TALLINN UNIVERSITY OF TECHNOLOGY
School of Information Technologies

Lüüli Suuk 183147IAAM

BUSINESS AND SYSTEM ANALYSIS TO ADD PURCHASE INVOICE MODULE IN JD EDWARDS ENTERPRISEONE

Master´s Thesis

Supervisor: Mikk Leini
MSc

Tallinn 2020

TALLINNA TEHNIKAÜLIKOOL
Infotehnoloogia teaduskond

Lüüli Suuk 183147IAAM

ÄRI- JA SÜSTEEMIANALÜÜS OSTUARVETE MOODULI LISAMISEKS JD EDWARDS ENTERPRISEONE ÄRISÜSTEEMI

Magistritöö

Juhendaja: Mikk Leini
MSc

Tallinn 2020

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.

Author: Lüüli Suuk

17.05.2020

Abstract

The thesis purpose is to conduct business and system analyse to replace the existing requisition order and supplier invoice handling process with ERP system related solutions using the standard and specialized JD Edwards EnterpriseOne business system modules. The methodology used in the thesis includes observation and interviews to understand the business process, stakeholders mapping, BPMN to model the processes, use cases to describe the functional requirements and UML diagrams (activity and component) for the process overview.

The current thesis will concentrate on the business and system analysis work process and results to understand the current process and to model new processes to replace the existing solution. The process has two main parts that require a new solution. The first one is the requisition order approving and purchase order handling of the indirect material. The second part is the supplier invoice saving and handling process, including the correct accounting and approvals. The new process should be modelled considering both; otherwise, the replacement will not be possible.

This thesis is written in English and is 70 pages long, including 5 chapters, 23 figures and 13 tables.

Annotatsioon

Äri-ja süsteemianalüüs ostuarvete mooduli lisamiseks JD Edwards EnterpriseOne ärisüsteemi

Töö eesmärk on viia läbi äri-ja süsteemi analüüs olemasoleva kulumaterjali ja tarnijaarvete haldamise süsteemile asenduse leidmiseks JD Edwards EnterpriseOne ärisüsteemis. Lahendus peab hõlmama protsessi mõlemat poolt. Esimene osa protsessist keskendub kulumaterjalide tellimuste kinnitusringile saatmisele ja tellimuste tarnijatele edastamisele. Teine osa protsessist on seotud tarnijatelt saadud arvete konteerimise ja kinnitamisega. Olemasoleva laheduse puhul tehakse need toimingud eraldiseisvas süsteemis ja tulemus saadetakse failina ärisüsteemi, kus siis need andmed salvestatakse ja tarnija arve tasutakse. Töös kasutatakse järgnevaid metoodikaid: vaatlus, intervjuud ja grupisessioonid äriprotsessi mõistmiseks, huvitatud osapoolte kaardistamine, BPMN mudelid protsesside modelleerimiseks, kasutusmallid funktsionaalsete nõuete kirjeldamiseks ning UML diagrammid (seisundimuutuse ja komponent) protsessist ülevaate andmiseks.

Töö autor keskendub äri-ja süsteemi analüüsi tööprotsessile, mille käigus valmivad uue protsessi mudelid ja kaardistatakse olemasoleva ja modelleeritud lahenduse lüngad. Töö tulemusteks on dokumenteeritud funktsionaalsed nõuded, olemasoleva AS-IS protsessi mudelid, modelleeritud TO-BE protsessid arvestades ärivajadusi ja ärisüsteemi võimalusi, lünkade kirjeldused ning lõpuks järeldus asendatavuse võimalikkusest.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 70 leheküljel, 5 peatükki, 23 joonist, 13 tabelit.

List of abbreviations and terms

AIS	Application Interface Service
API	Application Programming Interface
AS-IS	Abbreviation for the current situation description
BCM	Business Change Management
BCU	Business Use Case
BPM	Business Process Management
BPMN	Business Process Modelling Notation
BSSV	Business Services Server for JDE E1 integration
CMS	Camera Monitor System
ERP	Enterprise Resource Planning
HTTP	Hypertext Transfer Protocol
JDE E1	JD Edwards EnterpriseOne, ERP system by Oracle
MOST	Mission, Objectives, Strategy, Tactics
MRO	Maintenance, Repair, Operations
OCR	Optical Character Recognition
OEM	Original Equipment Manufacturer
RACI	Responsible, Accountable, Consulted, Informed
RASCI	Responsible, Accountable, Supportive, Consulted, Informed
SOX	Sarbanes-Oxley audit requirements
TO-BE	Abbreviation for the future situation description
Voucher	Supplier invoice after logging it in the ERP – JDE E1
UC	Use Case
UML	Unified Modelling Language

Table of contents

Introduction 12
1 Task and Problem Description 13
1.1 Company Description 13
1.2 Procure-To-Pay Process and Business System 14
1.2.1 JD Edwards EnterpriseOne Introduction 15
1.3 Current Solution 17
1.3.1 Problem Description 17
1.4 Stakeholders 18
1.5 Thesis Scope 20
1.6 Restrictions and Requirements 21
2 Business Analyse Methodology 22
2.1 Strategy 22
2.1.1 MOST Analysis 23
2.1.2 Resource Audit 23
2.1.3 Value Chain 24
2.1.4 Stakeholders 25
2.2 Business Process Management 26
2.2.1 Business Process Modelling 26
2.2.2 Information Gathering for Process Modelling 27
2.2.3 Business Process Analysis 28
2.3 Requirement Gathering and Analyse 29
2.3.1 Use Case 30
2.4 UML Diagrams 31
2.5 Change Management 33
2.6 Analyse Work Process Description 34
3 Results 36
3.1 Requisition and Purchase Order Process 36
3.1.1 User Access to Requisition Handling 37
3.1.2 Supplier Direct Connection 37

3.1.3 Requisition Order Entry and Approval 38
3.1.4 Purchase Order 46
3.1.5 Confirming Delivery 50
3.2 Supplier Invoice Handling 52
3.3 Conclusions 63
4 Summary 66
5 Kokkuvõte 67
References 68
Appendix 1 – AS-IS Process Component Diagram 70

List of figures

Figure 1. The company value chain. Core processes are product engineering and operations that determine the competitive advantage in the industry. 14
Figure 2. General AS-IS requisition and invoice handling process overview in Proceedo and JDE E1. 18
Figure 3. MOST diagram. Modified based on Cadle *et al.* [9] 23
Figure 4. Basic elements of the use case diagram based on Cadle *et al.* [9, p. 206] 32
Figure 5. Direct connection (punchout solution) AS-IS process to supplier web shop . 38
Figure 6. Requisition entry AS-IS process in Proceedo. Approval sub-process is described in Figure 8. 39
Figure 7. JDE E1 requisition order entry TO-BE process 42
Figure 8. Proceedo approval AS-IS process 43
Figure 9. Approval authority setup TO-BE process. The distribution list is set up with approvers and threshold amounts. 45
Figure 10. Requisition Order Approval TO-BE Process. Approval Authority Setup was described previously in Figure 8. 46
Figure 11. Purchase order manual generation TO-BE process 48
Figure 12. Purchase order generation scheduled TO-BE process 49
Figure 13. JDE E1 requisition order TO-BE process activity diagram 50
Figure 14. Confirm delivery AS-IS process 51
Figure 15. JDE E1 confirm delivery TO-BE process 52
Figure 16. Proceedo invoice handling AS-IS process. Approval Process sub-process is described separately in Figure 8 54
Figure 17. Supplier invoice and voucher logging TO-BE process. Scanning of the paper invoice will be decided during the project. Current figure describes the invoice in pdf format. 56
Figure 18. Voucher match TO-BE process. Voucher is the supplier invoice in JDE E1. Delivery confirmation sub-process is described in Figure 15. Process for the vouchers in status “Verify” will not be included in the current thesis. 59

Figure 19. Voucher approval TO-BE process. Approval authority setup sub-process is described in this thesis in Figure 9. 61
Figure 20. Voucher (supplier invoice) processing and purchase order matching TO-BE process activity diagram. This diagram does not include the scenario where purchase order is not found by the system. 62
Figure 21. Use case diagram including all TO-BE process use cases 63
Figure 22. TO-BE component diagram describing the JDE E1 structure and interfaces when embedded SCANMAN module is added. 65
Figure 23. AS-IS component diagram describing JDE E1 structure and interfaces. The requisitions and supplier invoices are handled in Proceedo. Data is received via a file that is saved into the JDE E1 inbound table and processed into vouchers in Accounts Payable. 70

List of tables

Table 1. Project stakeholders in alphabetical order 18
Table 2. Requisition and supplier invoice handling process RACI matrix. 19
Table 3. Five areas of the resource. Modified based on Cadle *et al.* [9] 24
Table 4. Use case structure sample. Modified based on Cadle *et al.* [9] 31
Table 5. BCM best practices based on D. Jones *et al.* [17, pp. 29-30] 34
Table 6. Use case describing the requisition order entry (UC01) 40
Table 7. Approval authority setup use case (UC02A) 43
Table 8. Requisition order approval use case (UC02B) 45
Table 9. Purchase order generation use case (UC03) 47
Table 10. Confirm delivery use case (UC04) 51
Table 11. Supplier invoice process use case (UC05) 54
Table 12. Voucher match use case (UC06) 57
Table 13. Voucher approval TO-BE process (UC07) 59

Introduction

Procurement is one of the important supporting functions in the company. Strategic sourcing and supplier relationship management should be the focus to ensure the direct material supply and manage the material costs. Financial accounting is an equally important function that depends on the input from other departments. Both functions together have initiated an investigation to replace the existing consumables ordering and supplier invoice handling process with the ERP system-based solution. The main goal is to eliminate the time and manual work spent on the reconciliation between two systems due to audit requirements. Other problems with the current system are lack of system support and the high cost of improvements and annual licence fees. Key benefits of the business system based solution are that the entire process will be in the same system, original supplier invoice could be stored and checked directly in the business system, there is an internal business systems team that will provide the support and reduction of annual costs. Also, the company's global preferred approach is to use the business system since the company needs to meet the Sarbanes-Oxley audit requirements.

The current thesis will concentrate on the business and system analysis to understand the current process and to model new processes to replace the existing solution. The process has two main parts that require a new solution. The first one is the requisition order approving and purchase order handling of the indirect material. The second part is the supplier invoice saving and handling process, including the correct accounting and approvals. The new process should be modelled considering both; otherwise, the replacement will not be possible.

This master thesis has five chapters. The first chapter includes the company's introduction, procure-to-pay process and business system introduction, current solution, and the problem description together with the thesis scope. The second chapter gives an overview of the methodology used in the thesis. In the third chapter, the author presents the results of the work process. The fourth and fifth chapters summarize the thesis.

1 Task and Problem Description

1.1 Company Description

Stoneridge Electronics belongs to an international Stoneridge corporation that is an independent designer and manufacturer of highly engineered electrical and electronic components, modules, and systems principally for the automotive industry. In April, Stoneridge won the 2020 Automotive News PACE Award for its MirrorEye® Camera Monitor System (CMS) [1]. This is a very high recognition in the automotive industry. CMS is an innovative product that will replace the traditional mirrors on trucks with integrated digital cameras and monitors. Also, Stoneridge is a market-leading supplier of instrument clusters to global commercial vehicle producers.

Stoneridge Electronics history in Europe goes back to 1997 when the company acquired Berifors in Sweden. A year later, a factory was opened in Estonia. Corporate headquarter is in Novi, Michigan, and the European headquarter is in Solna, Sweden. All European companies (aftermarket sales and OEM) are working in the common ERP system JD Edwards EnterpriseOne (JDE E1). The automotive industry is highly regulated by standards related to safety, quality, production, and environment. The company is following lean principles and is conscious of the environment. The company`s core values are integrity, customer orientation, teamwork, adaptability, accountability, and social responsibility.

The author cannot present the MOST analyse and Resource audit results in the thesis due to delicate business information, but this will not affect the overall understanding of thesis results. Stoneridge Electronics products can be divided into two groups: (a) electronics and (b) control devices. Control Devices products are electro-mechanical actuation systems, sensors for vehicle systems, switch, and connector solutions. Electronics products are driver information systems (instrument clusters), tachographs and compliance solutions, electronic control units. The main commodities provided by suppliers are plastics, circuit boards, metal stampings, connection systems, and custom

displays. Stoneridge Electronics is a supplier to several leading global commercial vehicle OEMs, including Scania, MAN, Ford, Volvo, and Daimler.

Based on Michael Porter`s value chain and organization structure [2], company processes can be divided into core and supporting processes (Figure 1). It includes the generic categories described by Porter, but core processes involve product design and operations because those are the key factors to the competitive advantage in the industry.

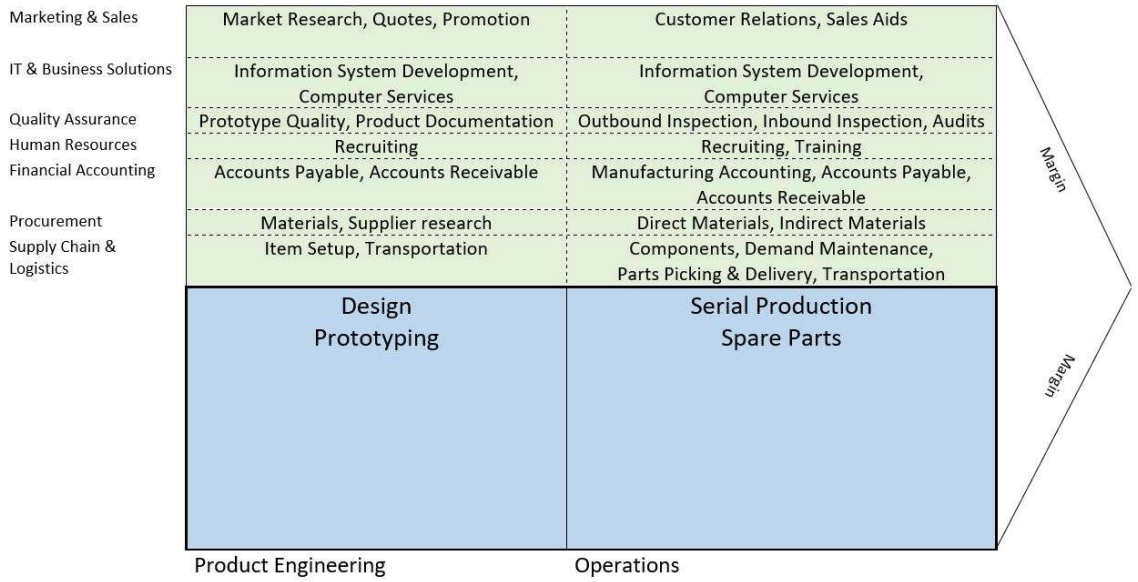

Figure 1. The company value chain. Core processes are product engineering and operations that determine the competitive advantage in the industry.

1.2 Procure-To-Pay Process and Business System

Purchasing, supply management, and procurement are used interchangeably to refer to the integration of related functions to provide effective and efficient materials and services to the organization [3, p. 4]. Procurement, like any other supporting function, should be effective. The control over the business process could be obtained by using appropriate technological tools. John Hagel has said that when accelerating performance improvements, then you have to stop focusing on the efficiency, but to focus on effectiveness, on impact, and on value delivered [4, p. 23].

Direct spend includes the goods that will be directly used in the end product; indirect spending is goods and services that keep the organization running [3, p. 38]. The current thesis concentrates on the process of purchasing indirect materials – maintenance, repair,

and operating (MRO) supplies. Stoneridge has a global procurement, that will handle purchases for all company divisions. According to Alan Harrison *et al.* [5, pp. 356-357] in order to generate value, most of the procurement time should be allocated to supplier relationship management and strategic sourcing (total 69%), and only 17 % should be spent on procure-to-pay and operational tasks and 14% on other activities (for example training).

