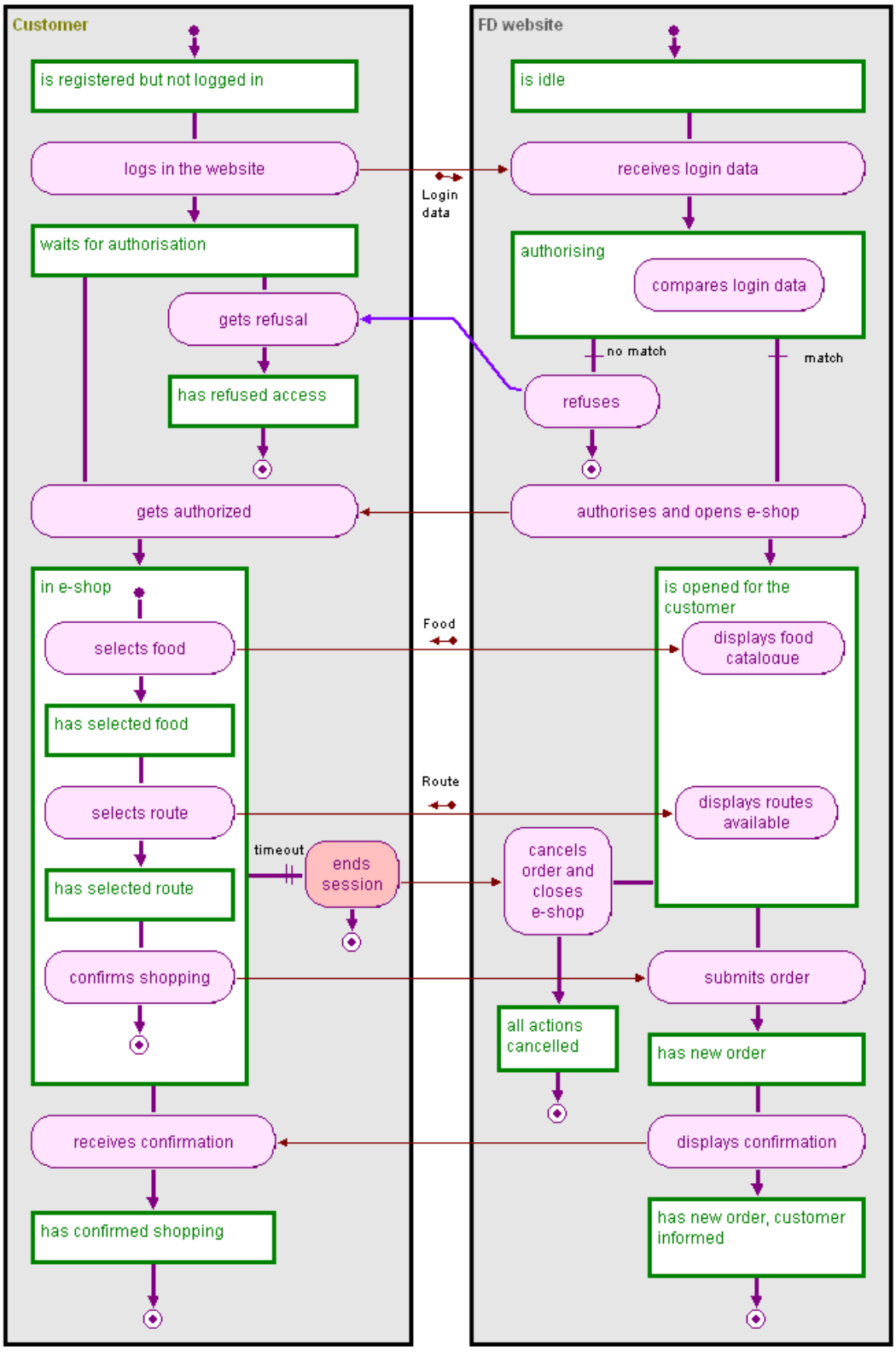

Figure 3.3 Example of a business process modelling – Craft.CASE

8.2 An Example of an enterprise