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# Analysis and Improvement of Tobacco Track and Trace Process in Coop Eesti Keskühistu AS

Master's thesis

Supervisor: Nadežda Furs

Master's degree

TALLINNA TEHNIKAÜLIKOOL

Infotehnoloogia teaduskond

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# Tubakatoodete jälgimise protsessi analüüs ja parendamine Coop Eesti Keskühistu AS-i näitel

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# Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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# Abstract

The problem addressed in the master's thesis is the constant lack of workforce in distribution warehouses, which has a negative effect on a company's essential capabilities, such as customer satisfaction, company reputation and competitiveness. Thesis centres on the tobacco track and trace process, current implementation of which is time consuming and totally detached from the company's infosystem, which involves a lot of manual work and attention. Tobacco track and trace process is a good and well-timed example to use automation in order to concentrate human resources on more complicated business processes.

The goal of this master's thesis is to design the solution, which can empower the process efficiency, minimise the human mistakes and cover the growing number of registered tobacco products from 2024, when the Tobacco Products Directive comes into full force. The practical use of this master's thesis is to prepare the necessary input for developing and launching the tobacco track and trace solution in Coop Eesti Keskühistu AS.

Researching the problem, an overview of the company's strategic goals and capabilities was created, the AS-IS processes were mapped, and the bottlenecks of the process were designated. The author has defined the best suited solution and new TO-BE processes were designed.

As a result of the master's thesis, the requirements were determined and a future high-level architecture view was described, which creates input for the future development of a new solution.

The master's thesis is written in English and consists of 99 pages of text, 6 chapters, 19 figures and 12 tables.

# Annotatsioon

Tubakajälgimise protsessi analüüs ja parendamine Coop Eesti Keskühistu AS näitel.

Magistritöös käsitletav probleem on pidev tööjõupuudus jaotusladudes, millel on negatiivne mõju peamistele näitajatele, nagu kliendirahulolu, maine ja konkurentsivõime. Lõputöö keskmes on tubakatoodete teekonna jälgimise protsess, mille senine lahendus on aeganõudev ja ettevõtte infosüsteemist täiesti eraldiseisev ning mis hõlmab palju manuaalset tööd ja tähelepanu. Tubakatoodete teekonna jälgimise protsess on hea ja ajakohane näide automatiseerimise kasutamisest, et suunata inimressursid keerulisematele äriprotsessidele.

Käesoleva magistritöö eesmärk on kavandada lahendus, mis võimaldab suurendada protsessi tõhusust, minimeerida inimlikke vigu ja käsitleda kasvavat registreeritud tubakatoodete arvu alates 2024. aastast, kui tubakatoodete direktiiv täies mahus jõustub. Antud magistritöö praktiline eesmärk on valmistada ette vajalik sisend tubakatoodete teekonna jälgimise lahenduse väljatöötamiseks ja käivitamiseks Coop Eesti Keskühistu AS-is.

Probleemi uurides loodi ülevaade ettevõtte strateegilistest eesmärkidest ja võimekusest, kaardistati AS-IS protsessid ja määrati protsessi kitsaskohad. Autor on määratlenud kõige sobivama lahenduse ja kavandanud uued TO-BE protsessid.

Magistritöö tulemusena määrati kindlaks nõuded ja esitati tulevane kõrgetasemeline arhitektuuriline visioon, mis loob sisendi uue lahenduse edasiseks arendamiseks.

Magistritöö on kirjutatud inglise keeles ja sisaldab 99 lehekülge teksti, 6 peatükki, 19 joonist ja 12 tabelit.

# List of abbreviations and terms

| | |
|---|---|
| AS-IS | Current process description |
| AOM | Advanced Order Management |
| BABOK | A Guide to the Business Analysis Body of Knowledge |
| BDM | Business Domain Model |
| BPMN | Business Process Model and Notation |
| CBD | Component-based Development |
| Covid-19 | Coronavirus disease |
| Coop | Coop Eesti Keskühistu AS |
| DSS | Decision Support System |
| ERD | Entity Relationship Diagram |
| EU | European Union |
| EUR | Official currency of 19 of the 27 member states of the European Union |
| F | Functional requirement |
| FURPS | Requirement classification technique |
| IMI | Industri-Matematik International AB |
| KMS | Knowledge Management System |
| KPI | Key Performance Indicator |
| MIS | Management Information System |
| MoSCoW | Requirement prioritization technique |
| NF | Non-functional requirement |
| TO-BE | Future process description |
| ThinClient | Software for WMS scanners |
| TPD | Tobacco Products Directive |
| TPS | Transaction Processing System |
| TTT | Tobacco Track and Trace |
| SDLC | Software Development Life Cycle |
| Voice | Software for WMS voice picking of customer orders |
| WMS | Warehouse Management System |

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# Introduction

In the past few years many companies started to think more thoroughly about automation and digitalization of processes because of Covid-19 pandemic, which has covered the whole world slowing or even stopping the businesses. Mostly that concerns the processes conducted inside the enterprises due to the lack of workforce during the high peaks of Covid infection spread.

This has also affected the Coop Eesti Keskühistu AS (further Coop) performance, whose employees are mostly warehouse workers who cannot be sent to home offices. Coop is a central association in Coop Estonia retail trade group, which provides logistics, marketing, IT support services to other associations within the group. At the most difficult times there was only half of the workforce available for the shifts, which for obvious reasons cannot fulfil the whole workload. Coop is constantly hiring workforce, not only from Estonia, but also from other countries, but that is not enough to cover all the needs.

While the Covid has its negative effect on performance, European Union (EU) authorities are tightening the rules, which leads to more complicated and time-consuming processing of logistics related services in Coop. Tangible changes came into force from May 2019, when all tobacco manufacturers, wholesalers and retailers must register the movement of tobacco products. This has forced enterprises who are dealing with tobacco to create new processes regarding tracking and tracing of tobacco products. If from 2019 this concerns only cigarettes and roll-your-own tobacco, from 2024 it will cover all tobacco products. So, the tobacco track and trace process will become more time demanding due to the increase in products that need to be registered.

This master's thesis focuses on the problem of constant lack of workforce in Coop warehouses, which has a negative effect on a company’s essential capabilities. Thesis centres on tobacco track & trace process, as the newish one it is fully detached from Coop’s logistics processes and not properly integrated into the logistics infosystem. The company is trying to adapt to new regulations starting from 2024 while automating the whole process by integrating into Coop’s infosystem. The main goal of this master's thesis

is to conduct business analysis and conceptual systems analysis in order to plan the possibilities for improving the company performance.

The master's thesis consists of introduction, six chapters, conclusion and appendixes. In the first chapter the author gives an overview of the problem and desired goals as well as setting the scope of the thesis. Second chapter gives a brief overview of the company and its infosystem. In the third chapter the author describes the tobacco directive and gives a theoretical overview on methods, which the author used for analysis of the existing problem and solution for it. In the fourth chapter the business analysis is performed, the author compiles the motivation model, value stream and the capabilities that support it. Author also describes the process and proposes solutions for improvement and compares them, business rules and requirements are developed, and TO-BE processes are mapped for the future solution. In the fifth chapter, system analysis is performed using use case, entity relationship and component diagrams. The sixth chapter gives an overview on project's key performance indicators and further steps in this project management. In conclusion the author summarises the analysis conducted in the master's thesis and goals achieved. The appendixes contain tables and figures that were created for the different parts of the master's thesis but are too big for adding them into chapters.

# 1 Problem background and statement

In this chapter the author describes the problem and its actuality, own role in the project, defines the scope of the master's thesis and gives a brief overview of the desired solution for the problem.

## 1.1 Problem actuality

Crisis is perfect for the performance reviews, because it highlights the trouble spots in the time of lacking essential process components. During the Covid-19 pandemic wholesale and retail trade numbers are growing even bigger despite the overall decrease in economics due to restrictions and problems with a lacking workforce. The total EU retail sales volume in January 2022 is 4,1 % higher than in February 2020, the month preceding the Covid-19 crisis [1]. While Estonia in January-February 2022 was experiencing the biggest numbers in Covid-19 spread, the peak number was on 5th February with 6908 cases per each 100 000 population within the 7 past days (Figure 1) [2].


Figure 1. Covid-19 cases per 100 000 population within 7 days [2]

This means that while the amount of work was increasing, the number of working people was harshly decreasing, which resulted in lack of workforce even for accomplishing routine daily tasks. Two ways companies have traditionally managed costs and reduced uncertainty during recessions are to adopt automation and redesign work processes to reduce manual labour. In a July 2020 McKinsey & Company global survey of 800 executives, two-thirds said they would increase their investment in automation slightly or significantly. Automation use cases that require physical work are usually the ones that

will accelerate the most, and as a result work arenas with the most human interaction are likely to see the greatest growth in automation [3].

The first thing the companies are trying to automate is the main business processes that have the most value for the customers and when it is done, they usually stop the automation process thinking that mission is accomplished. But the company or business does not consist of only value adding processes, there are processes that company is obligated to do, these processes do not directly add value to the customer but waste valuable time.

## 1.2 Problem description

One of the supportive processes that directly do not add value to customers in Coop is tobacco track and trace process (further TTT), which companies are obligated to follow by European regulations. This process brings much value to the government and European authorities in battle with illicit tobacco trade. Overall, illicit cigarettes accounted for 7.8 percent of total cigarette consumption in 2020 in the European Union, representing 34.2 billion cigarettes. As a result, the illegal sale of these products has resulted in the loss of € 8.5 billion in taxes in the EU [4]. This is the reason why the obligations to track and trace tobacco are going to be more severe within the following 2 years, which will result in more time spent on tobacco tracking activities on site. The more time is spent on non-value adding activities, the less time is remaining for the customer essential processes.

In the past two years Coop has focused on automation of customer-centric processes and several developments are in progress now, like automated customer returns or automated import of campaign order from pre-order system. The author has chosen the tobacco track and trace process, because this process is not under improvement now and right now is the correct time to start the analysis to be ready by 2024 when the EU directive comes into full force.

The current process implementation aggravates existing problems within the company, like lack of workforce. Company always focuses on key customer related processes. But in the state of workforce shortage even these operations are starting to suffer, and

supportive ones are postponed, partially executed or even stopped. In order to save the resources for essential processing, simple but time-consuming routines must be automated. Current implementation of the TTT process fits into an easily automated, but human resource consuming category. Process automation can free resources to be used for the activities that are more profitable for the company. Lack of workforce can also have a negative effect on customer satisfaction and in overall company's reputation and competitiveness as a result of delaying order deliveries. Manual process handling is a problem due to higher error rates, which therefore leads to increased error handling times (if the errors are further exposed) or result in inappropriate reporting (if errors stay in).

Overall, the author uses tobacco track and trace process as a good and well-timed example to use automation in order to concentrate human resources on more complicated business processes. This pattern can later be applied to similar processes. Currently the tobacco track and trace process is time consuming and totally detached from the company's infosystem, which involves a lot of manual work and attention.

## 1.3 Goal setting

In the master's thesis the author combines the lean thinking framework with the methods of business and systems analysis acquired during the studies in order to find the most optimised and valuable solution for improvement and automation of tobacco track and trace process. The goal of this master's thesis is to design the solution, which can cover the growing number of registered tobacco products from 2024, empower the process efficiency and minimise the human mistakes. The practical use of this master's thesis is to prepare the necessary input for developing and launching the tobacco track and trace solution in Coop.

In the first part of the master's thesis, an overview of the company's strategic goals and capabilities is created, the AS-IS process is mapped, and the bottlenecks of the process are designated. Further a new TO-BE process is offered, that would satisfy the expectations of stakeholders and will be aligned with the strategic objectives and capabilities. As a result of the master's thesis, the requirements are determined and a system analysis is conducted, which creates input for the future development of a new solution. The main goals to be achieved with a new solution are:

- Reduction of the workforce amount used for TTT process, which will lead to workforce increase in value adding processes.
- Reduce the amount of manual input from the end user, which will lower the error rate within the TTT system.
- Reduction in process uphold costs as a result of automation.
- Simplification of process handling will increase the process satisfaction between users.

## 1.4 The scope of the thesis and the role of the author

Author works in Coop as a logistics software specialist. In everyday work the author sees warehouse and accounting problems partially caused by obsolescence of TTT process, which affects not only the Coop inside job but also Coop duty to the state. With the help of interested parties, the author searches for a solution that would simplify the overall process and automate the manual parts of it, conducting received knowledge during master's studies.

In the author's research were also participating:

- Warehouse keeper, who is dealing with the TTT process in the warehouse.
- Warehouse workers, who are directly involved in the tobacco track and trace activities.
- Logistics project manager, who has substantial experience in Coop and was participating in the establishing the Coop TTT process in 2019.

To the scope of the thesis belong the following:

- Business analysis: stakeholders, motivation model and value stream.
- Modelling of business processes.
- Business rules and business domain model.
- Requirements to the solution, their classification and prioritisation.
- System analysis, including use-case, entity relationship and component diagrams.
- Key performance indicators (KPI) for the new solution.
- Proposition of further steps for developing and implementing the solution.

To the scope of the thesis do not belong:

- Estimates for solution development.
- Security analysis.
- Risk analysis.
- Prototyping.
- Solution development, testing and deployment.

# 2 Company introduction

Coop Estonia is Estonia's oldest and biggest group in retail trade. Coop Estonia's consumer cooperatives are associations created by the people whose aim is to maintain regional communities by improving local trading. Today the Coop family includes 19 consumer cooperatives with 330 stores all over the country. The Coop Eesti Keskühistu AS is a central association, which was established in 1917 for easing the communication between regional communities. Coop also has subsidiary companies – Coop Pank AS and Coop Energia OÜ (Figure 2) [5].


Figure 2. Coop Estonia [5]

Coop Eesti Keskühistu AS provides to consumer cooperatives a range of services, from logistics and warehouse services to pricing and promotions handling, as well as marketing. Figure 3 depicts Porter's value chain analysis for Coop - a collection of activities that are performed by a company to create value for its customers [6].

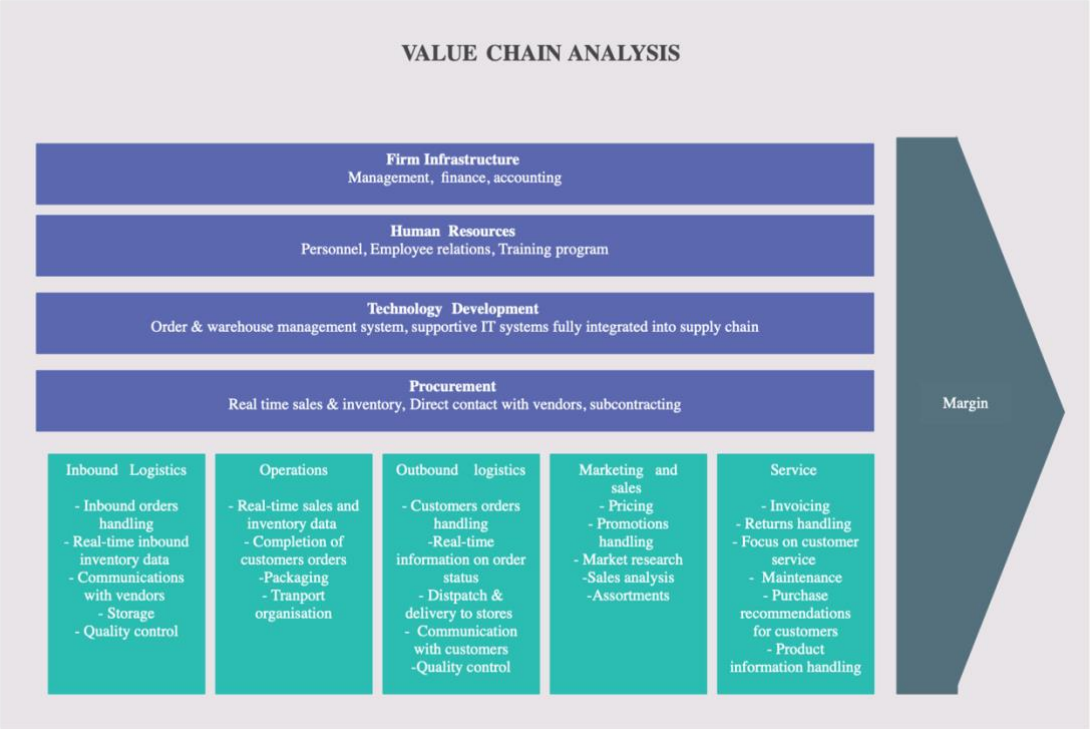


Figure 3. Porter's value chain analysis for Coop Eesti Keskühistu AS (created by author using Creately)

As seen from the picture supportive activities are:

- Firm infrastructure – primary activities are directed and supported by company management, finance and accounting.
- Human resources – this corresponds to personnel management, employee relations and different training programs for employees.
- Technology development – IT systems, which are supportive services for primary activities, such as order and warehouse or product management systems.
- Procurement – this covers subcontracting with vendors

One of the primary activities is marketing and sales. This covers market research for adjusted assortment handling, sales analysis, pricing management and product promotions and campaigns.

This thesis is mainly based on logistics services provided by Coop, which are represented on Figure 3 in Inbound Logistics, Operations, Outbound Logistics and Service sections. The central association provides to cooperatives following logistics services:

- Inbound Logistics – ordering needed quantity of goods from different vendors, receiving it at Coop central warehouse, storage and quality control of the incoming goods. Real-time inbound inventory data is provided by the warehouse management system.
- Operations – picking the consignments according to the customer orders, packaging of orders, organisation of transport from the central warehouse to the stores. Real-time sales and inventory data is provided by order and warehouse management systems.
- Outbound orders – handling of customer orders, dispatch and delivery of orders to the stores, quality control of the outbound. Real-time order status update is managed by order management system.
- Service – automated invoicing after order dispatch from the warehouse, handling of returns from the stores and to vendors, product up-to-date information handling, automated purchase recommendations to customers.

All primary activities combined with supportive ones increase production efficiency so that Coop can deliver maximum value for the customers with the least possible cost.

Nowadays all companies try to facilitate and empower their own business processes with information technologies and Coop is not an exclusion. In Coop there are many technological solutions in use that support the logistics services provided on a daily basis (Figure 4). Most of the systems are interconnected, sending the valuable information, except for one – Inextend, which is used for registering tobacco track and trace activities.

