TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY

Department of Machinery
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APECO BUSINESS PROCESSES IMPROVEMENT IN ARIS SOFTWARE

Author applies for degree of Master of Science in Engineering (M.Sc.)

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Author's Declaration

I have written the Master's thesis independently.
All works and major viewpoints of the other authors, data from other sources of literature and elsewhere used for writing this paper have been referenced.

Master's thesis is completed under Eduard Ševtšenko supervision

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Master's thesis is in accordance with terms and requirements "....."....."....."....."201….

Supervisor …..... signature.

Accepted for defence

..... chairman of defence commission

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TUT Faculty of Mechanical Engineering

MASTER'S THESIS TASK

2014 /2015 academic year 4th semester

Student: Ardo Perm, 132944

Field of study: Industrial Engineering and Management (MARM)

Supervisor: Senior Research Scientist, Eduard Ševtšenko

Consultant(s): Taivo Kangilaski, IT architect, +372 6202 100

Master's thesis topic (estonian and english languages):

Apeco Äriprotsesside Parendus ARIS Tarkvara Abil

Apeco Business Processes Improvement in ARIS Software

Tasks and timeframe for their completion:

Nr	Task description	Completion date
1	Topic proposal and structure of thesis	30-01-2015
2	Literature search and reading	2-03-2015
3	Simulations and results	27-04-2015
4	Comparison and conclusion	15-05-2015
5	Final reporting	25-05-2015

Engineering and economic problems to be solved:

Processes around organization changing continuously with variations in environment. Therefore, is crucial to sustain operations and increase competitiveness with process approach.

Defence application submitted to deanery not later than …..… Deadline …….....

Student ……. /signature/ ……..……. date ….....……

Supervisor…… /signature/ ……..……. date ….....……

Phone …… E-mail: ……

OBJECTIVES AND TASKS

The master thesis has the following objective:

To provide sufficient research about Business Process Management in Apeco. Topic is strongly related with ARIS software and applications what provide improvement under EPC (Event-Driven Process Chains) modelling language.

The master thesis has the following main tasks:

- to improve Apeco business processes in ARIS software;
- to create collaborative project management framework for partner network initiation;
- to implement and analyze EPC modeling language in Apeco.

ABBREVIATIONS

ARIS	-	Architecture of Integrated Information Systems
B2B	-	Business to Business
BPM	-	Business Process Management
CN	-	Collaborative Network
CNO	-	Collaborative Networked Organizations
CSF	-	Critical Success Factors
DMAIC	-	Define, Measure, Analyze, Improve, Control
DRIVE	-	Define, Review, Identify, Verify, Execute
EETT	-	Eesti Energia Tehnoloogiatööstus AS
EPC	-	Event-Driven Process Chains
FP	-	Focal Player
IDEF	-	Integration Definition Function Modeling
IT	-	Information Technology
KPI	-	Key Performance Indicators
OPE	-	Overall Process Effectiveness
PN	-	Partner Network
QMS	-	Quality Management System
SME	-	Micro, Small and Medium-Sized Enterprises
TOC	-	Theory of Constraints
TQM	-	Total Quality Management
UML	-	Unified Modelling Language
VAC	-	Value Added Chain
VO	-	Virtual Organization

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AKNOWLEDGEMENTS

Firstly, I would emphasize knowledge base what I have obtained during master program. All studied materials gave input for current thesis.

Secondly, thesis needs help of various persons who contributed their time and knowledge into topic. Especially, I would thank the supervisor who assistance and encourage to complete the work Mr. Eduard Ševtšenko – Faculty of Mechanical Engineering, Tallinn University of Technology. As well, I would thank colleagues from Apeco who provided support from organization side and Mr. Taivo Kangilaski who supported during usage of software.

Finally, I appreciate all people who make it all possible. I hope to give my contribution into Business Process Management development in Estonia as a whole.

INTRODUCTION

Efficiency as a target for organizations is one of the key objectives. Situation where costs are increasing with market, influence one or another way everyday operations in SMEs. As a result organization must analyse their internal and external processes and understand what part of it is reasonable to maintain and what should be improved. Moreover, approach should be cycle according to need.

It is common to all small organizations that environment behind them is constantly changing. Logically, change is an opportunity for organization to find improvement possibilities. Besides that, should be one of the objective dynamical approaches for processes what help to map and analyse more faster way.

The work is based on organization Apeco who provides input data about research problem. The organization is focused on industrial solution in order to provide following product groups:

- conveyor solutions;
- belt scales and dosing systems;
- components and spares.

Apeco represent normal SME who aiming market growth and sustainability. As organization want to be knowledge based in his all operations.

Unfortunately today most of small organizations are using static processes. What means that process has set as needed and change is hard to implement. As well, members of organization are interacted badly due to bad system. New approach suggests using ARIS software with dynamic processes what will constantly changing during time.

The research problem topic interacts with SME management issues. As a fact, today about 99% of all European business are SMEs [23]. This is a large number and evidence that SMEs a truly important for Europe as a whole. These are the organizations that employ most of people in Europe. It means that nine out of ten SMEs are micro enterprises with less than 10 workers. Although, these are the organizations that need to be effective in order to expand their market. Business Process Management could be one tool to increase SMEs competitiveness.

Current paper main objective is to provide sufficient research about Business Process Management in Apeco. Topic is strongly related with ARIS software and applications what provide improvement under EPC modelling language. According to basis of the set objective are related followings tasks:

- Apeco business processes modelling (AS-IS) and improvement (TO-BE);
- collaborative project management framework for partner network initiation;
- explaination and use of EPC as modelling languages;
- the implementation of ARIS simulation tools;
- cost calculations based on improvements.

Following thesis consist of six main chapters. First chapter is focusing on organization description and structure. In second chapter author define main problems to be solved from organization point of view. Third chapter give overview about theory and frameworks what are used later in problem solving part. Fourth chapter highlights problem solving parts where firstly is described AS-IS model with current status. After analysis, author suggest improved TO-BE model under fifth chapter. Based on TO-BE model are new parameters used for future steps. After modelling, author calculates financial results in order to understand future opportunities for the organization. Calculations should give indications for implementation.

The primary research question is basis for business process management and quality management. The paper also describes possible approaches what can be implemented by other SMEs.

1. GENERAL ORGANIZATION DESCRIPTION

Current thesis is written based on machine building organization Apeco. It is a micro organization which is offering products to various industrial organizations that are active in material handling market. Main products are different conveyor systems and project based solutions. On the other hand, organization offering customers value with other product what support main products, such as weighing and batching systems. In additions offers organization components and spears in order to provide sufficient service segment.

Apeco is a small Estonian organization located in industrial town Saue. Today all needed components and steel parts are procured by other partners and main focus in on strong partner relationship, engineering and purchase skills. There is certain strategy to be as close as possible to the end customers. Reason for this, is to be closer to the value chain and market in order to increase competitiveness.

Products are offered today mainly in Estonia, however customer are usually national organization who own local operations. With recent years, have Apeco gained better contact network and base for export to near regions such as Scandinavia and East Europe countries. As a fact, product itself is enough complex and useable in order to present it to another countries.

Apeco have B2B approach for various industries. It includes turnkey projects with strong focus on project management. Approach is on certain technology for certain industry. For instance, aggregate mixing plant for quarries what guaranteed quality aggregate mixtures for end customer. Taking all this into account, is supply chain one of the crucial aspects what organization should face with.

One of the important aspects for organization is quality management. Especially in industry sector where partnerships with customers are more long term and quality must be determined in a way that customer expects. Today, Apeco do not have ISO system, therefore current thesis should give strong input to organizations quality management.

1.1 Organizations Structure

Organization structure enables to allocate tasks between different departments. In other words, it is environment of different departments which help organization members to understand how their organization is built. Organization can be structured in many ways considering objective what management have set up in order to manage various functions.

Apeco structure is rather simple and not very complex (Figure 1). Structure is common to small organization where information flow between departments is very fast. Certainly this kind of situation gives advantage. However, small organizations like Apeco objective is to grow and it will change structure in a way that helps organization to develop. Also, it will mean that task allocation could change during time. Task must be implemented in way that they support organization all levels and create value.

Organization structure is managed by management where main role is carried by CEO. CEO is responsible for administration and managing all levels above him. Accounting main activity is related with financials and accounting daily operations. Sales dealing with customer relationship and market analyze. Purchase procures different items for operations. Engineering supporting all other department with input information and R&D activities. Project management lead projects according to project charter. Assembly is responsible for technical assembly operations.

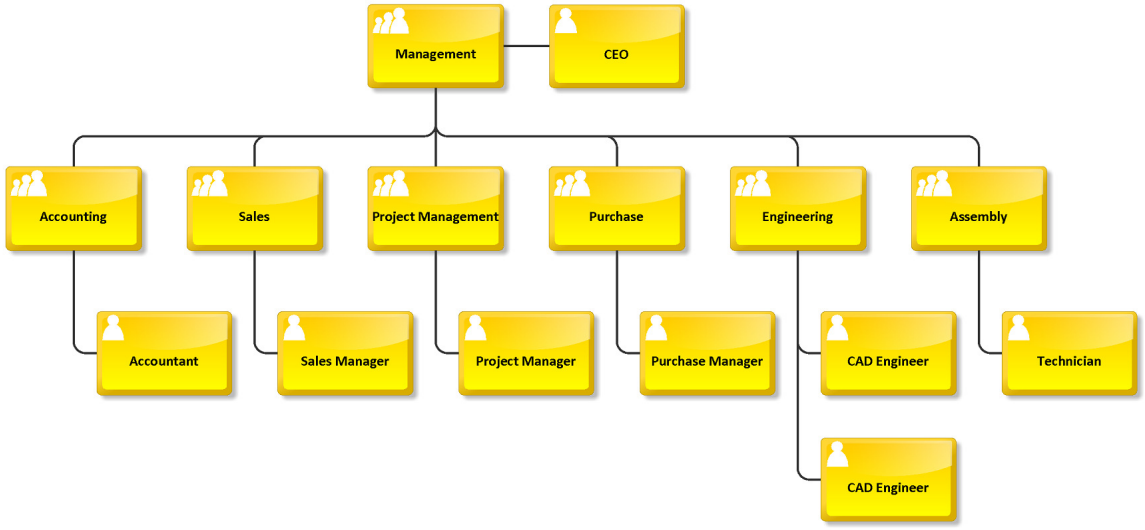


Figure 1. Apeco Organizational Chart

Source: Author

All tasks are allocated according to work instructions (Table 1). Each role has to own clear overview about his or her tasks. Task allocation is subject to change after certain time of period.

Table 1. Origanization Role and Tasks Allocation

Role	Tasks
CEO	• Overall strategy; • Sales assistance: • Vison; • Policy; • Goals; • Business process management.
Project Manager	• Planning; • Procurement procedures; • Project management.
Accountant	• Accounting; • Reporting; • Report creation.
Sales Manager	• Sales and marketing; • Budgeting. • Market research; • Customer relationship management.
Purchase Manager	• Purchase; • Logistics; • Inventory.
CAD Engineer	• Product lifecycle management • BOM creation; • Drawing creation.
Technician	• Assembly operations; • Site service; • Erection works.

Source: Author

1.2 Communication

Normally, small organization development is very intensive. But only in case, if management willing to come with it. Although, this should be only common for organization who really want to grow and establish stable business. Therefore, every body's involvement is very important. Fast information in one of the key issues what should be solved.

Organization that is base for the current thesis has lateral communication type. All information exchange is fast and flexible. It is possible mainly because of organization size and structure, but also location in terms of office placement. Hence, organization allows to keep same goal for all the people in organization.

On the other hand, communication could be poor due to a misunderstandings or non-compliance in processes. People tend to fail and such tools as IT systems could prevent such problems.

1.3 IT Systems

As one of key process inside organization is sales then suitable CRM systems is used and linked with organization needs. Currently Apeco is using Estonian cloud based software Erply. All major modules inside CRM IS system are:

- Customers
- Sales
- Warehousing
- Purchase
- Reports
- Other smaller modules (calendar, settings, etc.)

Additional needed documents e.g. project charter, lessons learned, BOM etc. are made by using MS Office package. All documents are archived in main server.

Product development will be carried out by Siemens CAD software Solid Edge ST7. Main environments are part, sheet metal and assembly. Each product has unique number which will be base for numbering. Same number will be used for tracking.

1.4 Products and Services

Organizations need products in order to earn profit. Products should be linked with organizations overall strategy and help increase operations. Apeco have three main product groups – Conveyor solutions, belt scale and dosing systems and components and spares (Figure 2).

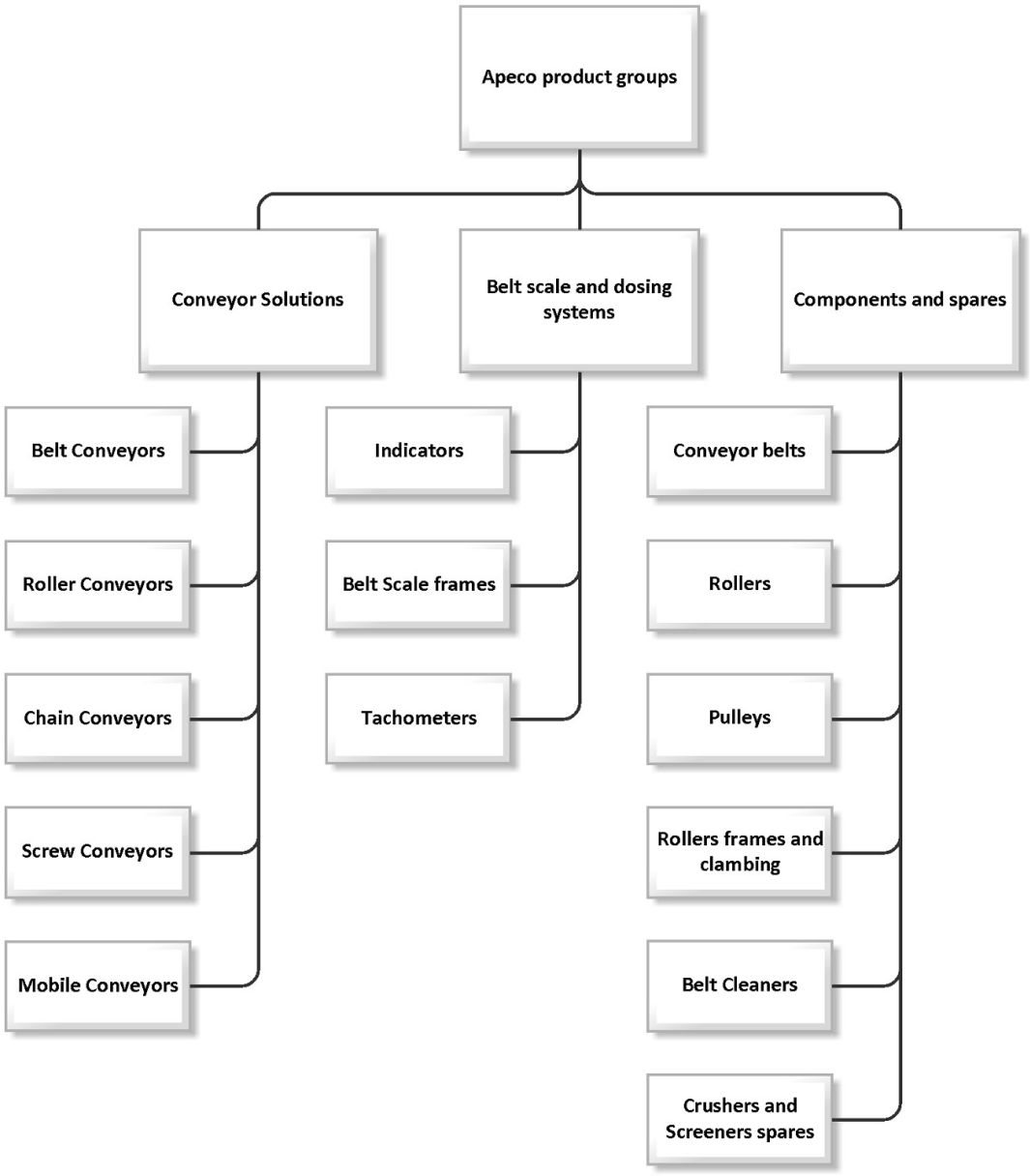


Figure 2. Apeco Products Tree

Source: Author

According to authors study, most of sales revenue is generated by conveyor solutions. Most profitable product range is belt scales and dosing systems. Components and spares are supporting before mentioned product groups as mentioned before.