A research article by Santanu Mandal [6] provides empirical support on how supply chain innovation as a dynamic capability ensures a strong performance for the firm in the presents of environmental uncertainty. Recent months have shown that the uncertainty is real, and supply chain issues may escalate with the number of days. This makes it essential that procurement can concentrate on the strategic sourcing and supplier relationship instead of recurring tasks with order and invoice handling. The solution within the ERP system would give better visibility of the MRO purchases and the invoices, and it will eliminate the need for invoice reconciliation between different systems and reduce the time spent on information inquiries.

Common issues that may influence the ERP implementation success of fail will also apply when adding new modules to the business system. Jennifer Lonoff Schiff [7] listed eleven common mistakes that may determine the outcome of the project. The thesis author lists some of the factors based on this article that should also be considered when replacing the existing process with another. Those factors are doing careful requirements gathering, including end-users in the decision-making process, working on the change management, supporting the implementation team, communicating information across departments, and creating a support plan. Underestimating any of those factors may potentially cause time delays, re-work, or complete failure.

1.2.1 JD Edwards EnterpriseOne Introduction

JD Edwards EnterpriseOne (JDE E1) is a web-based ERP system belonging to Oracle Corporation. JDE E1 system and networking side consist of environments with path codes and object configuration mappings. This determines the nature of the environment, the location of the data, and what logic should be executed when retrieving the data from the database. Oracle solves the bug fixes and enhancements by issuing Software Action Requests, that will be gathered into Electronic Software Update packages. Typically, this

package is downloaded, deployed to the test environment, and after testing deployed to the production environment. Objects in those packages are grouped by dependencies.

The main type of security in JDE E1 is application and action code security. Table access is controlled by the row and column security. Security is defined by roles, that can be set up based on the position or task.

The development of custom objects or modifying the standard object can be done since all source code on the application level is available. Development is done in Object Management Workbench. Following object types exist in the system:

- Interactive Application (APPL) - used to interact with the system on a real-time basis
- Business Function (BSFN) - used to run routines or sets of code
- Business View (BSVW) - view over a table or combination of tables
- Data Structure (DSTR) - parameter list
- Media Object Data Structure (GT) - block of text or embedded object or a link to a file
- Table Definition (TBLE) - data or file containing fields
- Batch Application (UBE) - processes that run on a server and either perform table updates and data processing or create reports

JDE E1 Tools is used to build the applications. A relational database tables store the data that application uses in columns and rows. JDE E1 is mainly programmed in Event Rules (visual interfaces such as Form Design Aid) developed by JD Edwards, business functions in C language. Business functions called Named Event Rules can be programmed by using the Event Rules, but during compilation, those will be converted to C language.

JDE E1 can run on multiple operating systems (Linux, Microsoft Windows) and various databases (Oracle, SQL) and virtual servers.

1.3 Current Solution

1.3.1 Problem Description

MRO (consumables) purchases and invoices are handled through a separate system (Proceedo) that has an interface to ERP - JDE E1. Problems with the current solution according to the process owners are the following:

- Difficult to reconcile the data with JDE E1 requires monthly manual work to perform the reconciliation
- Insufficient and time-consuming support from the software provider
- No internal technical support team
- The high cost of changes and improvements
- The high annual cost for licenses

Improvement project has been initiated by Finance and Procurement departments to be able to handle the requisition orders and supplier invoices directly in ERP.

Identified key benefits are:

- The entire process in one system, better visibility
- No need for separate reconciliation
- Internal Business Systems support team to handle the issues
- Possibility to reduce costs
- Meet the companies favoured approach to use ERP as much as possible

The process consists of two main parts, the requisition and purchase order handling and the supplier invoice handling (both include approvals).

Figure 2 describes the current AS-IS process on a high level. Requisition order, purchase order, and supplier invoice handling are performed in a separate system (Proceedo). The approved invoice data is transferred via a text file from Proceedo and saved to JDE E1

(voucher and general ledger records). Appendix 1 shows the component diagram for the AS-IS process (Figure 23).

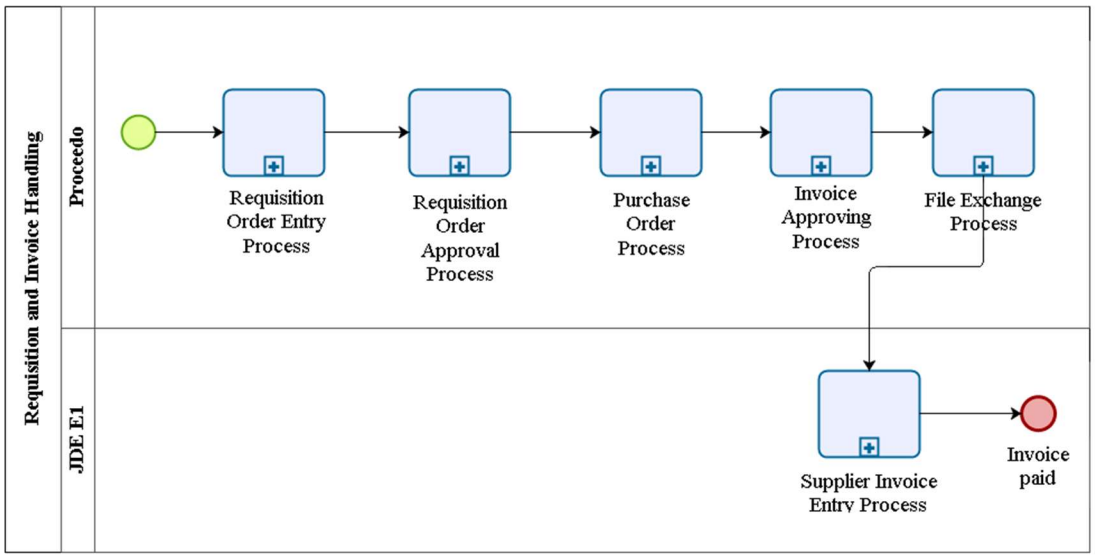

Figure 2. General AS-IS requisition and invoice handling process overview in Proceedo and JDE E1.

1.4 Stakeholders

Project stakeholders are described in Table 1. This table includes all the functions that should participate in the different stages of the project. Not all listed stakeholders are currently active members in the initial investigation and analyse phase.

Table 1. Project stakeholders in alphabetical order

Stakeholder	**Explanation**
Approver	The person who will see the invoices that needs approval and makes the decision to approve or not.
Business Solution Analyst	ERP expert that will work on with the setup and testing. In the later phase, this person is responsible for maintaining the setup, troubleshooting and issue handling.
Business Unit Owner	A person from management that is responsible for the cost centre.
Chief Accountant	The person who will handle the approved invoices in accounts payable and creates the payment files.
Commodity Manager	The person who makes sourcing decisions and handles supplier relations. This person can also act as Purchaser.
External Product Manager	Responsible for the communication and customer experience of implementing the supplier invoice handling module (SCANMAN).

External Product Solution Analyst	Working together with Business Solution Analyst to implement and setup the supplier invoice handling module (SCANMAN) in the ERP system.
Finance Manager	The person who is responsible for reporting the results.
Process Analyst	Subject matter expert that knows process details and best practices.
Project Manager	Responsible for the project plan, budget and meeting the set deadlines.
Purchaser	The person who will perform the ordering.

Table 2 shows the specific roles and responsibilities in the process presented as RACI matrix. Different letters and colours in the RACI table illustrate different roles. The table could be read as follows:

- Responsible (R in red) – a person who carries out the process
- Accountable (A in green) – a person who is ultimately accountable for the process or task being completed
- Consulted (C in purple) – a people who are not directly involved, but are consulted (stakeholder or subject matter expert)
- Informed (I in light blue) - people who receive the output from the process

Table 2. Requisition and supplier invoice handling process RACI matrix.

	Purchaser	Accountant	Approver	Commodity Manager	Chief Accountant
Entering requisition order	R	I	I	A	I
Moving order through approval route	C	I	R	A	I
Sending purchase order	R	I	C	C	I
Moving invoice through approval route	I	C	R	I	A
Paying the invoice	C	R	I	C	A

1.5 Thesis Scope

The scope of the master´s thesis is as follows:

- Gathering the business requirements
- Documenting the functional requirements
- Writing the use cases
- Defining the concept for the ERP specific solution
- Modelling TO-BE processes
- Identifying the gaps

A new solution has two parts that require analyse – the first part is the MRO handling in the ERP (standard functionality), and the second part is the new procurement invoice handling module that will be implemented in the ERP system. The procurement invoice handling module should be usable also without the MRO process for other vendor invoices. The thesis scope will not include the TO-BE processes for the direct material invoices or for the supplier invoices, where no purchase order and or receipt is created. Those processes will be considered during the project.

Thesis author worked on the following tasks:

- Understanding the AS-IS process
- Gathering business requirements through group sessions and interviews
- Writing down the use cases to describe the functional requirements
- Analysing the solution and modelling the TO-BE process

Non-functional requirements are not separately presented in the thesis. The solution involves an existing system that has been set up considering the company's requirements and restrictions.

The project is ongoing, and participants have been listed in the project stakeholders table (Table 1, pp 18), the thesis author will continue working together with external and internal project participants.

1.6 Restrictions and Requirements

The primary requirement is that improvements need to be done considering existing servers, hardware, and software. A standard requisition self-service process should be implemented together with a new invoice handling module in the JDE E1. Otherwise, it is not possible to replace the full AS-IS process in Proceedo. The procurement invoice handling module needs to be developed by the licensed Oracle partner and should follow the same programming and security principles as standard JDE E1. The procurement invoice handling module needs to include an option to store the original invoice in pdf format.

Any custom developments should be evaluated separately, if there is a requirement that potentially needs a custom development, then it should be analysed, and the value versus cost of this should be determined before any decision is taken.

Requirements should be categorized by importance and prioritised by the absolute necessity. The project will be limited by the budget and agreed time plan. Change from the existing solution to the new solution should be coordinated and managed to minimize the overlapping time. Change management practices should be considered in the transition phase.

All business systems and information technology-related changes should follow the Sarbanes-Oxley (SOX) audit rules. Accurate controls need to be in place to guard the financial data, and the company has created policies that should be considered during any software-related implementations and changes.

2 Business Analyse Methodology

Business analyses can be conducted for different reasons, for example, mapping the existing business process from the beginning to the end to understand it better and identify the weaknesses or to develop an entirely new process and find the system to support it. There are several techniques that can be used to perform detailed business analysis. The following chapter is describing the theory of the methodology that the thesis author has used to conduct the analyse.

2.1 Strategy

Strategy drives the organization and creates value. Based on Michael E. Porter [8, p. 35], there are three potentially successful generic strategic approaches to outperform other firms in the industry:

- Overall cost leadership (strong cost control)
- Differentiation (being unique and creating brand loyalty)
- Focus (buyer group, a segment of the product line, or geographic market)

An analysis of internal capability is essential to understand where the core skills of the organization lie so that the relevant courses of action can be identified, and any changes be made in the knowledge that they have a good chance of success [9, p. 2].

Next, an overview will be given regarding the analyse techniques used in this thesis:

- MOST (mission, objectives, strategy, tactics) Analysis
- Resource Audit
- Value Chain
- Stakeholders

2.1.1 MOST Analysis

The MOST analysis is used to analyse what an organization has set out to achieve (the mission and objectives) and how it aims to achieve this (the strategy and tactics). A MOST provide a statement of intent for the organization and is usually created following some strategic analysis activity. It is also used during the strategic analysis, since it can demonstrate strength within the organisation or expose inherent weaknesses [9, p. 9]. Figure 3 describes in detail what MOST stands for.

Figure 3. MOST diagram. Modified based on Cadle *et al.* [9]

2.1.2 Resource Audit

The Resource Audit is used to analyse key areas of internal capability in order to identify the resources that will enable business change and those that will undermine or prevent such efforts [9, p. 10].

There are five areas of resources to examine (Table 3). Analysing each of those areas will give an understanding of the strengths and weaknesses. Based on this, it is possible to determine does the company have the capability to progress.

Table 3. Five areas of the resource. Modified based on Cadle *et al.* [9]

Area	**Details**
Financial	The financial resources available – financial assets, the possibility of loans, and credit. Stability and funds for investments and development.
Physical	The land, buildings, and equipment available.
Human	The people employed by the company.
Reputation	The marketplace perception of the organization and the amount of goodwill.
Know-how	The information held within the organization and the way it is used to support the organization's work.

2.1.3 Value Chain

The value chain was developed originally by Michael Porter (1985) and showed the different organizational activities that are grouped together to deliver value to customers. The value chain is a useful technique for business analysts who are working on business process improvement assignments [9, p. 95].

There is also an option to create the value chain model to a specific area. If analysts are required to investigate the support activities, then the approach recommended by Cadle *et al.* [9, p. 96] is to concentrate on the support activities area and create the model specifically for it.

There are five generic categories of primary activities involved in competing in any industry [2, pp. 39-40]:

- Inbound logistics
- Operations
- Outbound logistics

- Marketing and Sales
- Service.

Support value activities can be divided into four generic categories [2, pp. 40-43]:

- Procurement
- Technology development
- Human Resources Management
- Firm Infrastructure

It is necessary to define the company value chain to get the understanding of competitive advantage. It can be defined in two steps starting from generic chain value activities for the company and then dividing each category to more detailed activities. [2, p. 45].

2.1.4 Stakeholders

Stakeholders can determine the success or the failure of making a change. A stakeholder is a group or individual affected by the system-to-be, who may influence the way this system is shaped and has some responsibility in its acceptance [10, p. 30].

The process of working effectively with stakeholders has three major steps [9, p. 61]:

- Stakeholder identification
- Stakeholder analysis
- Stakeholder management

Stakeholder cooperation is essential for building a shared understanding of the problems to be addressed by the system-to-be. Such cooperative learning is a critical path to obtaining complete, adequate, and realistic requirements [10, p. 62].

RASCI (responsible, accountable, supportive, consulted, informed) chart is one of the techniques that help to assess stakeholder´s roles and responsibilities. RASCI chart is a matrix that is used to list all of the tasks within a project or a business process with the roles of each stakeholder [9, p. 79]. One of the variants of RASCI is RACI (responsible,

accountable, consulted, informed). The thesis author has chosen to use RACI instead of RASCI when creating the responsibility matrix for the process.

2.2 Business Process Management

Business Process Management started from the movement in 1990s when the major focus was put on the business process re-engineering. The later more service-oriented approach was taken [11]. The effective business process creates value and gives a competitive advantage. To improve a process, it is important to understand how to use different techniques that help to achieve the desired result.

Business Process Management (BPM) is a holistic approach to managing an organization in order to align customer needs to corporate strategies [12, p. 465].

Process mapping is a proven analytical and communication tool intended to help you improve your existing processes or to implement a new process-driven structure in order to re-engineer your business processes [13, p. 2].

2.2.1 Business Process Modelling

The most used method to model the business processes is BPMN (*Business Process Model and Notation*). This is a language that uses different symbols with specific meanings. Key elements in BPMN are [9, pp. 105-106]:

- The event that initiates the process
- Tasks that make up the process
- The actors
- The flow of the tasks
- Decisions that lead to alternative flows
- The endpoint of the process

2.2.2 Information Gathering for Process Modelling

Based on A. van Lamsweerde [10, pp. 64-81], information gathering techniques could be divided into two categories, each containing number of different options.

The first group of techniques is artifact-driven:

1. **Background study.** It is sometimes also called content analyse. This means studying the existing documentation, and it helps to prepare before meeting the stakeholders.

2. **Data collection.** This could complement the background study to find the information (usage statistics, performance) that is not available in the documentation. Useful for the non-functional requirements.

3. **Questionnaires.** This means submitting a list of specific questions to selected stakeholders. Questions can be a different type (multiple-choice, weighting). This also allows getting access to subjective information.

4. **Repertory grids and card sorts.** Those techniques are sometimes used for knowledge acquisition in expert system development.