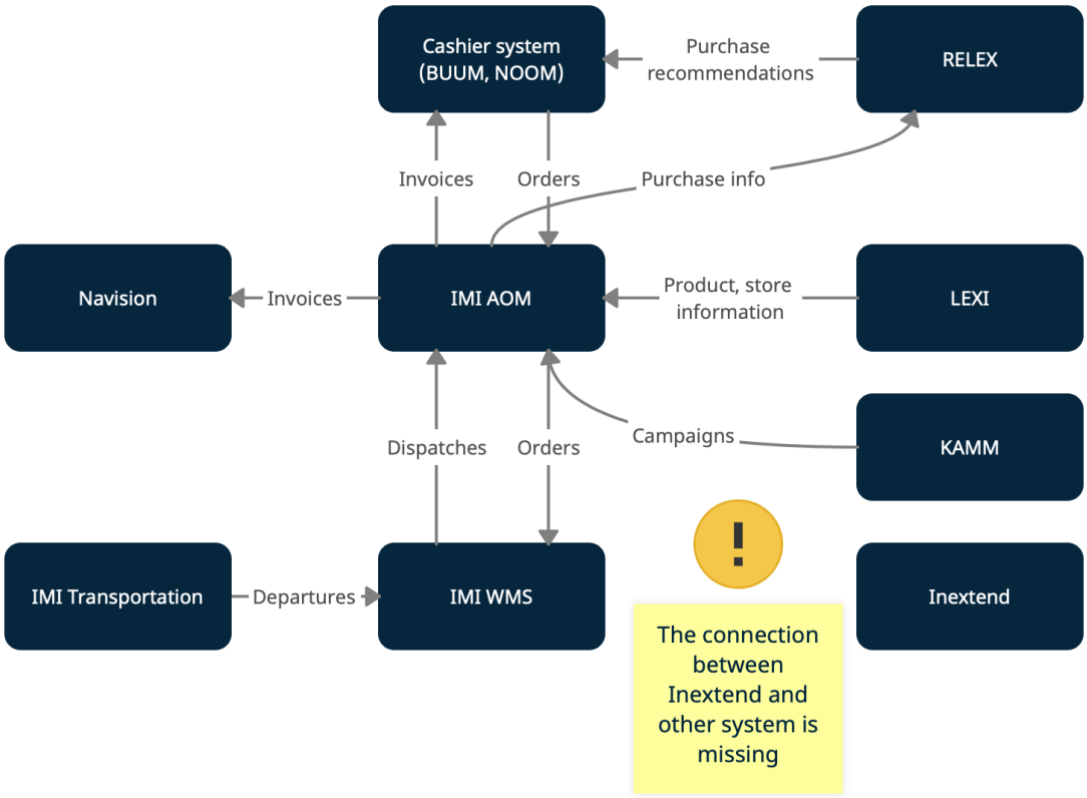


Figure 4. Coop Information system overview (created by author using Creately)

Two main logistics solutions that are in use:

- IMI Advanced Order Management system (AOM) is a flexible multi-channel order management system that provides complete visibility and control of sales, purchases, returns and inventory management processes throughout the global supply chain.
- IMI Warehouse management system (WMS) is an efficient system for the warehouse operations, it automates and enhances inhouse processes to improve space utilisation, reduce labour costs, and increase delivery reliability. In WMS for inbound and outbound activities mobile scanners are used with ThinClient software, and for completing the orders Voice software [7].

Both IMI AOM and WMS exchange the information with systems provided in Table 1.

Table 1. Coop infosystems (created by author)

| **System's name** | **Description** |
|---|---|
| BUUM | Cash register system |

| | |
|---|---|
| NOOM | Cash register system |
| IMI Transportation | Transport logistics system |
| LEXI | Product management system |
| KAMM | Campaign management system |
| Navision | Invoice management system |
| Relex | Purchase recommendation system |

LEXI and KAMM import the store, product and campaign information into the order management system (AOM). Cashier systems (NOOM, BUUM) import the orders to AOM, where orders are processed and exported to the warehouse management system (WMS). WMS creates the picking orders. IMI Transportation imports the available departures for the orders to WMS. After the order is picked it is further dispatched, information is sent to AOM, which starts the invoicing process. Invoices are further sent from AOM to cashier systems and accounting system Navision. AOM also sends the purchase information to RELEX and based on that info RELEX makes a purchase recommendation for the stores. All the systems are connected and form one big logistics infosystem [8].

# 3 Theoretical overview

In this chapter the author gives an overview on European regulations concerning tobacco track and trace process, introduces the methods used in master's thesis to analyse the tobacco track and trace process and justifies the choice.

## 3.1 Tobacco Products Directive

To gain a substantial overview on the Tobacco Products Directive 2014/40/EU (TPD), especially the tobacco track & trace process, the author has studied the following open-source documents published by the European Commission.

*The Tobacco Products Directive (2014/40/EU)*

This document's purpose is to make the tobacco and related products market more efficient while improving consumer safety throughout Europe. The Directive, which is based on the proposal of the European Commission, entered into force on 19 May 2014 and became applicable in the EU Member States on 20 May 2016 [9].

*Implementation analysis regarding the technical specifications and other key elements for a future EU system for traceability and security features in the field of tobacco products. Final report. Annex I. Annex II. Annex III*

Specifically, the document presents an assessment of implementation of the EU's system for traceability and security features for tobacco products based on the technical specifications. This document gives an overview of the tobacco track & trace system, describing how it is working and what requirements should be met to achieve the desired solution [10].

According to Tobacco Products Directive 2014/40/EU (TPD) the tobacco products need to be tracked and traced. From 20 May 2019 it concerns only cigarettes and roll-your-own tobacco, but from 20 May 2024 all other tobacco products too. The overall objective of the TPD is to provide a framework for laws, regulations and administrative provisions

in the Member States concerning the manufacture, presentation and sale of tobacco and related products. It includes traceability and security features, which are intended to increase security and control throughout the entire tobacco supply chain [9].

According to Article 15 of the TPD, tobacco products need to be tracked and traced. To achieve this, every packet of tobacco products manufactured or imported in the European Union must have a unique identifier. In addition, their movements must be recorded throughout the supply chain (up to the last level before the first retail store) [9].

Figure 5 describes the EU Tobacco Track & Trace system. According to the TPD Directive ID Issuer is responsible for generating and issuing unique identifiers, information about issued identifiers goes straight to Surveillance Data Storage. For Estonia the ID Issuer is Allexis s. r. o. Surveillance Data Storage is a domain, where competent authorities and auditors can access data. The European Commission appointed 'Dentsu Aegis Network Switzerland AG' as the provider to operate the Surveillance Data Storage in the European Union. Primary Data Storage solution each manufacturer can choose by itself from valid third-party solutions and inform the European Commission about their choice. As for the Coop the Primary Data Storage is an Inexto solution Inextend.

Manufacturers request the unique identifiers from the ID Issuer and must label each tobacco product with a unique identifier. On the manufacturer’s site tobacco products (items) can be aggregated to pallets (containers) and then dispatched. Aggregation and dispatch events are transmitted to Primary Data Storage. When products arrive at the Distribution warehouse, they must be registered in the system by arrival event. Warehouses can disaggregate containers and aggregate new ones or dispatch the products to the retailer as received [10]. For registering the tobacco products COOP uses Zebra mobiles with installed Inextend application. Arrival, disaggregation, aggregation and dispatch events are transmitted to Primary Data Storage and then to Surveillance Data Storage.

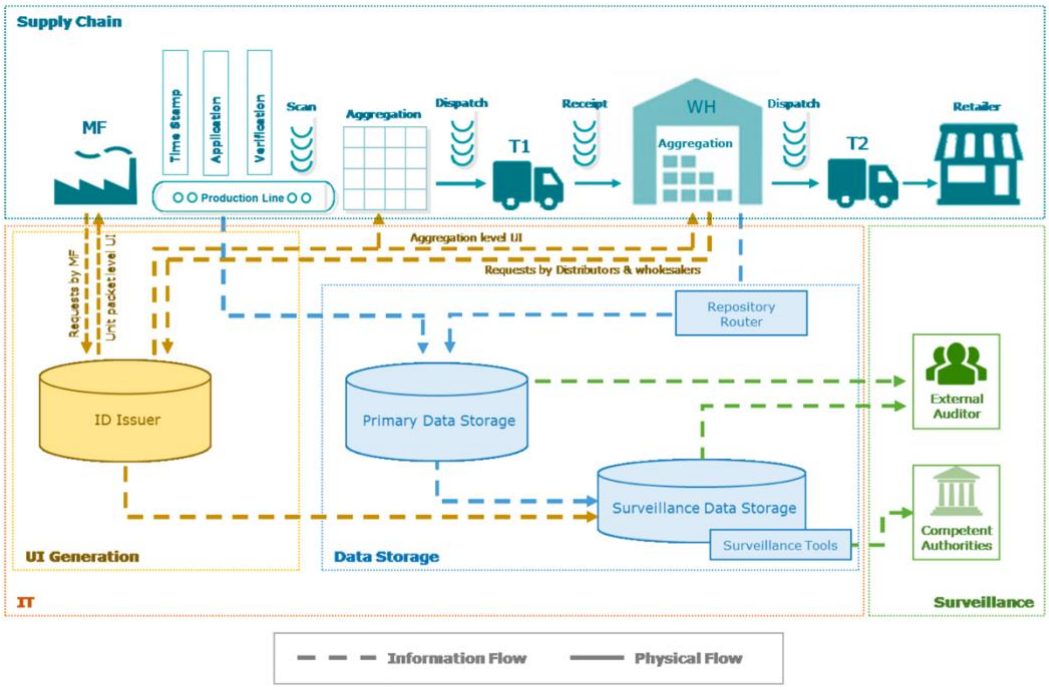


Figure 5 EU Tobacco Track & Trace system [10]

The list below shows how many times a tobacco product must be scanned during the distribution process:

- upon arrival to the warehouse – Arrival event
- while unpacking the items from the container or pallet – Disaggregation event
- while consolidating items into one container or pallet – Aggregation event
- upon dispatch from the warehouse – Dispatch event

Each European government has defined the fines for the inappropriate tobacco track and trace reporting. In Estonia the Tobacco Law (in Estonian Tubakaseadus) § $39^1$ states that failure to record transactions reflecting the actual transport route of the tobacco product packaging or to change or delete registered data is punishable by a fine of up to 3200 EUR [11].

## 3.2 Lean Thinking

Lean thinking is a transformational framework that aims to provide a new way to think on how to organise human activities to deliver more benefits and value while eliminating waste [12]. The author is using this framework in order to evaluate the existing processes and to redesign them eliminating unnecessary and automating all possible activities.

Waste is any step or action in a process that is not required to complete a process successfully. When Waste is removed, only the steps that are required to deliver a satisfactory product or service to the customer remain in the process. The idea of process improvement is to identify and remove all forms of waste from a process in order to increase efficiency, reduce cost and provide customer value [13].

According to Thangarajoo Y. and Smith A. the actions within process can be split in two categories:

- Value added - Changes the form, fit, function or utility of the product or service.
- Non-value added
    1. Unavoidable – the action or task must be performed due to law or regulation (or because the process cannot be completed without it).
    2. Avoidable – the task that does not create value for the customer and can be skipped (this does not lead to process failure) [14].

Author has chosen this framework for analysing the existing tobacco track and trace process and identifying the actions that waste valuable time with the aim of redesigning the processes, so they produce the most value with the least cost.

## 3.3 BABOK Guide ver. 3

BABOK guide (A Guide to the Business Analysis Body of Knowledge) is used as a framework for the business analysis of the current project. In the given master's thesis, the author is focusing on version 3 of BABOK guide. The content of BABOK guide is structured into six chapters:

1. Business analysis planning and monitoring. The purpose of this chapter is to explain how to decide what tools, techniques, activities, and stakeholder groups are needed for an analysis to be completed.
2. Elicitation. This chapter describes the research process and techniques for obtaining information from stakeholders and confirming the results.
3. Requirement analysis. This chapter includes methods for prioritising and organising requirements, along with the most efficient techniques for presenting requirements
4. Enterprise analysis. This chapter defines an effective way to apply the capabilities of an enterprise to reach a desired set of goals and objectives.
5. Requirements Management and Communication. The purpose of this chapter is to describe the steps that need to be taken to identify business needs.
6. Solution Assessment and Validation. It describes in detail how to select the best solutions to suit a particular business requirement [15].

Author has chosen the BABOK, because it is a living document and summarises the best practices of business analysis all around the world. BABOK is very agile, it provides a list of various options. It allows to pick techniques that better fit for the project. For this master's thesis author selected the following methods:

- Business capability analysis represents a company's ability to respond to or transform something that contributes to the achievement of a business goal or objective.
- Business rules analysis is used to validate, improve, and organise the rules that identify processes.
- Identifying of functional and non-functional requirements and their prioritisation
- Process analysis aims to evaluate an organisation's efficiency and effectiveness, as well as the opportunity for improvement in it.
- Process modelling describes the sequential flow of work or activities for a new proposed solution.
- KPI and metrics measure the performance of solution, solution components, and other matters of interest to stakeholders [15].

## 3.4 SDLC Waterfall model

In Coop are co-existing two different software development lifecycles. The Coop developer's team, working on the product management system, uses Agile SDLC. Outsourcing developments use Waterfall SDLC. As the current project is out of the Coop's development team scope, it will go for outsourcing. The Waterfall model has five phases: Requirements analysis and specification, design, implementation and unit testing, integration and system testing, and operation and maintenance (Figure 6). The steps always follow in this order and do not overlap [16].

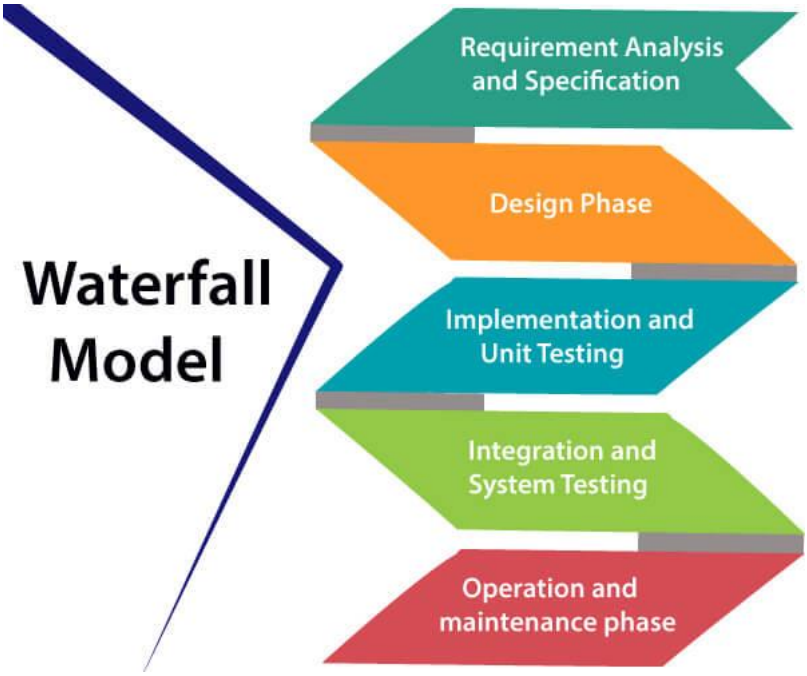


Figure 6. Waterfall model [16]

1. Requirements analysis and specification. The purpose of this phase is to understand the exact requirements of the customer and properly document them.

2. Design phase. In this stage, the requirements are transformed into a suitable form that can be coded in the programming language of choice. The overall architecture of the software is defined.

3. Implementation and unit testing. During this phase, design is implemented. During testing, the code is thoroughly examined and modified, if needed.

4. Integration and system testing. This phase is essential, because end product's quality is dependent on how well the testing was performed.

5. Operation and maintenance phase. Software maintenance is the process that follows delivery and installation of software to the customer [16].

This master's thesis covers the first two phases – requirements analysis and design. For identifying the requirements, the business analysis is held. Design phase is presented with a use case diagram, ERD and component model, which give a high-level overview on the desired solution.

# 4 Business analysis

Business analysis is used to identify and articulate the need for change in how organisations work, and to facilitate that change - identifying and defining the solutions that will maximise the value delivered by an organisation to its stakeholders. It facilitates understanding why the change is needed, highlights efficiency gains and outlines the main targets of the new solution [17].

Business analysis can be understood as a research discipline that helps to find the business needs and identify solutions to business problems. These solutions may include the development of a software or system component, improvements in process, organisational changes or strategic planning and policy development.

## 4.1 Motivation model

Archimate 3.1 motivation model is used to depict why a demand is meaningful: why this change is needed. In addition to identifying crucial drivers and root causes, this model also identifies actual goals and their related outcomes, as well as specific requirements for future development. The motivation model answers the questions to whom, why and what [18].

Motivation model consists of the following elements in Table 2 [19].

Table 2. Motivation elements [19]

| **Element** | **Description** |
|---|---|
| Stakeholder | The role of an individual, team, or organisation that has an interest in the project and can affect certain project aspects (such as requirements or architecture) following its own needs. |
| Driver | Represents an external or internal condition that motivates an organisation to define its goals and implement the changes necessary to achieve them. |
| Assessment | Represents the result of an analysis of the situation of the enterprise with respect to some driver. |
| Goal | Represents a high-level statement of intent, direction, or desired end state for an organisation and its stakeholders. |

| | |
|---|---|
| Outcome | Represents a result |
| Principle | Represents a statement of intent defining a general property that applies to any system in a certain context in the architecture. |
| Requirement | Represents a statement of need defining a property that applies to a specific system as described by the architecture. |

Author has created the Motivation model (Figure 7) focusing on the tobacco track and trace process, defining the stakeholders, their drivers, goals, desired outcomes and requirements for achieving them. The upper part of the model concentrates on the company drivers and goals to achieve, while the bottom part concentrates on the outcomes from tobacco track and trace process improvement and what capabilities and resources support the improvement.