Industrial project solutions need service after commissioning. Therefore, have Apeco three main service areas (Figure 3). Following thesis do not focus on service activities in content because of volume of work.

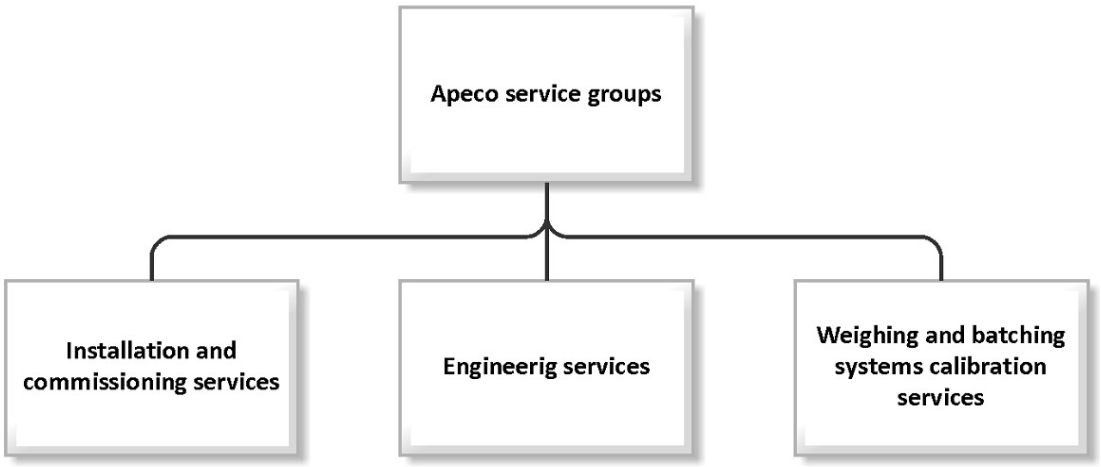


Figure 3. Apeco Service Tree

Source: Author

2. CURRENT PROBLEMS IN ORGANIZATION

Normal SME facing various difficulties daily basis. Difficulties could start with finding customer as sales problem and end with business processes as problem in operations level. These problems are uncommon for larger organizations, because of available resources. Therefore, should SME allocate resources more effective way, in order to stay competitive. All below mentioned problems vary according to product produced or service offered. Combination off all problems is most relevant to whole process. In fact, normally these problems occur one or another way. From this viewpoint, organization managers should understand and realize how to manage problems in order to achieve future improvements. The size of the problem can be monetary smaller or bigger.

As mentioned before problems in small organization are common. Current thesis author emphasize by experiences major problems like:

- lack of management competence;
- limited time and resourced for working tasks;
- founder dependence;
- fatigue creation inside company.

Above mentioned problem list is just a on part of whole iceberg. Usually problems are connected with each other and affect system in a different way. Most commonly in small organizations solving methods are base on founder's knowledge and experiences. Usually these experiences are not efficient enough and knowledge should be obtained from somewhere else. It means that external help is needed.

Thankfully, today we have rich data platform and all kind information can be easily followed. BPM could be one of the tools what is forth of implementing. Good overview about processes guarantees better probability to succeed.

Even in a small organization business processes play important role. It is huge threat if managers do not value process as tool for clearing everyday operations for everyone inside organization. On the other hand, environment in small organization is very intensive and all kind of changes comes up fast. This constraint means mainly lack of resources for perform tasks. As a fact, human error may increase it unpredictable way.

As mentioned before, process management plays important role in every organization and all kind of documentation come with it. As a fact, today most organization use digital documents instead of paper documents. Therefore, is danger to produce too much documentation what has no needed value. Huge amount of different instructions could mislead and not clear operations for the people who are working in organization. When people are dealing more with instructions and less with their main work then something has to change. On the other hand, this is not the rule. Different work description in different field could need special documentation and higher safety.

Small organization can run all kind of improvements very fast and get needed information from customers, suppliers and personnel very fast. In contrast, big corporation's improvement measurements take longer time. Usually it will lead to situation where decisions take also longer time with improvement cycle. When we consider all this then we understand how important is for small organizations to be dynamic.

2.1 Apeco Problems

Current paragraph outline all the major problems inside organization.

2.1.1 Delivery Time Delay

Apeco have situations where products or project delay mainly because of huge work load. Capacity is limited and is hard to allocated resources effectively. With worse-case scenario organization is not capable to allocate more resources and manage them if needed. It is a problem what affects all other processes as well.

For better overview selected author randomly 6 different orders and compared planned delivery date with actual delivery date (Table 2). Result shows that only 1/6 of orders where fulfilled according to schedule. Average delay in days where approx. 5. It means one working week delay with almost every order.

Table 2. Planned Delivery Date VS Actual Delivery Date

Order No.	Planned delivery date	Actual delivery date	Delay in days
1	6.5.15	11.5.15	-5
2	9.4.15	10.4.15	-1
3	27.3.15	8.4.15	-12
4	14.4.15	17.4.15	-3
5	16.4.15	30.4.15	-14
6	3.6.15	28.5.15	6
		Avarage delay in days	**-4,83**

Source: Author

2.1.2 Processes Continuity

Organization does have flow charts about all processes which are internal and involving departments. However, for a small organization it is very hard to maintain all processes routing as needed. Described problem is connected strongly with processes continuity.

For instance, new market opportunities drive organization to another path. With movement change the process and organization must used to it. In that sense organization is static and need more dynamic approach.

2.1.3 Unstable Partnership

Under unstable partnership term is meant situation where outsourcing partner's capacity is full and delivery time gets critical. Appearance of that kind of situation is possible nevertheless, purchase order or contract are in place. Situations like that could affect customer relationship seriously and overall organization reputation. Normally, wrong timing during production mean compromises on quality and cost structure.

2.1.4 Working Capital

Big projects need funding and huge amount of working capital. As well conditions are complex and died strongly with main contract. It even could mean that third parties can influence transaction between buyer and seller, e.g. bank. Small organization need to understand nature of risk and analyze how contract conditions impact everyday operations.

Good financial planning help to minimize risks which are related with bad working capital ratio. As baseline, must project managers perform certain procedures according to project charter.

2.1.5 Non-Profitable After Sales Activities

When speaking about project closure and after sales activities, then expenditures are not always predictable and crossing limits what has been set before. There may be many factors what allow to make such expenditures:

- need for giving over the project to customer according to lead time;
- default or missing capability what have occurred during process;
- internal organization default.

Possibly there may be more factors but previously mentioned ones are the main.

2.1.6 Stable Sales Revenue

Generally sales revenue tends to change according to sales activity. For instance, low sales activity during certain periods could create instability in cash flow. As a result, suffers working capital ratio and work in progress (WIP).

Reason for such kind of situation may be caused by responsible person overload of work for other purpose than sales. Mentioned problems can happen when project have difficulties and some part of it need extra help or even work. It includes various conversations with customer where different aspects are confirmed.

2.1.7 Lack of Information Flow

The flow of information can be found from every organization. In small organizations information flow is fast and moves easily between different roles. However, it will not guarantee value to a user of that information. When certain role is asking information from another role in order to perform task, then data could not produce value to end user.

Another side of those problems are related with IT systems. Firstly, small organization does not have special IT personnel and secondly, there could have problems with discipline

of filling in needed information into IT systems. IT generally, plays crucial role in today's organizations. Most of the systems are linked somehow with IT systems, e.g. transport orders.

3. THEORY

Following part is describing theory of current paper. All covered topics are relevant to thesis.

3.1 Business Process Management

"If you can't describe what you are doing as a process, you don't know what you're doing."

W. Edwards Deming

Mr. Deming has said golden words as an introduction to Business Process Management (BPM). BPM is a systematic approach to making an organization's workflow more effective, more efficient and more capable of adapting to an ever-changing environment. A business process is an activity or set of activities that will accomplish a specific organizational goal [1].

Process itself does not guarantee expected results, unless people inside organization make effort to carry out these operations. When operations increase inside organization due to a normal development then all kind of documents, e.g. data, etc. increase parallel. Therefore, is necessary to understand and develop business processes at same time. Moreover, it should be dynamic approach, where processes are not any more static but change according to environment around them.

Processes are not a single goal in system, but rather a means to achieving a business objective. The selection of a business objective and the approach to achieving that objective is the strategy of the organization. The management team is responsible for selecting the organization objectives and ensuring that the processes support, or contribute to, the fulfillment of the objectives. Thus processes that are aligned with the strategy and objectives are most effective in achieving these objectives and are more sustainable in the medium to long term. [2; 67]

BPM helps to keep organization healthy by providing a tool for analyze. Each role in organization can understand what the tasks to perform are and how value is created. John Jeston and John Nelis in their book "Business Process Management" emphasize model [2; 51] where BPM projects need framework with lower layer organization strategy and

process architecture. Especially, when improvements with BPM are considered then vision of the organization should be clear to all members of the team.

BPM keep organization memory what make whole system stronger. Memory has previously collected information about products, projects, experiences, etc. As today we hear lot about learning organization concept in business domain, then process is one dimension of that concept [15]. Today managers of the organization should guarantee knowledge transfer between people and data given. Each lesson from particular case should be input for future improvements. Effective organization learns and helps others to learn for the common objectives.

3.2 Quality Management Systems

Quality management systems (QMS) are essential in every industry. Quality management interacts and engages people inside organization. According to Oakland, it begins with the identification of the customer requirements and ends with their satisfaction [7; 79]. Customer plays an input and output in a same time.

Today in Estonia, most common quality management system is ISO 9000 [19]. Many other QMS could find application in various industries, but organization domain give best input for selection. For example, mass production has lot of help from Six Sigma mythology and ISO 9000 can help smaller organization. Equally important for both frameworks are business processes.

Not many organizations follow the guidelines of QMS. It could happen that organization use to forget the main reason for everyday operations – why they are using QMS. Due to a fact, that most of development plans are connected with internal quality problems. Another strong aspect is static procedures, what tend to be outdated. Especially, when organization is in intensive development phase.

3.3 Business Process Modeling

Industries around globe have developed over the decade's involving people and organizations. The idea that work can be viewed as a process, and then improved, is hardly new [2]. Although, modeling of business processes is related with all the major management tools e.g. lean, TQM, etc. Competition and globalizations set new standards to organizations where speed and dynamic approach are one of the key elements. Markets

can be unstable and all kind of external factor could affect business seriously. On the other hand, organizations can deal with their internal processes and prepare best for hard times by playing through all scenarios.

First of all, process modeling helps to understand what is going on. What are the weak and strong points? What people are doing and what they are not doing? Therefore, process modeling is widely used within organizations as a method to increase awareness and knowledge of business processes, and to deconstruct organizational complexity [3]. It is an approach for describing how businesses conduct their operations and typically includes graphical description of at least the activities, events/states, and control flow logic that constitute a business process [4].

Before starting any modeling project is important to be clear about why you are modeling and who the user of that model is. Rob Davis highlights surprising fact that people start modeling without any idea of what the models are for [16;9]. As well he point out that process model is not a replica of real world; it is merely a representation – a viewpoint.

Indeed, objectives of modeling may change during life of organization. The change may come due to a changing requirements, discovery of new opportunities or planned enhancement of the model [16;9]. Model hierarchy depends on organization structure and operations. Usually smaller organizations have less levels and bigger organizations more levels. Although, we must distinguish functional level and operational level. Where last term mean bigger view of process and normally it will take more process time thanks to many other functions inside.

Below is a list of key questions what modeler should ask himself before modeling [16;9]:

- Why are you modeling?
- What are you modeling?
- Who are you modeling?
- When are you modeling?

Normally models consist of many different processes where each process describes each department work. In order to create the most efficient and cost-effective business we want to use a common approach wherever possible, only creating different specific processes when absolutely necessary [16; 141]. In practice, people inside organization are

not communicate and could happen that they do not own big picture about functions inside whole organization. This kind of narrow thinking could lead to situation what is called "stovepipes" [16; 141]. New designs of process are often called that way because instead of the processes fitting within an existing process hierarchy, each product has its own, narrowly focused and distinct process hierarchy or stack.

Instead of creating stovepipe solutions, we want to create a process hierarchy that promotes reuse, allows flexibility, but manages and contains that flexibility [16; 141]. Each department must understand that kind of problems and look broader view of whole organization.

3.4 Key Performance Indicators

Key Performance Indicators (KPI) are linked strongly with business processes and help organization to define and measure perspective goals. KPI should set common goal to all members in organization and they should define value for them. For instance, organization could measure overall "delivery delay value" by analyzing it from perspective. Each department could own their own KPI or organization as a whole could use more general KPIs. KPIs are set up by keeping in mind general strategy.

In context of small business, should KPI be realistic and possible to use as a tool. From author own experience in smaller organizations could be highlighted the fact that usually activities are complex and hard to follow. Major reason for this is ongoing and main activities which earn profit for the organization. Other activities are hard to noticed and arise upon problems which affect everyday business performance. Realistic KPI´s could be 3 main parameters what are crucial in terms of existence. It is easy to follow and use in activities as an indicator. In future, is reasonable to look over all the KPIs and make corrections if needed.

3.5 Different Business Process Description Methods

Following chapter describe different business process methods and give general overview about them. Listed methods are widely used around world with sufficient load of information about them. Current thesis describes more detail following standards: EPC, IDEF, BPMN and UML.

Each organization should understand and research for them best suitable standard. Selection may depend on managing person competence or experiences. It could be quite time consuming implementation, however right objectives should be describe before any implementation phase.

3.5.1 Event-Driven Process Chains

Event-driven process chains (EPC) are used by many well known organizations for modeling, analyzing and redesigning business processes. The resulting EPC models are used as a starting point for the development of information systems and for the definition of workflows [5]. EPC is a widely used as a tool for documenting various business processes.

EPC provides comprehensive means for modeling different aspects of a business process. It is mainly used for [5]:

- business process re-engineering (BPR);
- definition and control of workflows;
- configuration of standard software;
- software development;
- simulation;
- activity based costing (ABC);
- quality-related documentation of processes according to the requirements of ISO 900x.

Figure 4. Example of an EPC Model

Source: [14]

EPC enables to all stakeholders different views on to the overall system. This kind of holistic approach helps to understand all levels inside organizations. Internal connections are active and produce value, as well as so called users can trace all kind on data and use it for needed purpose.

The different types of diagrams are all mutually related. They provide different views on the overall system: the organizational view, the functions view, the product view, the data view, and – integrating the other views – the control view. This structure of integrated views is part of the ARIS [5, 5].

3.5.2 Integration Definition Function Modeling

More than 25 years ago the US Air Force adopted Integration Definition Function Modeling (IDEFØ), as a part of its Integrated Computer-Aided Manufacturing (ICAM) architecture. The IDEFØ modeling languages provide a useful structured graphical framework for describing and improving business processes [7, 62].