5. **Storyboards and scenarios.** The use of narratives could be effective in the early stage of the requirements engineering. There are different types of scenarios like positive vs. negative and normal vs. abnormal. Scenarios are often used during the software lifecycle.

6. **Mock-ups and prototypes.** This could make it easier for stakeholders to understand the future working conditions. Instead of reading difficult documentation, stakeholders could play the process through.

7. **Knowledge reuse.** People in the project tend to use knowledge from past experiences with similar systems. Benchmarking could be one option. There are also threats such as evaluating is the fragment worth of reusing or compatibility.

The second group of the techniques is stakeholder-driven:

1. **Interviews.** This is considered a primary technique for requirements gathering. Interviews can be structured or unstructured. Some of the guidelines that A. van Lamsweerde [10, pp. 78-79] is giving are the following:

    a. Identify the right sample of people

    b. Prepare for the interview

    c. Be focused and open-minded

    d. Quality and the form of questions is important

2. **Observation and Ethnographic Studies.** It may be easier to understand the task by observing it; this applies especially to business processes and working procedures.

3. **Group sessions.** Group sessions can be structured or unstructured, depending on how clearly the roles in the group are established. The less formal style of interaction can reveal issues that otherwise may remain hidden in case of formal interviews. A broader range of ideas will be generated from brainstorming.

The single technique will not be enough, combining both artifact-driven and stakeholder-driven techniques will give more accurate results.

Manuel Laguna and Johan Marklund [12, pp. 91-92] also list benchmarking as one part of the business process-design project framework. Benchmarking allows assessing the company's process current performance compared to other companies and inspires ideas on how to improve the process.

2.2.3 Business Process Analysis

Critical process analysis techniques based on Kathy A. Long [14] are:

- Gap Analysis
- Value-Added Analysis
- Root Cause Analysis
- Observation

- Examining the Experience

In the current thesis, the author is using the Value-Added analysis technique to analyze the business process. Value-Added analyze concentrates on a detailed examination of each activity to understand does it supports the requirements or needs. According to Kathy A. Long [14], there are three categories of value-add:

- Real Value-Added (RVA) – activities essential to the process.
- Business Value-Added (BVA) – activities essential to conducting business (unavoidable waste).
- Non Value-Added (NVA) – activities that do not add value nor are essential to conduct business

Each step in the process can be classified into one of those three categories. The first category shows the actions that give real value to the process. The second category could be considered waste, but it is necessary due to standards, laws, or other business requirements. The third category represents the pure waste. Categorizing each action in the process will give an understanding of the needed improvements.

2.3 Requirement Gathering and Analyse

There are three main activities in the requirements engineering process [15, p. 55]:

- *Requirements elicitation and analysis*. Information gathering through observation, discussions, workshops, or other means.
- *Requirements specification*. The gathered information is translated into a document that defines the set of requirements.
- *Requirements validation*. Checking the requirements for realism, consistency, and completeness, to detect any errors in the requirements documentation.

Business Use Case (BCU) is a technique for requirements gathering. BCUs are associated with business events. One example of the business event is doing checkout in a webstore. Checkout decision triggers the number of responses in the system. BCUs will allow documenting the required functionality.

The requirements analyst should look past the obvious and the current way of doing business, and instead understand the true nature of the work [16, p. 77].

Designing resilient systems is important; part of it should be considered already in the requirements gathering phase. Designing systems for resilience involves two closely related streams of work [15, pp. 424-425]:

- Identifying critical services and assets
- Designing system components that support problem recognition, resistance, recovery, and reinstatement (the 4R model)

BUCs form can be different, but in general, they should still meet the following criteria [16, pp. 68-69]:

- They are partitions where each one makes a logical contribution to the work
- They have minimal connectivity to other parts of the work
- They have clearly defined scope
- They have rules for defining the scope
- They have boundaries that can be defined
- They can be named in a recognizable manner
- Their existence can be readily determined
- They have one or more stakeholders that are experts of that area

2.3.1 Use Case

The term *use case* comes from 1987 when Ivar Jacobson used it to describe the interaction between a system and a user of that system [16, p. 69]. Use case (UC) is a structured way of presenting the functionality in a system – something that users would like to do [9, p. 205]. It is a requirement modelling technique, that can be defined as use case diagrams or as use case descriptions. Use case description has a specific structure where actor and

system interaction are described. Table 4 [9, p. 210] shows the structure of a use case description.

Table 4. Use case structure sample. Modified based on Cadle *et al.* [9]

Use Case	
Scope	
Primary actor(s)	
Preconditions	
Trigger/Event	
Stakeholders(s)	
Main success scenario:	
Alternate scenario(s):	
Postconditions:	

2.4 UML Diagrams

Different abstract models of a system are developed during system modelling. Those models can be used during different project phases (from requirements engineering to implementation) to keep track of the detailed requirements [15, p. 139]. Five main diagram types based on Ian Somerville [15, pp. 140-141] are:

- Activity diagrams
- Use case diagrams
- Sequence diagrams
- Class diagrams
- State diagrams

Activity diagrams show the activities in the process. Use case diagrams show interactions between a system and its environment. Sequence diagrams show interactions between actors and the system and between the system components. Class diagrams show the object classes and associations between them. State diagrams show how the system reacts to internal and external events.

In the current thesis, the author is using activity diagrams, use case diagrams, and component diagram do describe the system requirements.

Component model main elements are [15, pp. 470-471]:

- Interfaces
- Usage information
- Deployment

Activity diagrams show the activities in a process and the flow of control from one activity to another [15, p. 143].

The basic elements of a use case diagram are described on Figure 4. The use case diagram usually has a box that indicates the boundary of the system. The representing elements are different depending on if the actor is someone (person) or something (another system). A person is described with a human figure and system with a box. The use case is functionality used by the actor, and the connection line indicates the association between the actor and the use case.

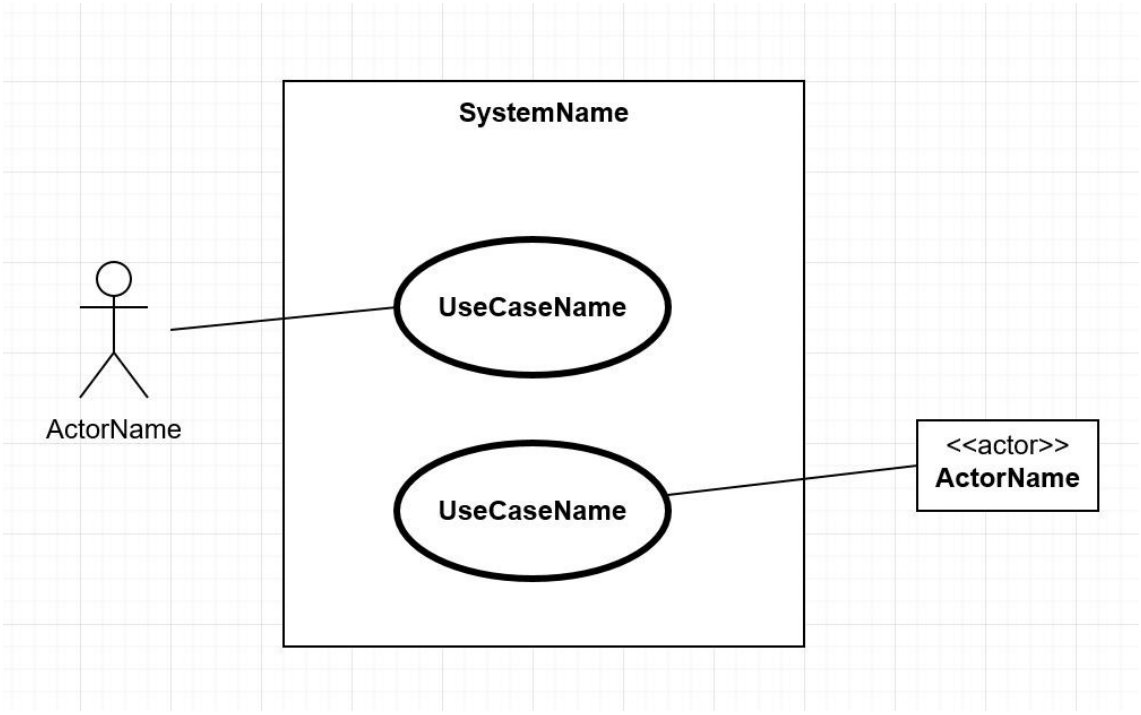

Figure 4. Basic elements of the use case diagram based on Cadle *et al.* [9, p. 206]

2.5 Change Management

One of the stages that are often underestimated in the business process analyse project is how organization will cope with the change. People are those who will make or break it. Resistance can come from different reasons, but it is important to identify it and handle it in the early stage. Business change management (BCM) involves three main topics [9, p. 229]:

- Organizational change
- People change
- Benefits management and benefits realization

Some of the common change risks and issues, according to David Jones and Ronald Recardo are [17, pp. 18-29]:

- Little or no commitment to the change
- No sense of urgency or momentum
- Infighting and increasing conflict (both passive and aggressive)
- Sabotage attempts
- Lack of unity and cross-functional cooperation (silo effect)
- Emotional roadblocks
- Lack of sponsorship and leadership
- Missing the milestones
- Poor understanding of the change road map, roles, and dependencies

They also list the business change management best practices (Table 5).

Table 5. BCM best practices based on D. Jones *et al.* [17, pp. 29-30]

Group	**Actions**
Decisive Leadership	Make a vision of change clear. Identify the problems and probe the causes. Make the tough calls.
Engagement	Model the change. Make the change personal and accountable.
Organization Alignment	Clarify the boundaries between the old and new. Consistently communicate to reinforce the change.
Culture Alignment	Assess readiness and detect inhibitors early. Recognize and reward change process constantly. Support the transition.
Balanced Measurement	Develop a balanced and meaningful scorecard.
Program Management and Change Integration	Create change road map and plan. Manage the white space.

2.6 Analyse Work Process Description

Analyse process includes the following steps:

1. The thesis author reviewed the current AS-IS process by going through the existing documentation and observing the process flow.

2. Group sessions were held with the project participants. The first sessions were led by the thesis author, then each team (finance, procurement) held separate meetings to define the needs. Results from the sessions were presented in a written form.

3. The thesis author analysed the outcomes from the group sessions and held additional interviews to clarify the requirements. Then wrote the requirements down in the use case format, which will help to describe and identify the requirements in an organized way.

4. A demo introduction of SCANMAN was held by the external partner. SCANMAN is an invoice handling module designed for JDE E1 and meets the general restrictions and requirements (described in 1.6). Product documentation was provided by the external partner.

5. TO-BE processes were modeled by the thesis author and will be discussed during interviews with project stakeholders for validation and feedback.

6. Test setup of standard Requisition Self Service process (MRO handling) in the JDE E1 testing environment was done by the thesis author. It could be considered as prototyping.

3 Results

This chapter will describe the results from the work process, where the TO-BE process was designed to replace the current AS-IS process. This chapter will include process descriptions and models, use cases, and different diagrams.

3.1 Requisition and Purchase Order Process

Every employee registered in the company Active Directory can enter a requisition order for consumable material. The system will send the requisition order to the approval route based on the order total amount. Different approvers are defined in the approval route based on the amount levels. The approver can reject the requisition order and will add a reason for the rejection. The system will direct the requisition order back to the originator. The number of the people in the approval route depends on the order amount – the higher the amount, the more approvers there can be. Originators can enter the requisition orders in multiple currencies; the approval route should consider the values in a specific currency. Requisition orders and approvers are linked to a specific business unit. Exact supplier details may not be available during the requisition order entry; then, the originator cannot enter the supplier number. The exact item number may not be available during the requisition order entry. In that case, free-text descriptions will be used. When the requisition order has passed the approval route and has a correct status (approved), then the purchase order will be generated and sent to the supplier or supplier shopping chart is used to perform the purchase.

Based on the description and the AS-IS process, following business requirements will need a TO-BE solution:

- All employees should have an option to enter the requisition order
- Direct connection to supplier website
- Requisition order entry
- Approval route setup
- Purchase order generation

- Sending the purchase order to the vendor
- Confirming the delivery of the goods or services

3.1.1 User Access to Requisition Handling

In the current AS-IS process, all employees (Estonia and Sweden) have access to Proceedo, and right to create the requisition purchase orders. In the case of ERP, access needs to be granted in the JDE E1, and role should be assigned to the user. The requirement is currently to monitor the access by named user due to licensing agreements.

There are options to simplify the requisition and purchase order handling by considering the following:

- Linking the JDE E1 requisition entry application to SharePoint
- Setting up Requisition Self Service portlet and interface
- Using mobile applications (for example standard app RSS Approvals – JDE E1 from Oracle)

The named access requirement would remain in case if those options listed above. The number of new users should be estimated, and licensing details checked. In the current thesis, it will be considered as a gap.

3.1.2 Supplier Direct Connection

Supplier direct connection means a punchout solution where products can be selected from the supplier's webshop and then bring those items back to the requisition entry shopping chart. In the current process, there are two suppliers were this connection had been set up between Proceedo and the supplier webshop. Figure 5 describes the AS-IS process when the supplier has a direct connection setup, and it is possible to use their webshop to add the items to the purchase order in Proceedo.

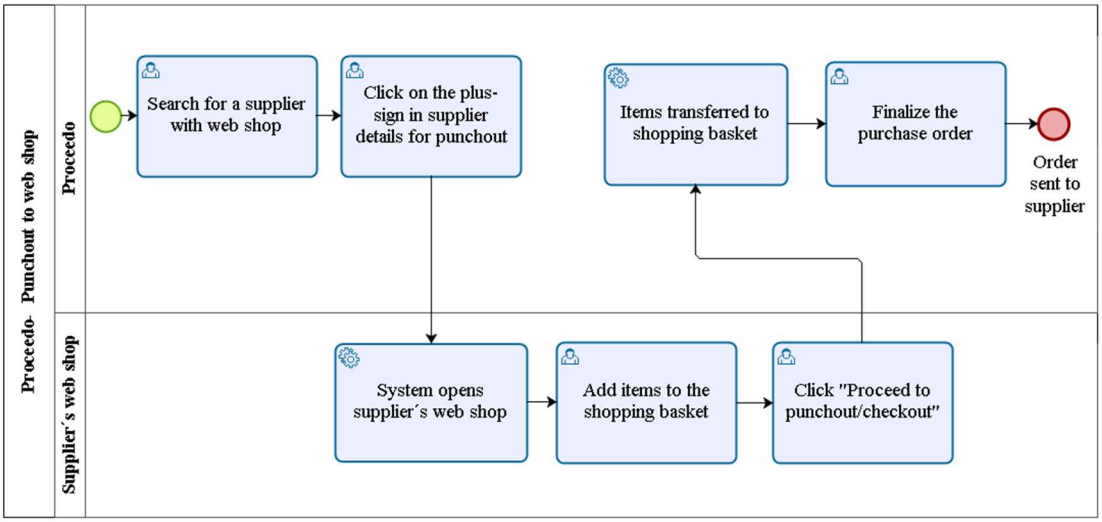

Figure 5. Direct connection (punchout solution) AS-IS process to supplier web shop

In JDE E1 Requisition Self Service, is an option to set up the same type of connection. This could include both the direct connection and purchase order dispatch to the supplier. The solution is based on the Business Services server (BSSV). Oracle provides some services for the direct connection - direct connect authentication processor and shopping chart processor and PO dispatch processor business service for the purchase order delivery. Network configuration (firewalls) may prevent such traffic, so this should be considered when setting up the direct connection. Currently, the company does not have BSSV installed. Another possible option is to use the Application Interface Service (AIS) to set up a connection with the supplier website. The company has the AIS server setup, and Oracle Orchestrator Studio to create and manage external connections based on AIS.

The thesis author will continue working on the possible TO-BE solution and cannot present it in the thesis. In the conclusion of this thesis, it will be considered as a gap.