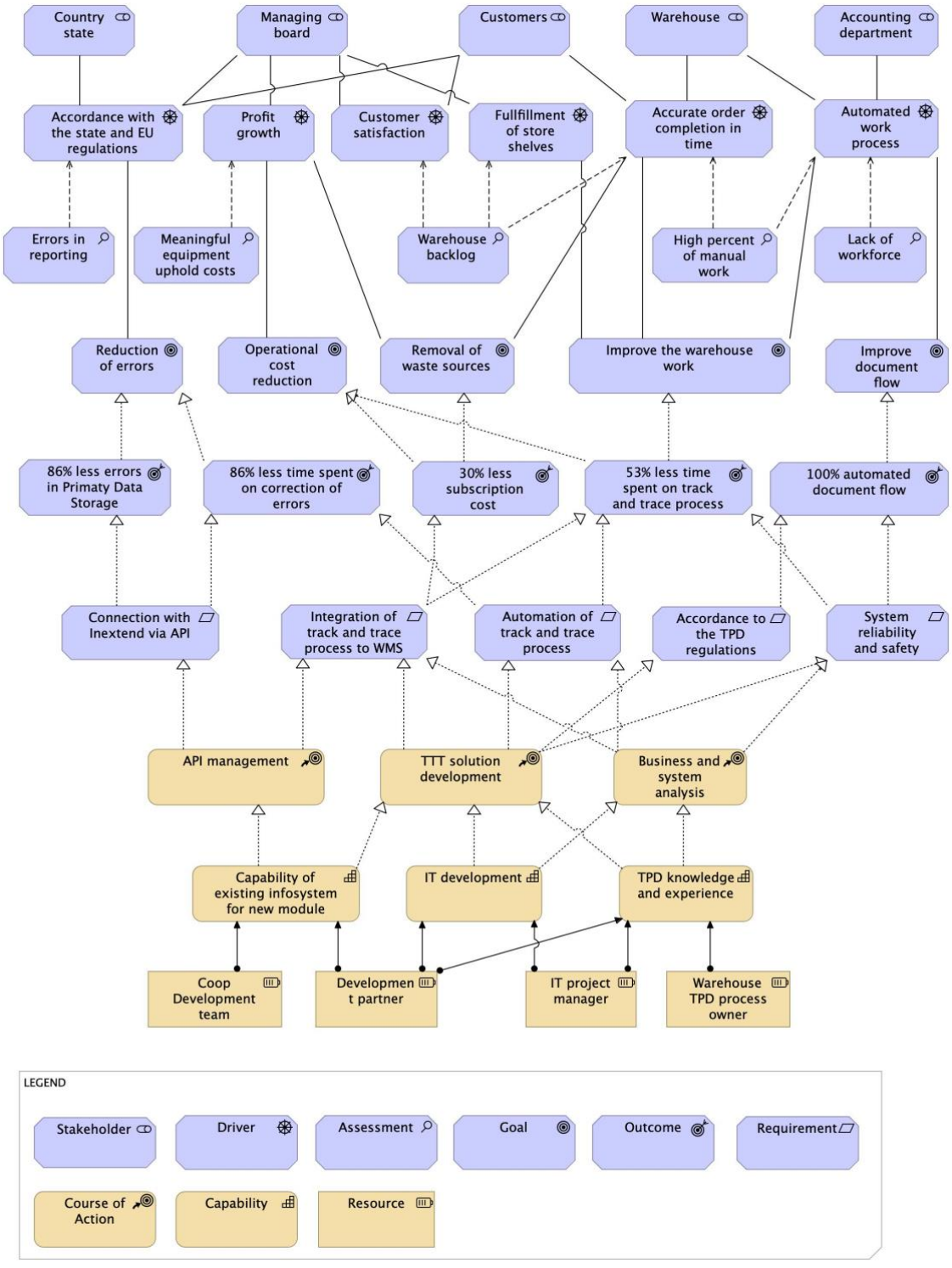


Figure 7. Motivation model (created by author using Archimate 3.1)

The tobacco track & trace process stakeholders are:

- Country state is interested that all company activity would be in accordance with the European Union and state regulations. Concerning tobacco track and trace process that would be timely submission of TPD events without erroneous reporting.
- Managing board is focused on cost reduction, profit growth and customer satisfaction. The essential driver for them is also accordance to the European Union and state regulations.
- Customers are driven by accurate and in time completion of their orders and fulfilment of store shelves. Customers are also interested to receive the products that are corresponding to the EU regulations. Customers prefer to avoid end-product price increases, due to complex regulations and processes in logistic chains.
- Warehouse is targeted to automate trivial and time-consuming internal processes to save the workforce for more essential tasks. Accurate order completion stands as an additional driver.
- Accounting is concerned about automation of their work processes, which will allow them to concentrate more on other tasks.

The goals that are supposed to be achieved with a new solution, are compatible with the stakeholder's drivers.

*Reduction of errors* will affect the correctness and accuracy of reporting the TPD events resulting in 80% less error occurrence within 50% of time reduction spent on error handling.

*Removal of waste sources and Operational cost reduction* will lead to 30% cost reduction in device service, which affect the profit growth.

*Improving warehouse work* through TTT automation will lead to 50% reduction in time spent on TPD activities and affect the operational cost reduction and accuracy of order completion.

*Improving the document flow* will automate the work process and lead to 100% reduction in time spent on reporting the documents to Primary Data Storage.

Motivation model provides the courses of actions to meet the requirements, company capabilities and resources to meet the desired goals.

## 4.2 Value stream and its connection to company capabilities

Lean Thinking is about defining values from the customer's perspective, mapping and streamlining value giving activities, developing the ability to perform activities without interruption and always continuing to improve those activities [12].

Defining the value means understanding all the activities that are needed to produce a particular product, and then optimising the process from the customer’s perspective. The activities that are part of the company's value stream perform three important management tasks that are not affected by the product or service being created:

- solving the consumer problem,
- managing information
- ensuring the physical change of the product [12].

A value stream model is a useful tool for illustrating how business capabilities relate to value stream. This reveals the role and importance of each capability (and associated resources) and the actual value of the capability in the overall value stream [18].

On Figure 8 the author pictured the supply chain process from the customer’s point of interest. Firstly, the warehouse should handle the purchase order to have sufficient stock to pick the customer order. Second action is completing the customer order in time without missing products. Then the order is dispatched to the customer and delivered on the agreed time. After that order is automatically invoiced and an invoice is sent to the customer. Each value stream action has its own supporting capabilities and provides a customer with some meaningful value. As a result, a customer has received the order in good condition and is satisfied with it.

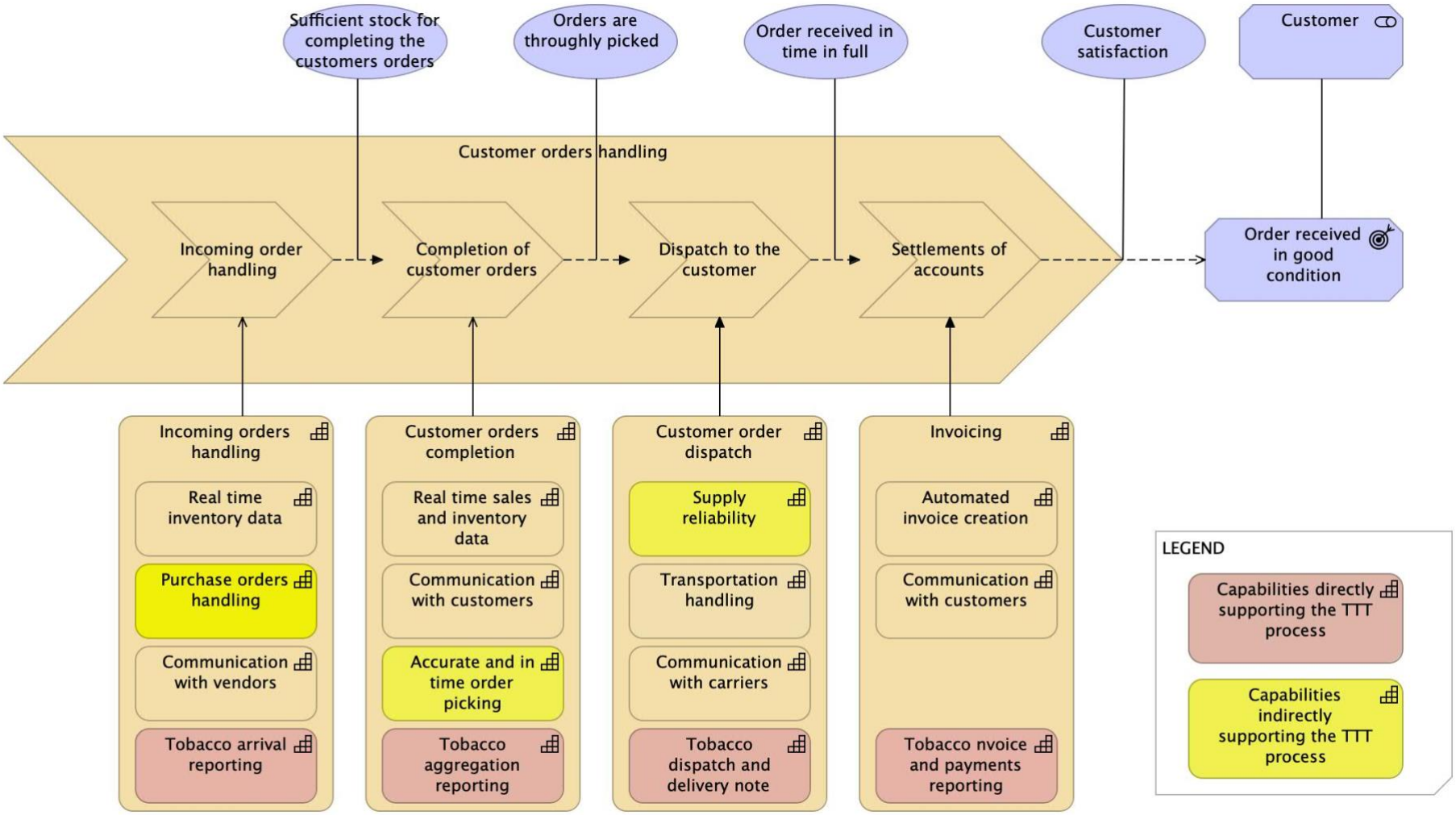


Figure 8. Value flow and its connection to company capabilities (created by author using Archimate 3.1)

As seen from the Figure 8 some capabilities are marked with colour (red or yellow), these are the capabilities that author tries to improve with TTT solution. The capabilities marked with yellow have an indirect effect on TTT process:

- *Purchase orders handling* will be revised during the process analysis facilitating and automating the reporting tobacco arrival to Primary Data Storage.
- *Accurate and in time order picking* will be improved by minimising the time spent on tobacco orders aggregation.
- *Supply reliability* will be improved by automating the reporting of dispatched tobacco orders to the customer.

The ones that are marked with red have a direct input to tobacco track and trace process, these capabilities are in need for improvement the most:

- Tobacco arrival reporting
- Tobacco aggregation reporting
- Tobacco dispatch reporting
- Invoice and payments reporting

During the analysis of the value stream and capabilities, the author also puts a list of TTT process capabilities, that can be added to the TTT process and make it more efficient and flexible:

*Forehanded error handling.* Will provide a possibility to set the automated checks for reported events to monitor the inconsistencies between data, therefore finding potential mistakes.

*Real time tobacco products inventory* from the perspective of TTT. That means having the report of unique identifiers in stock, that would contribute to the preventive error handling.

## 4.3 Detailed process description & evaluation

Coop started to track and trace tobacco products in 2019 and since then the process has not been changed, but from 2024 the overall number of products that need to be tracked will be bigger and it could make the process even more complicated and time-consuming. According to the Coop sales data for the past 3 months, the tobacco products number that needs reporting will increase by 15% [8]. Author sees the problem in outdated and sufficiently non-automated process, which can be improved by integrating the tobacco track and trace process into the logistics supply chain.

For TTT Coop uses Inexto (specifically Inextend) software solution. Inexto is a leading provider of software and services for authentication, secure serialisation and track & trace of tobacco products. Inextend is a mobile, Cloud-connected track and trace solution that makes it possible to scan tobacco products entering or leaving a warehouse and to establish track and trace records for each movement of the goods [20].

The main problem is that tobacco, as regular products, are also scanned by ThinClient scanners to register them in the Coop IMI WMS (also arrival, consolidation and dispatch). A worker should scan the same tobacco containers with two different scanners to deliver mostly the same information to two different systems.

Within 30 days, approximately 105000 bundles of cigarettes are aggregated into 1500 containers, which are shipped to 277 customers. This means about 50 tobacco orders shipped and 2 incoming orders daily. Aggregation scanning takes about 5 minutes depending on order size, dispatch takes 3 minutes, registering the arrival consumes 5 minutes. So, for each outgoing order warehouse worker spends about 8 minutes, which results in 6 hours and 40 minutes a day plus 10 minutes for incoming orders (Table 3).

Table 3. Amount of time spent on Inextend Operations (created by author)

| **TPD Operations** | **Amount per day** | **Minutes spent per one operation** | **Total minutes spent daily** |
|---|---|---|---|
| Arrival | 2 | 5 | 10 |
| Aggregation | 50 | 5 | 250 |
| Dispatch | 50 | 3 | 150 |
| Invoice | 1 | 6 | 6 |

| | | | |
|---|---|---|---|
| Payment receipt | 1 | 6 | 6 |
| Delivery note | 50 | 1 | 50 |
| Error handling | | | 15 |
| **TOTAL** | | | **487** |

Directive also obligates importing of the delivery notes, invoices and payment receipts to the Primary Data Storage. Delivery notes are created in the mobile application by the warehouse worker after registering the dispatch. Invoices and payment receipts are exported from IMI AOM and Navision accordingly to excel files, and these excel files are imported to the Inextend system manually every day. This work takes about 5-7 minutes for checking and uploading the file to the system for each file. To sum up, around 12 minutes a day for invoices and payments receipts plus 50 minutes for delivery notes (1 minute per delivery note).

Overall, 7 hours and 52 minutes a day are spent on obligatory tobacco reporting to Primary Data Storage. Error handling is yet another time-consuming activity. Author has conducted research on errors that occur during tobacco products reporting and the results are shown in the Table 4. Approximately 35 reporting errors are discovered monthly, in the table below the author has divided them by the root cause.

Table 4. Errors description and percentual number of errors (created by author)

| **Root cause** | **Number of errors** | **Percentage (%)** | **Time spent on correction (minutes)** | **Average time per error (minutes)** |
|---|---|---|---|---|
| Missing Dispatch event | 20 | 57% | 255 | 12,75 |
| Missing Arrival event | 2 | 6% | 25 | 12,50 |
| Wrong delivery note number | 8 | 23% | 105 | 13,13 |
| Vendor sent erroneous container / item | 5 | 14% | 65 | 13,00 |
| **TOTAL** | **35** | **100%** | **450** | |
| **AVERAGE** | **1,17 error per day** | | **15 minutes per day** | **12,85 minutes per error** |

The majority of error cases are explained by the warehouse workers, who have forgotten to report to the system the dispatch event or reported the wrong delivery note number to the system. Missing arrival event or vendor related errors are found less frequently. The time spent on correction of each error type is almost the same, which means that for correction of one error is spent about approximately 12,85 minutes per error or about 15 minutes a day. Summing up the total amount of time spent on tobacco track and trace is 8 hours and 7 minutes a day.

The same actions are reported by warehouse workers to the IMI WMS system using Thin Client scanner for arrival and dispatch, and Voice software for aggregations. Large amount of information reported is duplicated in both systems, Inextend and IMI WMS. Meaning that people mostly do double work to get the same outcome.

There is also one event that is reported to the Primary Data Storage, but not daily. This event is a Failed Delivery event, that is meant for returning the tobacco products to the vendor. The reasons for return might be inappropriate, damaged, wrong (not ordered) products or erroneous reporting of the dispatch from the vendor's site. This event was not taken into consideration in spent time calculations, because of its inconsistent nature.

Concluding, the main problems in TTT process now are:

- ineffective use of the workforce, same actions are done twice.
- high costs for use of different equipment to report the same actions.
- manual work, reporting of invoices and payment receipts.
- high percent of errors that lead to extra use of the workforce.

## 4.4 Analysis & comparison of alternative solutions

The goal is to identify if a proposed solution complies with the following:

1. Automates or partially automates the tobacco track & trace process.
2. Eliminate waste actions from the process.

3. Improve the document flow within the process.

4. Facilitate the process for warehouse workers (easier to instruct).

5. Lower the rate of mistakes occurring in the track & trace events reporting.

Author has studied different tobacco track and trace solutions, most of them are separate software with their own equipment for use (not integrated with WMS). But there are also solutions that offer WMS and TTT together, there are a few of them. It is hard to evaluate the productivity of that software without really using it, but having the WMS and TTT together seems to be the best choice for the distribution warehouses like Coop. Although, Coop is not going to change the WMS software for the following reasons:

- Current IMI WMS has been used in Coop for over 8 years and Coop has not experienced troubles with it. Also, IMI is constantly upgrading their product to meet customer needs.

- During 8 years of use Coop has implemented more that 160 additional developments fitting the WMS processes with the Coop ones or creating the new features.

- WMS in Coop is used in cooperation with AOM from the same developer. Changing the WMS means changing the AOM, that is doubling the concerns.

- TTT functionality is incomparable (dramatically smaller) to the existing processes covered by IMI WMS.

Those are the reasons why the author does not consider the option of developing or implementing new WMS solution with tobacco track and trace features. There is another argument in addition to the obvious argument of high development cost - EU regulation forbids the development of track and trace solutions for the parties that are involved in tobacco production or sales. Author has also consulted the IMI WMS R&D department to confirm that the development of a standalone TTT solution is not in the IT department's roadmap. Currently there is no better alternative for the Inextend software.

Considering the above points author has identified three possible solutions:

1. No changes to the current process. Therefore, the current and all upcoming workload is managed by human resources.

2. Automate the sending of transactional documents to Inextend.

3. Development of a new tobacco track and trace add-on (further TTT Module) to be fully integrated with the existing warehouse management system

Table 5 is showing the comparison on alternative solutions giving their advantages and drawbacks. The time gain listed in the Table 5 is calculated in Appendix 2.

Table 5. Alternative solution's advantages and drawbacks (created by author)

| **Solution** | **Advantages** | **Drawbacks** | **Time gain** |
|---|---|---|---|
| 1 | No expense needed for development and implementation.<br>No additional education for employees needed. | Slow and ineffective process.<br>Non efficient labour force usage.<br>Constant error handling.<br>Additional equipment in use (Zebra mobiles with Inextend app). | 0,00% less.<br>In perspective, time gain is negative, meaning taking even more human resources due to the broader tobacco product line to trace. |
| 2 | Average expenses.<br>No additional education for employees needed. | Only partly automated process.<br>Costs are bigger than value received.<br>Additional equipment in use (Zebra mobiles with Inextend app).<br>Error handling. | 13,44% less. |
| 3 | The most value-cost balanced solution.<br>Process fully integrated to supply chain.<br>Minimum level of manual activities.<br>No additional equipment needed (Zebra mobiles with Inextend app) – lower Inextend subscription cost. Zebra mobiles | Need to teach the workers changes in the process.<br>Additional product to support by local IT.<br>Requires investment for development. | 52,95% less. |

| | | | |
|---|---|---|---|
| | can be set up with Thin Client without any cost.<br>Error level is minimal.<br>Does not require additional resources in case of increased volumes of tobacco products. | | |

The author has chosen the third solution – to fully integrate tobacco track and trace process into the warehouse management system. Despite the bigger cost this option provides the most value and as well reduces the number of manual activities and therefore errors. The percentual time gain after integration and process improvement is 52,95%, that means that it will free 257,9 minutes per day (4 hours and 18 minutes) for more valuable activities.