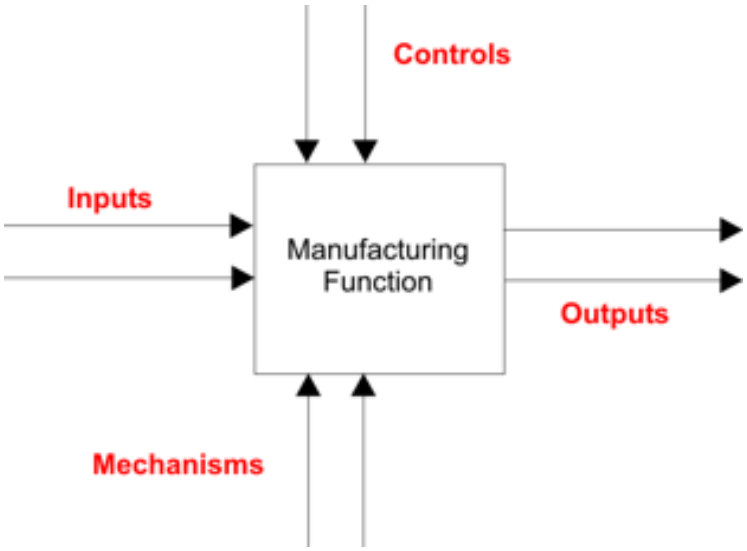


Figure 5. IDEFØ Box and Arrow Graphics

Source: [8]

The IDEFØ methodology includes procedures for developing and critiquing process models by a group of team of people. The creation of an IDEFØ process model provides discipline teamwork procedures for process understanding and improvements [7, 63].

3.5.3 Business Process Model and Notation

The Business Process Modeling Notation (BPMN) is a standard notation for capturing business processes, especially at the level of domain analysis and high-level systems design. [11]

BPMN process models are composed of: (i) activity nodes, denoting business events or items of work performed by humans or by software applications and (ii) control nodes capturing the flow of control between activities. Activity nodes and control nodes can be connected by means of a flow relation in almost arbitrary ways. [11]

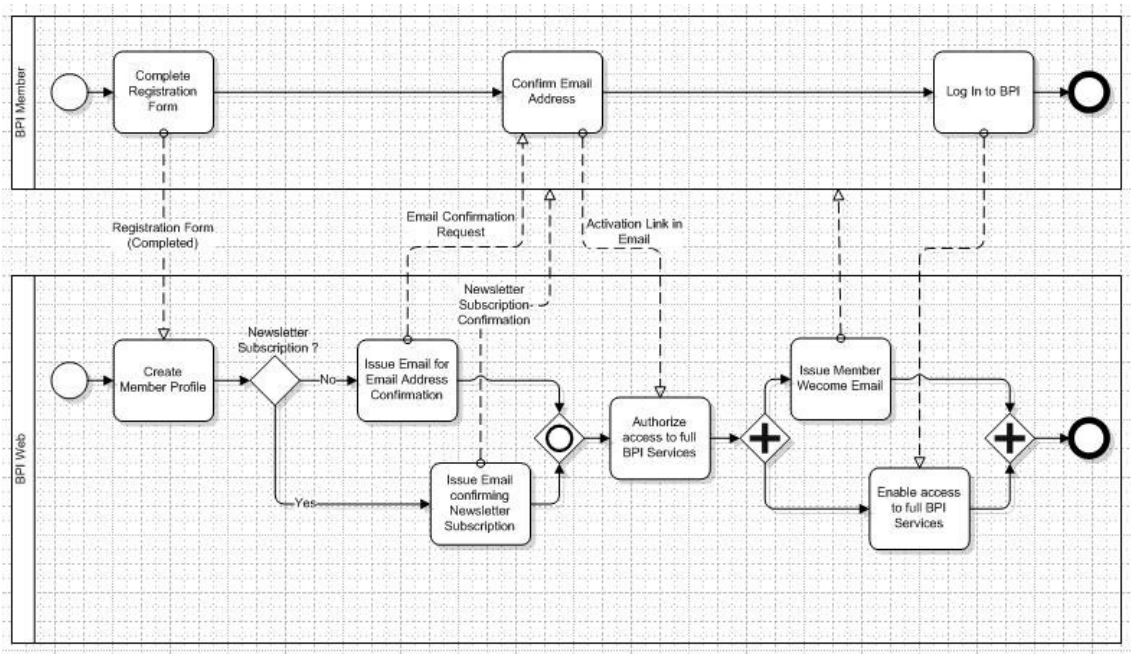


Figure 6. BPMN Process Model

Source: [12]

3.5.4 Unified Modelling Language

The Unified Modeling Language (UML) as the new standard for object-oriented modeling combines the most important existing object-oriented approaches [5; 3]. Unified Modeling Language (UML) is a family of graphical notations, backed by single metamodel, that help in describing and designing software systems, particularly software systems built using the object-oriented (OO) style [10; 14].

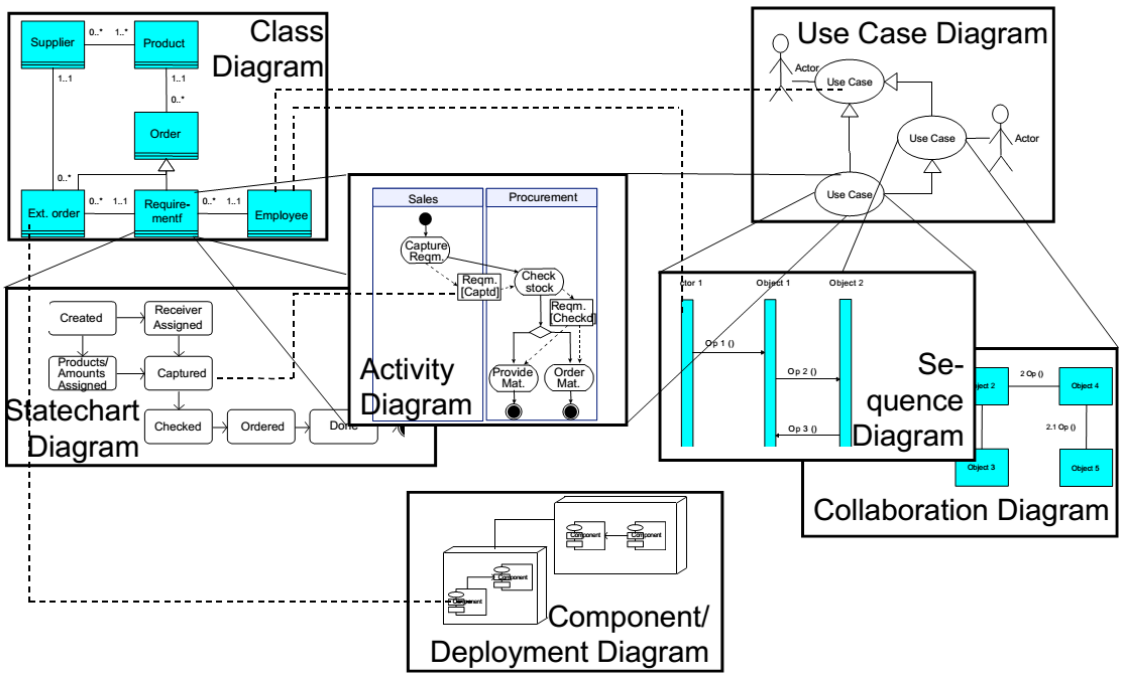


Figure 7. Diagrams of the Unified Modeling Language and Their Connections

Source: [5;2]

3.6 ARIS Software

The ARIS software is made for Business Process Management (BPM) [16; 1]. Software finds application in smaller and bigger organizations with various packages. ARIS consist of four main platforms [16; 1]:

- the strategy platform;
- the design platform;
- the implementation platform;
- the controlling platform.

Architecture of Integrated Information Systems (ARIS) is a well-known worldwide approach to enterprise modeling. ARIS started as the academic research of Prof. A.W. Scheer and it has an explicit industrial background. It is not a standard, but popularity in different interests groups is huge and therefore, it is widely used as software in BPM. In addition to the high-level architectural framework, ARIS is a business modeling method, which is supported by a software tool. ARIS is intended to serve various purposes:

documentation of existing business process types, blueprint for analyzing and designing business processes, and support for the design of information systems. The tool is intended for system designers [6;37].

Good way to describe ARIS concept is description of ARIS house framework, a model where organization, data, control, functions and product interact together like Figure 8 is showing. Important component in ARIS house is information and data what is moving between different departments. Every activity has a task what should be performed for certain purpose. It means clear description for workers who are performing these tasks.

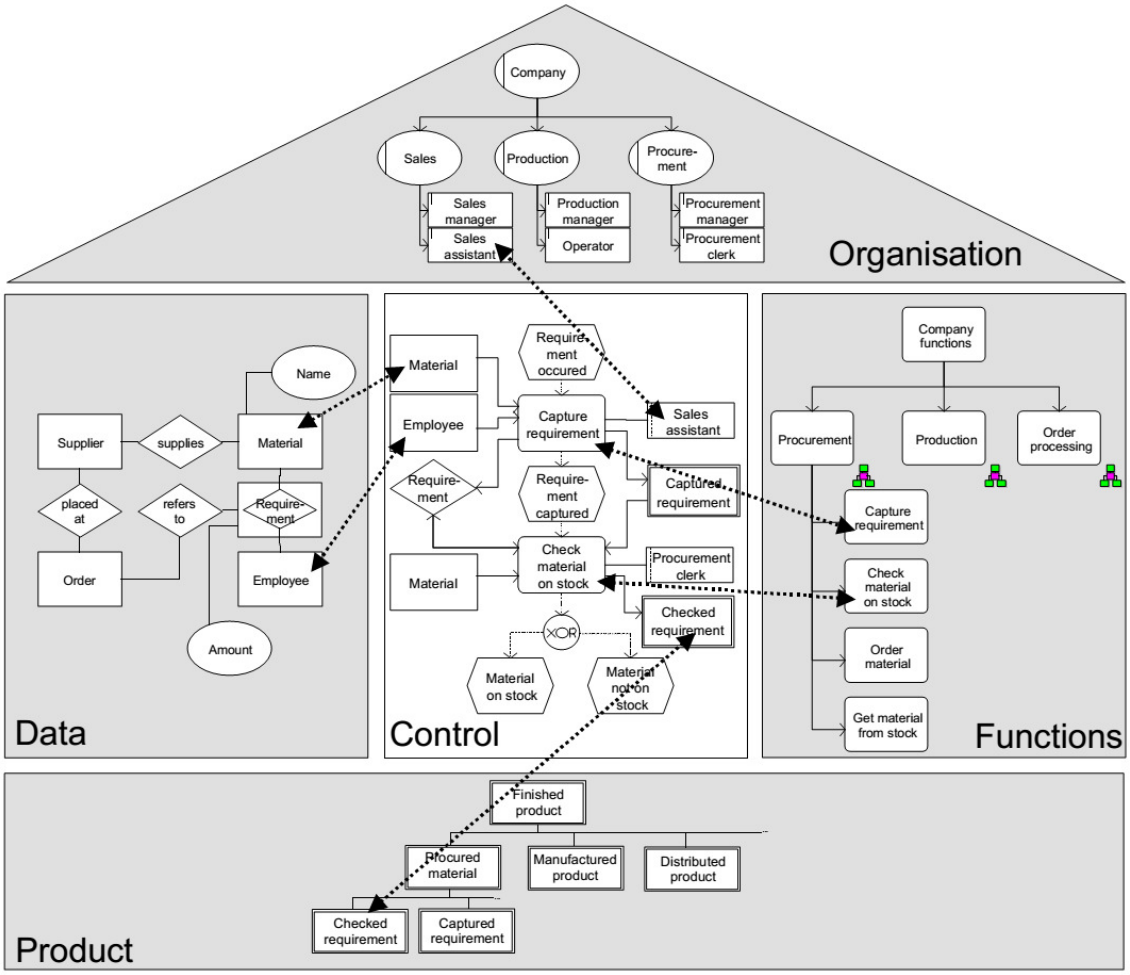


Figure 8. ARIS House

Source: [5;4]

The ARIS Toolset includes various editors that can be used to design and edit several types of diagrams. The most important are value-added chain diagrams, organizational

charts, interaction diagrams, function trees, and EPCs (Event-Driven Process Chains) [6; 38].

3.7 Rules of Using the EPC in ARIS

To model a process we need to create rules and follow them. It helps process engineers and users generally to understand process and create common sense. As all processes about Apeco has been done by ARIS 9 software then basic rules are followed for a solid foundation.

We can extend the basic rules of using the EPC to cover modeling process flows [13; 119]:

- every model must have at least one start Event and one end Event;
- functions and Events always alternate;
- functions and Events only have a single incoming and outgoing connections;
- process path always separate and combine using a Rule;
- multiple Event triggering a Function combine using a Rule;
- decisions are taken by Functions;
- functions that take decisions are always followed by Rules,
- rules show the valid combination of paths that follow the decision;
- events following Rules indicated the actual outcomes of decisions;
- rules cannot have multiple input and multiple outputs.

All mentioned general rules are guidelines for modelers. Modeling guidelines help to create common thinking for people who are responsible modelers in organization. Thus, have most organizations own modified guidelines for all modelers (e.g. under another domain, CAD engineers use guidelines for drawings).

For better overview author describe all the main symbol types in process model. Symbols are divided into two categories:

- EPC logical connections of events and activities in models;
- General symbols.

All the main EPC models consist of logical connections which drive events and functions. Mentioned main symbols are described below showed Table 3.

Table 3. EPC Logical Connections of Events and Activities in Models

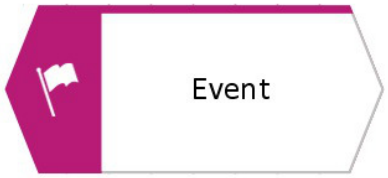
Operator	**Following a function (single input, multible outputs)**	**Preceeding a function (multible inputs, single outputs)**
OR 	**OR decision** One or many possible paths will be followed as a result of the decision	**OR Trigger** Any one Event, or combination of Events, will trigger the function.
XOR 	**Exclusive OR decision** One, but only one, of the possible paths will be followed.	**Exclusive OR Trigger** One, but only one, of the possible Events will be the trigger
AND 	**AND branch** Process flows splits into two or more parallel paths	**AND trigger** All events must occur in order to trigger the following function

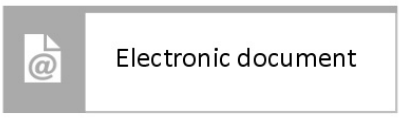
Source: [13,119]

EPC logical connections are strongly related with other ARIS symbols which are described below in Table 4.

Table 4. ARIS Symbol Description

Function	An Activity (or Function) describes an incidental task that typically consumes time and resources. Therefore, it is an active component and has decision-making authority [17].	

Event	An Event describes, in accordance with DIN 69900, an occurred defined condition that causes a sequence of activities. Therefore the event is a passive component and may have no function in contrast to the decision-making authority. Events can trigger functions. Functions are triggered by events. Events describe an occurring condition [17].	
Value-added chain	Value-added chain symbol is one part of main process landscape. They enable all parties involved to better understand how the company works as a whole and how a specific work area fits in [18].	
Process Interface	Process interface connects different process parts with each other. In models, they are normally locate first or last symbol.	
Role	Role is a position for specific task, for instance Sales Manager, etc.	
Position	The smallest organization unit in a organization is a position. It reflects assignment to employees [24].	
Product / Service	Product and service provide direct value creation process. They are the result of a human act or a technical procedure [24].	

Electronic document	Electronic document is a information carrier in order to store information in electronics means.	

Source: [17]; [18]; [24].

Description of the symbols is more versatile than showed below. However, most relevant symbols are listed in current paper.

Author suggests using the 4+1 levels in organization:

Level 1 – Value Added Chain (VAC) model
Level 2 – VAC model
Level 3 – Event Process Chain (EPC) model
Level 4 – EPC model
Level 5 – IT views related to IS integration

Above described approach is based on Total Quality Management (TQM). Below shown illustration is showing breakdown structure from core process to task level. Moreover, TQM suggest using mission statement and Critical Success Factor (CSF) before core processes. Mission is an expression of the aspiration of the organization [7; 245]. CSF are the what's not the how's, and are not directly manageable – they may be in some cases statement of hope or fear [7; 248].