3.1.3 Requisition Order Entry and Approval

The requisition entry AS-IS process includes both the requisition entry details and the purchase order (Figure 6). Filling the form is slightly different depending on it is a known supplier or an alternative free-text entry. In the first case, the system requires only item-related information; in the second case, it is important to fill in the supplier name and e-mail address to be able to deliver the order to the supplier. AS-IS punchout to the supplier webshop process is described in Figure 5, and the approval process in Figure 8.

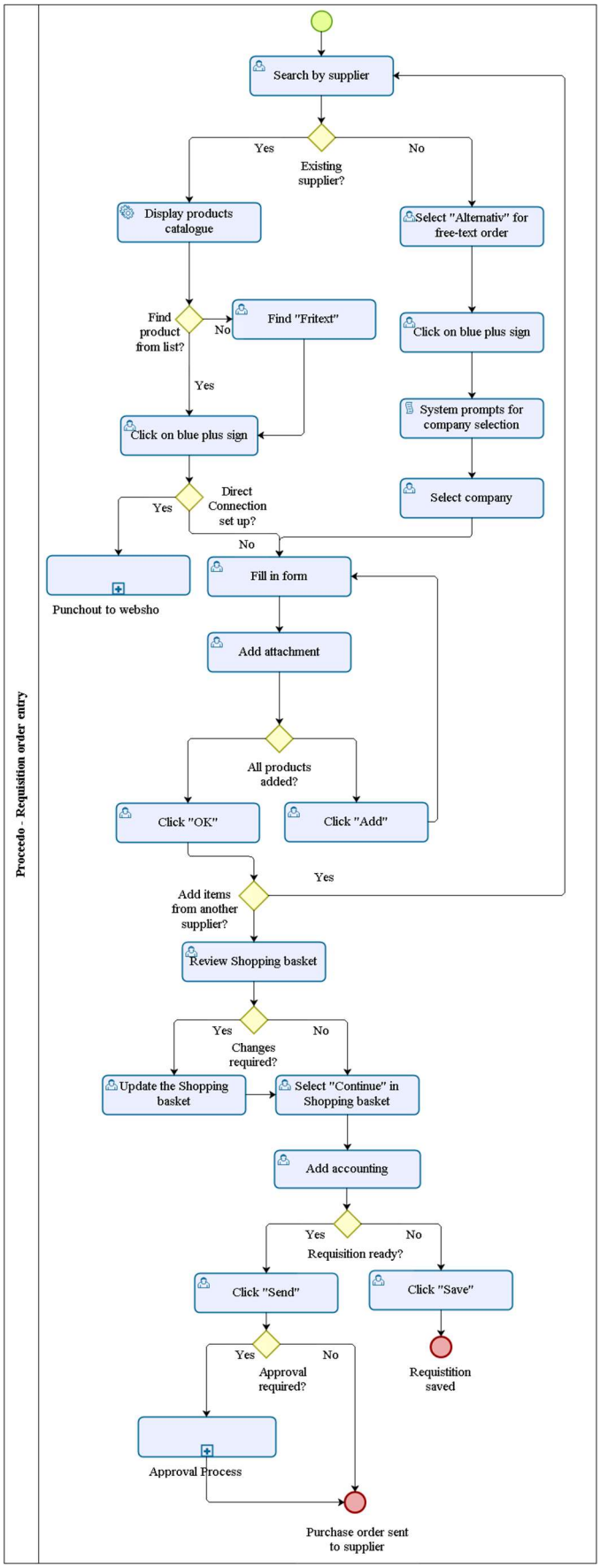

Figure 6. Requisition entry AS-IS process in Proceedo. Approval sub-process is described in Figure 8.

The first use case (Table 6) is describing the main success scenario and alternative scenarios for the requisition order entry process. The main actor in this process is an employee (the purchaser), but some of the details will be predefined and filled automatically by the system. It is possible to add multiple suppliers during the same requisition order entry. Every order in JDE E1 is split into two sets of information. One set is order header (general for all the order lines), and the other set is order detail (order lines with line-specific information).

Table 6. Use case describing the requisition order entry (UC01)

Use Case	UC01 - Requisition Order Entry
Scope	The purchaser has a demand to order consumable material. The purchaser will enter a requisition order in the system.
Primary actor(s)	The purchaser
Preconditions	The purchaser has the authorization to enter requisition orders. Approval authority has been set up by the business unit or employee (UC02A).
Trigger/Event	Indirect material needs
Stakeholders(s)	The approver, the commodity manager, the process analyst
Main success scenario: 1. The purchaser opens the application to enter requisition orders. 2. The system fills predefined data including the purchaser user code and business unit. 3. The purchaser selects an existing supplier. 4. The purchaser enters an item number. 5. The purchaser enters a quantity. 6. The purchaser enters a unit price (amount). 7. The purchaser enters expense account details: a. System verifies that the header business unit is the same as business unit in the expense account details, if not, error is issued. 8. The purchaser can repeat the steps 3-7 multiple times. 9. The purchaser attaches additional documentation if required. 10. The purchaser submits the order. 11. The system generates the order number and updates order status.	
Alternate scenario(s) Alternate scenario UC01-1: 1. The purchaser opens the application to enter requisition orders. 2. The system fills predefined data including the purchaser user code and business unit. 3. The purchaser leaves the supplier number blank, since a) supplier is still unknown; b) supplier has not been setup in the system.	

4. The purchaser enters an item number.
5. The purchaser enters a quantity.
6. The purchaser enters a unit price (amount).
7. The purchaser enters expense account details:
    a. System verifies that the header business unit is the same as business unit in the expense account details, if not, error is issued.
8. The purchaser can repeat the steps 3-7 multiple times.
9. The purchaser attaches additional documentation if required.
10. The purchaser submits the order.
11. The system generates the order number and updates order status.

Alternate scenario UC01-2:

1. The purchaser opens the application to enter requisition orders.
2. System fills predefined data including the purchaser user code and business unit.
3. The purchaser selects an existing supplier.
4. The purchaser enters a free-text item number and description, since a) item is not set up in the system or b) item will not be set up in the system.
5. The purchaser enters a quantity.
6. The purchaser enters a unit price (amount).
7. The purchaser enters expense account details:
    a. System verifies that the header business unit is the same as business unit in the expense account details, if not, error is issued.
8. The purchaser can repeat the steps 3-7 multiple times.
9. The purchaser attaches additional documentation if required.
10. The purchaser submits the order.
11. The system generates the order number and updates order status.

Alternate scenario UC01-3:

1. The purchaser opens the application to enter requisition orders.
2. The system fills predefined data including the purchaser user code and business unit.
3. The purchaser leaves the supplier number blank, since a) supplier is still unknown; b) supplier has not been set up in the system.
4. The purchaser enters a free-text item number and description, since a) item is not setup in the system or b) item will not be setup in the system.
5. The purchaser enters a quantity.
6. The purchaser enters a unit price (amount).
7. The purchaser enters expense account details:
    a. System verifies that the header business unit is the same as business unit in the expense account details, if not, error is issued.
8. The purchaser can repeat the steps 3-7 multiple times.
9. The purchaser attaches additional documentation if required.

10. The purchaser submits the order. 11. The system generates the order number and updates order status. Alternate scenario UC01-4: 1. The purchaser opens the application to enter requisition orders. 2. The system fills predefined data including the purchaser user code and business unit. 3. Preconditions are not filled, and approval authority has not been set up. 4. The system will issue a hard error and stop the requisition entry. 5. The purchaser should turn to the appropriate function to have approval authority setup.
Postconditions: Requisition order is saved, and it has a number and status.

The use case UC01 process is described in Figure 7 below. It is including the main success scenario and three alternative scenarios that will still end with order entry. Alternative scenario UC01-4 is not described in Figure 7, but it is essential to avoid entering requisition orders without approval authority setup. Without this control, approvals could be bypassed and cause a financial impact. Data entry points listed in the process are the minimum; it is possible to add additional text or attach documents to the requisition order for the approvers. The purchaser user is linked with specific a business unit in the system, but it is possible to allow the purchaser to change the business unit during the requisition order entry. Also, there is an option to setup the commodity structure to ease the ordering process (like the products catalogue in AS-IS process in Proceedo in Figure 6).

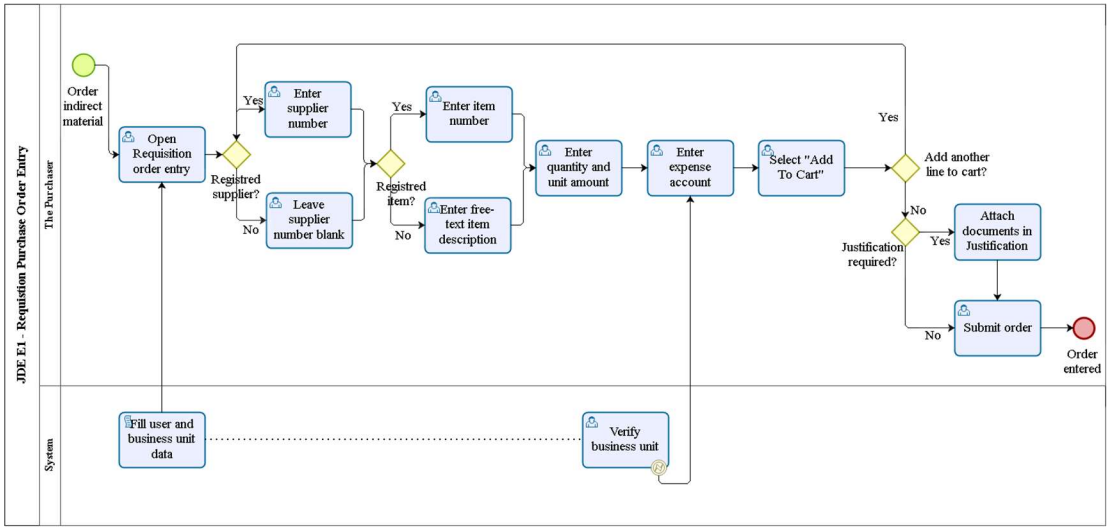

Figure 7. JDE E1 requisition order entry TO-BE process

After the requisition order has been entered, it is possible to see the list of approvers who need to approve the requisition and the status of the approval.

Approval authority setup has two parts:

- a onetime system setup defining the approval authority parameters
- adding approvers to the approval authority workflow

In the current AS-IS process, the approval route is setup by the accounting details and depends on the business unit (Figure 8).

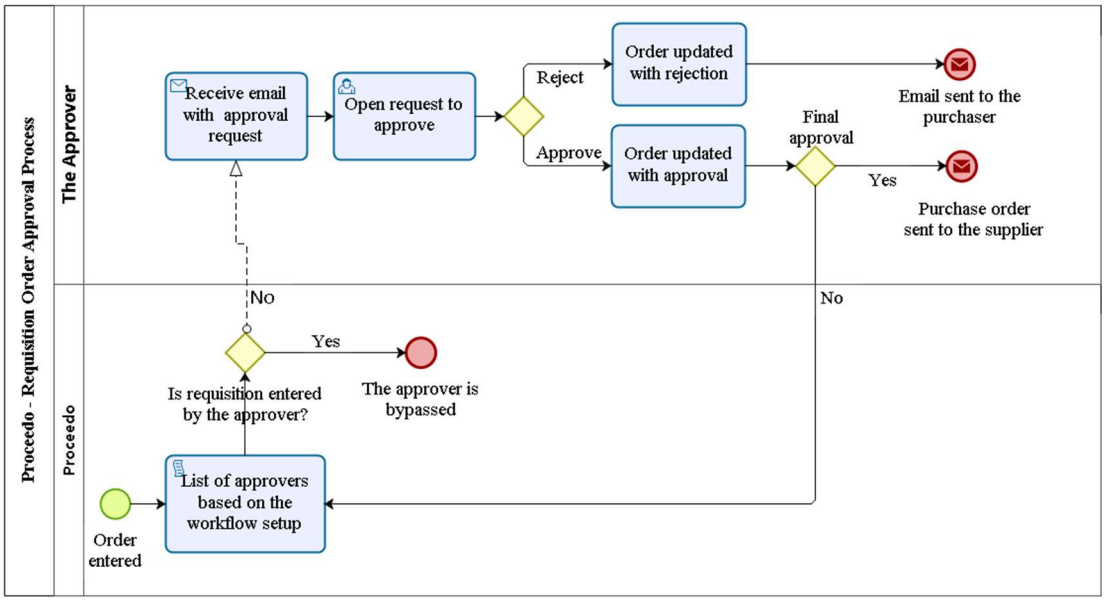

Figure 8. Proceedo approval AS-IS process

The Approval authority workflow set up details are described in the UC02A use case in Table 7. Request to setup the approval authority will be handled through the company´s help desk ticket system due to the SOX audit requirements.

Table 7. Approval authority setup use case (UC02A)

Use Case	UC02A – Approval Authority Setup
Scope	Approval authority is setup by the employee or by the business unit.
Primary actor(s)	The business system analyst
Preconditions	SOX audit rules should be followed.
Trigger/Event	Helpdesk ticket with authority setup details.
Stakeholders(s)	The commodity manager, the finance manager, the process analyst, and all business unit owners

Main success scenario:

1. Request is raised for approval authority setup based on employee or business unit.
2. The business systems analyst creates the requested approval route in JDE E1:
    a. Approver address book record is linked to a distribution list.
    b. Amount threshold is added to the approver.
    c. Effective dates are added due to system specific requirement.
3. The business unit owner confirms the setup.

Alternate scenario(s)

Alternate scenario UC02A-1

1. Request is raised for approval authority setup based on employee or business unit.
2. The business system analyst creates the requested approval route in JDE E1.
3. The business unit owner requests additional changes in the approval authority setup:
    a. Approver address book record is linked to a distribution list.
    b. Amount threshold is added to the approver.
    c. Effective dates are added due to system specific requirement.
4. The business system analyst makes the requested changes.
5. The business unit owner confirms the setup.

Postconditions: Approval authority has been setup by the employee or the business unit.

The system parameters are set to allow approval routes to be set up by an employee or by business unit (cost centre). Figure 9 describes the approval authority setup TO-BE process. The number of approvers in the approval distribution list is defined by thresholds. It is possible to enter multiple approvers for the same threshold. Approval authority can be delegated, and when the purchaser is in the distribution list, then the purchaser will be bypassed from approving, and the system directs the requisition to the next approver. JDE E1 specific requirement is that the approver records in the distribution list have a beginning and expiry dates filled, otherwise the system will issue an error during the order entry. If there is an approver set by the employee (the purchaser) and there is also an approval route by business unit, then system will select the setup by the employee.

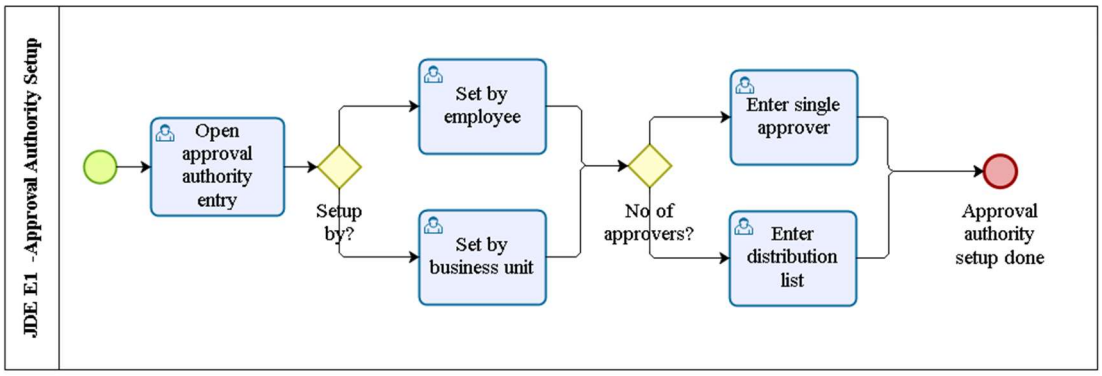

Figure 9. Approval authority setup TO-BE process. The distribution list is set up with approvers and threshold amounts.