## 4.5 Business rules and business domain model

Analysis of business rules covers identifying business rules, formulating them clearly, validating with stakeholders, aligning with business goals, and organising so the rules can be effectively managed and reused. Business rules may not just be used as a mechanism to make applications more flexible, but also as a bridge to keep an organisation's entire information system in line with business [21].

It is recommended that business rules are clearly identified in the process and documented separately. This helps to avoid frequent changes to the process documentation, as it is not the process or activities and their sequence that changes, but the business rules or the content of an individual activity. Separation of processes and business rules also makes it possible to build information systems that better support processes and have lower maintenance costs, where the management of business rules has been taken out of the system and their change does not require separate software development [21].

The methodology defines all the necessary activities that need to be done in the development of an information system to create a link between the implementation of a business rule and its sources in the business environment. When changes occur at the enterprise level, the methodology and tool help to identify the applications and their components that are affected by the changes [22].

Author has described the business rules of the solution (Table 6), the terms used in the rules are defined in the business glossary in Appendix 3.

Table 6. Business rules (created by author)

| ID | Business rule |
|---|---|
| R1 | ***User*** must have only one ***User Group***, but ***User Group*** can have null or many ***Users***. |
| R2 | ***User*** must be connected to only one ***Warehouse***, but ***Warehouse*** can have null or many ***Users***. |
| R3 | ***Warehouse*** must have null to many **Containers**, but **Container** must be connected to only one **Warehouse**. |
| R4 | ***Container*** can have at least one or many **Items,** but **Item** must be connected to only one **Container**. |
| R5 | ***Warehouse*** can have null or many **Items**, but **Item** must be connected to only one **Warehouse**. |
| R6 | ***Warehouse*** can have null or many **Arrivals**, but **Arrival** must be connected to only one **Warehouse**. |
| R7 | ***Arrival*** can contain at least one or many ***Containers***, but ***Container*** must be connected to only one ***Arrival***. |
| R8 | ***Arrival*** can contain at least one or many ***Items***, but ***Item*** must be connected to only one ***Arrival***. |
| R9 | ***Disaggregation*** can have one ***Container*** and ***Container*** must have only one ***Disaggregation***. |
| R10 | ***Disaggregation*** can have at least one or many ***Items***, but ***Item*** must have only one ***Disaggregation***. |
| R11 | ***Aggregation*** can have at least one or many ***Items***, but ***Item*** must have only one ***Aggregation***. |
| R12 | ***Aggregation*** must have only one ***Container*** and ***Container*** must have only one ***Aggregation***. |
| R13 | ***Dispatch*** can have at least one or many ***Containers***, but ***Container*** must be connected to only one ***Dispatch***. |
| R14 | ***Dispatch*** can have at least one or many ***Items***, but ***Item*** must be connected to only one ***Dispatch***. |
| R15 | ***Warehouse*** can have null to many ***Customers***, but ***Customer*** must have only one ***Warehouse***. |
| R16 | ***Customer*** can have null or many ***Dispatches***, but ***Dispatch*** must have only one ***Customer.*** |

| | |
|---|---|
| R17 | ***Dispatch*** must have only one ***Delivery Note*** and ***Delivery Note*** must be connected to only one ***Dispatch***. |
| R18 | ***Dispatch*** can have at least one or many ***Invoices***, but ***Invoice*** must have only one ***Dispatch***. |
| R19 | ***Invoice*** can have at least one or many ***Payment Receipts***, but ***Payment Receipt*** must have only one ***Invoice***. |
| R20 | ***Customer*** can have null or many ***Invoices***, but ***Invoice*** can be made to only one ***Customer.*** |
| R21 | ***Failed Delivery*** can have at least one or many ***Containers***, but ***Container*** must be connected to only one ***Failed Delivery***. |
| R22 | ***Failed Delivery*** can have at least one or many ***Items***, but ***Item*** must be connected to only one ***Failed Delivery***. |

User is a warehouse worker, who has an account in IMI WMS and has a unique WMS number. According to the R1, each user must be connected to a user group. User groups define the abilities that user can perform in the system and specifics of how the user will be managed by the system. One user group can have many users connected to it. R2 describes that user must be connected to only one warehouse that has a unique code, so a warehouse worker cannot work in many warehouses at the same time, whereas a warehouse can have null or many users. R3 says that warehouse can have 0 or many containers in stock, but container should be stocked in only one warehouse (there is no possibility that container is stocked in two different warehouses). Containers must have their unique IDs. R4 describes that a container should consist of at least one or many items. Item must be connected to only one container; one item cannot be placed in two different containers. Each item has its identifier. R5 shows the relationship between item and warehouse, it is similar to container – item relationship as item must be connected to only one warehouse whereas a warehouse can hold many items. R6 says that arrival event must be registered to only one warehouse. According to R7, arrival can have at least 1 or many containers, at the same time container can participate in only one arrival event, R8 states the same but with items. Disaggregation event should contain at least 1 container and 1 or many items (R9 and R10). Aggregation event as a disaggregation holds at least 1 container and 1 or many items (R11 and R12). R13 describes the dispatch event containing at least one or many containers, but container can be connected to only one dispatch, R14 states the same, but with items. R15 says that Customer should be connected to one warehouse, from which the dispatch event is held. According to R16,

the dispatch should be made to only one customer, but the customer can have many dispatches sent to him. For every dispatch a delivery note, and an invoice must be created. Dispatch can have one delivery note, and at least one or many invoices for the specific customer (R17, R18 and R20). R19 describes that invoice payment should be confirmed by at least one payment receipt. R21 says that failed delivery can consist of at least one or many containers, R22 states the same but concerning items.

The Business Domain Model (BDM) is a conceptual data model that represents the business concepts to be fulfilled by the system and how they relate to one another. BDM does not contain technical information, such as primary keys, foreign keys, technical attributes for history support. BDM provides an enterprise-wide, generic, and flexible data representation for the design of operational or informational systems, serving as an overall reference point for business and IT [23].

BDM provides a strong starting point for analysis and design of operational or informational systems, because it is understood by both business and IT professionals, providing a powerful and precise means of communication, and helping to bridge the innate gap between business and IT perspectives. It is also independent of organisational or technological considerations, providing a stable basis for business modelling and a flexible view of the business that can be customised according to specific requirements [23].

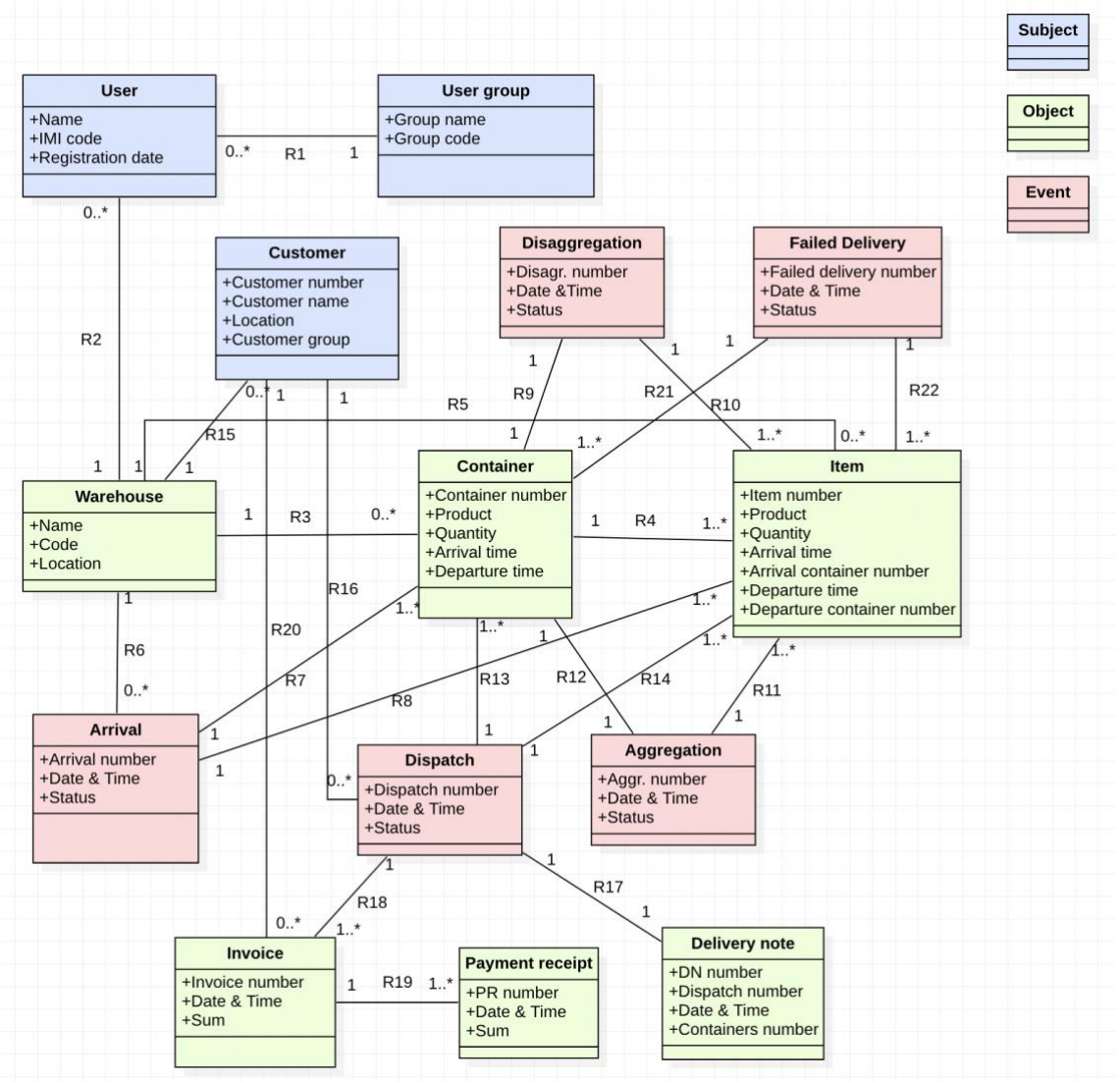


Figure 9. Business domain model (created by author using StarUML)

Figure 9 shows the business domain model. The model shows relationships between subjects, objects and events. Subjects are marked with blue; they are users, user groups and customers as people or groups of people identified by some common attribute. Objects are marked with green; they are warehouse, container and item. Their definitions are listed on the Business Glossary, Appendix 3. Events are arrival, disaggregation, aggregation, failed delivery and dispatch as was specified earlier in the tobacco track and trace process description (page 26).

BDM on Figure 9 shows also the user and user group subjects, as application workflows contain different warehouse workers with corresponding responsibilities. So, user groups are needed to distinguish what responsibilities one or another group of workers has.

Author has decided to show the responsibilities between different users with Responsibility (RACI) matrix as per BABOK (ver 3) (Table 7). RACI is an acronym standing for responsible, accountable, consulted and informed [15]. Tobacco track and trace process actions are listed along the side of the table. On the top of the table are process participants. Resulting matrix holds a role of each person for the task:

- R - responsible for completing the task.
- A - accountable for completing the task or delivering the milestones.
- C - consulted for opinions regarding the completion of the task.
- I - informed about the progress of the task [15].

Table 7. RACI Matrix (created by author)

| **TTT process tasks and participants** | **Warehouse worker** | **Head of shift** | **Warehouse manager** | **Accountant** | **Claims manager** |
|---|---|---|---|---|---|
| Arrival event | R | A | C | I | I |
| Dispatch event | R | A | C | I | I |
| Aggregation or disaggregation event | R | A | C | I | I |
| Resend the events | | R | A | I | I |
| Resend the transactional documents | | C | A | R | I |
| Failed delivery event | | C | A | I | R |

As seen from the Table 7 each task has only one responsible and only one accountable person. The warehouse workers are responsible for the events (Arrival, Aggregation / Disaggregation, Dispatch), because these are the actions that are physically made on the site. Heads of the shifts are accountable for these events, as they need to ensure that all the set tasks are fulfilled during their shift. Head of the shift can resend the events,

corrected from the vendor side to change their transaction status. Warehouse manager is consulted about events if something goes wrong and is accountable for the correction of mistakes (resending the events and documents). Accountant and claims manager are mostly informed about the tasks performed during the TTT process, but they each have one task they are responsible for: resending the transactional documents in case of erroneous transaction for the accountant and performing the failed delivery event for the claims manager.

## 4.6 Modelling of business processes

The Business Process Model and Notation (BPMN) 1.0 specification was released to the public in May 2004. The main goal was to provide easy-to-understand symbols for all business users, from business analysts, who create initial drafts of processes, to technical developers, who are responsible for implementing the technology needed to run these processes, and finally to the people, who manage and monitor these processes. Thus, BPMN creates a standardised bridge between business process design and process implementation [24].

Business process modelling is used to communicate a wide variety of information to different audiences. Within the variety of process modelling objectives, there are two basic types of models that can be created with a BPMN:

- Collaborative (Public) Processes
- Internal (Private) Business Processes [25].

In this thesis BPMN will be used for visualisation of internal tobacco track & trace process, showing the current process (AS-IS) and the desired process flow (TO-BE).

Process modelling helps companies locate opportunities for improvement by breaking the current business process down and analysing the supporting elements. That way it is possible to understand whether a company is operating at optimal levels or if there's room for improvement.

Figure 10 depicts the general TTT process starting from purchasing of the tobacco products and accepting the goods into the warehouse and ending with dispatching the

order and invoicing the customer. The process consists of 5 events, all have their own subprocesses, which will be thoroughly analysed further. General process will not be affected by the proposed solution and will remain the same as shown on Figure 10.

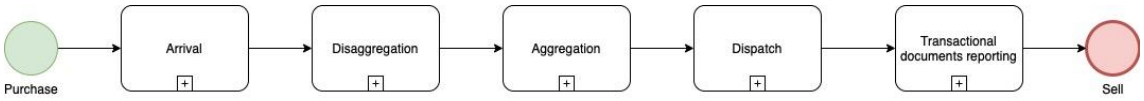


Figure 10. General Tobacco Track & Trace process (created by author using Draw.io web application)

Further will be analysed the arrival, aggregation and dispatch events, comparing AS-IS (current process) and TO-BE (new) process versions and depicting the disappeared and added activities. Both logistics and TTT processes are described in further AS-IS diagrams, because one of the main purposes of the current project is to integrate the TTT process into the existing warehouse environment. TO-BE diagrams should demonstrate the desired integration level between processes.

Figure 11 shows the Inbound order handling and TTT Arrival event AS-IS diagram, while Figure 12 shows the TO-BE diagram. AS-IS diagram represents that inbound order handling and TTT Arrival events are parallel processes that are triggered by incoming purchase order arrival to the warehouse. Inbound order handling is held by ThinClient mobile devices supported by IMI WMS, while TTT arrival event is registered by Inextend mobile devices. WMS inbound order handling starts with creating the inbound receipt, a warehouse worker should insert the inbound purchase order, scan the product codes and insert the delivered product quantity. When all products are scanned the receipt is confirmed and the data is sent to IMI WMS. After that, products are transported to the warehouse shelves for storage or picking the orders. For registering the TTT Arrival event warehouse workers should use the Inextend mobile application, create the Arrival, scan the incoming TTT container IDs and insert the stock owner code. As a result of confirmation, the event is sent to Primary Data storage for further registration.

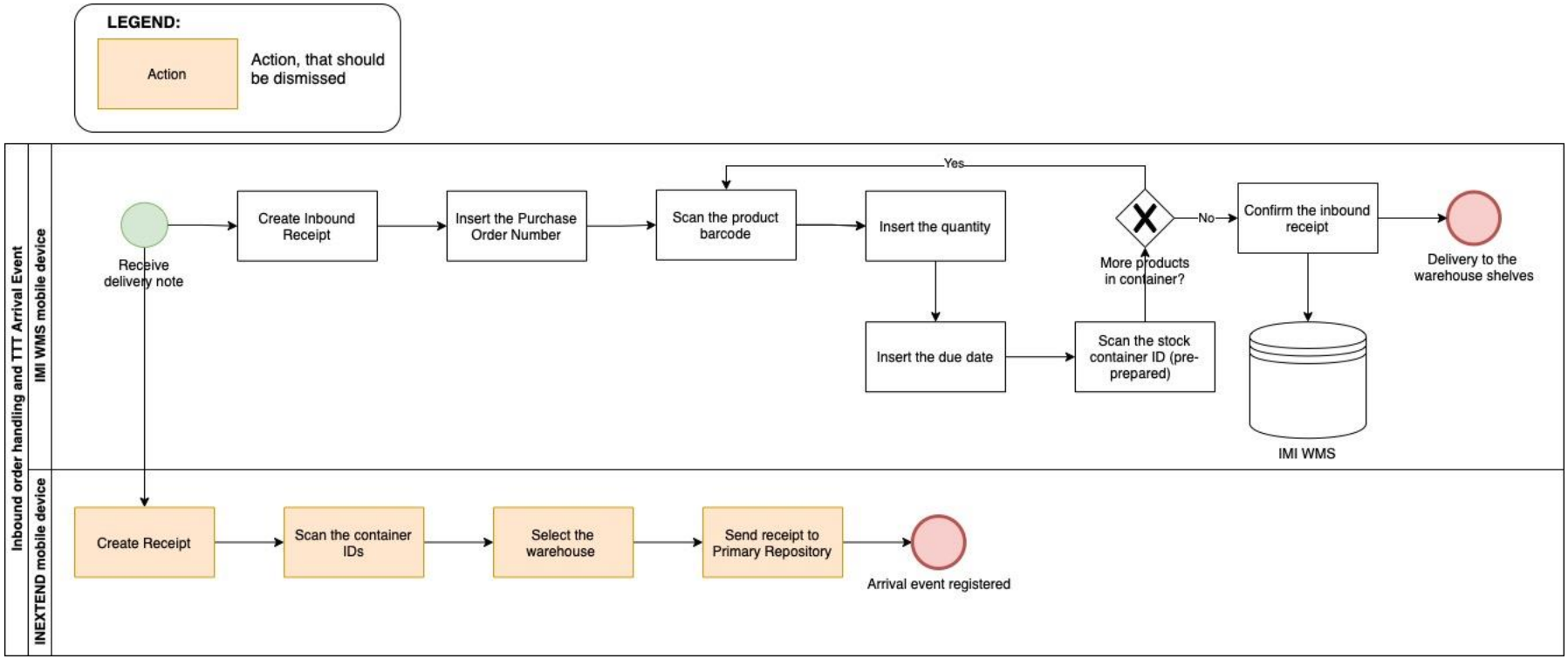


Figure 11. Inbound order handling and TTT Arrival event AS-IS diagram (created by author using Draw.io web application).