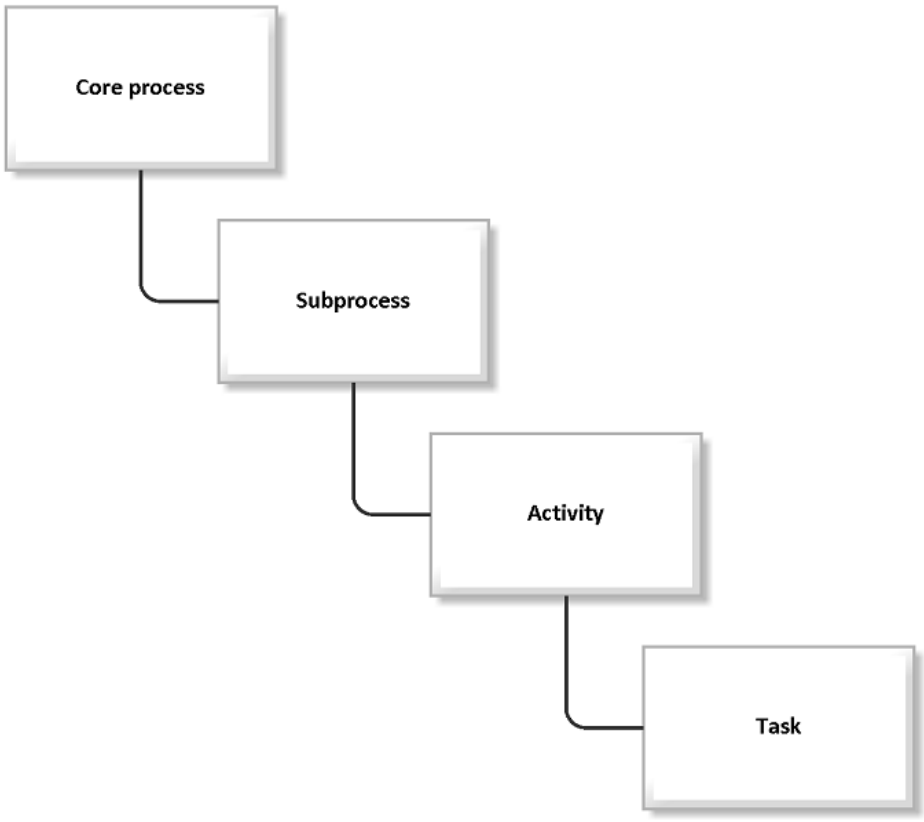


Figure 9. TQM Process Hierarchy

Source: [7; 252]

3.8 Business Process Improvement

Improving the quality of organization processes should be essential for those organizations who want to establish long term approach. Improvement should be carried out as a continuous cycle what increases awareness of problems inside organization. This is learning process for all who are internal and external members of the organization.

Improvement means that something is improved, e.g. process. On the other hand, decisions for improvement need input from solid foundation with figures. Measurement is necessary and constant feed of information enable to perform improvement.

Improvement base will be AS-IS model what shows current state of the process. It is important to ensure detail information with right parameters where accurate input data ensures better process improvement. When improvement has been carried out will be output TO-BE model. Explained framework is common for current thesis as well.

Today there are numerous of different frameworks. Most commonly used frameworks are:

- DRIVE;
- DMAIC;
- Deming Circle;
- Simulation;
- Process Mapping;
- Statistical Process Control (SPC).

Following thesis is based on mainly Simulation improvement method under DMAIC methodology as described on Figure 10. DMAIC Circle [9]. Simulation platform is developed by Software AG and belongs to ARIS product range [21]. It is a widely used tool for various applications (also in Estonia). By collecting information from business process model, evaluate ARIS results based on inserted data. Results can be exported in various ways (e.g. chart, excel sheet, etc.). Particularly, this is systematic approach what creates figures for analyze. In fact, software provider also offers solution what will be in cloud and allow information exchange via internet.

Figure 10. DMAIC Circle

Source: [9]

From SMEs point of view, help simulation receive fast and appropriate information about processes. Showing particularly dynamic behavior of all possible applications. For process designer point of view is easy to understand what should be maintained and what should be changed. This kind of approach is useful for learning and tracking. Each process need output and output creates value what can be measured. All kind of animations and graphics help users of that data understand what the core processes are.

Process designer in SME often tend to be CEO. Due to a small size of organization is problem with resources. However, resources should be divided and task allocated as motioned before. ARIS process mapping tool help to do them works dynamically and offers flexibility.

3.9 Organizations as Socio-Technical Systems

Organizations could develop socio-technical systems in accordance with general strategy and goals. Relationships could be based on external network which enables to create dynamic systems. Such collaborative network (CN) of enterprises forms Partner Network (PN) [20]. It is system of companies who perform under certain rules and operate according to agreement. The main objective of PN is cooperation between organizations in order to increase overall efficiency of partners. For instance, one process for specific organization could need improvement and selected partner can be subcontractor who increases efficiency with their own process. Following cooperation will operate under feedback and data is reasonable and guarantee quality.

Collaborative Networked Organizations (CNO) are autonomous, geographically distributed networks that support organizations common goals trough their interactions [20]. It is long-term approach, with the reasonable implementation time. System owns a Focal Player (FP) who enables to coordinate resources inside PN (Figure 11). Moreover, PN are planned to work under project management environment. It means that each partner support project with their own resources and FP (broker) have responsibility to carried out main role, e.g. FP could have market leading positions with specific technology [20]. Other partners can be subcontractors in production, engineering, etc.

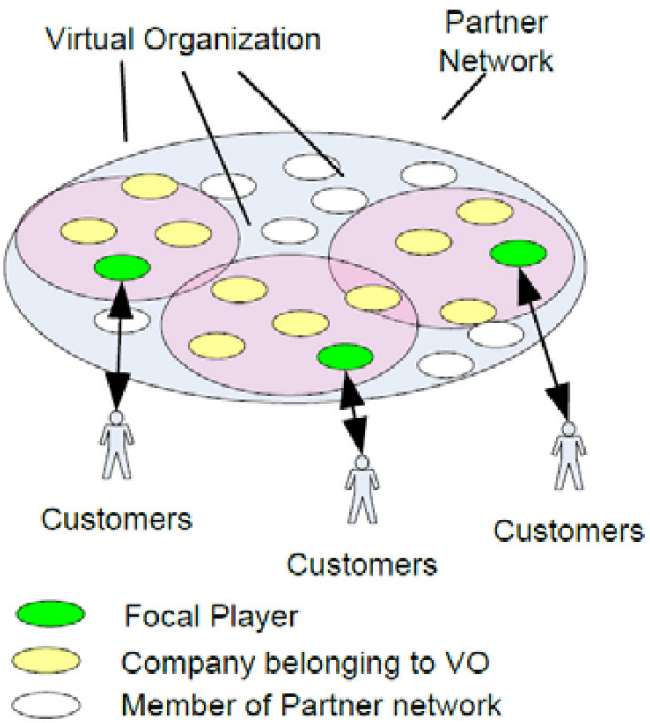


Figure 11. Virtual Organization

Source: [26]

FP selects the required domain, defines the project steps and describes the production route (as in the case of manufacturing domain). After the FP described the routing operation the suitable partners are selected based on the resources specifications and resource availability data. [20]

PN initiative helps to increase SMEs competitiveness under on common goal. It is way how smaller organization could unite operations and increase productivity with help of IT systems. Especially when SMEs are active in project based production where time, cost and quality plays crucial role. If there is fast dynamic feedback under previously agreed conditions then adaptively is easy to maintain.

4. ANALYSIS OF THE RESEARCH QUESTION

One of the main objective of the following paper is business processes improvement based on organization named Apeco. Whole idea is linked strongly with sustainability in terms of business development and operations. As it is one of the major challenges for the organization under current state. Moreover, overall performance should be improved with help of different methodologies. All decisions are based on facts and authors own experiences and theory.

Organization on which following thesis is based does not had enough sufficient Business Process Management (BPM). Although, organization does not had key metrics in place for process evaluations. In more detail, all main problems are described in the beginning of paper. Previously where all main processes described, however functional level description where insufficient. Another missing component where roles without link in functional level. All of these constraints where removed as first step in improvement process (AS-IS model). BPM served solid foundation for other tools such as TQM, KPI, etc.

Before modeling where compared different modeling tools. Author selected ARIS software which has enough functionality to meet requirements. Another important fact is load of information and available study materials which help to learn faster particular software. As all processes are modeled with help of ARIS 9 then in future organization is planning to use ARIS Cloud which is rather simpler for cost savings.

As more than 50% of Apeco revenue is coming from project sales then effective operations and holistic view in project management is needed. One way to ensure these conditions is PN methodology [20]. It is a framework what triggers all SMEs into another viewpoint by making all partners inside cluster more competitive.

Due to a feedback where described all processes to major team members and discussed strong and weak points together as teamwork. It is important, because viewpoint could be different from each individual perspective.

Author starts with AS-IS model and based on that suggest improvements. TO-BE model will be with needed improvements.

4.1 AS-IS Apeco Model

AS-IS model represents current situation of process. It reflects base for TO-BE model for analyze of whole process. As well, help to understand organization weak and strong areas. Whole process should be described with relevant input and output data.

Effective organizations use help of IT systems and provide fully dynamic approach. As it mean that all process filling has been done by help of special software, e.g. ARIS. Moreover, model is most effective if process information spreads among all the people in organization. AS-IS model ensures that people can view process if ever they need it.

4.1.1 Apeco Value Added Chain Process Description

Main process consists of other sub processes where all are adding value. All these processes are linked together and consist of functions. Each process and function has logical sequence according to operations based on organization. Main reason for process landscape is overview about all processes inside organization where all workers understand highest level.

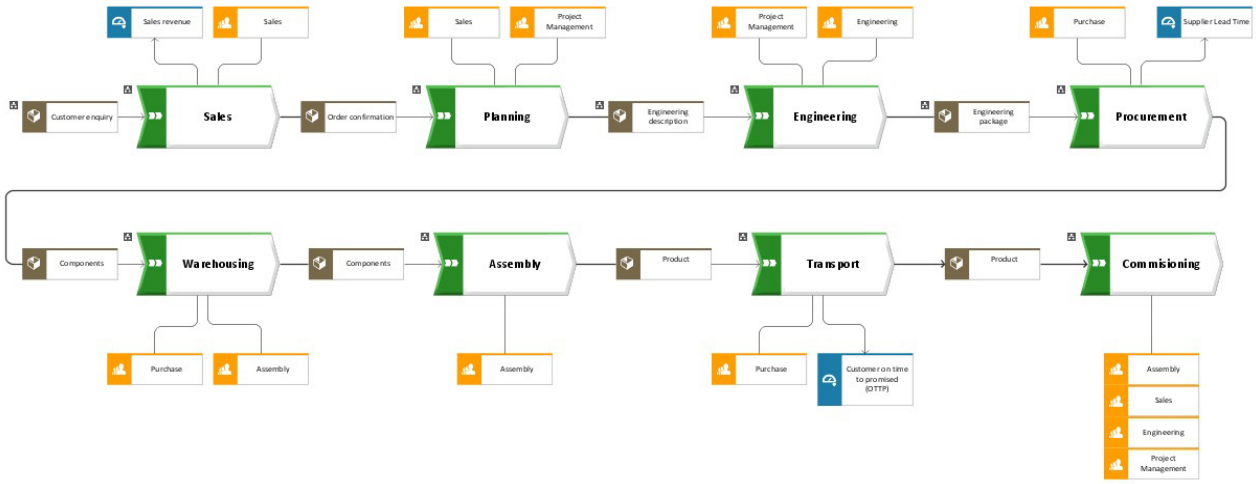


Figure 12. Apeco VAC Level AS-IS

Source: Author

VAC shows main process with input and output product / service (Figure 12). All main processes have department who carried out operations according to description. In fact, most important KPIs are added in order to receive feedback about process.

Apeco VAC process starts with sales and end with commissioning. Longest process is engineering what takes up to 3 months period. Least process in duration is planning and takes about 1 to 2 days.

4.1.2 Apeco Sales Process

Main process starts with sales where customer gives input with requirements. Input data is described by customer enquiry. Customer send enquiry via e-mail or call and describe what is needed in order to fulfill order (Figure 13). Customer enquiry will be baseline for future calculations and agreement draft. Output of the process will be product what will be ready for consuming by the customer.

All tasks are performed by sales department where main role is carried out by Sales Engineer. All commercial issues must be consulate by the CEO.

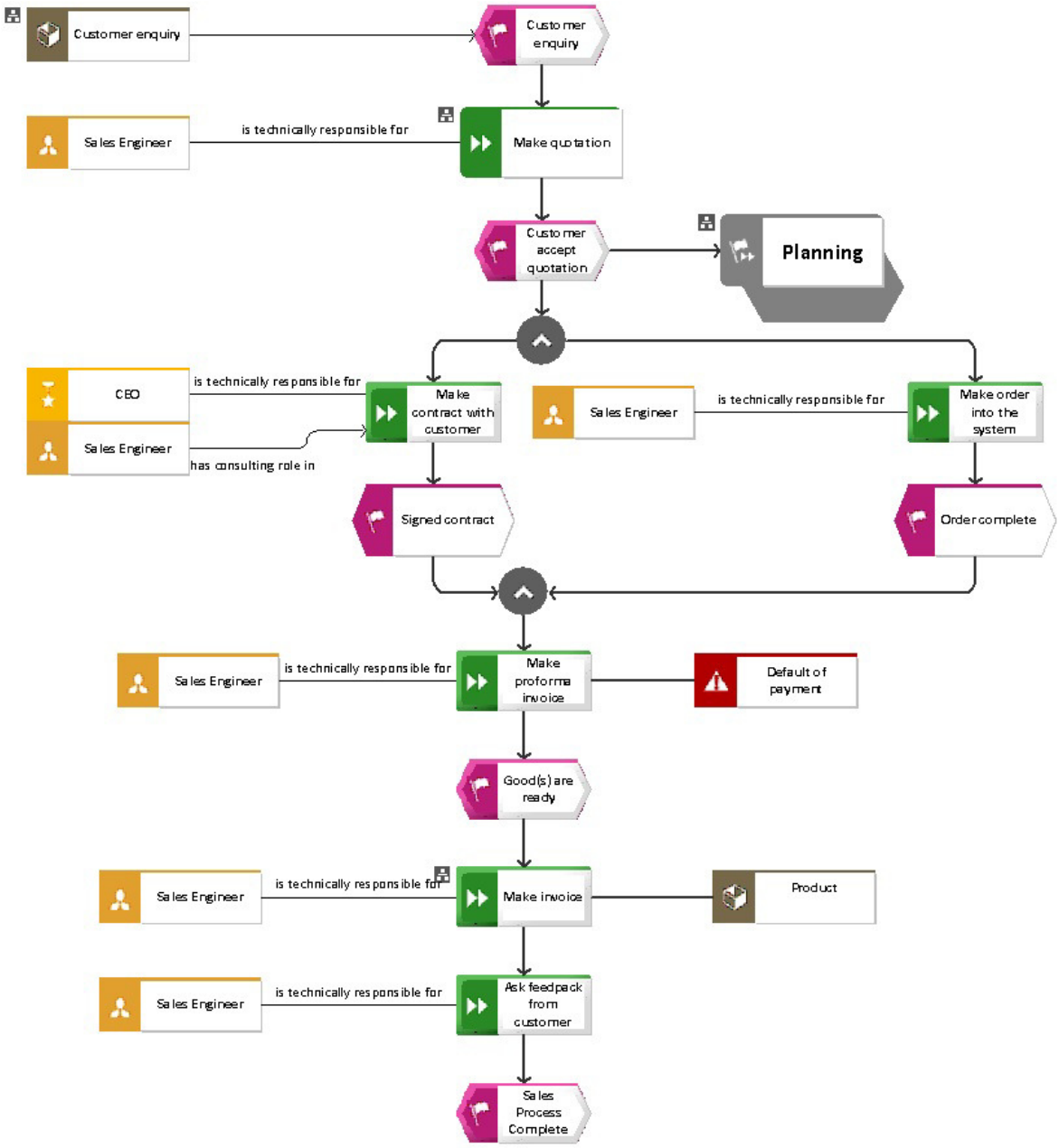


Figure 13. Apeco Sales Process AS-IS

Source: Author

4.1.3 Apeco Planning Process

Planning activities includes resource allocation for organization with all available resources. It could be organized as a way that extra resources will be outsourced from various vendors. One of the main objectives is delivery on date with customer satisfaction. Planning process engage all member who are related with particular project or product. All should give input for it and describe their viewpoints as showed in Figure 14.