The next use case UC02B (Table 8), describes the requisition order approval process. The number of approvers depend on the requisition order amount and the thresholds set in the distribution list.

Table 8. Requisition order approval use case (UC02B)

Use Case	UC02B - Requisition Order Approval
Scope	The system will direct the requisition order through an approval route based on the approval authority setup.
Primary actor(s)	The approver
Preconditions	UC01, UC02A
Trigger/Event	Requisition order has been entered.
Stakeholders(s)	The commodity manager, the finance manager, the process analyst

Main success scenario:

1. The approver will receive an email regarding requisition waiting for approval.
2. The approver will open the requisition approval application in the system.
3. The approver will approve the requisition.
4. The system will set the status on the specific approval step to approved:
    a. List of approvers and statuses can be checked in the requisition order review.
5. The system will repeat the approval process until final approver has approved the order:
    a. If one of the approvers has entered the requisition order, then this person will be bypassed, and approval is directed to the next approver.
6. The system will set the order status to approved after receiving the final approval.
7. The system will give a signal to generate a purchase order.

Alternate scenario(s) Alternate scenario UC02B-1 1. The approver will receive an email regarding requisition waiting for approval. 2. The approver will open the requisition approval application in the system. 3. The approver will reject the requisition. 4. The system sets the requisition order status to rejected. 5. The system will send signal to the purchaser about the rejection.
Postconditions: Requisition order is approved.

In the requisition order approval TO-BE process (Figure 10), the number of approvers depend on the approval authority setup and if the requisition is entered by one of the approvers in the distribution list, then this approver will be bypassed, and approval request will be set to next approver.

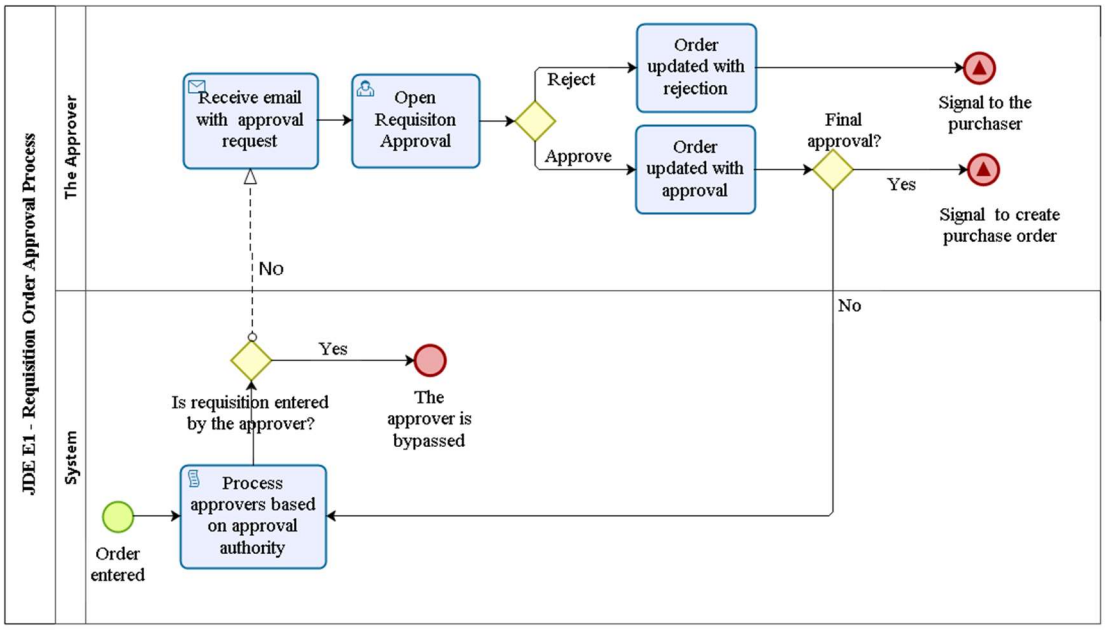

Figure 10. Requisition Order Approval TO-BE Process. Approval Authority Setup was described previously in Figure 8.

3.1.4 Purchase Order

When the requisition order has received the final approval, then purchase order can be generated and sent to the supplier. This is the main difference between the requisition order and the purchase order. The requisition order is for internal use, but the purchase order will be sent to the supplier. AS-IS process (Figure 6) do not have a separate purchase

order generation step, the requisition order is transformed into purchase order after approvals and before sending it to the supplier by the system. In JDE E1, the purchase order needs to be generated from the approved requisition order (Table 9). There are two options to do that, either manually or by a scheduled job. It is possible to create a consolidated purchase order for the same supplier. Approved requisition order cannot be cancelled, but it is possible to cancel the purchase order after it has been generated.

Table 9. Purchase order generation use case (UC03)

Use Case	UC03 – Purchase order generation
Scope	The requisition order has been approved. A purchase order will be generated and sent to the supplier.
Primary actor(s)	The purchaser
Preconditions	UC02
Trigger/Event	Requisition order is in approved status.
Stakeholders(s)	The commodity manager, the process analyst
Main success scenario: 1. The purchaser opens a list of approved requisitions. 2. The purchaser generates the purchase order. 3. The system saves the purchase order. 4. System directs the purchaser to Purchase Order Dispatch. 5. The purchaser prints the purchase order by submitting a batch job. 6. The purchaser sends the purchase order to the supplier: a. Automated emailing based on the email address in the supplier set up details. b. Manually emailed by the purchaser.	
Alternate scenario(s) Alternate scenario UC03-1 1. The purchaser opens list of approved requisitions. 2. The purchaser adds the supplier number. 3. The purchaser generates the purchase order. 4. System directs the purchaser to Purchase Order Dispatch. 5. The purchaser prints the purchase order by submitting a batch job. 6. The purchaser sends the purchase order to the supplier: a. Automated emailing based on the email address in the supplier set up details. b. Manually emailed by the purchaser. Alternate scenario UC03-2 1. The purchaser opens list of approved requisitions.	

2. The purchaser adds the supplier number. 3. The purchaser generates the purchase order. 4. The purchaser cancels the purchase order. 5. System sets the purchase order status to cancelled. Alternate scenario UC03-3 1. The purchaser reviews the approved requisition orders: a. Adds supplier number if needed. b. Marks “Postponed” checkbox if system should not generate the purchase order. 2. An automated job generates the purchase orders from the approved requisitions that have not been marked as postponed. 3. The system sends the purchase orders to suppliers.
Postconditions: Purchase order was sent to the supplier.

Option to postpone the purchase order generation could be used when communication is open with several suppliers or purchasing should be held until the next period due to special reasons. Figure 11 shows the purchase order generation process performed by a person. If the supplier number was under investigation during the requisition order entry, then it should be entered before the purchase order generation. Otherwise, the system will stop the generation and issue an error. This is different from the AS-IS process (Figure 6) option named “Alternative” where purchaser order can be sent to the supplier that has not been set up in Proceedo.

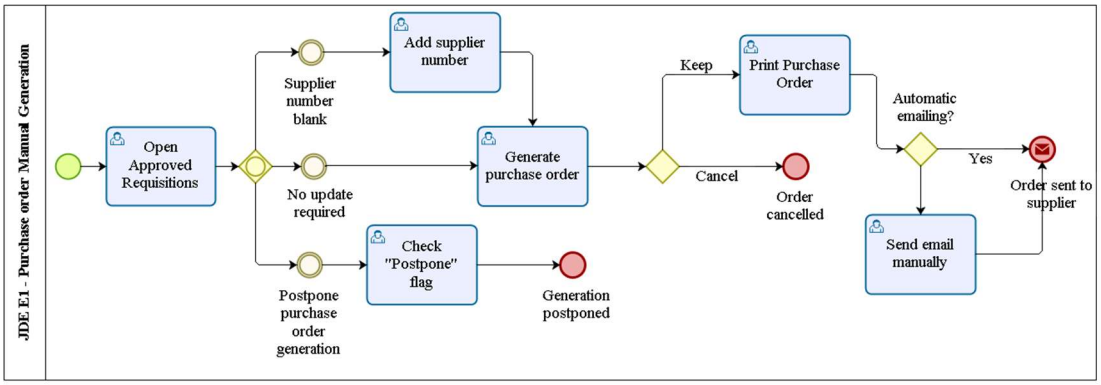

Figure 11. Purchase order manual generation TO-BE process

Same applies for the use case UC03-3 (Table 9), the supplier number needs to be filled in order to be able to generate the purchase order. Process where scheduled job will generate and send the purchase order is described in Figure 12.

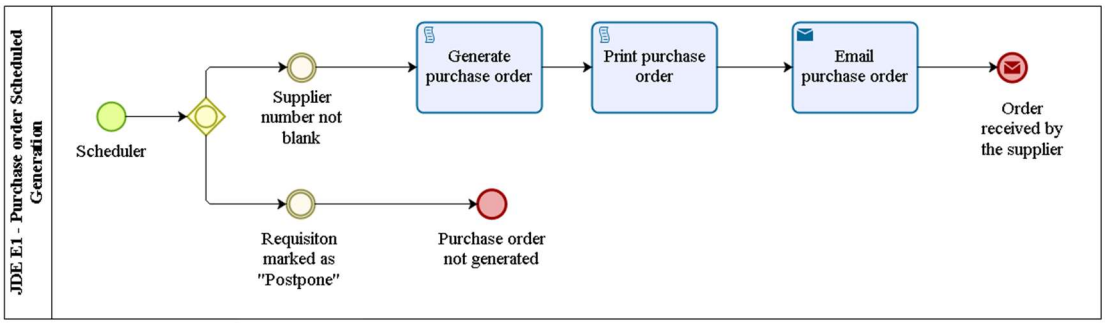

Figure 12. Purchase order generation scheduled TO-BE process

The requisition order will not be active after the purchase orders have been generated for all the order lines. The activity diagram (Figure 13) will show the requisition order statuses in different steps that give an option to trace the progress of the requisition order. The requisition order remains active until the purchase order is generated. After that, the requisition order status will be updated, and it will become not active.

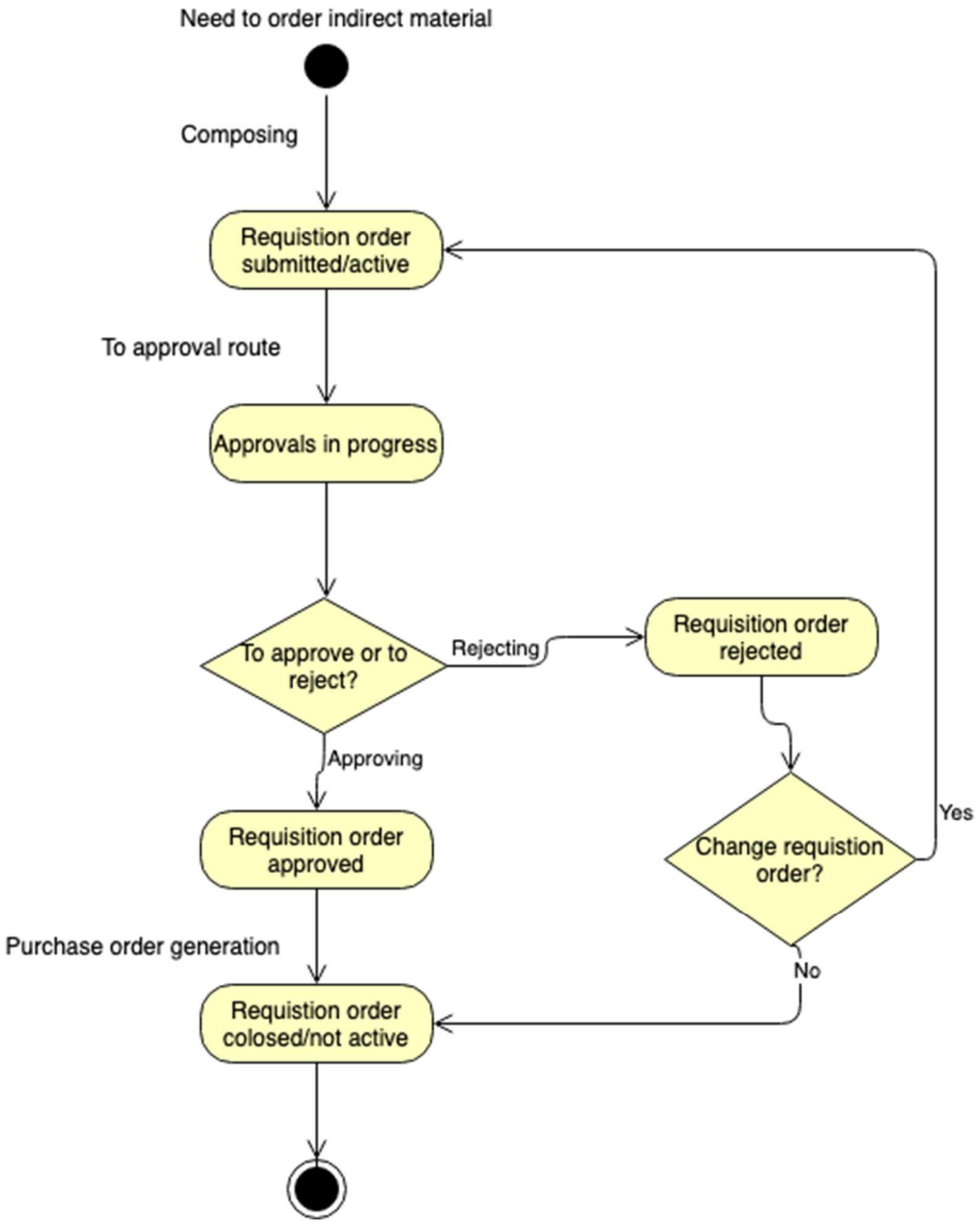

Figure 13. JDE E1 requisition order TO-BE process activity diagram

3.1.5 Confirming Delivery

AS-IS process (Figure 14) has an option to confirm the delivery. If delivery is confirmed, then system can automatically match the supplier invoice to the requisition order.

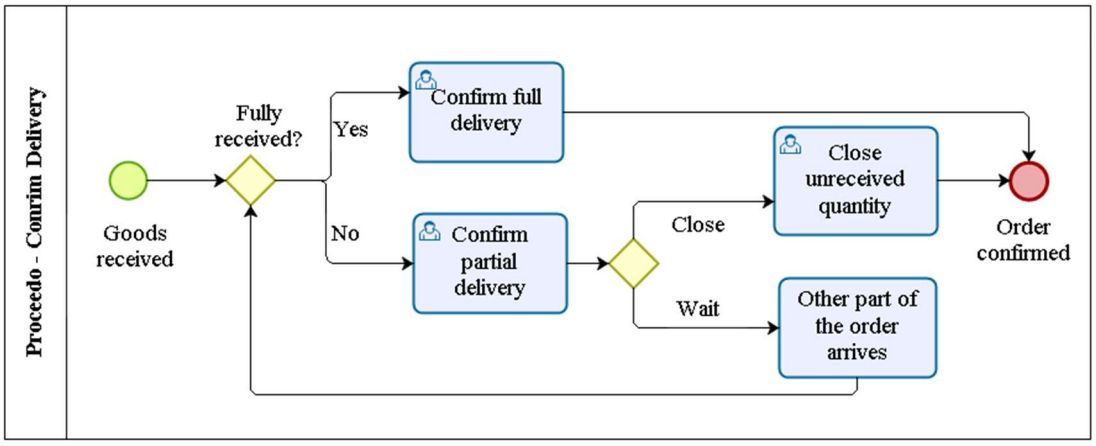

Figure 14. Confirm delivery AS-IS process

Use case UC04 (Table 10) will be done by the purchaser after receiving the goods or services; this confirmation will also be an input for automatic matching of requisition with the supplier invoice.