The project sets the goal to integrate the TTT Arrival process with WMS Inbound order handling. TTT Module will be created on the WMS basis, which will send the TTT data to Inextend as Primary Data Storage. In TO-BE diagram (Figure 12) the actions taken in Inextend application disappear as no longer needed – these actions were marked by orange colour on Figure 11. Actions added to IMI WMS inbound order handling are marked with blue colour on Figure 12. The additional actions to be taken to the existing WMS inbound handling are the following:

- Scanning the inbound TTT container ID – this will assure the necessary information existence for further sending to Primary Data Storage.
- Option for adding more TTT containers to one receipt – this will ensure that all TTT containers are registered.
- Sending the Arrival event to Primary Data Storage – this will aggregate all needed info and send it to Primary Data Storage for registering the Arrival event.

TO-BE process will also give an opportunity to track what products came in what container, this will simplify the error handling, when the supplier has completed the containers in the wrong manner.

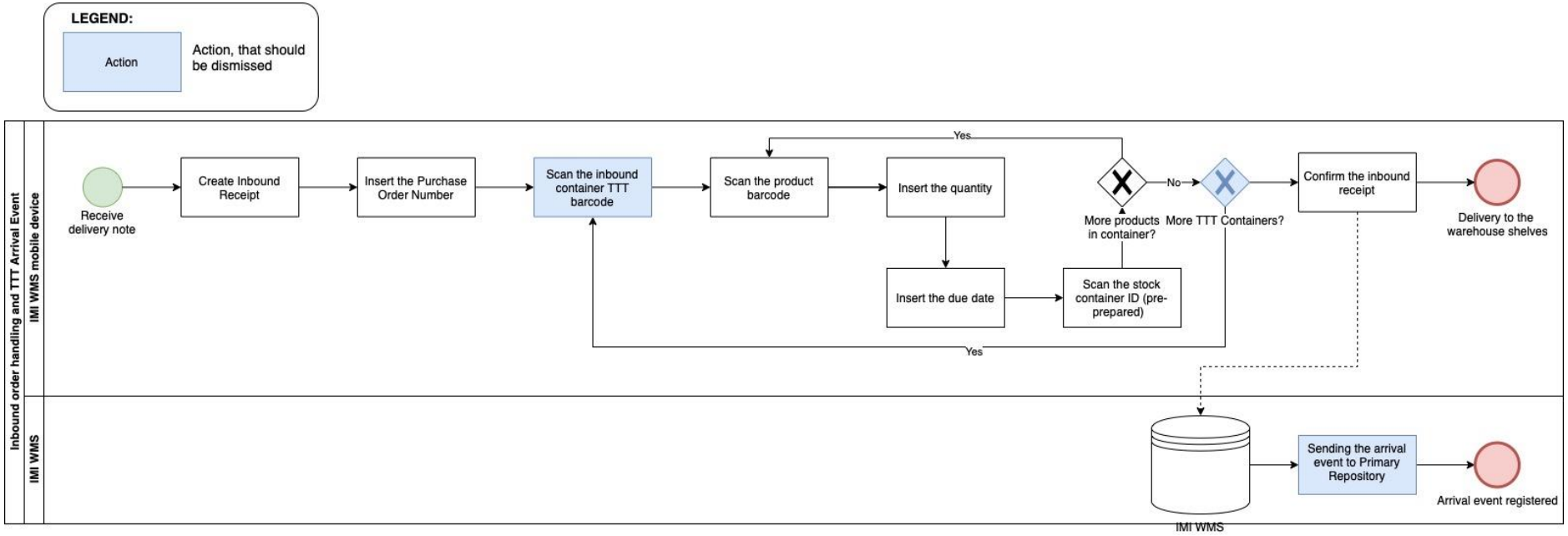


Figure 12. Inbound order handling and TTT Arrival event TO-BE diagram (created by author using Draw.io web application).

Disaggregation event is held via Inextend application by choosing the TTT container at a specific warehouse and the system will delete the TTT container and add to storage item IDs that were stored in this container (receiving corresponding information from Primary Data Storage). The process of disaggregation will be the same, the only difference is that data processing happens on the IMI WMS side, while communication happens using API WMS.

Figure 13 depicts WMS order completion and TTT Aggregation event AS-IS diagram. Order completion process starts in IMI WMS, when the order is released to the warehouse for picking. IMI WMS creates the picking order which is further sent to Voice equipment for a warehouse worker to pick. Voice software guides the worker through warehouse shelves giving information about location and product quantity to pick up. When order picking is complete the container label is printed and attached to the container. The picking information is sent to IMI WMS. During the picking of the products the warehouse worker creates an Aggregation event with the Inextend application, item IDs are scanned and attached to the container ID. As a last step, an Aggregation event is sent to Primary Data Storage.

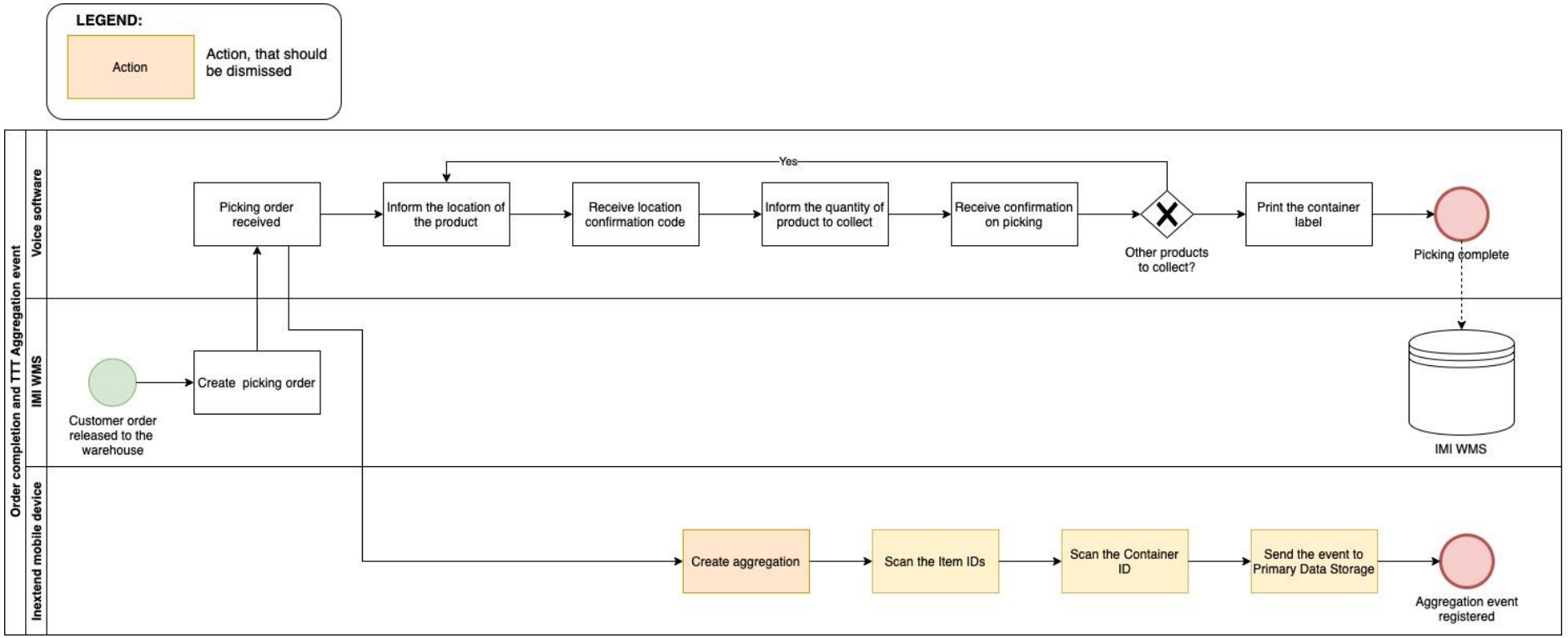


Figure 13. Aggregation AS-IS (created by author using Draw.io web application)

TO-BE diagram (Figure 14) describes the integrated process between the TTT Aggregation process and WMS order completion process. Updated process removes Inextend application related actions completely – these actions were marked by orange colour on Figure 13. New actions added to IMI WMS order completion are marked with blue colour on Figure 14. The additional actions to be taken are the following:

- Insert the picking order number - the picking order number will connect the information received from Voice and IMI WMS mobile devices and aggregate it in IMI WMS.
- Scan the item IDs - item IDs will be scanned by WMS mobile device and the container IDs are received from Voice.
- Send the Aggregation event to Primary Data Storage - IMI WMS will aggregate and appropriately format the received information from Voice and WMS mobile devices before sending it to Primary Data Storage.

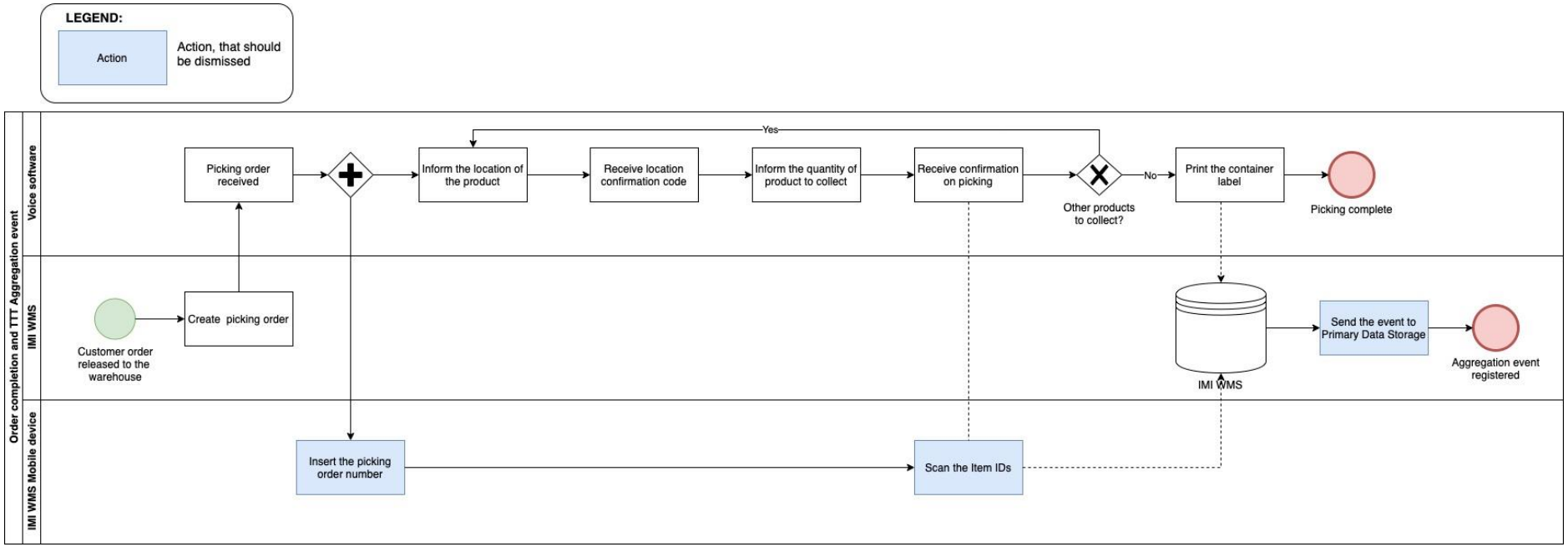


Figure 14. Aggregation TO-BE (created by author using Draw.io web application)

Figure 15 shows order dispatch and TTT dispatch event AS-IS diagram. The process starts with registration of departure. Departures are handled by the IMI Transportation Module and then sent to IMI WMS. Departure can be related to one or more customers, according to that information these customer's containers are connected to the departure. Loading step starts as soon as the picking process is complete. Warehouse worker inserts the departure number to the WMS mobile device and scans all the container IDs loaded to the truck. Then the departure can be finished in WMS and the delivery note is printed. As a separate process the Dispatch event is created in Inextend mobile device, worker should specify delivery note number, stock owner, destination, sold-to customer code, truck numbers and tobacco container ID followed by the dispatch confirmation. After that Dispatch event is ready to be sent to Primary Data Storage.

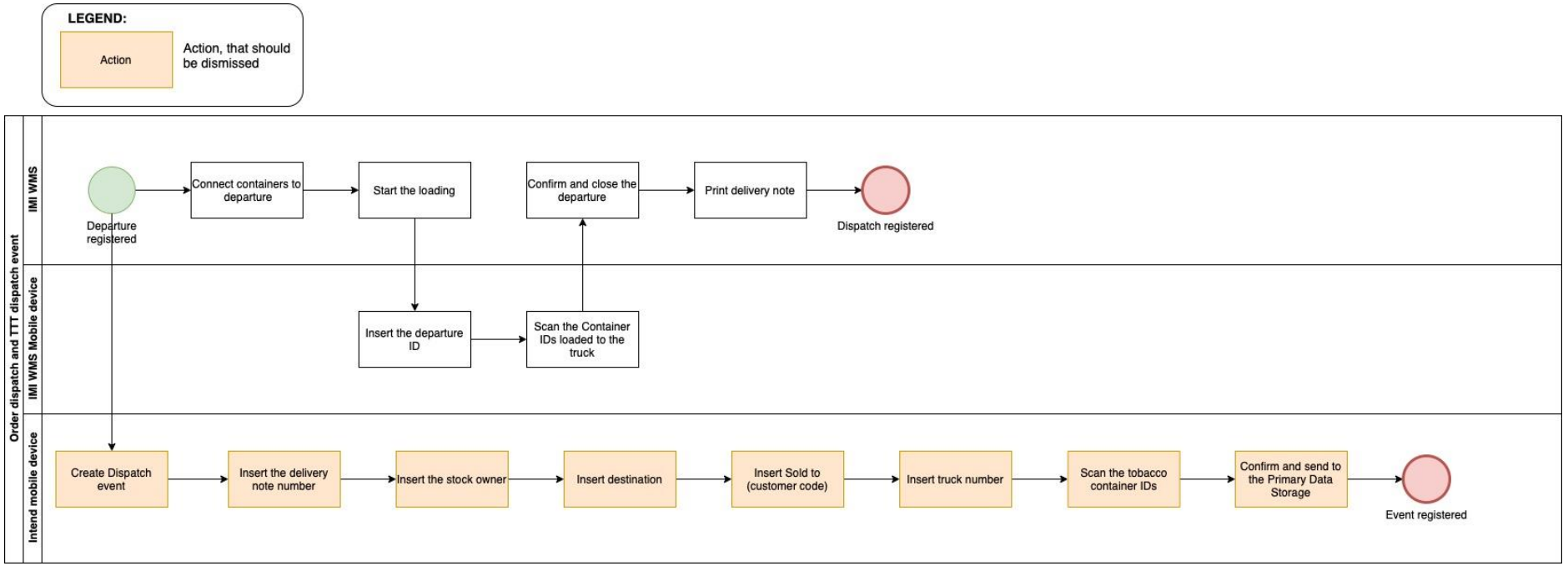


Figure 15. Dispatch AS-IS (created by author using Draw.io web application)

TO-BE diagram (Figure 16) describes the integrated process between the TTT Dispatch process and WMS dispatch process. Updated process removes Inextend application related actions completely – these actions were marked by orange colour on Figure 15. New actions added to IMI WMS order completion are marked with blue colour on Figure 16. The additional action to be taken is the following:

- Send the dispatch event to Primary Data Storage – this is the only action added, because all the needed information as delivery note number, stock owner, destination, sold-to customer code, truck numbers, tobacco container IDs is already stored in WMS. So, WMS should aggregate and format the information before sending it to Primary Data Storage.

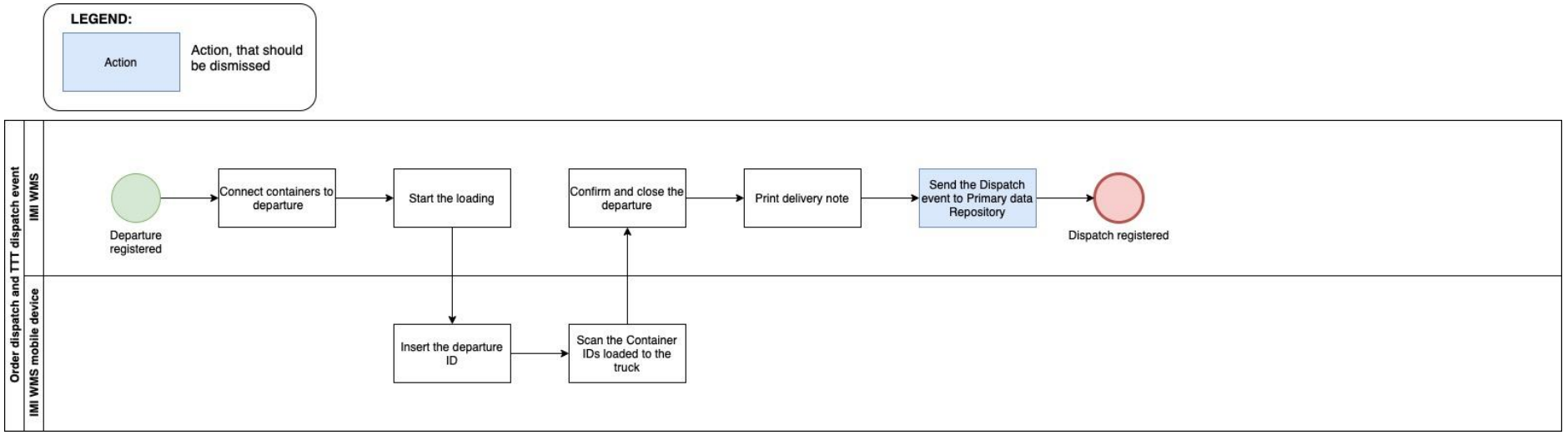


Figure 16. Dispatch TO-BE (created by author using Draw.io web application)

Failed delivery event takes place in two cases: warehouse has received some damaged items from the vendor that need to be returned or the arrival event fails because of the vendor's reporting mistake. Failed delivery event means that the delivery is not fulfilled, and the containers or items are returned to the previous location. Now the failed delivery is handled in the Inextend app, creating the failed delivery and specifying the container number and location. TO-BE process handles failed delivery events using both ThinClient and TTT Module.

Document flow will be reorganised and fully automated. As soon as dispatch is done, the TTT Module generates the delivery note, imports invoice from AOM, which is followed by the automatically generated report sent to Inextend. Payment receipt is sent to the TTT Module from Navision upon the payment from the client, and then the TTT Module reports it to the Inextend. The document flow and missing dispatches are currently the main sources of errors in tobacco track and trace process, its automation is designed to solve that issue.