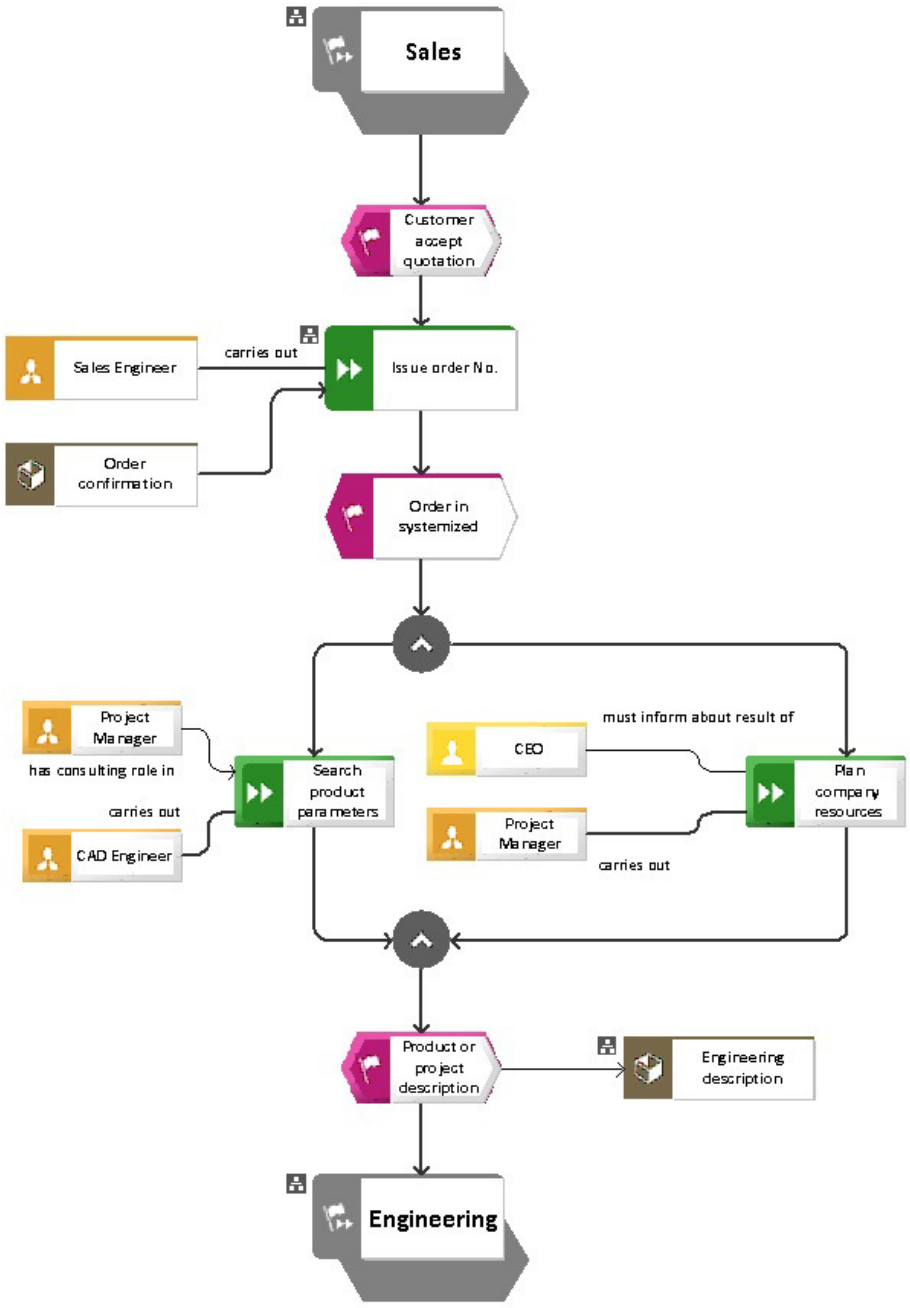


Figure 14. Apeco Planning Process AS-IS

Source: Author

4.1.4 Apeco Engineering Process

After planning comes engineering where creation of machine design have been made (Figure 15). Apeco is using Siemens CAD software Solid Edge ST7 as major tool for this process. Engineer responsible for doing all technical calculations and ensure correct readings for production.

All starts with planning where next event is product or project description. This phase includes mainly guide for engineering where all important issues will be emphasized. Following document includes:

- Main parameters;
- Project or product description;
- Time frames;
- Documentation info.

When engineering department is reading all that information as a input data it will be easier to carry out operations. These documents will be written by Project Manager. On the basis of the documentation next task will be 3D modeling where customer gets first visual insight about product. Although product change can be done quite easily compeer to next steps where change request could affect seriously process (e.g. finalization of 2D). Because of that, all main functions should be approved by someone who is responsible of final result. All phases need to be clear and dynamic.

When all previous events and functions are carried out then direct value is created with package. It is called that way because it includes number of different documents what are consumable for next processes. Normally package consists of following documents:

- 2D drawings;
- 3D model;
- laser cutting trajectory files;
- BOM;
    - list of steel parts;
    - list of fasteners;
    - list of purchase products.

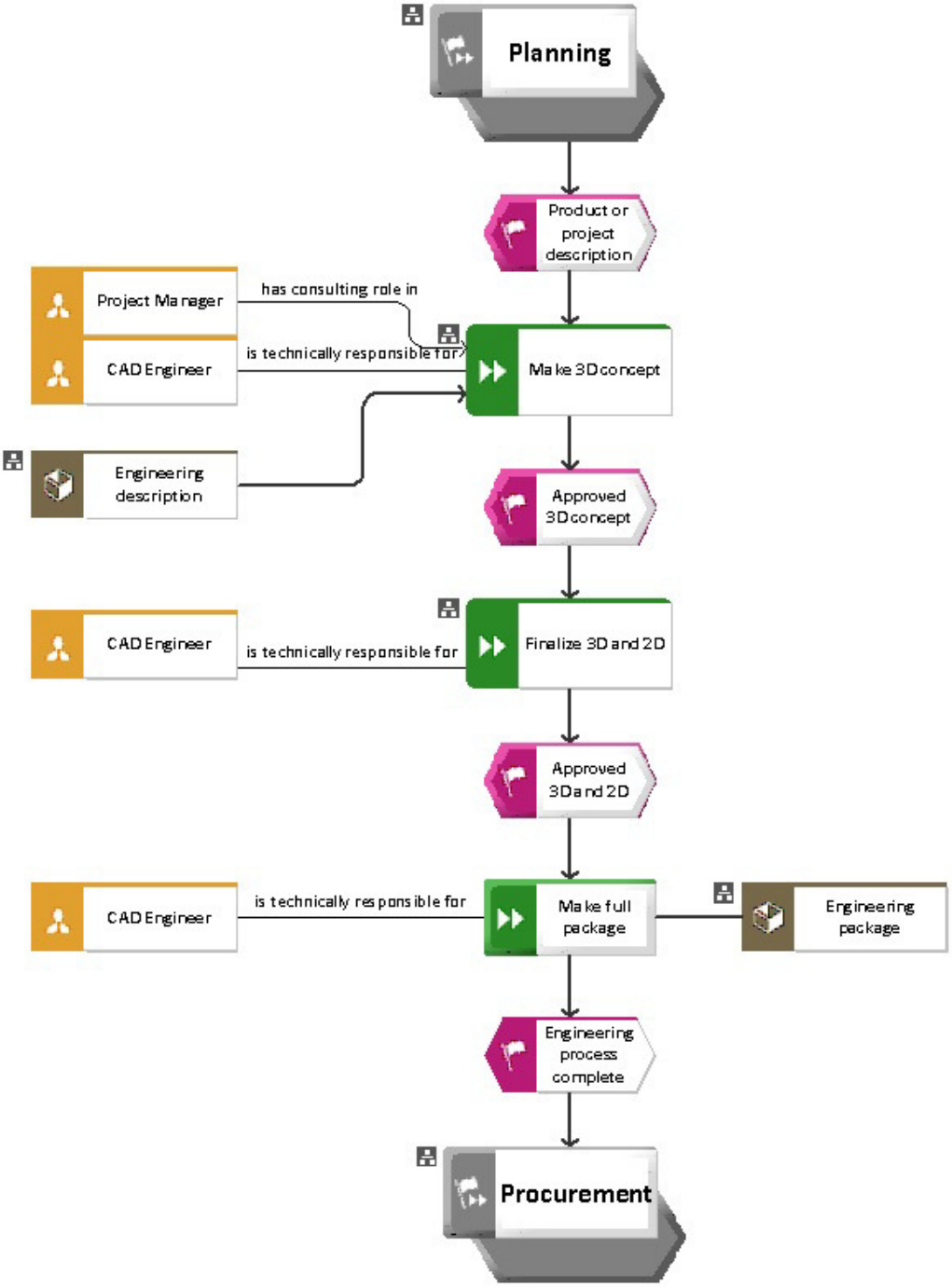


Figure 15. Apeco Engineering Process AS-IS

Source: Author

4.1.5 Apeco Procurement Process

After engineering comes procurement what receives major input from engineering package (Figure 16). The engineering package provides information for procurement main activities. Organization has due to an experience and history list of possible vendors. Some of them are major partners; however there could be organizations who procure their products not so often. When possible vendors for particular order are selected then next step will be final selection among final round vendors. Then will be selected the vendor who will supply needed service or product. After final selection comes issue final documentation functions. It includes from organization side contract and purchase order. Purchase order is processed by software Erply. Contract will be made only when order is bigger than 10 000 Euros. All lower deals are covered juridical with general agreement.

When all documents are correct and approved as needed then next step is order waiting according to lead time. For example, during this process Project Manager may ask how far production is and avoid possible problems for assembly. In fact, all steel constructions and parts are outsourced.

When goods arrive in warehouse, then next step is documentation check and confirmation. All received products will pass visual quality control. However, there is risk that some components are missing or poor quality of products. In this case vendor will be informed about problems via official complaint. Complaint will be removed according to agreement.

Final stage in following process will be a comparison of PO and invoice. When there were no problems with quality or invoice, then accounting will get input for invoice processing. Each product or project has unique number and this will be added on invoice in order to receive data about expenditures with context of product or project.

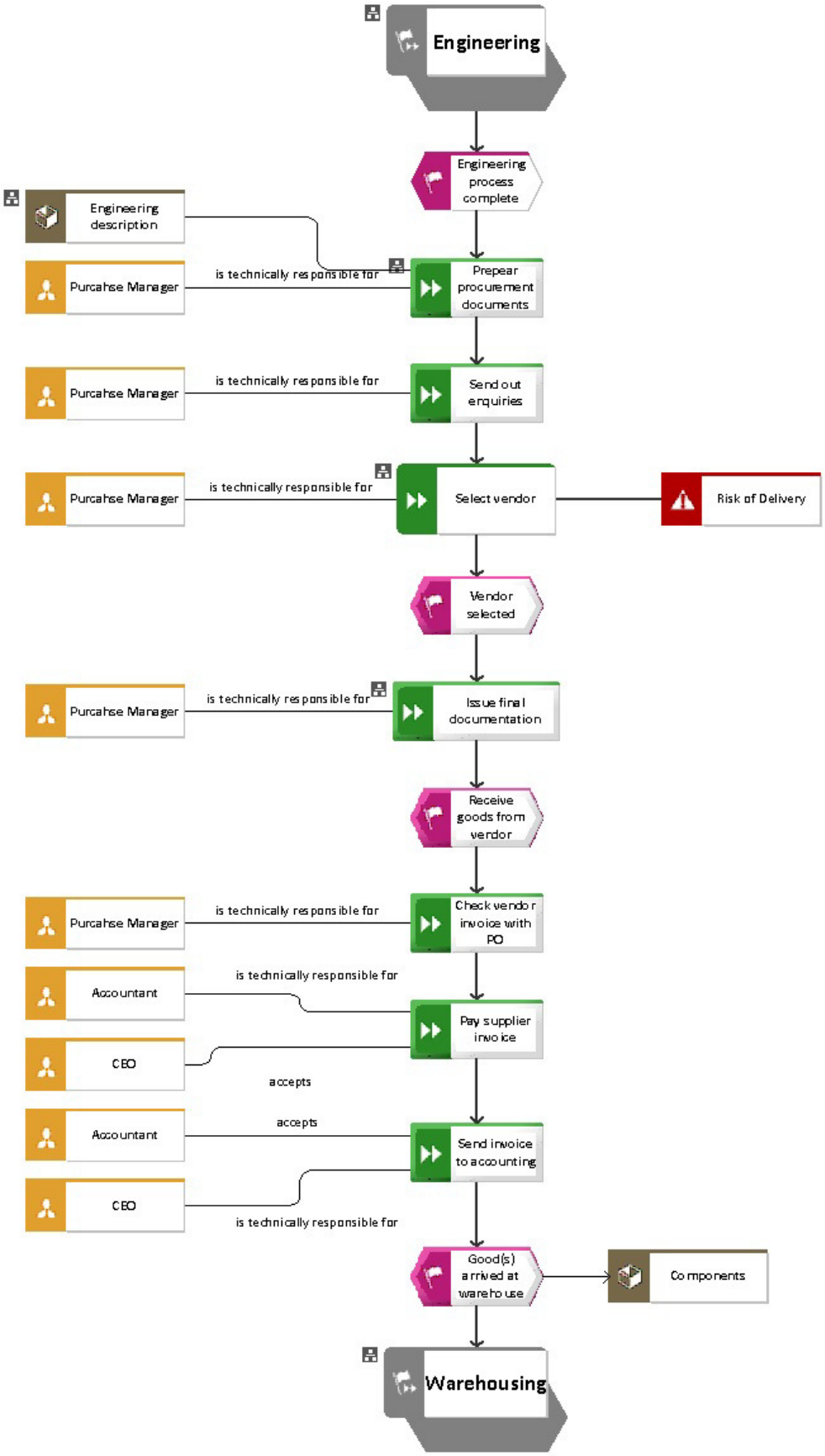


Figure 16. Apeco Procurement Process AS-IS

Source: Author

4.1.6 Apeco Warehousing Process

Apeco have warehouse where all ordered and produced goods are stored. Warehousing process starts with goods which are arriving into a building (Figure 17). Then worker who is responsible of receiving goods (e.g. technician) will take delivery note from truck driver. Products are stored in designated area. Most products are placed on standard ISO pallets. After that should responsible person type into a system that needed goods are ready and it is possible to use them (it means that they are available). If there are no goods which are related with project sales, then Sales Engineer is informing customer and make invoice.