architecture built in Archi

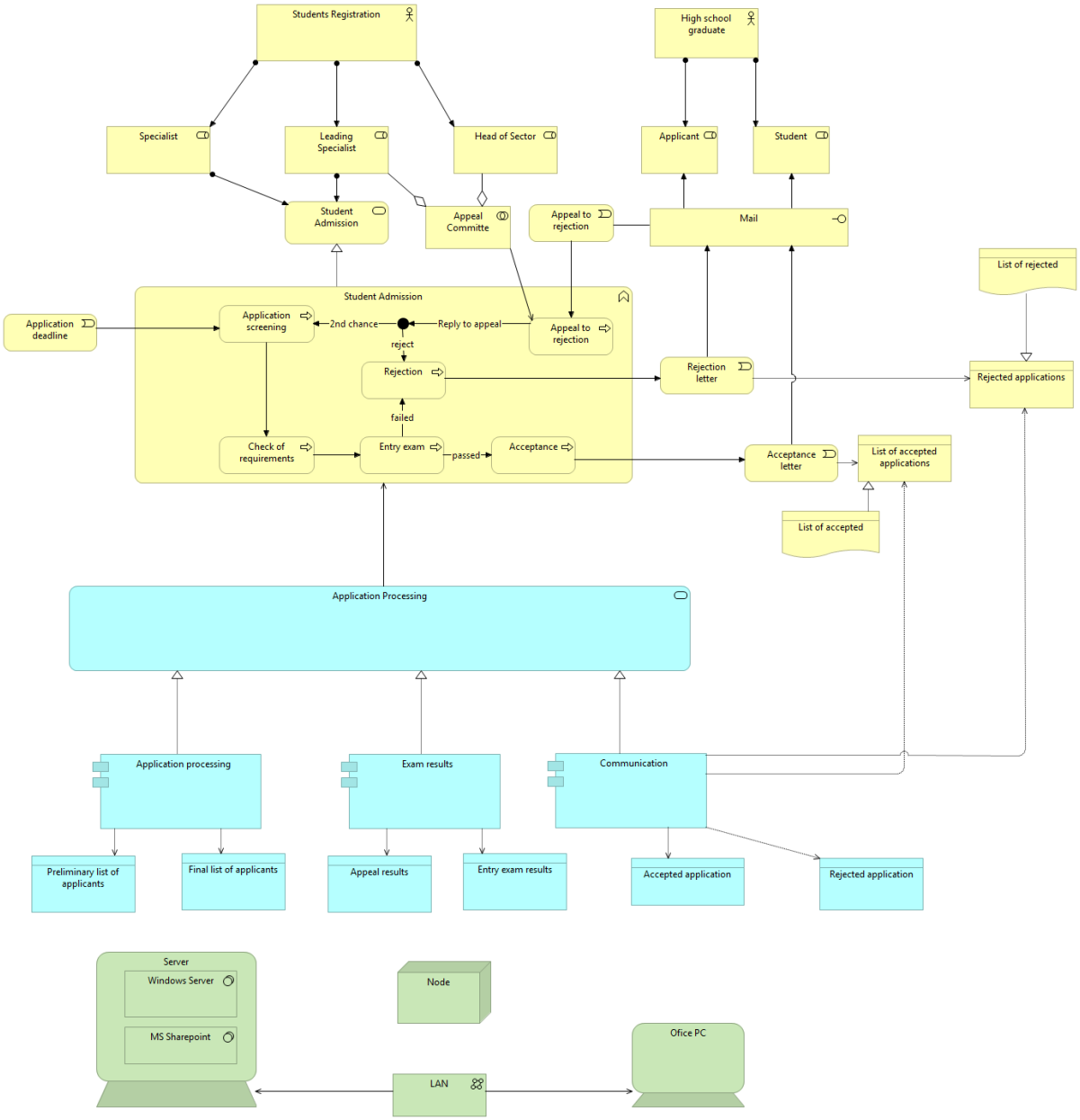

Figure 3.4 Example of an enterprise architecture built in Archi