Table 10. Confirm delivery use case (UC04)

Use Case	UC04 – Confirm delivery
Scope	The purchaser will confirm the delivery of indirect material or services.
Primary actor(s)	The purchaser
Preconditions	The supplier sends the indirect material or provides the service.
Trigger/Event	Indirect material or service is received and can be paid for.
Stakeholders(s)	The commodity manager, the process analyst, the accountant
Main success scenario: 1. The purchaser receives the material or services from the supplier. 2. The purchaser will confirm the full delivery: a. Over receipt should be possible in case the supplier delivers more units than in the order. 3. The system marks the requisition and linked purchase order delivered.	
Alternate scenario(s) Alternate scenario UC04-1 1. The purchaser receives the material or services from the supplier. 2. The purchaser will confirm the partial delivery. 3. The system marks the requisition and purchase order partially delivered. 4. The purchaser will confirm the partial delivery until full quantity received. 5. The system marks the requisition and linked purchase order delivered. Alternate scenario UC04-2	

1. The purchaser receives the material or services from the supplier. 2. The supplier informs that the missing quantity will not be delivered. 3. The purchaser will confirm the partial delivery and closes the missing quantity. 4. The system marks the requisition and linked purchase order delivered in partial quantity. Alternate scenario UC04-3 1. The supplier informs that it is not possible to deliver the goods or services. 2. The purchaser will cancel the requisition purchase order. 3. The system marks the requisition purchase order cancelled.
Postconditions: Delivery is confirmed.

Same process is available in JDE E1, depending on the situation, it is possible to confirm the delivery partially, fully or register an over receipt. It is possible to confirm the partial delivery and then close the requisition order and linked purchase order if rest of the quantity will not be delivered. If there is no delivery, then it is possible to cancel the requisition and linked purchase orders. TO-BE process is described on Figure 15, options "Select Receive and Close" and "Select Cancel" are not available for consolidated purchase orders (it is possible to consolidate the purchase order by supplier number during the purchase order generation).

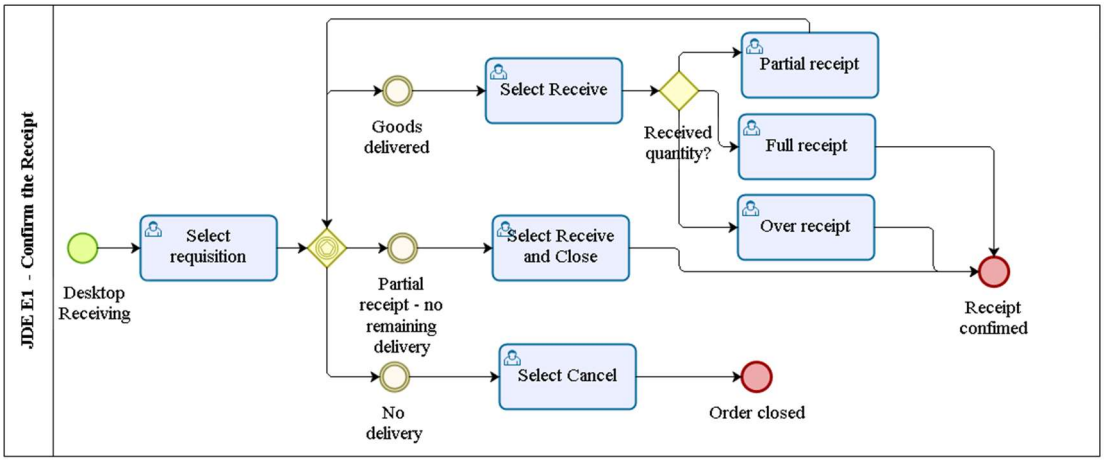

Figure 15. JDE E1 confirm delivery TO-BE process

3.2 Supplier Invoice Handling

The supplier will process the order and issues an invoice. The invoice can be issued in a different language and can include tax. The invoice should be scanned when received via post or saved directly to a folder when received via email. Optical character recognition

(OCR) is used by the system to process the invoice. After saving the invoice date, the system will send it for approval. The approver will add the business unit and account for the cost. The approver can split the cost between different business units and accounts. There can be more than one approver, depending on the invoice amount. The system will register the approved invoice in accounts payable. The finance department is paying the invoice based on the due date. The scope in the current thesis will only include the processes with indirect material and a 2-way match[1]. The invoice handling module should also handle the direct material and 3-way match[2] and supplier invoices without purchase orders and or receipts.

In the AS-IS process (Figure 16), the invoice is received in pdf format, or the paper invoice is scanned by the external service provider. It is possible to see the original pdf invoice in Proceedo. When the invoice has a correct requisition order number (starts with STR) on the invoice, then the system will perform the match and sets the invoice status to "Ready". If the requisition order number is not present or not recognized from the invoice, then error message is issued, and the accountant will need to manually interfere in the process and assign the invoice to the purchaser (based on the contact reference on the invoice or considering other details on the invoice). The purchaser needs to take actions based on the invoice status:

- Confirm the delivery of the requisition order and finalize the match
- Add the accounting details to the supplier invoice if there was no requisition order entered previously

The system will then send the invoice to the approval route based on the business unit specific approval setup when the supplier invoice amount is greater than the approved requisition and when there is no approved requisition existing for the supplier invoice.

[1] In 2-way matching, the invoices are matched to purchase orders

[2] In 3-way matching, the invoices are matched to receiving information

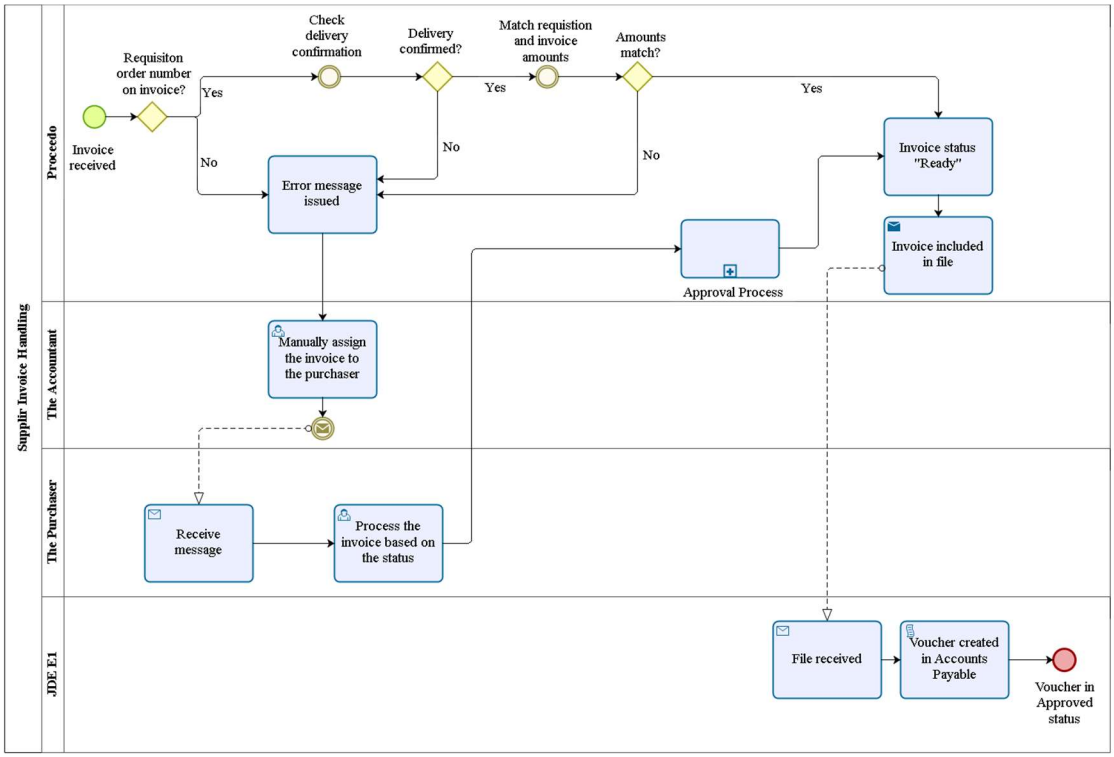

Figure 16. Proceedo invoice handling AS-IS process. Approval Process sub-process is described separately in Figure 8

The use case UC05 in Table 11 describes the invoice processing. If a paper invoice is received, then this needs to be digitalised first by scanning it. It will be determined during the project how the scanning will be organized (internally or by external service provider). If a vendor sends the invoice via email, then it should be saved to a specific folder. The company has a common email address for the supplier invoices where the received invoices should be saved automatically to the designated shared folder.

Table 11. Supplier invoice process use case (UC05)

Use Case	UC05 – Process Supplier Invoice
Scope	Digitalised invoice is processed by SCANMAN optical character recognition, and the voucher is created in ERP -JDE E1.
Primary actor(s)	System
Preconditions	PDF invoice has been saved to a shared folder.
Trigger/Event	Unprocessed invoice exists in the folder.
Stakeholders(s)	The chief accountant, the finance manager, the process analyst
Main success scenario:	

1. Received invoice is saved to a shared folder. 2. The system checks the folder and processes the invoice. 3. Invoice is logged in JDE E1 with correct details (including tax) and set to status "Unprocessed". 4. Invoice PDF is saved as attachment in JDE E1.
Alternate scenario(s) Alternate scenario UC05-1 1. Received paper invoice is scanned. 2. Scanned invoice is saved to a shared folder. 3. The system checks the folder and processes the invoice. 4. Invoice is logged in JDE E1 with correct details (including tax) and set to status "Unprocessed". 5. Invoice PDF is saved as attachment in JDE E1. Alternate scenario UC05-2 1. Received invoice is saved to a shared folder. 2. The system checks the folder and processes the invoice. 3. System does not recognize all data. 4. Invoice is logged with partial information (status "Error"), and manual correction is required. 5. Invoice PDF is saved as an attachment in JDE E1. 6. The accountant will correct the logged invoice details based on the attached PDF. 7. The accountant or the business system analyst will train the system to recognize the data to ensure the automatic processing next time.
Postconditions: Invoice is processed and logged in JDE E1 with a specific status.

SCANMAN standard solution includes:

- Optical Character Recognition (OCR) technology that supports 150 Latin languages and for additional licence fee it is possible to add languages with special character set (for example Chinese and Arabic)

- Key-word database that contains already Chinese and Estonian keywords, and Swedish will be an addition to the current set of the languages (translation of the invoice fields should be added to the system)

The keyword database ensures that SCANMAN is pre-trained to recognize the data from the invoice. Additional keyword mapping might be required depending on the language and specific invoices.

In JDE E1, the supplier invoice will be called voucher. Each voucher has a document number and document type, original supplier invoice number is included in the voucher details and will be referred to during the payment process. When the system has been set up to recognize the invoices, then this process could be fully automatic. Any exceptions should be manually processed, and then the system should be trained to recognize the data in the future. After the invoice is processed in JDE E1, it will be referred to as the voucher from that point forward. The voucher (supplier invoice) logging process is described in Figure 17. Pay status of the logged voucher will be "H" (payment held) until the voucher is matched with the purchase order and or approved by the approver.

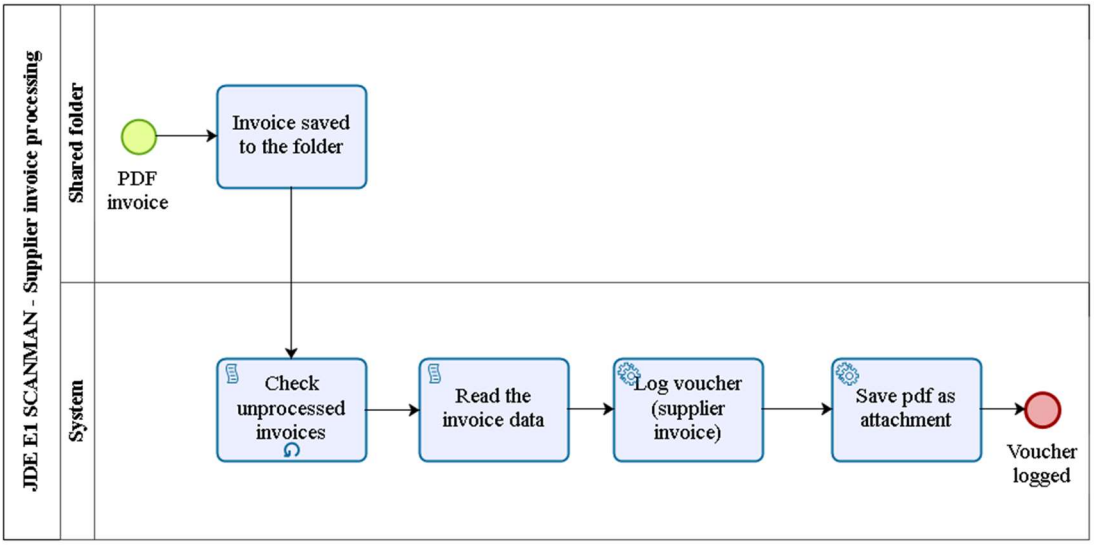

Figure 17. Supplier invoice and voucher logging TO-BE process. Scanning of the paper invoice will be decided during the project. Current figure describes the invoice in pdf format.

Next, the system will perform a 2-way match suggestion with an existing purchase order. If delivery has been confirmed (Figure 15) and the amount matches, then voucher can be matched automatically and it will be confirmed for payment. Use case UC06 in Table 12 describes the scenarios for this process. The thesis author is concentrating on the invoice handling process where requisition purchase order exists. The invoice handling module should also be possible to use with a 3-way match and without purchase order or receipt, but those scenarios are not in the scope of the current thesis.

Table 12. Voucher match use case (UC06)

Use Case	UC06 – 2-way match
Scope	The system checks the open purchase orders and performs the match, if delivery has not been confirmed, then the purchaser is alerted.
Primary actor(s)	The system, the purchaser
Preconditions	UC03, UC04, UC05 and the supplier is coded to have a 2-way match.
Trigger/Event	Scheduled batch job
Stakeholders(s)	The chief accountant, the finance manager, the commodity manager

Main success scenario:

1. The system checks the list of open purchase order lines.
2. The system finds a match where:
    a. Delivery is confirmed.
    b. The quantity invoiced is less than or equal to the requisition order quantity.
    c. The invoice amount is less than or equal to the requisition order amount.
3. The system updates the purchase order line status.
4. The system updates the voucher status to “Approved”:
    a. Pay status will be set to “A” (approved).
5. The voucher (supplier invoice) will be paid according to the due date.

Alternate scenarios

Alternate scenario UC06-1

1. The system checks the list of open purchase order lines.
2. The system finds a matching purchase order where:
    a. Delivery has not been confirmed.
    b. The quantity invoiced is less than or equal to the requisition order quantity.
    c. The invoice amount is less than or equal to the requisition order amount.
3. The system updates the purchase order line status.
4. The system updates the voucher status to “Suggested”:
    a. Pay status will remain “H” (payment held).
5. The system sends an email to the purchaser to confirm the delivery.
6. The purchaser confirms the delivery.
7. The system completes the match.
8. The system updates the voucher status to “Approved”:
    a. Pay status will be set to “A” (approved).
9. The voucher (supplier invoice) will be paid according to the due date.

Alternate scenario UC06-2

1. The system checks the list of open purchase order lines.
2. The system finds a match where:
    a. Delivery is confirmed.
    b. The quantity invoiced is greater than the requisition order quantity.
    c. The invoice amount is greater than the requisition order amount.
3. The system updates the purchase order line status.
4. The system updates the voucher status to “Pending approval”:
    a. Pay status will remain “H” (payment held).
5. The system sends the voucher to approval route based on the approval authority.