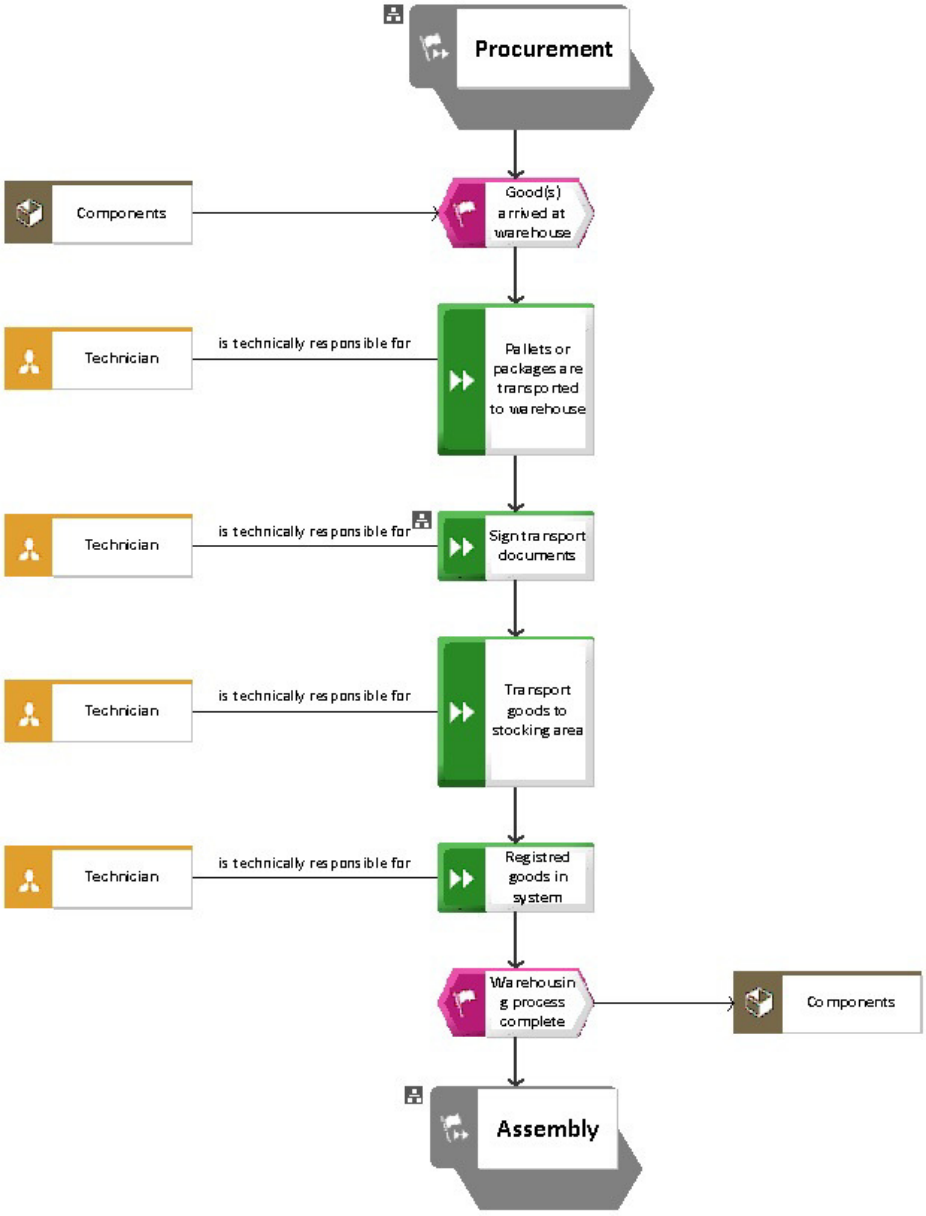


Figure 17. Apeco Warehousing Process AS-IS

Source: Author

4.1.7 Apeco Assembly Process

Assembly process starts with prepare assembly function where all needed assembly components are prepared (Figure 18). During preparation phase are carried out checks that control compliance according to process. However, there could happens a situation that some component or steel structure is missing. If this happens, then it is important to identify missing element and order new one. Ordering process should be as fast as possible because delivery date could seriously be affected.

With more complex products assembly, workers are supported by engineers in order to guide and help them. In addition to that, they may help to make them special drawings with explosion views. Normally, assembly workers have drawings with information on it and they do not need extra help. However, everybody is informed about these situations and if they have something to ask, then they must ask. Previously planned work changes are prohibited.

When preparation works are done then next step will be sub-assemblies preparation for production of assemblies. All operations under these functions are carried out by product based layout. It means continuous flow for those products with certain sequence of operation. Assembly procedures are complete when all needed components are in place. After that will come inspection for assembly before first test run. If test run where successful, technician will grease and label accordingly. All ready products are packed carefully for transport. Finally, package will get labeled delivery note and invoice.

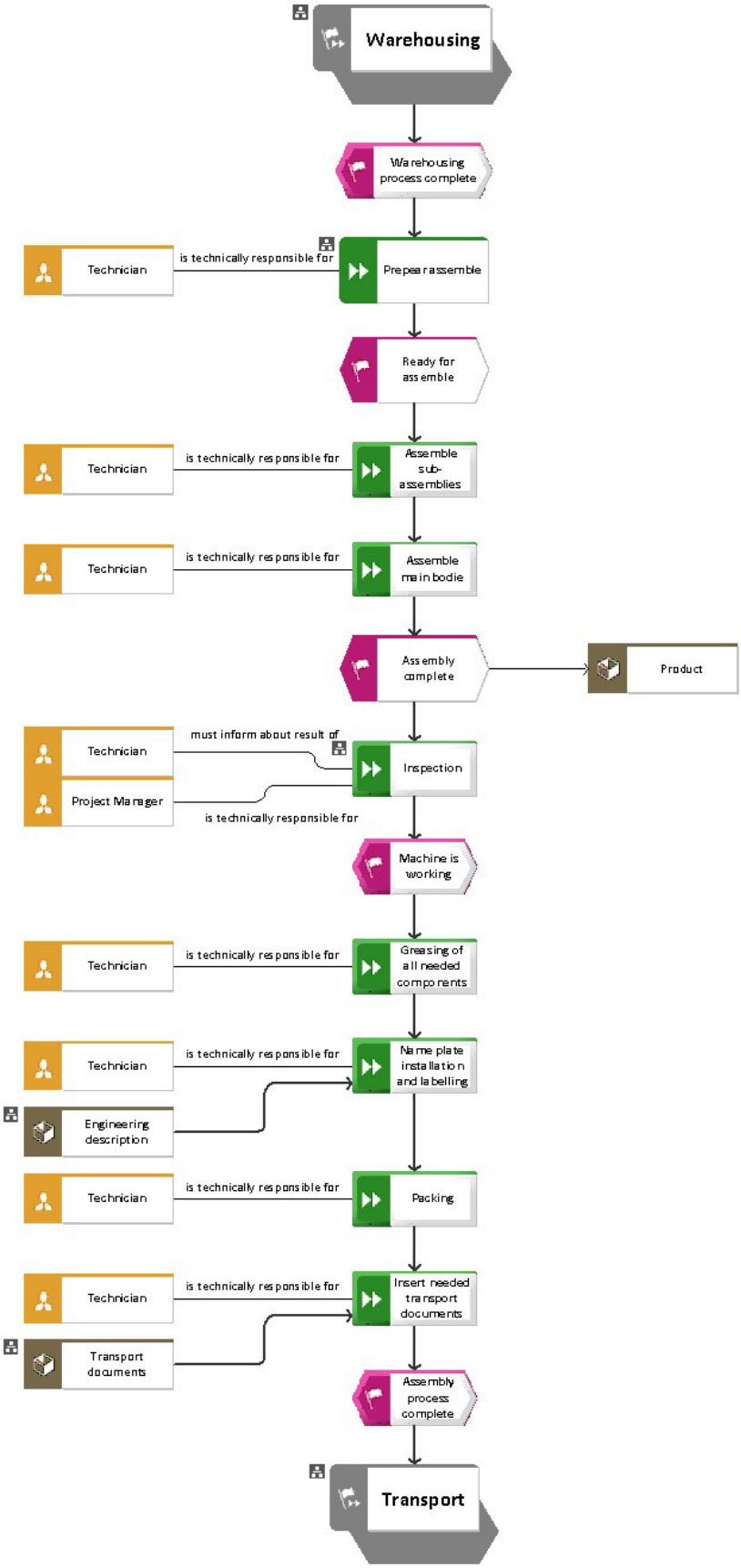


Figure 18. Apeco Assembly Process AS-IS

Source: Author

4.1.8 Apeco Transport Process

Transport process main objective is to carry items from one place to another. There are two possible ordering scenarios that normally occur (Figure 19). Customer will order transport by himself under delivery term EXW, or transport will be arranged by Apeco. First scenario will simplify whole process; on the other hand, Apeco does not have control over the process. Second possibility where transport is arranged by the Apeco, needs more resources but control over the process is achievable.

Information about transport will come from order confirmation and printed out for warehouse worker under packing list. Mentioned list is necessary in order to pick up right products for order fulfillment. As this is the process what comes after transport order.

Selected items should be checked and packed in a way that they do not get damaged during transport. Materials for that purpose are provided and selected according to item. When packing is done, then product will be labeled with packing list sticker where all needed information for all parties are showed (e.g. customer, product name, quantity, weight, etc.) After all these procedures comes transport company and pick pallet or package from stocking are. Final function will be signing of transport papers.

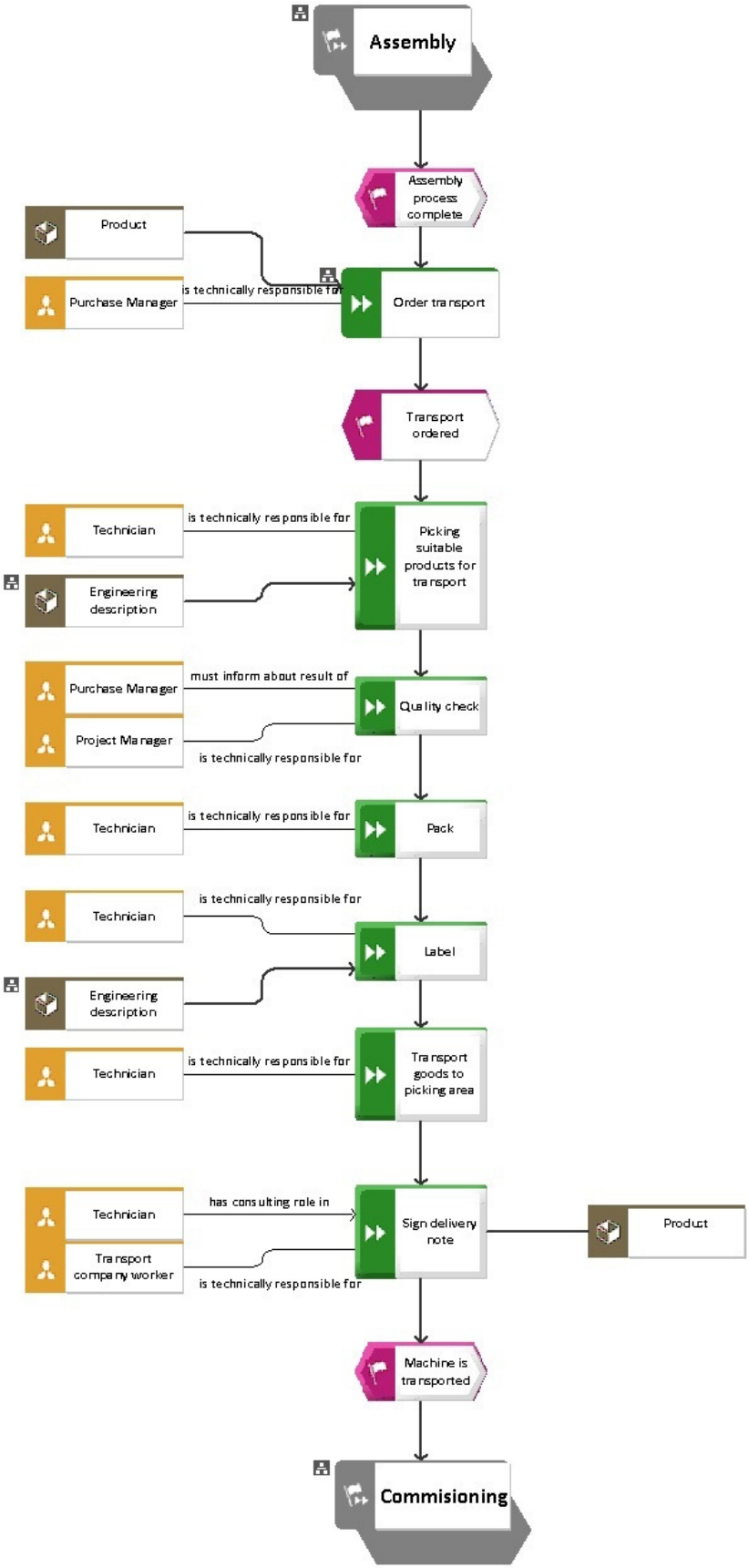


Figure 19. Apeco Transport Process AS-IS

Source: Author

4.1.9 Apeco Commissioning Process

Commissioning process includes activities during erection period (Figure 20). It will provide set-up of the product in a stage where it could be ready for the work. As a first step in whole process, machine which is a product will be adjusted. When everything is in order, then will be performed final test and if it succeed all expectation then training for the customer worker will be carried out.

Commissioning will be provided mainly under situations when customer order turn-key project which includes erection works on site. On the other hand, customer could decide not to order erection works and install all system by himself. Last scenario is a rather rare occurrence.

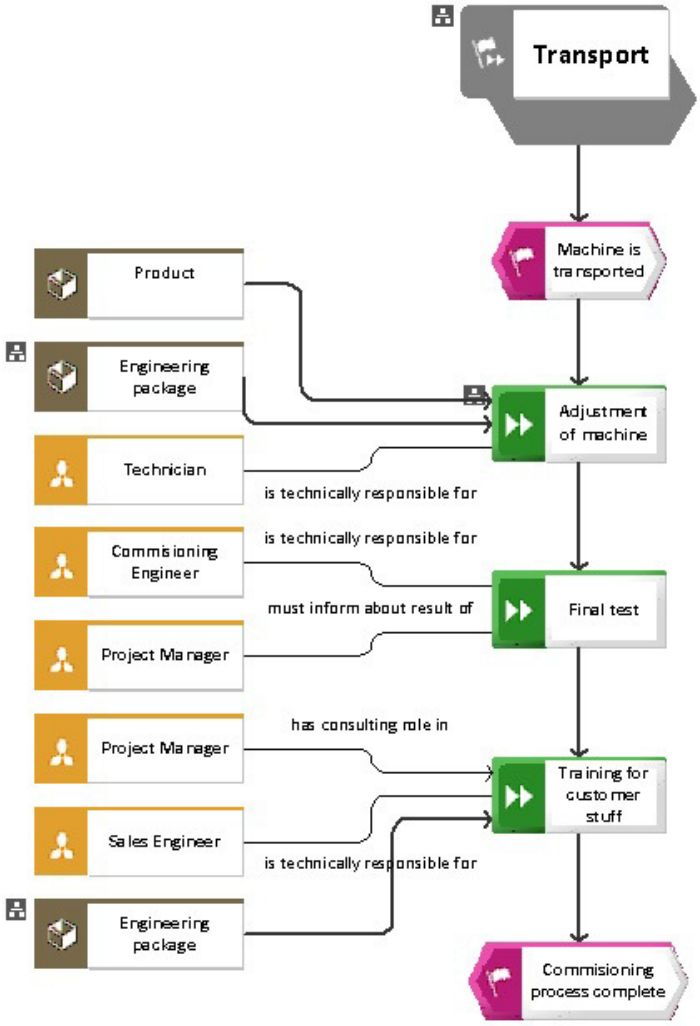


Figure 20. Apeco Commissioning Process AS-IS

Source: Author

5. PERFORMANZE ANALYZE

The core logic behind performance analyze is understanding of processes and creating base for measures and management. In order to make objective decisions, process engineers must carried out in first place business performance analyze, because process graphical description is limited and do not provide enough information for decisions.