## 4.7 Functional and non-functional requirements, classification and prioritisation

Requirements gathering process consists of the following steps:

1. Assign roles - identify stakeholders.
2. Interview stakeholders to understand their needs and interests in a documented form.
3. List assumptions and proposals
4. Get approval - confirmation from stakeholders that ensures user needs [26].

The following techniques were used to gather requirements:

- Interviews. It is one of the most frequently used requirements gathering techniques. The author has conducted about 10 brief interviews (up to 20-25 minutes) with process participants: warehouse workers, head of shift, warehouse manager, accountant. The end result of the set of interviews is an integration of

perspectives from multiple users, which allows to understand the users' problems and needs.

- Field studies. The author has participated in the tobacco track and trace processes on site: arrival, picking, dispatch, transactional documents reporting.

- Focus group. The author has gathered the focus group of warehouse manager, accountant, head of shift, project manager to map out the requirements [15]. In this session the Mind mapping technique was used. In the centre of your mind map the main project objective is placed. In bubbles branching off from the main objective, list categories of things you need [27].

Gathered and analysed business requirements is a result of the following activities: direct communication with the end-users and stakeholders, brainstorming sessions and the requirements for the tobacco track and trace solution [10]. The requirements are meant for designing the solution.

FURPS Is a technique for validating requirements after understanding customer needs. The acronym FURPS is Functionality, Usability, Reliability, Performance, and Supportability:

- ***Functionality*** - includes the main product features.

- ***Usability*** - includes requirements based on user experience.

- ***Reliability*** - includes availability, accuracy, and recoverability requirements.

- ***Performance*** - includes information output across the system, system response time, recovery time, and start-up time.

- ***Supportability*** - requirements related to testing, maintenance, compatibility, configuration, scalability and localization [28].

The MoSCoW method is one of the most popular methods for prioritising requirements. MoSCoW technique is used by analysts in collaboration with stakeholders to prioritise requirements [29]. According to the MoSCoW mechanism, the list of requirements can be classified according to four priority categories:

- M - Must have; this group must include the project requirements. Failure to comply with these requirements would mean that the entire project would have failed.

- S - Should have; a function that is not critical to perform. However, this is important, and the implementation is of great value to users. Such requirements fill the second place in the list of priorities.

- C - Could have; desired requirements that are not essential. Less important than the requirements in the previous group.

- W - Won't have; requirements that are not being realised in current developments but may be considered in the future [30].

Proposed solution assumes TTT functionality integration into the existing WMS system, therefore the Table 8 and Appendix 4 contain only the requirements that are supposed to be added to WMS as TTT Module and cover desired TTT functionality. ThinClient software (WMS mobile devices) related requirements are marked separately (-TC).

Applying the FURPS and MoSCoW within a single model, enables the author to validate the importance of certain requirements followed by their prioritisation, moreover this approach is easily communicated to and that is understood by most of the stakeholders. This simple format enables stakeholders to quickly visualise the requirements-priority matrix and engage more fruitfully with the prioritisation process and the development of the ensuing backlog [31]. Table 8 shows the requirements classification by FURPS and prioritisation by MoSCoW. The Functional requirements are in Table 8 and the Usability, Reliability, Performance and Supportability requirements are in table in Appendix 4. This table gives an overview on what requirements should be met first and have high priority and what are not so substantial and can be fulfilled later.

The functional requirements give an overview on the functionalities that should be added to the TTT Module in order to be able to receive and send the events and documents to Inextend system. Usability requirements contribute to the user experience. For example, improvements for event monitoring. Reliability requirements focus on uninterrupted and correct data transmission within different systems. Performance requirements cover the

system uptime and response time. The supportability requirements show the overall pattern for designing the solution.

Table 8. FURPS-MoSCoW model (created by author)

| **ID** | **Requirement** | **MoSCoW** | | | |
|---|---|---|---|---|---|
| | | **M** | **S** | **C** | **W** |
| | **F - Functional** | **Must** | **Should** | **Could** | **Wont** |
| BR01 | New TTT Module should be created in WMS. | x | | | |
| BR02 | New user group should have access to the TTT Module. | x | | | |
| BR03 | Arrival event is a registration of incoming container ID or item ID to the warehouse. | x | | | |
| BR04 | Incoming containers IDs or item IDs are added to the Warehouse Stock. | x | | | |
| BR05 | Disaggregation event is an action, where container ID is disaggregated into item IDs. | x | | | |
| BR06 | Disaggregation event should be performed on the Disaggregation tab by choosing the container and pushing the button “Disaggregate”. | x | | | |
| BR07 | During the disaggregation event, container ID is deleted from the stock, and item IDs that were in this container ID are added to the stock. | x | | | |
| BR08 | Aggregation event is an action, where item IDs are aggregated into one container ID in order to dispatch them to the customer. | x | | | |
| BR09 | Aggregated item IDs should be deleted from the Warehouse stock, while aggregated container IDs added to the stock. | x | | | |
| BR10 | Dispatch event is an outbound of aggregated tobacco container IDs or item IDs to the specific customer. | x | | | |
| BR11 | Container IDs or item IDs dispatched should be deleted from the stock. | x | | | |

| | | | | | |
|---|---|---|---|---|---|
| BR12 | Failed delivery event is an action, where container IDs or item IDs are sent back to the previous location (vendor). | x | | | |
| BR13 | During Failed delivery event container IDs or item IDs should be deleted from the stock. | x | | | |
| BR14 | Events should be submitted to Inextend immediately after creating. | x | | | |
| BR15 | Documents should be submitted to Inextend within 24 hours after creation. | x | | | |
| BR16 | Events or documents cannot be edited. | | x | | |
| BR17 | Events are allowed to be re-send to Inextend. | | x | | |
| BR18 | Arrival event should be imported from IMI WMS Inbound Overview to TTT Module, if the receipt contains tobacco products. | x | | | |
| BR19 | Aggregation event should be imported from IMI WMS Outbound to TTT Module, if the picking order contains tobacco products. | x | | | |
| BR20 | Dispatch event should be imported from IMI WMS Outbound to TTT Module, if departure contains tobacco products. | x | | | |
| BR21 | Tobacco invoices should be imported to TTT Module from IMI AOM. | x | | | |
| BR22 | Delivery notes should be created for TTT Dispatches imported from IMI WMS. | x | | | |
| BR23 | Payment receipts should be imported from NAVision. | x | | | |
| BR24-TC | Aggregation information should be sent to IMI WMS, picking order number is used as a common identifier. | x | | | |
| BR25-TC | While creating the receipt, system should identify the incoming tobacco products by purchase order number. | x | | | |

| | | | | | |
|---|---|---|---|---|---|
| BR26-TC | While receiving tobacco products, user should be able to scan the incoming tobacco container ID(s). | x | | | |
| BR27-TC- | Aggregation event should be added to the ThinClient application. | x | | | |
| BR28-TC | Disaggregation event should be added to the ThinClient application. | x | | | |
| BR29-TC | Picking order number must be inserted to start the aggregation. After that items that are picked to one container should be scanned. | x | | | |
| BR30-TC | Failed delivery event should be added to the ThinClient application. | x | | | |

Table 8 lists key functional requirements that are agreed with the stakeholders. They mostly specify what event means within the system, how the system should respond for specific actions and how the information exchange is done. For example, the aggregation event:

- BR08 specifies what the aggregation event means
- BR09 says how system needs to react on that event, meaning deleting the item IDs from the stock and adding the container ID to the stock
- BR27-TC and BR25-TC describe the ThinClient functionality needed to be added to the application in order to complete the Aggregation event.
- BR19 specifies the information exchange between WMS and TTT Module.

There are some common requirements that do not concern specific events, but describe the overall functionality, like BR14 and BR15 specifying the events and documents reporting time to the Inextend system.

The requirements having -TC postfix show the additional development for the ThinClient application that is used in WMS. These requirements are included in the development, enabling warehouse workers to perform tobacco track and trace related actions using ThinClient scanners instead of Inextend application. This will result in lower subscription cost for Inextend, because the subscription depends on the number of equipment used for the processing. Also, Zebra mobiles used for Inextend application can be installed with ThinClient without any additional cost.

## 4.8 Summary of results from business analysis

During the business analysis the author has identified the stakeholders' drivers and goals, mainly focusing on the tobacco track and trace improvements. After that the author has defined the capabilities that support the value stream, outlining the ones that need improvement. The author has described the existing tobacco track and trace process in the Coop evaluating the time spent on different activities and concluding the total time spent on TTT in a day (24H). The analysis of the current process organisation resulted in

3 solutions that were proposed by the author for improvement of the process. The solutions were analysed and evaluated by time saved with the improvement done. The author has chosen the full integration of the TTT process into the existing WMS system. Then the Business Domain model was created to show a generic data representation for the chosen solution. With the help of the RACI matrix author has identified the stakeholders and their responsibilities on different tasks within the process. The author has modelled AS-IS and TO-BE processes using BPMN to demonstrate the differences between existing and future process handling. That also helped to identify the requirements for the solution that needed to be met. Requirements were classified by FURPS and prioritised by MoSCoW. The performed business analysis creates an input for further system analysis.

# 5 Systems analysis

System analysis gives a high-level view on the solution, its functionality and structure. For the system analysis of the proposed solution the author uses a use case diagram, physical data model and component model.

## 5.1 Use case diagram

Use case diagram is the primary form of system / software requirements to be created. Use cases determine the expected behaviour, not the exact method to achieve it. The use case modelling helps to design the system from the end user's perspective. This is an effective way to convey system behaviour in user view, specifying externally visible system behaviour [32].

A use case diagram is usually simple. It does not show the specifics of the use cases:

- It only summarises some of the relationships between use cases, actors, and systems.
- It does not show the order in which steps are performed to achieve the goals of each use case [32].

Figure 17 describes TTT Module use case diagram. The module end users are warehouse worker, head of shift, claims manager and accountant. In the RACI matrix (page 48) was also mentioned Warehouse manager, but this role is not listed on the use case diagram, because he is only monitoring that all events and documents are reported according to the rules. Warehouse worker is responsible for event reporting such as arrival, disaggregation, aggregation. Accountant and head of shift both can resend the events or documents to the Primary Data Storage and view history. Head of shift can also view the actual stock of tobacco products. Claims manager is responsible for registering the returns. With the implementation of the new TTT Module user interaction is no longer

needed for Dispatch event and all the related documents, such as delivery notes, invoices and payment receipts, because this activity is fully automated.

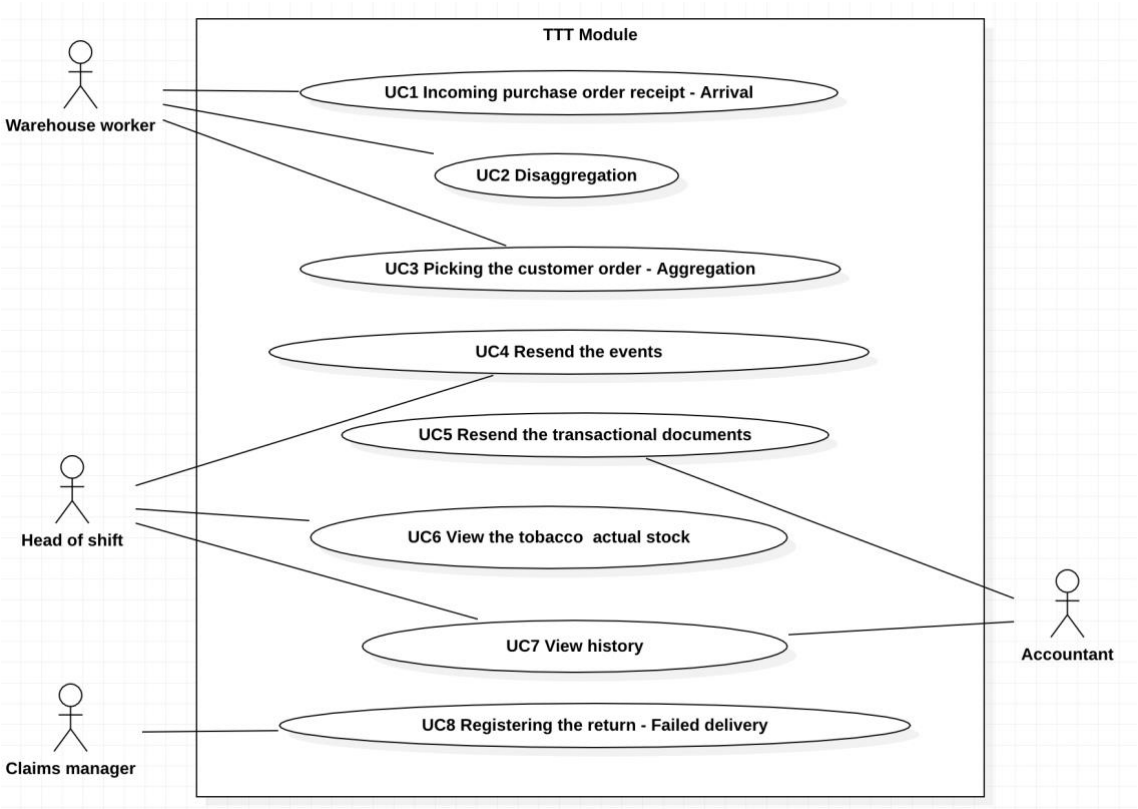


Figure 17. Use-case diagram (created by author using StarUML)

UC6 and UC7 correspond to the features that are not existing in the current tobacco track and trace system and will be added to the TTT Module in order to cover the desired capabilities listed on page 37 - forehanded error handling and real time tobacco products inventory. UC7 adds a possibility to view the history of reported events, which contributes to error handling to identify when and what was reported to the tobacco track and trace system.

Use cases describe the interactions between the primary actor, the solution, and any secondary actors needed to achieve the primary actor's goal. Table 9 lists the main and alternative scenarios for the UC1 - Incoming purchase order receipt, as well as preconditions and subsequent conditions. The main scenario consists of 6 steps an end user needs to do in order to achieve the desired result – report the Arrival event to the tobacco track and trace system. As for alternative solutions, they are triggered only if any mandatory information is missing.

Table 9. Use case: Incoming purchase order receipt – Arrival (UC1) (created by author)

| | |
|---|---|
| **General description** | Warehouse worker can report an Arrival event for tobacco products via TTT Module using ThinClient scanner. |
| **Main scenario** | 1. Warehouse worker creates Inbound Receipt in ThinClient.<br>2. Warehouse worker inserts the Purchase order number.<br>3. Warehouse worker scans the tobacco product container number.<br>4. Warehouse worker scans the product barcode, inserts quantity and due date.<br>5. Warehouse worker scans the stock container number.<br>6. If there are several different tobacco products in one container, warehouse worker should repeat actions 4-5 till all products are scanned.<br>7. If there are several tobacco product container numbers, warehouse worker should repeat the actions 3-5 till all containers are scanned.<br>8. Warehouse worker confirms the Inbound Receipt. |
| **Alternative scenario** | A. If the purchase order is missing, the products cannot be received. Warehouse worker should cancel the Inbound Receipt and report the problem to the Head of shift.<br>B. If product barcodes are not recognized, the products cannot be received and should be returned to the vendor. Warehouse worker should report the problem to the Head of shift.<br>C. If an incoming tobacco container cannot be scanned or the unique TTT identifier is missing, the container must be returned to the vendor. Warehouse worker should report the problem to the Head of shift.<br>D. If the stock container number cannot be scanned, the warehouse worker should contact the Head of shift to reprint the label. |
| **Preconditions** | Purchase order exists in the WMS. |
| **Subsequent conditions** | Inbound Receipt is registered in the WMS.<br>Arrival event is registered in TTT Module.<br>Arrival event is sent to Inextend.<br>The event transmission status is received from Inextend. |

Table 10 describes the use case UC2 – Disaggregation event produced by warehouse worker. The precondition for the main scenario is that the container must be in stock, but not yet disaggregated. Warehouse worker can make the disaggregation event using the ThinClient application or TTT Module in WMS. After confirming the event, event data is sent to Inextend and the transmission status is received.

Table 10. Use case: Disaggregation (UC2) (created by author)

| | |
|---|---|
| **General description** | Warehouse worker can disaggregate the received tobacco container into items in TTT Module or ThinClient. |
| **Main scenario** | 1. Warehouse worker selects or scans the received tobacco container.<br>2. Warehouse worker disaggregates the tobacco container into items.<br>3. Warehouse worker views the items list.<br>4. Warehouse worker confirms the disaggregation. |
| **Alternative scenario** | A. If the container does not exist in the system, the responsible person should investigate the missing container's whereabouts.<br>B. If the items list is not shown due to technical issues, the event should be cancelled. |
| **Preconditions** | Received tobacco container in stock, that was not yet disaggregated. |
| **Subsequent conditions** | Disaggregated container is deleted from stock.<br>Items are added into stock.<br>Disaggregation event is sent to Inextend.<br>The event transmission status is received from Inextend. |

Use cases UC3, UC4, UC5, UC8 are described by the author in Appendix 5. UC6 and UC7 are skipped, because they are simple and consist of no more than 2 actions performed by the user to view the requested information, like the actual stock or history.

Use cases should give the developers an overview on how end users will use the system and what actions they need to perform. Use case is a supportive mechanism for the requirements description, to give a detailed view from the end user perspective.

## 5.2 Physical Data Model

In this chapter the author describes the physical data model in the form of entity–relationship diagram (ERD), which essentially shows how the data will be stored in the TTT Module.

An entity relationship diagram (ERD) is a graphical representation that depicts relationships among people, objects, places, concepts or events within an information technology system. An ERD uses data modelling techniques that can help define business processes and serve as the foundation for a relational database. Entity relationship

diagrams provide a visual starting point for database design that can also be used to determine information system requirements. [33].

Entity-relationship diagram is visualised on the Figure 18. The author used the standard Crow's Foot Notation as per BABOK v3 [15]. The following relationships were used: zero to many; only one; any number from one to many. The entities are all shown as rectangles, with the unique entity name. First row of a rectangle contains a unique identifier (PK), followed by all the attributes that describe the entity. A foreign key (FK) refers to the primary key (PK) in another table. Each attribute has the attribute type, most used ones are Varchar, Integer and Date or DateTime.

In the current project we are not going to focus on the overall data model of the WMS. Firstly, the scope of WMS is much broader compared to the targets of TTT Module. Secondly, despite the fact TTT Module is a part of a bigger WMS system, it is designed to be built as a standalone microservice, therefore avoiding direct dependencies on WMS data model, only the communication interface must be negotiated in advance. Data layer of TTT Module is described by ERD below.