Alternate scenario UC06-3

1. The system checks the list of open purchase order lines.
2. The system does not find a match.
3. The system updates the voucher status to “Verify”.
4. The system sends an email to the accountant to handle the unprocessed records.

Postconditions: Voucher is matched with the purchase order and directed to approval in case of higher amount.

2-way match process possible scenarios are shown in Figure 18. If supplier invoice quantity and amount match with the approved requisition order and the purchaser has confirmed the delivery, then voucher can be matched automatically without any manual interference. Additional approval is required when the voucher (supplier invoice) amount and or quantity are higher than initially confirmed in the requisition. Current thesis will not include the detailed scenario when voucher is set to status “Verify” (described on Figure 18), this business process will be covered during the project together with the scenario where there is no requisition purchase order entered in the system. Current thesis will concentrate the process where requisition purchase order exists.

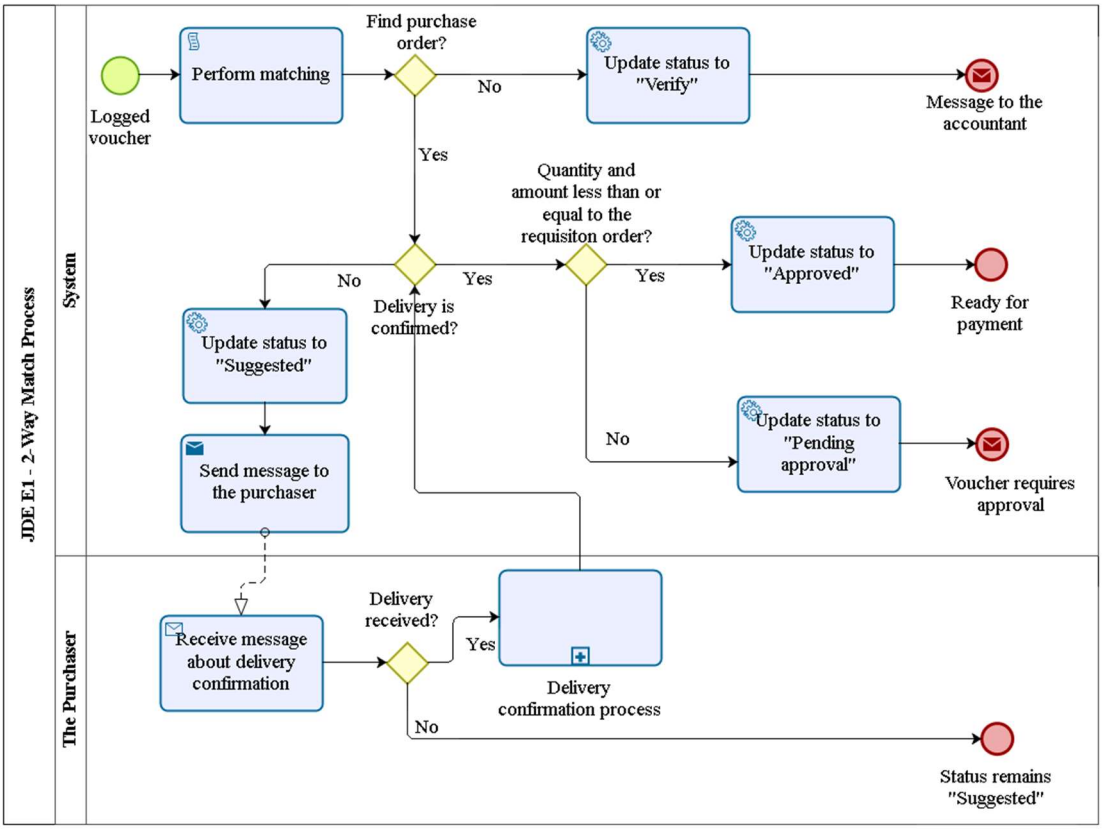

Figure 18. Voucher match TO-BE process. Voucher is the supplier invoice in JDE E1. Delivery confirmation sub-process is described in Figure 15. Process for the vouchers in status "Verify" will not be included in the current thesis.

After the 2-way match has been performed, the system will direct the voucher for approval if the voucher (supplier invoice) quantity and amount are greater than the initially approved quantity and amount in the requisition order. Approval will be performed by the approval authority set by the business unit or employee. Figure 9 describes the approval authority setup. UC07 (Table 13) describes the voucher approval scenarios.

Table 13. Voucher approval TO-BE process (UC07)

Use Case	UC07 – Voucher Approval
Scope	Logged voucher is delegated to the approval route based on the business unit. The approver will check and approve the voucher.
Primary actor(s)	The approver
Preconditions	UC05, UC06 and approval authority set up by business unit (UC02A).

Trigger/Event	Voucher is matched to a purchase order.
Stakeholders(s)	The chief accountant, the finance manager, the process analyst, the commodity manager
Main success scenario: 1. The approver receives an email regarding voucher waiting for approval. 2. The approver opens the voucher approval workbench in the system. 3. The approver checks and approves the voucher: a. Original PDF supplier invoice can be opened in the system. 4. The system sets the status on the specific approval step to approved. 5. The system repeats the approval process until final approver has approved the voucher. 6. The system sets the voucher status to "Approved" after receiving the final approval.	
Alternate scenario: Alternate scenario UC07-1 1. The approver receives an email regarding voucher waiting for approval. 2. The approver opens the voucher approval workbench in the system. 3. The approver checks and reject the voucher: a. Original PDF supplier invoice can be opened in the system. 4. The system sets the status on the voucher to "Rejected". 5. The system sends an email to the purchaser about rejected voucher.	
Postconditions: Voucher is approved and ready for payment.	

The voucher approval process flow is described in Figure 19. Approval authority setup sub-process is described in Figure 9; it is the same setup that applies to the requisition entry.

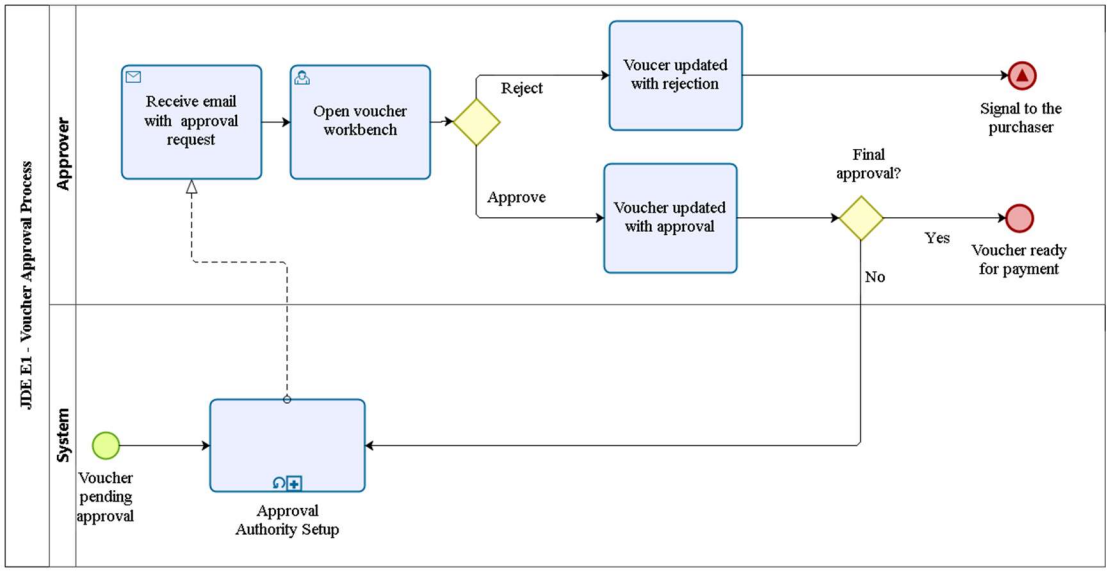

Figure 19. Voucher approval TO-BE process. Approval authority setup sub-process is described in this thesis in Figure 9.

Figure 20 shows the activity diagram for the invoice handling the TO-BE process in JDE E1. It includes both processing the received invoice and handling the voucher approval. The voucher (supplier invoice) is active until the due date arrives, and it will be paid. After the payment is processed, the voucher will be closed (status “Paid”). The activity diagram (Figure 20) only involves the scenarios where the requisition purchase order exists in the system.

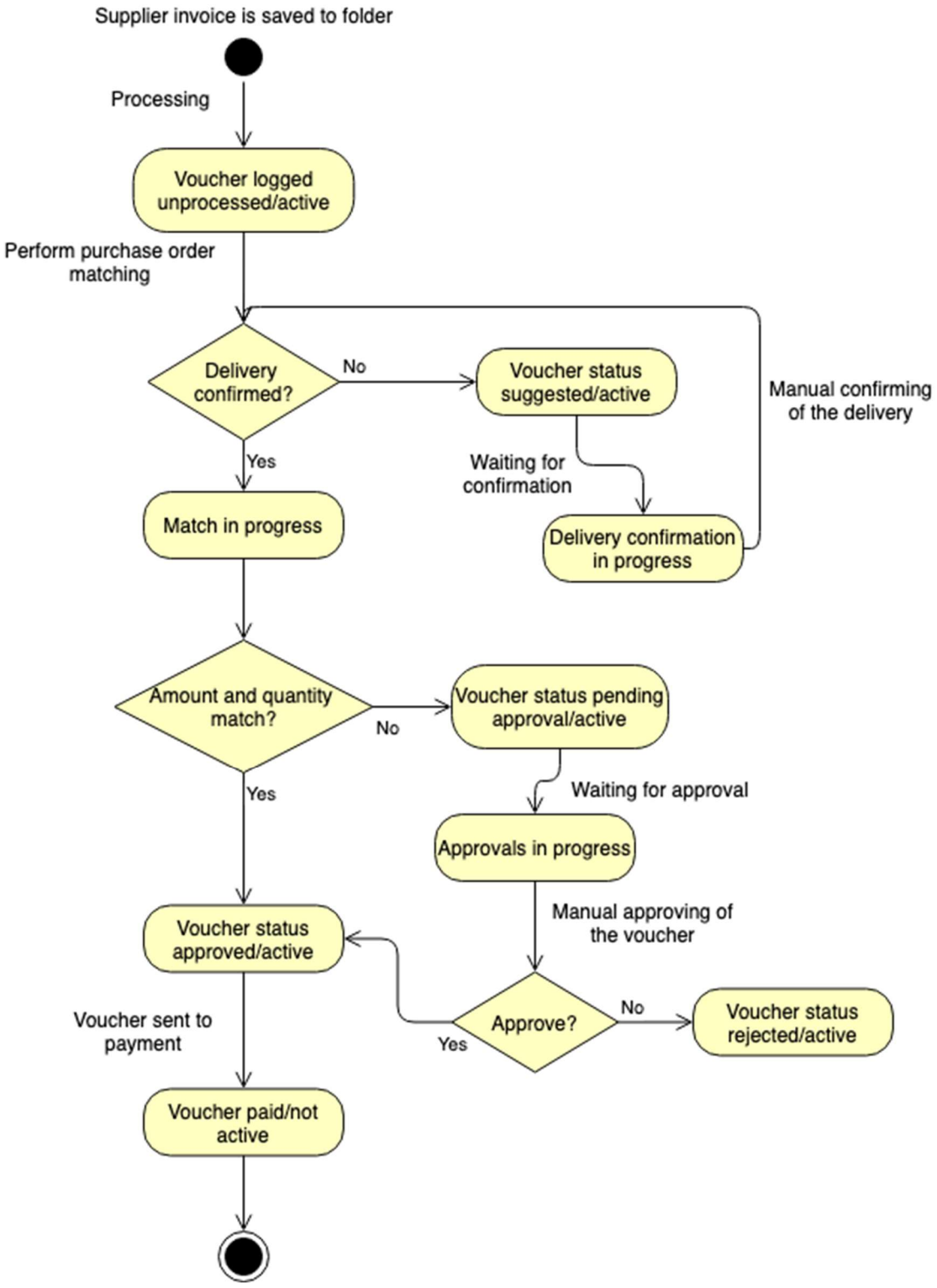

Figure 20. Voucher (supplier invoice) processing and purchase order matching TO-BE process activity diagram. This diagram does not include the scenario where purchase order is not found by the system.

3.3 Conclusions

Based on the use cases and modelled TO-BE processes, the thesis author concludes on the possibility of replacing the existing AS-IS process and what are the current gaps.

The use case diagram in Figure 21 gives a general overview of all the use cases described in the thesis. Thesis author split the process into eight use cases, where approval authority setup use case is grouped together with the requisition order approval use case.

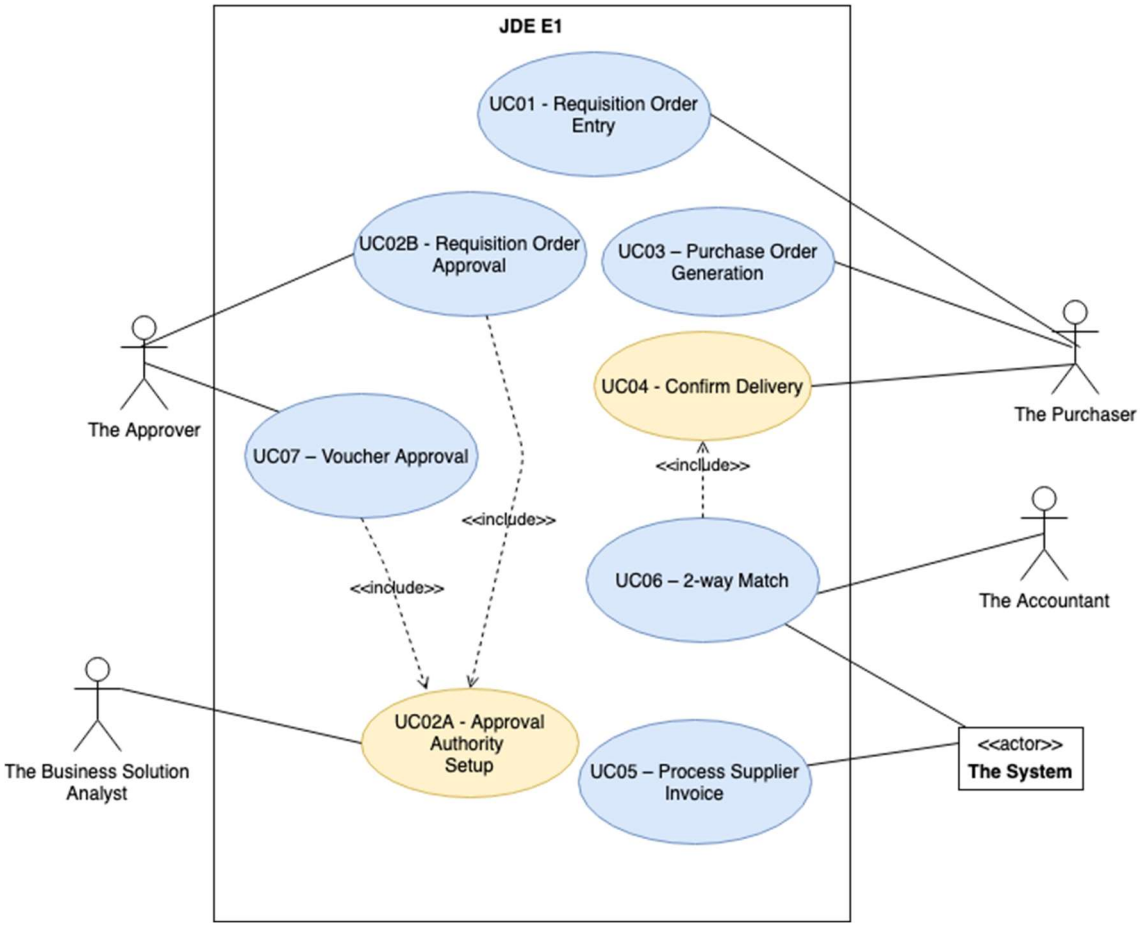

Figure 21. Use case diagram including all TO-BE process use cases

It is possible to replace majority of the AS-IS processes with the TO-BE processes in ERP – JDE E1 using standard Requisition Self Service module and special SCANMAN supplier invoice handling module. During the analyse, thesis author has identified following gaps:

1. **Every employee should be able to enter the requisition order.** In case of JDE E1 it is required that the access be monitored by the named user due to the

licencing agreements. This means that besides the employee is setup in the Active Directory, the employee also needs an access and a role with appropriate security in JDE E1. There is some further investigation needed to find a solution for this gap:

- Estimate the number of employees who will enter the requisition orders and do not have access to JDE E1 now to identify how many additional licences will be used and does the current plan cover it.