Beginning of the paper author stated problems for Apeco, what are affecting organization performance. Author suggests using these problems as a baseline for Critical Success Factors (CSFs). The framework of performance analyze will be applied into TQM methodology. All CSFs are stated in a following way:

- we must deliver products with promised lead time;
- we must keep our processes continuous in a way that they produce value;
- we must have right supplier who meet our expectations;
- we must ensure enough working capital for operations;
- we must have excellent after-sales activities;
- we must ensure stable sales revenue;
- we need best information flow inside organization.

When all CSFs are clarified and agreed among team members in organization then next step is measurable Key Performance Indicators (KPI). The KPIs will be used to monitor progress and as evidence of success for the organization, in every direction, internally and externally [7; 248].

Author suggests choosing all important KPIs according to CSFs in a following way:

- Order Lead Time
- Supplier Lead Time
- Overall Process Effectiveness (OPE)
- Sales Revenue

Selected KPIs cannot be too complicated. Vice versa, they should be easy to maintain and follow. Team members have to ensure appropriate data what should be collected and

recorded. Helpful tools in this case could be, e.g. information systems. For instance, various accounting software's enables to export meaningful data about financial figures.

5.1 ARIS Simulation

Organizations must do decisions based on facts rather than feelings. All decisions need input in order to find best practice for processes. ARIS simulation software enables to analyze processes and see if processes are executable. As a result, ARIS help to find process weaknesses and bottlenecks.

Simulation is based on Apeco and has carried out on author's average measurements inside organization. All input parameters are given based on Apeco conveyor solutions product group which make most of operations inside organization. Main input data attributes are given through avg. wait time and avg. processing time. Wait time means time before process, e.g. preparation for production assembly. Processing time means time during specific process. Mentioned parameters are most relevant due to measured KPIs. Inserted numbers are average because results are base on more than one product.

When functions have needed values then next step is probability attribute under Events. Probability defines the probability of an object being processed or a relationship being run through. If the attribute is not specified, a probability of occurrences of 1 is assumed [24]. Probability value will be given from 0 to 1. Zero as no probability and 1 as absolutely probable. Such values are especially important if process includes two different Event scenarios after XOR and according to measurement, one of event has bigger probability.
After inserted parameters under function and events should be determined simulation period. Author determine simulation period as 30 days (April, 2015). Such period represent results approx. 1/12 of whole year. After that is reasonable to simulate each process and export all data about results. Finally, results must be converted into readable figures. For better overview all numbers are represented as cumulative results. It enables general view to all processes for better understanding.

Output of data processing will be figures about Processing time SUM among different departments. Based on Figure 21 findings is possible to see engineering part domination. Following results indicates too high process utilization. However, processing time can vary because of seasonality, project scope, etc. Although, simple products need less time for

engineering and more time for assembly. During analyze is important to understand that how results depend on various factors.

Graph represents processing time SUM during 30 days what includes one entity:

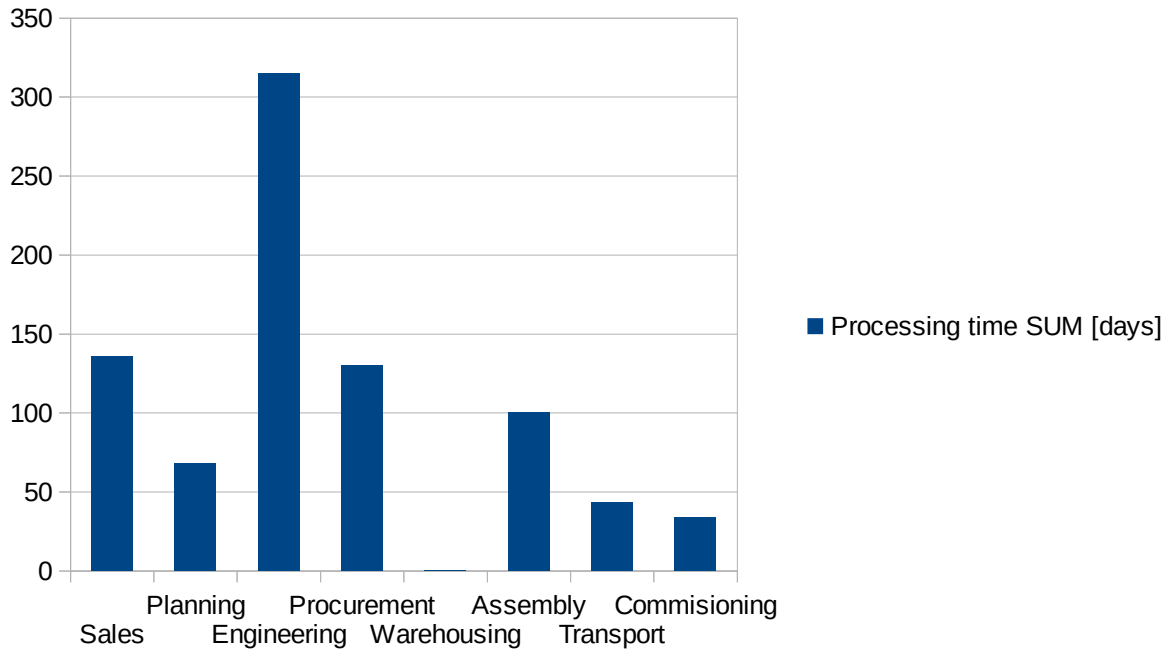


Figure 21. Apeco Processing Time SUM – AS-IS

Source: Author

Bottle neck theory from Theory of Constraints (TOC) emphasizes eliminating of all bottle necks and local optimizations in process. In that sense, should engineering be more effective in terms of processing time. Procurement cannot perform task if engineering have not provide them appropriate input data and vice versa. Final goal should be minimization of processing times under each process. High peaks should be leveled, because they do not allow moving fast and a stable way.

As each process inside organization have functions in order to perform tasks should be analyze processed functions. From Figure 22 is possible to see how processing time is linked e.g. with processed functions. Correlation between two separate indicators show that the number of engineering process functions are relatively low compare to assembly. On the other hand, assembly processing time is lower than procurement and sales.

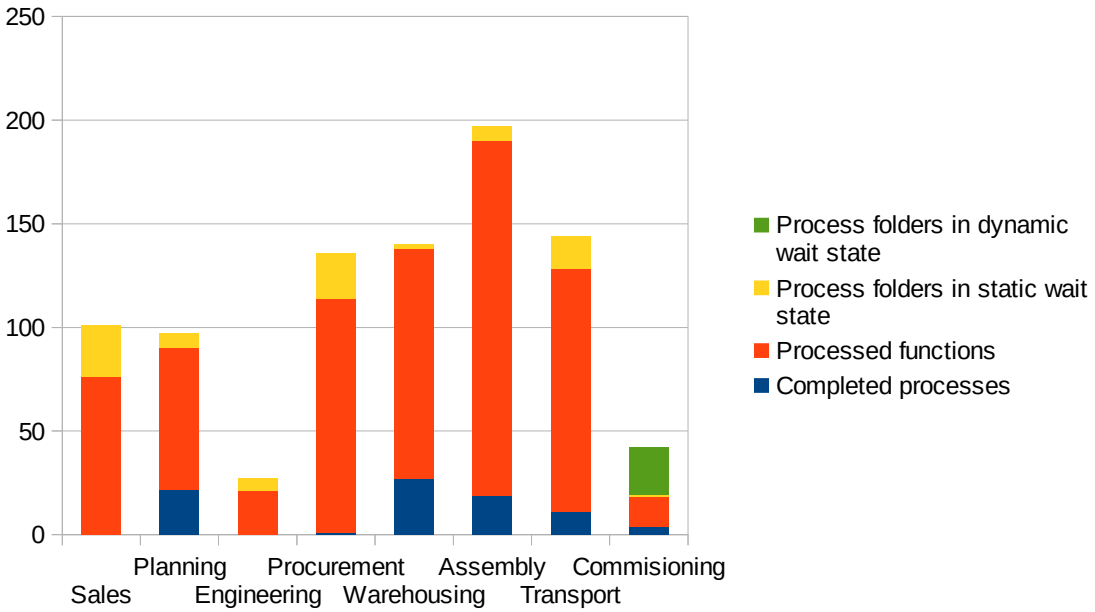


Figure 22. Apeco Process Information AS-IS

Source: Author

In context of "Process folder is dynamic wait state" under commissioning process shows rather high numbers. Best viewpoint will appear from Figure 23. The goal should be maximization of complete processes and decrease of process folder is dynamic wait state. Reason for this is created value what should be one of the most important aspect in process optimization.

Theoretically, complete processes shows that functions are complete. Statistics about Apeco shows that planning and warehousing complete most processes. In contrast, sales, engineering and procurement complete least processes. Sales, engineering and procurement are processes which consume time, especially sales where process management are difficult in most cases. Process scenario depends on many factors such as: customer decision, market situation, lead time, etc.

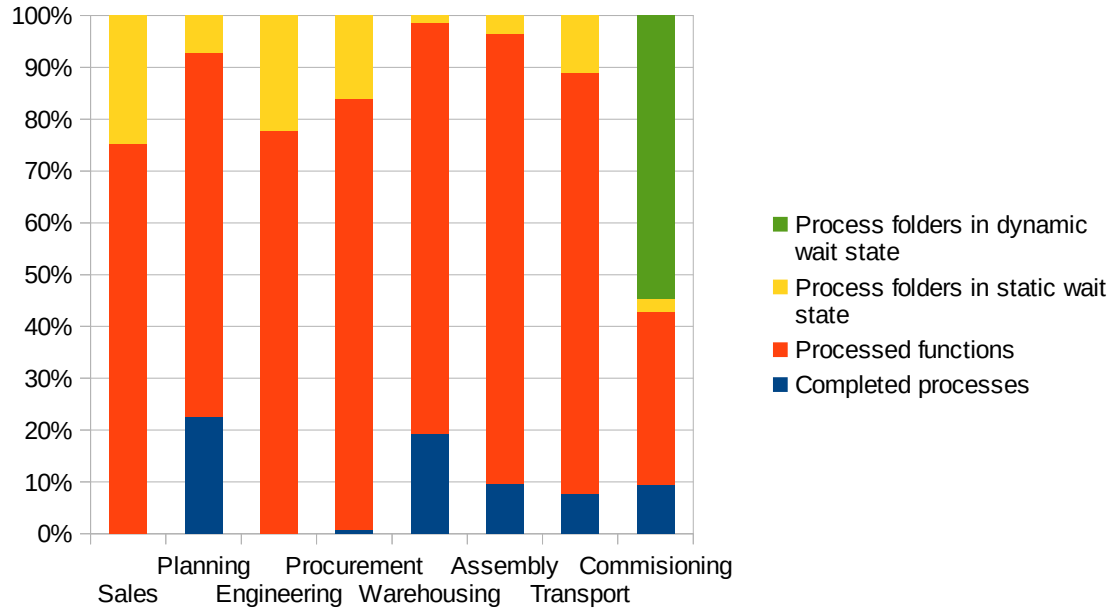


Figure 23. Apeco Process Information in Percentages AS-IS

Source: Author

As engineering is currently weakest process from all other processes. Then deeper analyze of the process is needed. ARIS enable to analyze processes from events and functions. Engineering have 4 different events and 3 different functions on a first EPC level. ARIS simulation tool provide for both graphs about process. Totally, have process more functions because of sub-processes under 2 level EPC functions.

Process folders received specifies the number of process folders that have arrived at an event in the current simulation run. The simulations specify this attribute for all events that are not start events. [24]

Process folders processed specify the number of complete functions executions based on the last simulation run. [24]

Activations specify how often an event or a rule was activated during the last simulation run. An event was activated if a process folder left the event i.e., if the event has occurred and assumed the value True. A rule was activated if a process folder left the rule during the last simulation run. Process folders with identical process number arriving at the rule from different paths are counted only once. [24]

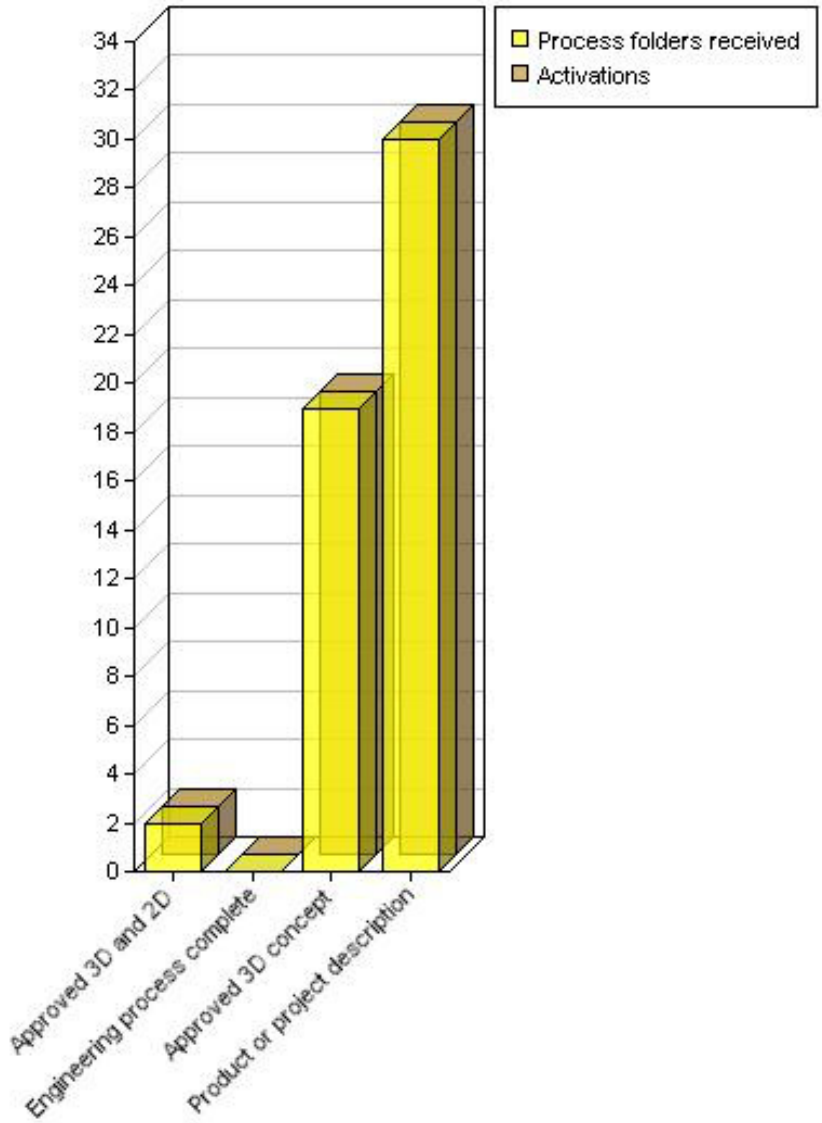


Figure 24. Event Process Folders Received and Activations AS-IS

Source: Author

Above showed Figure 24 describes how many process folders received and activations have done during 30 days for 1 entity. Product or project description shows most activations and engineering process complete least activations. According to sequence, events starts from the beginning lower numbers of activations and end, where will be more activations. Based on graph is relevant linear increase of activations.