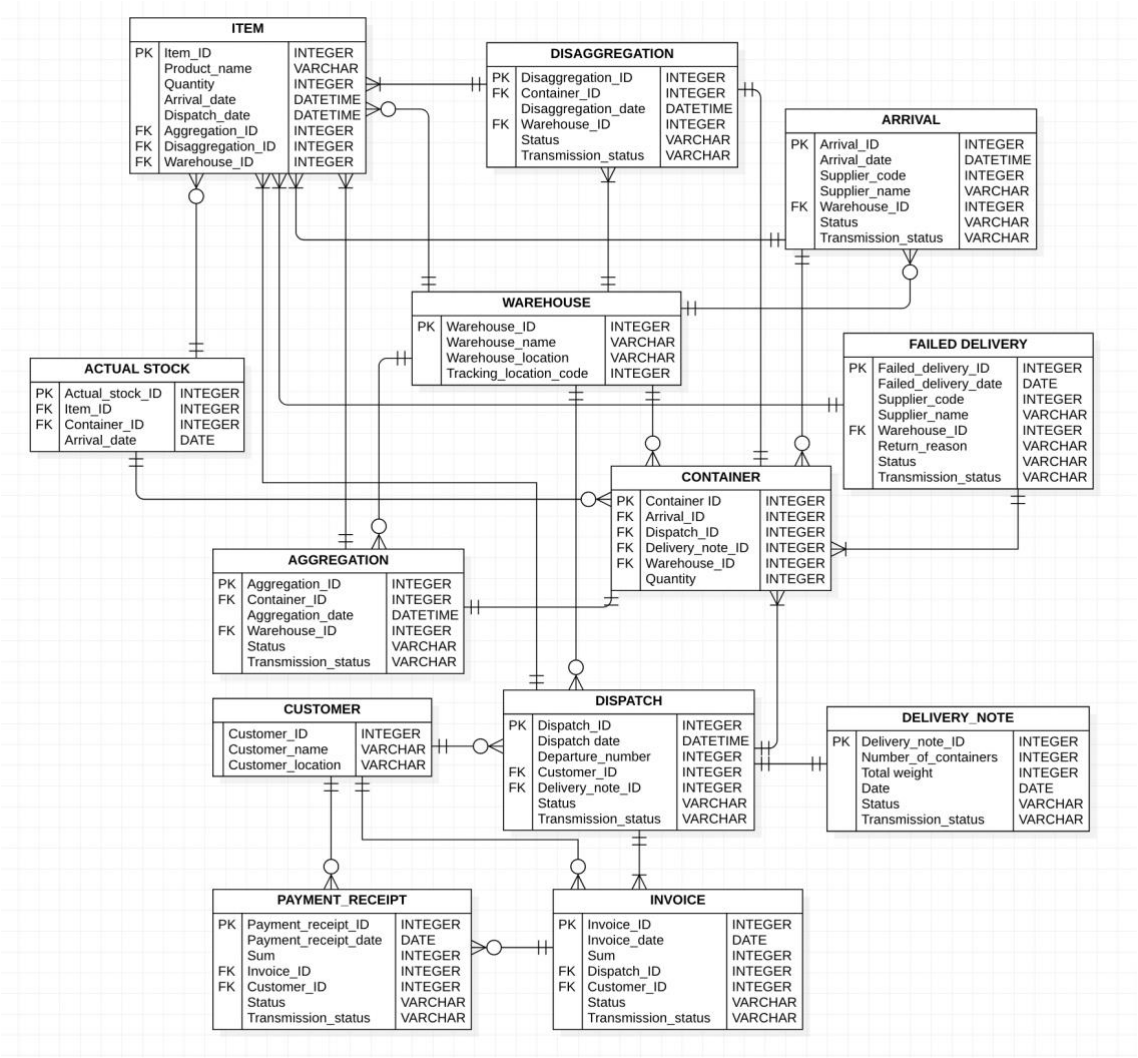


Figure 18. TTT Module Entity Relationship Diagram (created by author using StarUML)

The ERD mostly complies with the Business Data Model, but with some important differences. New entity Actual Stock is added to the physical data model. Actual stock contains aggregated information which is figured based on arrivals, dispatches and failed deliveries. Actual stock information is used as a cache to optimise heavy stock related computations. This optimization is required due to frequent usage of actual stock data that otherwise will lead to unnecessary calculations. Due to potential discrepancies actual stock data is applicable in short term use and is going to be invalidated and recalculated daily.

User and user group entities are missing in ERD on Figure 18 compared to the business domain model, because user authorities will be handled by WMS and the ERD depicts only TTT Module entities.

## 5.3 Component model

Component-based Development (CBD) and object-oriented development usually go hand in hand. Component diagrams are used as communication tools for stakeholders and developer teams. Although component diagrams are usually targeted at system developers, they can generally facilitate the understanding of the system for stakeholders because the diagram provides an early overview of the entire system under construction [34].

Architectural modelling should focus on identifying the initial architectural landscape of the system. Schemas of UML components are ideal for this purpose, as they allow the modelling of high-level software components and the interfaces of these components. Once the interfaces have been defined and agreed in the team, it will be much easier to organise the development activities between the subgroups [34].

Developers find the component diagram useful as it gives a high-level view on the system's architecture, helps to prepare the implementation plan and split detailed tasks across the team. Component diagram is used by system administrators to get an early overview of the logical software components running on their systems. Although system administrators cannot identify physical machines from the schema, it anyway provides early information about the components and their relationships [35].

Component model for TTT Module created by the author is depicted on Figure 19.

IMI roadmap already contains a planned migration from monolith to microservices architecture (within the 2-year frame). The author's choice to add the tobacco track and trace module as a microservice should ergonomically fit into recently agreed targets of the WMS microservices architecture.

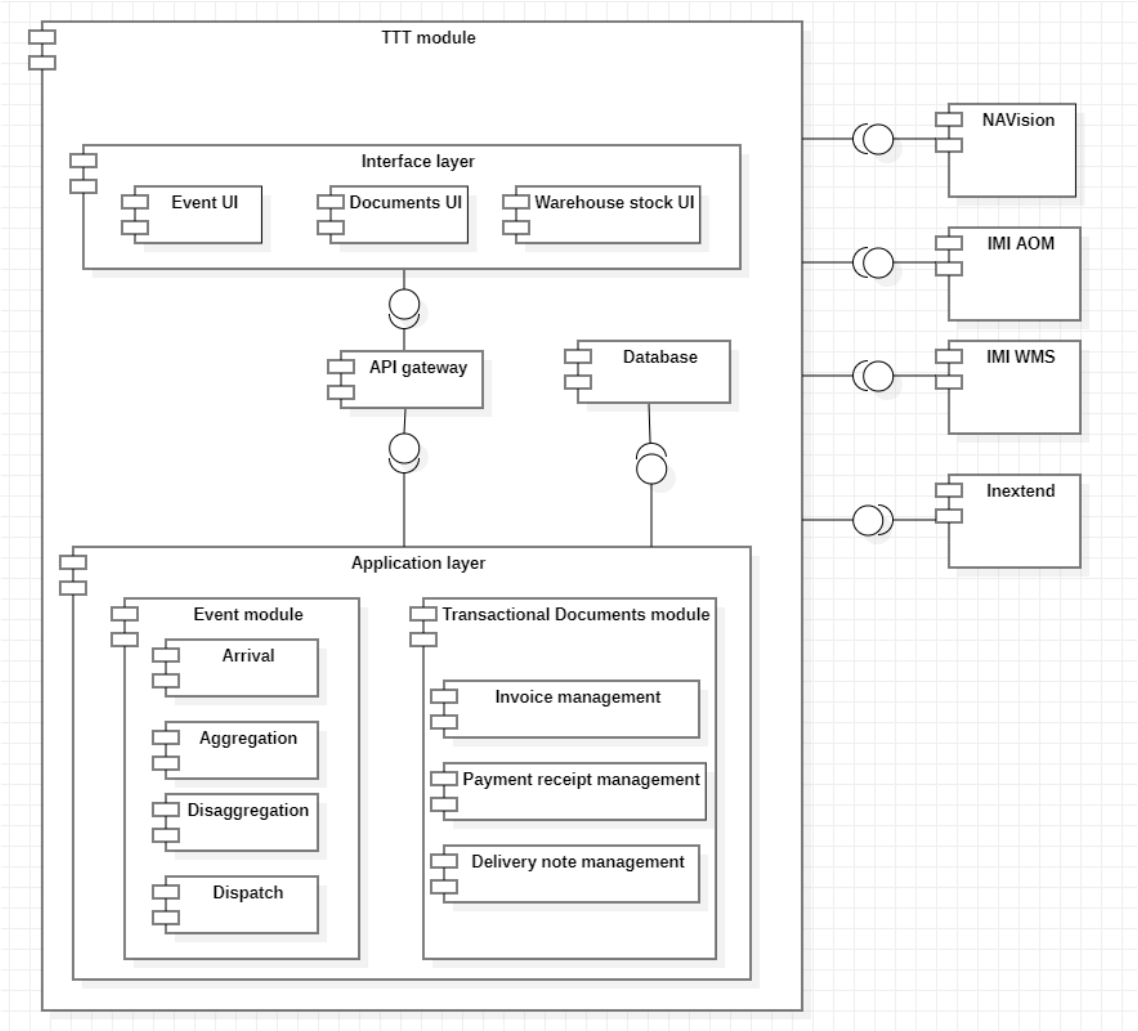


Figure 19. Component diagram (created by author using StarUML)

Component model shows the TTT Module and connected external systems. TTT Module consists of an interface layer, API gateway, application layer and database.

User interface is divided into different modules - event UI, document IU and Warehouse stock UI, because each module is used by different groups of users and they show the information from a different application layer module. Communication between layers is organised via API Gateway. If necessary, application layer can request information from database, which is stored separately from WMS database. Application layer consists of Event Module, which is handling the events data, and Transactional Documents Module. Event module communicates with WMS to receive tobacco track and trace process events from it. Transactional Documents Module is dealing with documents, receiving them from Navision or IMI AOM or creating them. Both modules are transmitting data about

events and transactional documents to Inextend system and receiving the transmission status from it.

## 5.4 Summary on system analysis

System analysis provided by the author consisted of the use case diagram, physical data model and component diagram. The use case modelling helps to design the system from the end user's perspective. The author has created a use case diagram, defining eight use cases and 4 system end users. Each use case is described with main and alternative scenarios as well as specifying the preconditions and subsequent conditions. The entity relationship diagram shows the data entities that need to be added to deliver the necessary functionality of the TTT Module. Component model provides an early overview of the entire system under construction and is depicted as an outstanding module to provide the necessary input for the developers on how the TTT Module is architecturally organised.

# 6 Conclusions

In this chapter the author will summarise the main conclusions made based on the results from business and system analysis and will provide an overview of how those will be used in future.

## 6.1 Key Performance Indicators

Finally, the author described the key performance indicators (KPIs) that will help measure how successful the proposed solution of TTT Module is. KPIs presented in Table 11 describe the numerical outcomes from the improvement of tobacco track and trace process.

Table 11. Key performance indicators (created by author)

| **KPI** | **Baseline 2022** | **KPI target** | **Activity-indicator** |
|---|---|---|---|
| TTT process satisfaction among workers in 2023 | 45% | 80% | Percentage of workers that are satisfied with the TTT process |
| Time spent on tobacco track and trace process per day. | 487 minutes | 229,1 minutes | Minutes spent by workers for reporting tobacco track and trace activities. |
| Errors in TTT process | 35 error in a month | 5 errors in a month | Quantity of errors produced by TTT process in a month |
| Inextend equipment used in TTT process | 20 pcs | 0 pcs | Additional equipment used in TTT process |

The first KPI states for end user satisfaction, this has a great impact on the process organisation, because if the workers are not satisfied with the process, they treat it superficially. The improvement of the tobacco track and trace process is also directed on user satisfaction, with the satisfaction increase up to 80% the responsibility level of the worker will also increase (the workers will perform process tasks more carefully).

One of the KPIs is the time spent on TTT activities, as it corresponds to the initial target to free more time for company's essential processes. The time will decrease by 52,95%, this has been achieved by automatic reporting of all transactional documents and dispatches to Inextend without any manual intersection. As for the arrival, aggregation and disaggregation, the manual work in these events will be on minimal level.

The KPI for errors amount is targeted to 5 errors per month compared to 35 errors monthly. Most error producers are missing dispatches and erroneous transactional documents, both will be 100% automated, so the error amount should also significantly decrease. The errors that will remain are the errors that came from the vendors.

Last KPI stands for additional equipment usage. Current implementation of the TTT process uses Zebra mobiles with Inextend application, which is covered by Inextend subscription. In that case, the more user accounts the company uses the higher is the monthly subscription cost. In the new solution all the functionality of tobacco track and trace process will be produced by WMS ThinClient application, so there is no need in Inextend application user accounts that will lower the subscription cost for Inextend. Zebra mobiles can be reinstalled with ThinClient and used for regular warehouse activities.

## 6.2 Further steps

The roadmap for the implementation of the TTT Module project (Table 12) follows the main process of IT project management in Coop and provides estimated deadlines for achieving the key points. The implementation roadmap considers the company's internal deadlines when preparing the strategy and budget to ensure that the development project reaches the budget for the next financial year in time and has been validated by responsible process managers.

The project roadmap correlates with Waterfall SDLC, covering such phases as implementation and testing, integration and system testing, and operation and maintenance [16].

Table 12. Project roadmap (created by author)

| Year quarter | Steps to complete |
|---|---|
| **Q3 2022** | Submission of performed analysis to the expert's group for evaluation.<br>Feedback from the expert's group and if necessary, additions to the analysis. |
| **Q4 2022** | Submission of the upgraded analysis to the IMI IT department for price evaluation.<br>Discussion of the future project technical details with the IMI IT department.<br>Creation of the documentation for the project.<br>Receiving the price evaluation for the project implementation.<br>Getting confirmation from the finance department. |
| **Q1-Q2 2023** | Development of the project. |
| **Q3-Q4 2023** | Project testing and deployment.<br>Finalising and publishing of the documentation.<br>User's education and active usage of the module. |
| **Q1 2024** | Active user support and system maintenance |

In the third quarter of 2022 the performed analysis should be submitted to the expert's group, whose purpose is to determine if the project has a potential for development within Coop and what exact value it will bring. Expert's group usually consists of project's interested parties, who can evaluate the impact of project enforcement on their business areas. If necessary, additions to the performed analysis should be made, if the expert group demands them.

In the fourth quarter of 2022 an expert's group analysis should be submitted for price evaluation to the IMI IT department. For the price evaluation some additional technical details of the project can be discussed with IMI and the documentation is created. After that, the price calculation is submitted to the finance department for approval.

In the first and second quarters of 2023 the development of the project should take place, followed by testing and deployment phases in the third quarter of 2023. Users should be educated to use the new system as well.

Following this roadmap, the new TTT Module should be implemented by the end of 2023, the first part of 2024 will be dedicated to teach end users to work by the new process.

From May 2024 the improved tobacco track and trace process should cover the increase in the number of reported tobacco products without any additional resources.

# Summary

Nowadays company’s internal process automation is the key aspect for gaining competitive advantage. Automation reduces time, effort and cost, giving business more time to focus on a company's primary objectives. Tobacco track and trace is an obligated process to every company, who is trading the tobacco, but it is not in the primary list. Automation and integration into the supply chain of such supportive services will give a company an opportunity to focus on other value adding activities.

The purpose of this master’s thesis was to

- analyse the existing tobacco track and trace process
- propose the optimised solution that meets requirements
- conduct business and system analysis of the proposed solution
- create an input for further development of the proposed solution

For the better understanding of the company’s needs the author has identified the stakeholders’ drivers and goals, has outlined the capabilities that support the value stream, but need improvement. The advised solution for the existing problem is the full integration of the tobacco track and trace process into the existing warehouse management system. With the help of the RACI matrix author has identified the main users of the future system and their responsibilities on different tasks within the process. After that the author has modelled the processes AS-IS and TO-BE processes to identify the 75 requirements for the future solution.

System analysis of the solution was done using a use case diagram, physical data model and component model. The analysis provided in the master’s thesis will be used for further development of this project in Coop being the initial solution description for presentation to the expert’s group. The aim is to deliver the working solution by 2024 in order to meet new European Union regulations in the field of tobacco tracking and tracing applied from May 2024.

# Kokkuvõte

Tänapäeval on ettevõttesiseste protsesside automatiseerimine konkurentsieelise saavutamiseks üks olulisemaid aspekte. Automatiseerimine säästab aega, vaeva ja hoiab kokku kulusid, andes ettevõtjatele rohkem aega keskenduda ettevõtte peamistele eesmärkidele. Tubakatoodete jälgimine on kohustuslik protsess kõigi tubakatoodetega tegelevate ettevõtete jaoks, kuid see ei ole esikohal. Selliste tugiteenuste automatiseerimine ja integreerimine tarneahelasse annab ettevõttele võimaluse keskenduda muudele lisaväärtust loovatele tegevustele.

Käesoleva magistritöö eesmärk oli

- analüüsida olemasolevat tubakatoodete jälgimise protsessi
- pakkuda välja nõuetekohane optimeeritud lahendus
- viia läbi pakutava lahenduse äri- ja süsteemianalüüs
- luua sisend kavandatava lahenduse edasiarendamiseks

Ettevõtte vajaduste paremaks mõistmiseks on autor tuvastanud asjaosaliste ajendid ja eesmärgid ning toonud välja võimekused, mis toetavad väärtusvoogu, kuid vajavad täiustamist. Soovitatav lahendus olemasolevale probleemile on tubakatoodete jälgimise protsessi täielik integreerimine olemasolevasse laohaldussüsteemi. Autor on vastutusmaatriksi abil määratlenud protsessi kasutajad ja nende vastutuse erinevate ülesannete täitmisel. Seejärel on autor modelleerinud AS-IS ja TO-BE protsessid, et teha kindlaks tulevase lahenduse vajalikud nõuded (kokku 75).

Lahenduse süsteemianalüüs viidi läbi kasutusmallide diagrammi, füüsilise andmemudeli ja komponentmudeli abil. Töös esitatud analüüsi, mis on ekspertrühmale esitatava lahenduse esialgne kirjeldus, kasutatakse Coopis projekti edasiseks arendamiseks. Eesmärgiks on pakkuda toimiv lahendus 2024. aastaks, et täita Euroopa Liidu uusi tubakatoodete jälgimise alaseid eeskirju, mida kohaldatakse alates 2024. aasta maikuust.