- Options to have custom simplified requisition order entry and approval handling from SharePoint or mobile

2. **Direct connection to the supplier webshop (punchout solution).** There is a standard solution suggested by the Oracle for JDE E1, but not all the prerequisites are fulfilled now. Separate analyse should be conducted regarding the TO-BE process.

Solutions for the identified gaps require further analyse. Discussion with the stakeholders will be held to determine the severity of those gaps in the project.

The component diagram in Figure 22 shows the new structure after the SCANMAN invoice handling module is added to JDE E1. Current AS-IS structure (Figure 23) can be compared with the TO-BE process (Figure 22).

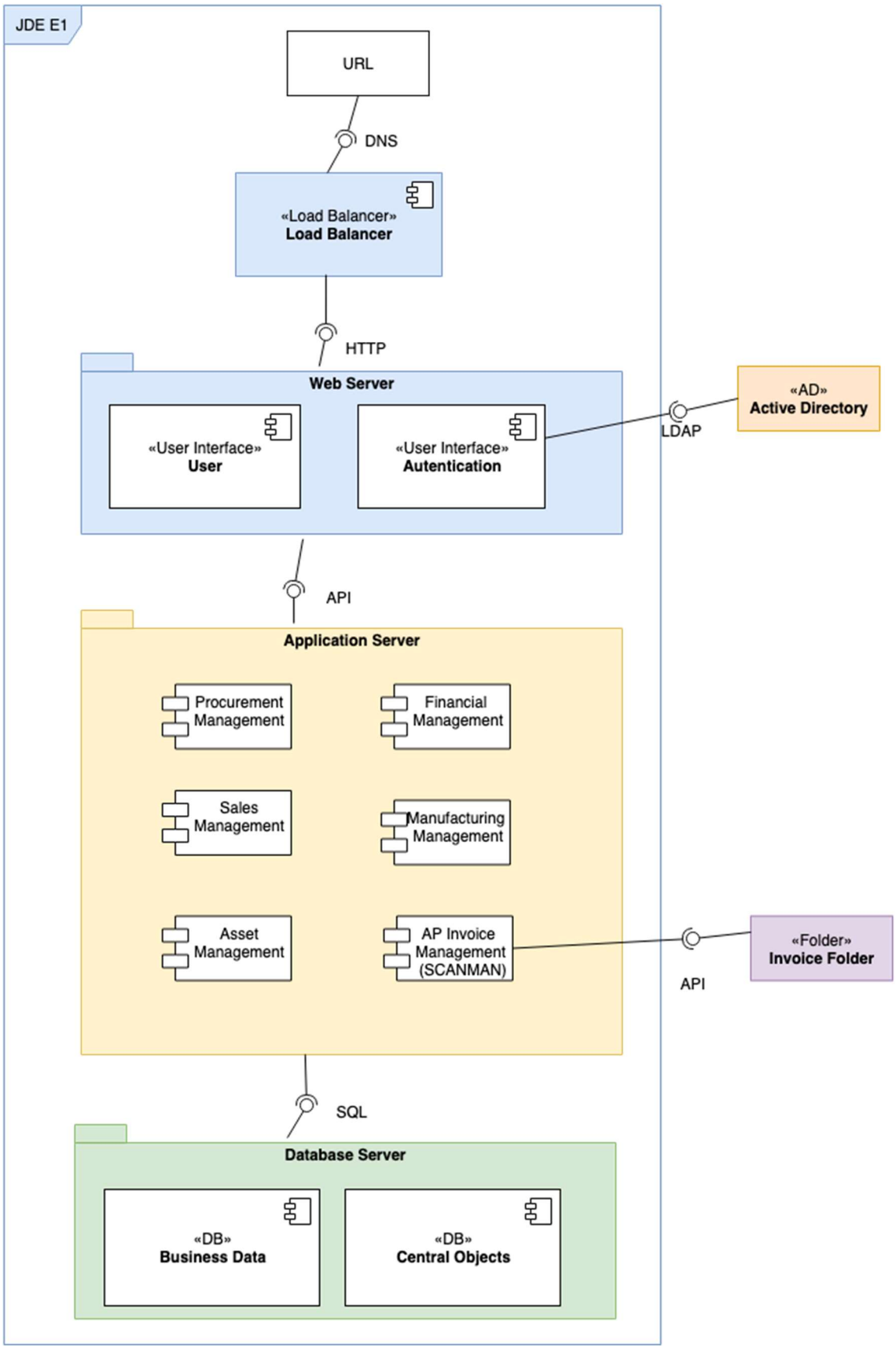

Figure 22. TO-BE component diagram describing the JDE E1 structure and interfaces when embedded SCANMAN module is added.

4 Summary

The thesis purpose was to conduct business and system analyse to replace the existing requisition order and supplier invoice handling process in Proceedo with the standard and specialized JDE E1 modules. Work described in the thesis was one part of the ongoing project to move the process to ERP based solution. The results of this thesis will be an input for the next phase, where TO-BE processes will be presented and discussed with the stakeholders. The severity of identified gaps will be evaluated, and the actions will be decided. The thesis author considered during the analysis that the TO-BE solutions could be rolled out on a global level in all sites that are working in the JDE E1 business system.

The following results are presented in the thesis:

- Documented functional requirements in use case format. The thesis author divided the process into eight use cases and analysed each separately.

- Current AS-IS processes and new modelled TO-BE processes are described. The thesis author did a test set up in the JDE E1 prototype environment for the Requisition Self Service to understand the system capabilities when modelling the TO-BE processes.

- Based on the analyse it is possible to conclude that majority of current AS-IS processes can be replaced with TO-BE processes in JDE E1. This can be done by using the standard Requisition Self Service configuration for the requisition handling and specific SCANMAN module for the supplier invoice handling.

- During the analyse two gaps were identified, the first gap is about the access requirement. JDE E1 requires a named user and role set up. The second gap is about the direct connect (punchout solution) to the supplier webshop. Both gaps require additional investigation and discussions with the stakeholders and IT management.

The analyse was conducted, and all results in the thesis are developed by the author.

5 Kokkuvõte

Magistritöö eesmärk oli viia läbi äri- ja süsteemianalüüs olemasoleva kulumaterjali tellimise ja ostuarvete haldamise süsteemi asendamiseks JDE E1 ärisüsteemi keskse lahendusega. Magistritöös kirjeldatud toimingud olid üks osa käimasolevast projektist ja töö tulemused on sisendiks projekti järgmises faasis, kui huvitatud osapooled neid arutavad. Töö käigus tuvastatud protsessilünki hinnatakse eraldi ja nende osas võetakse vastu tegutsemisplaan. Autor võttis arvesse uute protsesside modelleerimisel, et lahendust oleks võimalik kasutada globaalselt kõigis ettevõtte JDE E1 kasutatavates üksustes.

Töös on esitatud järgnevad tulemused:

- Dokumenteeritud funktsionaalsed nõuded kasutusmallidena. Autor jagas protsessi kaheksaks kasutusmalliks ja analüüsis igat eraldi.

- Hetkel kasutuses olevate ja uute modelleeritud protsesside kirjeldused. Töö autor tegi test seadistuse JDE E1 Requisiton Self Service moodulis, et süsteemi võimalusi täpsemalt mõista uute protsesside modelleerimisel.

- Analüüsi tulemusena jõudis autor järeldusele, et enamus hetkel kasutuses olevaid protsesse on võimalik asendada ärisüsteemi keskse lahendusega kasutades selleks standard Requisition Self Service ja spetsiaalset ostuarvete haldamise SCANMAN moodulit.

- Analüüsi käigus tuvastas autor kaks lünka, esimene on seotud kasutaja ligipääsuga ja teine otseühendusega tarnija e-poodi. Esimese puhul eeldab JDE E1 nimelist kasutajat ja rolli ning teise lünga puhul tuleb leida tehnoloogiline lahendus. Mõlemad lüngad vajavad eraldi analüüsi ja arutelu nii huvitatud osapoolte kui ettevõtte IT juhtfunktsioonidega.

Kõik töös esitatud tulemused on autori enda poolt välja töötatud.

References

[1] Stoneridge, “www.stoneridge.com,” Stoneridge, Inc, 28 04 2020. [Online]. Available: https://www.stoneridge.com/2020/04/28/stoneridge-wins-2020-automotive-news-pace-award-for-its-mirroreye-camera-monitor-system/. [Accessed 30 04 2020].

[2] M. E. Porter, „Competitive Advantage: creating and sustaining superior performace,“ New York, Free Press, 1985, pp. 33-62.

[3] M. Leenders, F. Johnson, A. Flynn ja H. Fearon, Purchasing and Supply Management, New York: The McGraw-Hill Companies, Inc, 2006.

[4] G. Kane, A. N. Phillips, J. Copulsky and G. Andrus, The Technology Fallacy. How People Are the Real Key to Digital Tranformation., Massachusetts: The MIT Press, 2019.

[5] A. Harrison, R. van Hoek and H. Skipworth, Logistics Management and Strategy. Competing Through the Supply Chain., Harlow: Pearson Education Ltd, 2014.

[6] S. Mandal, "An empirical competence-capability model of supply chain innovation," *Business: Theory and Practice,* vol. Vol.17, no. 2, pp. 138-149, 2016.

[7] J. L. Schiff, „CIO - 11 common ERP mistakes and how to avoid them,“ IDC Communications, 4 10 2017. [Võrgumaterjal]. Available: https://www.cio.com/article/2397802/article.html. [Kasutatud 13 04 2020].

[8] M. E. Porter, Competitive Strategy. Techniques for Analyzing Industries and Competitors, The Free Press: New York, 1998, pp. 35-41.

[9] J. Cadle, D. Paul and P. Turner, Business Analysis Techniques. 72 Essential Tools for Success, Swindon: British Informatics Society Limited, 2011.

[10] A. v. Lamsweerde, Requirements Engineering, Chichester: John Wiley & Sons Ltd, 2012.

[11] P. H. S. M. P. &. S. H. Allen, "Service Orientation: Winning Strategies and Best Practices," in *Business Process Management.*, Cambridge, Cambridge University Press, 2006, pp. 42-56.

[12] M. Laguna and J. Marklund, Business Process Modeling, Simulation and Design, Boca Raton: Taylor & Francis Group, LLC, 2013.

[13] V. D. Hunt, Process Mapping. How to Reengineer Your Business Processes, United States of America: John Wiley & Sons, Inc, 1996.

[14] K. A. Long, "Business Rules Community," Business Rules Solutions, LLC, 12 2012. [Online]. Available: http://www.brcommunity.com/a2012/b679.html. [Accessed 19 02 2020].

[15] I. Sommerville, Software Engineering, Essex: Pearson Education Limited, 2016.

[16] S. Robertson and J. Robertson, Mastering the Requirements Process. Getting Requirements Right., Massachusetts: Pearson Education, Inc, 2013.

[17] D. Jones and R. Recardo, Leading and Implementing Business Change Management : Making Change Stick in the Contemporary Organization, New York: Routledge, 2013.

Appendix 1 – AS-IS Process Component Diagram

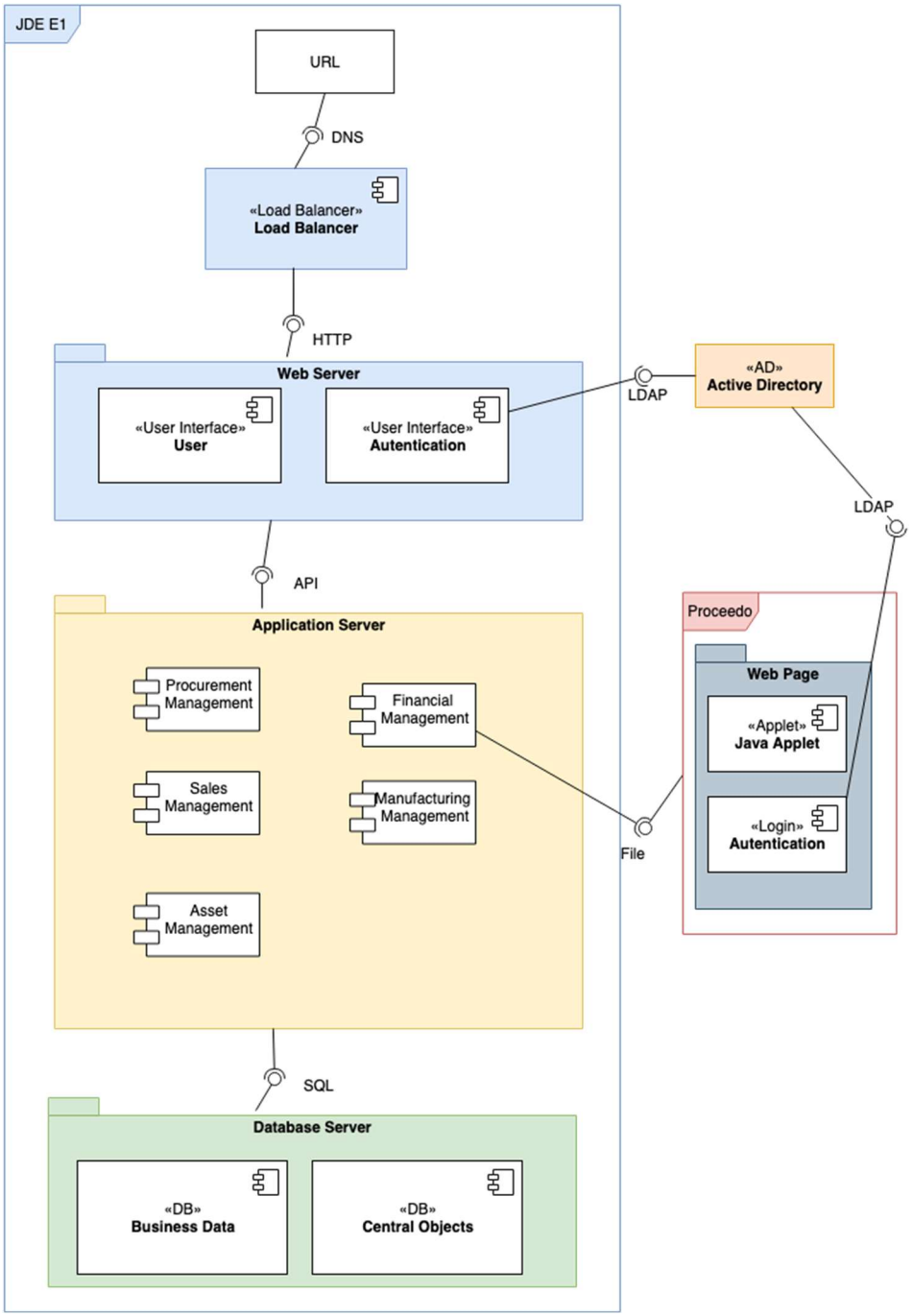

Figure 23. AS-IS component diagram describing JDE E1 structure and interfaces. The requisitions and supplier invoices are handled in Proceedo. Data is received via a file that is saved into the JDE E1 inbound table and processed into vouchers in Accounts Payable. Diagram does not include all components of Proceedo; only the web page part is described to illustrate that Proceedo uses Java technology.