# Bibliography


[1] Eurostat, “Impact of Covid-19 crisis on retail trade.,” 22 March 2022. [Online]. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Impact_of_Covid-19_crisis_on_retail_trade. [Accessed 4 May 2022].

[2] Terviseamet, “Koroonaviiruse andmestik,” 2 May 2022. [Online]. Available: https://www.terviseamet.ee/et/koroonaviirus/koroonakaart. [Accessed 4 May 2022].

[3] Susan Lund, Anu Madgavkar, James Manyika, Sven Smit, Kweilin Ellingrud, Mary Meaney, Olivia Robinson, “The future of work after COVID-19,” February 2021. [Online]. Available: https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19#. [Accessed 4 May 2022].

[4] Philip Morris International, “KPMG report shows unprecedented rise in counterfeit cigarettes in the EU,” 1 July 2021. [Online]. Available: https://www.pmi.com/illicit-trade-prevention/blog/kpmg-report-shows-unprecedented-rise-in-counterfeit-cigarettes-in-the-eu. [Accessed 04 May 2022].

[5] Coop, “Company website,” 2022. [Online]. Available: https://www.coop.ee/about-coop-estonia. [Accessed 04 May 2022].

[6] M. E. Porter, Competitive Advantage: Creating and Sustaining Superior Performance, Free Press, 2008.

[7] Industri-Matematik International AB, “Sustainable Supply Chain Solutions,” 2022. [Online]. Available: https://im.se. [Accessed 4 May 2022].

[8] Coop, “Company intranet,” 2022. [Online]. [Accessed 04 May 2022].

[9] European Parlament and the council of the European, “Directive 2014/40/EU,” *Official Journal of the European Union,* 2014.

[10] Consumers, Health, Agriculture and Food Executive Agency (European Commission) , Everis , NTT Data Company, “Implementation analysis regarding the technical specifications and other key elements for a future EU system for traceability and security features in the field of tobacco products,” 18 May 2018. [Online]. Available: https://op.europa.eu/en/publication-detail/-/publication/aed337f1-5ca4-11e8-ab41-01aa75ed71a1/language-en. [Accessed 04 May 2022].

[11] Riigikogu, “Tubakaseadus,” Riigikogu, 2005.

[12] J. P. Womack, Lean Thinking: Banish Waste and Create Wealth in Your Corporation, Free Press, 2010.

[13] N. Skhmot, “The 8 Wastes of Lean,” 5 August 2017. [Online]. Available: https://theleanway.net/The-8-Wastes-of-Lean. [Accessed 4 May 2022].

[14] S. A. Thangarajoo Y., “Lean Thinking: An Overview,” *Industrial Engineering & Management,* vol. 4, no. 2, 2015.

[15] International Institute of Business Analysis, A guide to the business analysis body of knowledge. Ver.3, Toronto: IIBA, 2015.

[16] "Waterfall model," [Online]. Available: https://www.javatpoint.com/software-engineering-waterfall-model. [Accessed 4 May 2022].

[17] IIBA, "What is business analysis," 2022. [Online]. Available: https://www.iiba.org/professional-development/career-centre/what-is-business-analysis/. [Accessed 4 May 2022].

[18] E. Hosiaisluoma, "ArchiMate Cookbook," 2021 July 13. [Online]. Available: http://www.hosiaisluoma.fi/ArchiMate-Cookbook.pdf. [Accessed 4 May 2022].

[19] The Open Group, "ArchiMate® 3.1 Specification," November 2019. [Online]. Available: https://pubs.opengroup.org/architecture/archimate3-doc/. [Accessed 4 May 2022].

[20] Inexto, "Inextend," [Online]. Available: https://inextend.com. [Accessed 4 May 2022].

[21] RIA, "Protsessianalüüsi käsiraamat," [Online]. Available: https://www.ria.ee/sites/default/files/content-editors/ITT/programm/ariprotsesside_kasiraamat_062013.pdf. [Accessed 4 May 2022].

[22] Marko Bajec, Marjan Krisper , "A methodology and tool support for managing business rules in organisations," *Information Systems,* vol. 30, no. 6, pp. 423-443, 2005.

[23] IBM, "Business Data Model," 5 March 2021. [Online]. Available: https://www.ibm.com/docs/en/dmeu/2.0?topic=uim-business-data-model. [Accessed 4 May 2022].

[24] OMG, "Business Process Modeling Notation Specification," 6 March 2006. [Online]. Available: https://www.omg.org/bpmn/Documents/OMG_Final_Adopted_BPMN_1-0_Spec_06-02-01.pdf. [Accessed 4 May 2022].

[25] S. A. White, "Introduction to BPMN," *BPTrends,* 2004.

[26] Team Asana, "A 6-step guide to requirements gathering for project success," [Online]. Available: https://asana.com/resources/requirements-gathering. [Accessed 4 May 2022].

[27] Kathy Baxter, Catherine Courage, Understanding Your Users: A Practical Guide to User Requirements Methods, Tools, and Techniques, Elsevier, 2005.

[28] Center of Excellence for Professional Development, "What is FURPS+?," 5 August 2014. [Online]. Available: https://businessanalysttraininghyderabad.wordpress.com/2014/08/05/what-is-furps/. [Accessed 4 May 2022].

[29] Amjad Hudaib, Raja Masadeh, Mais Haj Qasem, Abdullah Alzaqebah, "Requirements Prioritization Techniques Comparison," *Modern Applied Science,* vol. 12, no. 2, 2018.

[30] K. Walters, "Prioritization using MoSCoW," 12 January 2009. [Online]. Available: http://cs.anu.edu.au/courses/COMP3120/local_docs/readings/Prioritization_using_MoSCoW_AllAboutAgile.pdf. [Accessed 4 May 2022].

[31] J. Dyson, “Conjoining FURPS and MoSCoW to Analyse and Prioritise Requirements,” 7 January 2019. [Online]. Available: https://www.linkedin.com/pulse/conjoining-furps-moscow-analyse-prioritise-jonathan-dyson/. [Accessed 4 May 2022].

[32] Visual Paradigm, “What is Use Case Diagram?,” [Online]. Available: https://www.visual-paradigm.com/guide/uml-unified-modeling-language/what-is-use-case-diagram/. [Accessed 4 May 2022].

[33] J. Biscobing, “Entity Relationship Diagram (ERD),” September 2019. [Online]. Available: https://www.techtarget.com/searchdatamanagement/definition/entity-relationship-diagram-ERD. [Accessed 4 May 2022].

[34] Agile Modeling, “UML 2 Component Diagrams: An Agile Introduction,” [Online]. Available: http://agilemodeling.com/artifacts/componentDiagram.htm. [Accessed 4 May 2022].

[35] D. Bell, “UML basics: The component diagram,” *IBM Developer,* 2004.

[36] K. Siau, Lihyunn Lee, “Are use case and class diagrams complementary in requirements analysis? An experimental study on use case and class diagrams in UML,” *Computer Science,* 2004.

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# Appendix 2 – Calculations of the time gain in different solutions

2. Time gain calculation for the second solution – Automation of transactional documents sending to Inextend.

| **TPD Operations** | **Total minutes spent per day** | **Comment** |
|---|---|---|
| Arrival | 10 | Stays the same |
| Aggregation | 250 | Stays the same |
| Dispatch | 150 | Stays the same |
| Invoice | 0 | Automated |
| Payment receipt | 0 | Automated |
| Delivery note | 0 | Automated |
| Error handling | 11,4 | 24% of errors are caused by erroneous transactional documents (15-(15*0,24) =11,4) |
| **TOTAL** | **421,4** | |

The total spent time on tobacco track and trace process will be 421,4 minutes per day, which is only 65,5 minutes less. So, the time gain will be 65,5 minutes or **13,44%.**

3. Time gain calculation for the third solution – Development of a new tobacco track and trace add-on (further TTT Module) to be fully integrated with the existing warehouse management system.

| **TPD Operations** | **Total minutes spent per day** | **Comment** |
|---|---|---|
| Arrival | 2 | Only 1 minute per arrival will be spent, because only container numbers will be scanned during the arrival. |
| Aggregation | 225 | Aggregation will take 0,5 minute less – 4,5 minutes per order, |

| | | |
|---|---|---|
| | | because there is no need to scan the aggregated container |
| Dispatch | 0 | Automated |
| Invoice | 0 | Automated |
| Payment receipt | 0 | Automated |
| Delivery note | 0 | Automated |
| Error handling | 2,1 | 14% of errors will remain after integration, because they depend on vendor's correct reporting (15*0,14 =2,1) |
| **TOTAL** | **229,1** | |

The total spent time on tobacco track and trace process will be 229,1 minutes per day, which is 257,9 minutes less. So, the time gain will be 257,9 minutes or **52,95%.**

# Appendix 3 – Business Glossary

| Term | Definition |
|---|---|
| User | Worker that has a user account in the system. |
| User Group | Group that contains users with the same authorities. |
| Warehouse | Facility for the goods storage. |
| Container | A pallet, box or other packaging material that contains several tobacco products and has a unique identifier. |
| Item | A tobacco product that has a unique identifier. |
| Arrival | An inbound of the tobacco products to the warehouse. |
| Disaggregation | An event during which container is split into items. |
| Aggregation | An event during which items are combined into container. |
| Dispatch | An outbound of the tobacco products from the warehouse. |
| Customer | A person who buys goods from a business. |
| Delivery Note | An electronic document, that is issued after Dispatch event and specifies date, the container ID and the customer to whom the container is shipped. |
| Invoice | An electronic commercial document that is issued after the dispatch event and specifies the date, customer, sum and delivery note ID. |
| Payment receipt | An electronic document that is issued after the receiving of the payment from the customer and specifies the date, customer, sum and the invoice ID. |

# Appendix 4 – FURPS – MoSCoW Model

| ID | Requirements | MoSCoW | | | |
|---|---|---|---|---|---|
| | U - Usability | **Must** | **Should** | **Could** | **Wont** |
| BR31 | TTT Module should show Arrival, Disaggregation, Aggregation, Dispatch and Failed Delivery events, Transactional documents, Warehouse stock as tabs. | x | | | |
| BR32 | On the Arrival tab should be shown recent Arrival events with Arrival IDs, supplier, arrival date, status and transmission status. | x | | | |
| BR33 | Clicking the arrival event should show additional information: tobacco container IDs received, warehouse code. | | x | | |
| BR34 | Arrival events can be sorted by date, status, supplier or ID. | | | x | |
| BR35 | Arrival events can be filtered by date, status, supplier or ID. | | | x | |
| BR36 | One part of the Disaggregation tab should show recent Disaggregation events with Disaggregation IDs, event date, status and transmission status. | x | | | |
| BR37 | The other part of the Disaggregation tab should show the incoming container IDs, that are in stock and can be disaggregated. | x | | | |
| BR38 | Clicking the disaggregation event should show additional information: tobacco container ID disaggregated, items added to stock, warehouse code. | | x | | |

| | | | | | |
|---|---|---|---|---|---|
| BR39 | Disaggregation events can be sorted by event date, status, container ID or disaggregation ID. | | | x | |
| BR40 | Disaggregation can be filtered by event date, status, container ID or disaggregation ID. | | | x | |
| BR41 | On the Aggregation tab should be shown recent Aggregation events with Aggregation IDs, event date, status and transmission status. | x | | | |
| BR42 | Clicking the aggregation event should show additional information: items aggregated, tobacco container ID and warehouse code. | | x | | |
| BR43 | Aggregation events can be sorted by event date, status, container ID or aggregation ID. | | | x | |
| BR44 | Aggregation events can be filtered by event date, status, container ID or aggregation ID. | | | x | |
| BR45 | On the Dispatch tab should be shown recent Dispatch events with dispatch IDs, dispatch date, customer, status and transmission status. | x | | | |
| BR46 | Clicking the dispatch event should show additional information: tobacco container IDs dispatched, warehouse code, customer code, departure number. | | x | | |
| BR47 | In the dispatch event should also show documents that were created for this dispatch – delivery note, invoice(s) and payment receipt(s). | x | | | |
| BR48 | Dispatch events can be sorted by date, status, customer or container ID. | | | x | |
| BR49 | Dispatch events can be filtered by date, status, customer or container ID. | | | x | |

| | | | | | |
|---|---|---|---|---|---|
| BR50 | On the failed delivery tab should be shown recent failed delivery events with failed delivery IDs, date, vendor location, status and transmission status. | x | | | |
| BR51 | Clicking the failed delivery event should show additional information: tobacco container IDs returned, warehouse code, vendor code. | | x | | |
| BR52 | Failed delivery events can be sorted by date, status, vendor or container ID. | | | x | |
| BR53 | Failed delivery events can be filtered by date, status, vendor or container ID. | | | x | |
| BR54 | Clicking the documents should show additional information: tobacco container IDs, warehouse code, customer code, dispatch number. | | x | | |
| BR55 | Warehouse stock should show the list of tobacco containers and items that are in stock. | x | | | |
| BR56 | Warehouse stock should be able to show the history list of tobacco containers and items that were in stock for the past three months. | | | x | |
| BR57 | Clicking the container or item in stock should show additional information: all the events that were done to this container or item should be listed with IDs. Clicking the event ID should give the user additional information. | | x | | |
| BR58 | Status of event or document should show, if this event was already submitted to Inextend or not. | x | | | |
| BR59 | Transmission status should show what status has received this event or document in Primary Data Storage. Transmission status for the event or document is received from Inextend. | x | | | |

| | | | | | |
|---|---|---|---|---|---|
| BR60 | The user must be able to access the TTT Module with the username and password provided. | x | | | |
| BR61 | The TTT Module should be available in Estonian and English. | | x | | |
| BR62 | The user must be able to return to the main menu (WMS Modules) from any page. | | x | | |
| | R - Reliability | **Must** | **Should** | **Could** | **Wont** |
| BR63 | The TTT Module shall provide one endpoint through which to deliver one or more messages at a time. | x | | | |
| BR64 | The TTT Module shall ensure that all events received are submitted to the Primary Data Storage. | x | | | |
| BR65 | The TTT Module shall persist the outgoing messages until the messages are successfully delivered. When trying to transmit the outgoing messages, the TTT Module shall handle transient failures by transparently retrying a failed operation. | x | | | |
| BR66 | The TTT Module shall return an acknowledgement of a successful data receipt to the failing with a consistent error code. | x | | | |
| BR67 | The TTT Module shall resolve and authenticate the sender's identity against a trusted identity provider. Messages sent from an unauthenticated sender shall not be accepted. | x | | | |
| BR68 | The TTT Module message management shall be designed to avoid acquiring and reprocessing the same message multiple times, since messages of the Tracking and Tracing System are not idempotent. | x | | | |
| | P - Performance | **Must** | **Should** | **Could** | **Wont** |

| | | | | | |
|---|---|---|---|---|---|
| BR69 | The TTT Module shall be available for use with an uptime target of 98.00% | | x | | |
| BR70 | The TTT Module shall support rates of message throughput for input/output operations in the range of 1 thousand (1,000) messages per second per instance. | | x | | |
| BR71-TC | The ThinClient shall be available for use with an uptime target of 98.00% | | x | | |
| BR72-TC | The ThinClient shall support rates of message throughput for input/output operations in the range of 500 messages per second per instance. | | x | | |
| | S - Supportability | **Must** | **Should** | **Could** | **Wont** |
| BR73 | The TTT Module shall be designed based on an event-driven architectural pattern for the data acquisition and data processing components. | | x | | |
| BR74 | The main components of the TTT Module shall be designed to support fault isolation, in order not to propagate its errors to other components of the solution and limit the impact of any problem to the minimum. | | x | | |
| BR75 | The TTT Module is convenient and logical for the users. | x | | | |

# Appendix 5 – Use cases

Use case: Picking the customer order - Aggregation (UC3) (created by author)

| | |
|---|---|
| **General description** | Warehouse worker can aggregate items into container via ThinClient. |
| **Main scenario** | 1. Warehouse worker inserts the picking order number.<br>2. Warehouse worker scans the picked items IDs.<br>3. Warehouse worker confirms that all items are picked.<br>4. Warehouse worker scans the container ID.<br>5. Warehouse worker confirms the aggregation event. |
| **Alternative scenario** | A. If the picking order is not correct, the warehouse worker should report the problem to the Head of shift.<br>B. If the container ID cannot be scanned, the warehouse worker should contact the Head of shift to reprint the label. |
| **Preconditions** | Received items to the stock.<br>Picking order has generated the container ID. |
| **Subsequent conditions** | Aggregated container is added to the stock.<br>Items are deleted from the stock.<br>Aggregation event is sent to Inextend.<br>The event transmission status is received from Inextend. |

Use case: Resend the events (UC4) (created by author)

| | |
|---|---|
| **General description** | Head of shift can resend the erroneous events such as arrival, aggregation, disaggregation or dispatch to correct the transmission status. |
| **Main scenario** | 1. Head of shift opens the corresponding event tab in TTT Module.<br>2. Head of shift selects the event with the erroneous status.<br>3. Head of shift resends the event to Inextend. |
| **Alternative scenario** | - |
| **Preconditions** | Erroneous event existing in TTT Module.<br>Previous events were corrected from the Vendor side. |
| **Subsequent conditions** | Event is sent to Inextend.<br>New transmission status is received from Inextend. |

Use case: Resend the transactional documents (UC5) (created by author)

| | |
|---|---|
| **General description** | Accountant can resend the erroneous transactional documents such as delivery note, invoice, payment receipt to correct the transmission status. |
| **Main scenario** | 4. Accountant opens Transactional Documents tab in TTT Module.<br>5. Accountant selects the document with the erroneous status.<br>6. Accountant resends the document to Inextend. |
| **Alternative scenario** | - |
| **Preconditions** | Erroneous transactional document existing in TTT Module.<br>Previous events or documents were corrected from the Vendor side. |
| **Subsequent conditions** | Transactional document is sent to Inextend.<br>New transmission status is received from Inextend. |

Use case: Registering the return - Failed Delivery (UC7) (created by author)

| | |
|---|---|
| **General description** | Claims manager can register the return of tobacco products in TTT Module or ThinClient |
| **Main scenario** | 1. Claims manager creates the new Failed delivery event.<br>2. Claims manager scans the item IDs or container IDs that need to be returned.<br>3. Claims manager confirms the supplier from the suggested values.<br>4. Claims manager marks the return reason.<br>5. Claims manager confirms the Failed delivery event. |
| **Alternative scenario** | A. If the item or container IDs cannot be scanned, claims manager must have the possibility to enter the IDs manually and proceed with the action 3 of the main scenario. |
| **Preconditions** | Items or containers that have damage or contain erroneous events. |
| **Subsequent conditions** | The containers or items added to this event is deleted from the stock.<br>Failed delivery event is sent to Inextend.<br>The event transmission status is received from Inextend. |