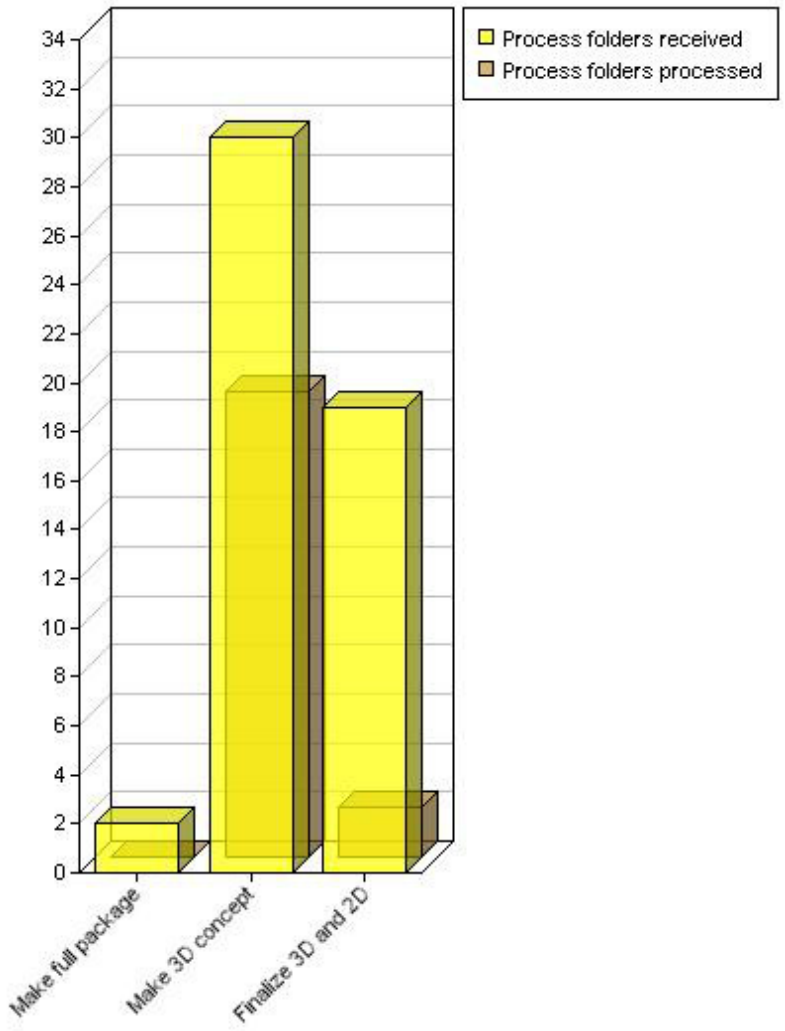


Figure 25. Functions Process Folders Received and Process Folders Processed AS-IS

Source: Author

Functions are improved with function allocation diagrams. It means that most functions include other functions and main objective of such approach is to optimize graphical view of information user. The load of information should be adequate rather than spreading. From process folders received view is relevant linear increase as events in engineering process (Figure 25). On the other hand, process folders processed shows non-linear graphic with more stable bars. It indicates to a more stable process flow.

Make 3D concept receives more process folders than actually are able to process. This is first function what must be completed before heading to next one which is finalization of 3D and 2D. High number of process folders received indicates on large input rather than

capacity to perform task on given time period. According to that should be reasonable to level a process folders received more down.

Processes where dependence of external factor is highest are hard to manage. Hence, controlling of process plays a crucial role. It is organization responsibility to control and receive feedback about process development. Simulation is only one step of whole process.

5.2 Apeco TO-BE Model

TO-BE model represents outcome of analysis which will be the base for improvement. It shows the concept how process should become from AS-IS concept. In fact, AS-IS model quality must be determined by organization policy for better understanding. Same approach should be common with TO-BE model.

As results of simulation showed – main improvements are needed with engineering what affect process EPC level most. According to analyze other processes need minor improvements and, therefore they are not described in details. However, final results on improvement occur after implementation period.

Organization can improve process by many ways. For instance, increasing the number of employees would be the one solution. Hence, this kind of solution increases cost and responsibility. Organization must avoid simple and fast solutions what are not scalable before decision. Fact based decisions with appropriate analyze help to fulfill objectives of the improvement.

Current TO-BE scenario increase engineering department efficiency by combination of PN concept with other smaller internal improvements like web based input form filled by partner, process guide, etc. In contrast, procurement, engineering and sales have less complete processes and are one with the most processed functions percentage. The importance of complete processes express in process efficiency. Mentioned Figure 23 shows that sales process does not complete processes. It indicates that process is inefficient due to a combination of long processing time and complete processes.

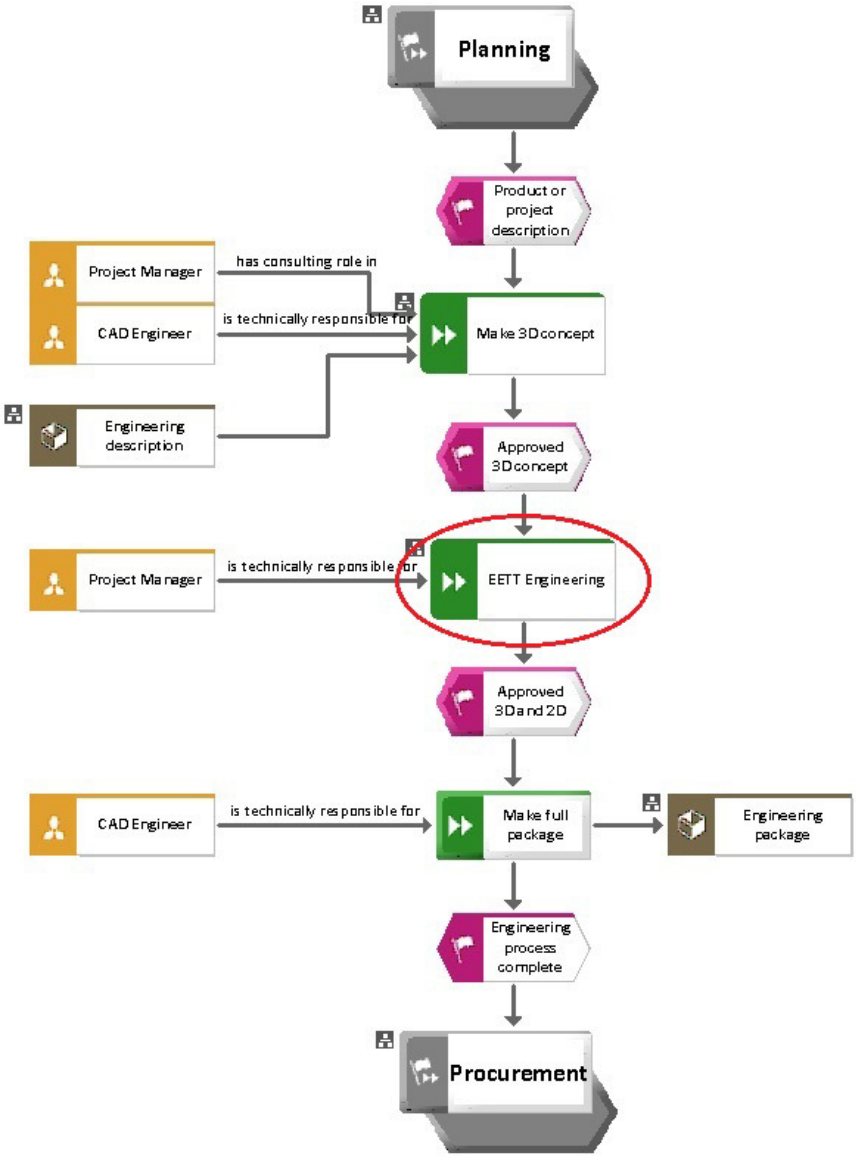


Figure 26. Apeco Engineering EPC Level TO-BE Process

Source: Author

First of all, previously have organization gathered input data through regular e-mail. For instance, Project Manager will send out enquiry and ask quotation with base documentation. Documentation normally include following information:

- Technical parameters;
- Due date;
- Needed documentation;
- etc.

Valid quotation is needed in order to avoid misunderstandings in future. Preventive action can be achieved by price list what bound different parties to agree on pricing. In order to avoid mess is important to use systematic approach what ensures certain flexibility. Author highlights possibility to use web based filling forms what input all needed data by vendor for order fulfillment. For example, today all major logistics organization are using web forms for order fulfillment. We can call it "pull" type of information exchange.

Previous approach was very slow due to quotation waiting time. Partner long time for quotation was caused normally by overload of work. Another problem was selective approach by possible vendor who constantly seek bigger orders. Smaller orders were not interesting due to low volume.

Apeco engineering process starts right after they have received initial working task. If Apeco is focal player in PN then is possible to interact procurement process before purchase department action. It enables to save time in procurement process. Paralleling will get partner who is in PN order from Project Manager by filled web-based form. Required data fields are specified by the partner.

When partner has been selected then feedback about order process are required by partner, who is offering product or service. Previously Project Manager have asked progress information by e-mail. Suggested new approach assume that partner give feedback about progress by himself more convenient way, e.g. inform about progress in percentages with help of web. (e.g. how many percentages of 100 have been done so far) . Suggested feedback period will be about 1 week.

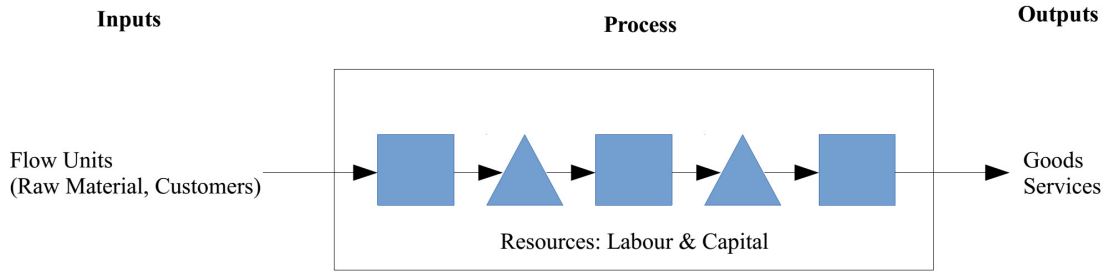


Figure 27. The Process View of an Organization

Source: [27; 15]

Selected partner in PN network provide goods and services according to "black box" principle (Figure 27). Partner will receive input and should provide output as agreed. All costs are covered by product or service provider.

PN imitative requires partner who have needed background for deliverable service or product (Figure 26). Current paper has chosen for main engineering partner Eesti Energia Tehnoloogiatööstus AS (EETT). The main idea behind PN imitative is own engineering department engineering efficiency increase. Chosen organization is offering engineering service under engineering department. Base numbers for partner cost calculations are given based on EETT general price policy.

After simulation with new TO-BE model in ARIS, EETT help to decrease engineering department processing time as theoretically was planned (Figure 28). Totally new concept reduced engineering time 4 days. Although, Apeco gained process where their responsibility is not any more so high and same time available resources can perform more tasks.

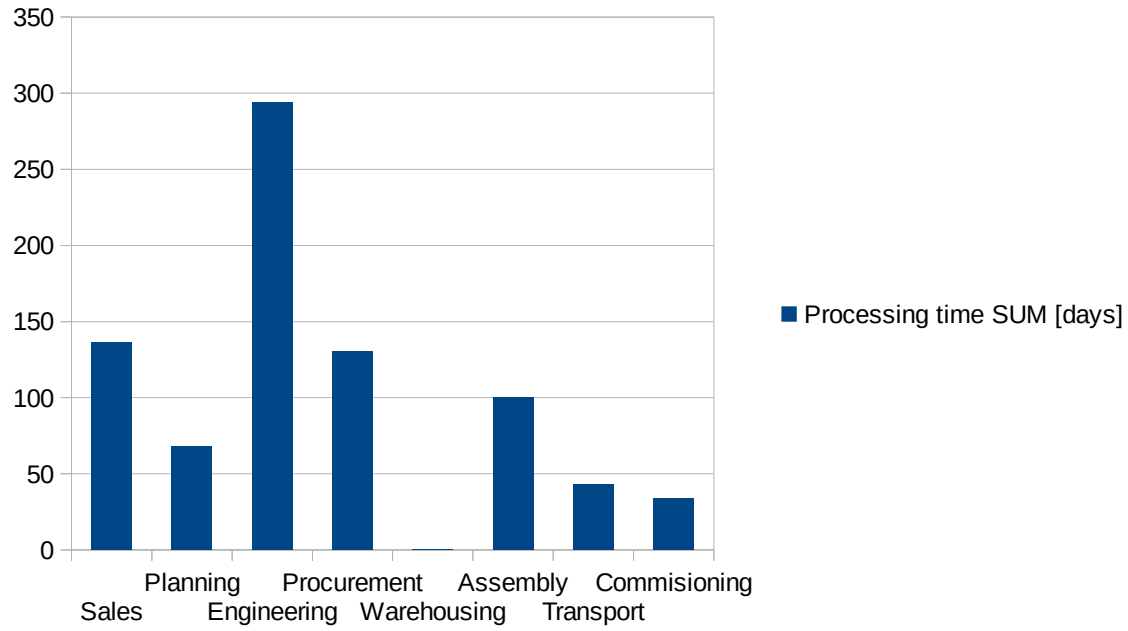


Figure 28. Apeco Processing Time SUM – TO-BE

Source: Author

Apeco engineering process has dropped from 315 to 294 days. Another important aspect is numbers of complete processes in TO-BE model (Figure 29). When previously none of processes under engineering where complete, then with new model, engineering

complete process. For example, new concept allows completing 12 such engineering projects in a year.

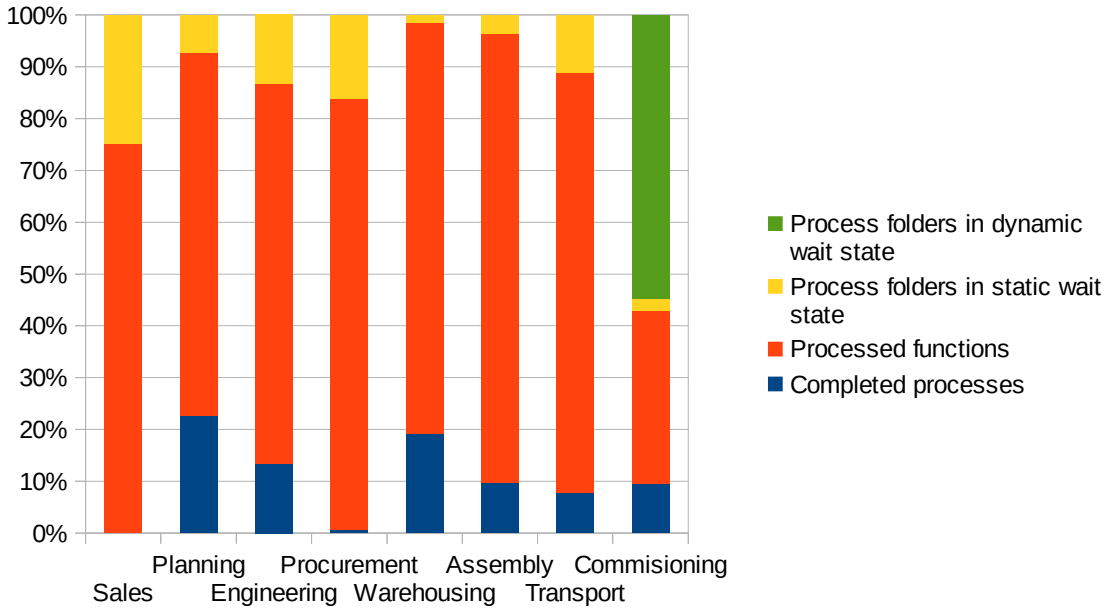


Figure 29. Apeco Process Information in Percentages TO-BE

Source: Author

When going more deeply into process then TO-BE process under "event process folder received and activations" have improved number of approved 3D and 2D event (Figure 30). It has been caused by PN imitative. EETT reduced time for that specific event and overall result are better.

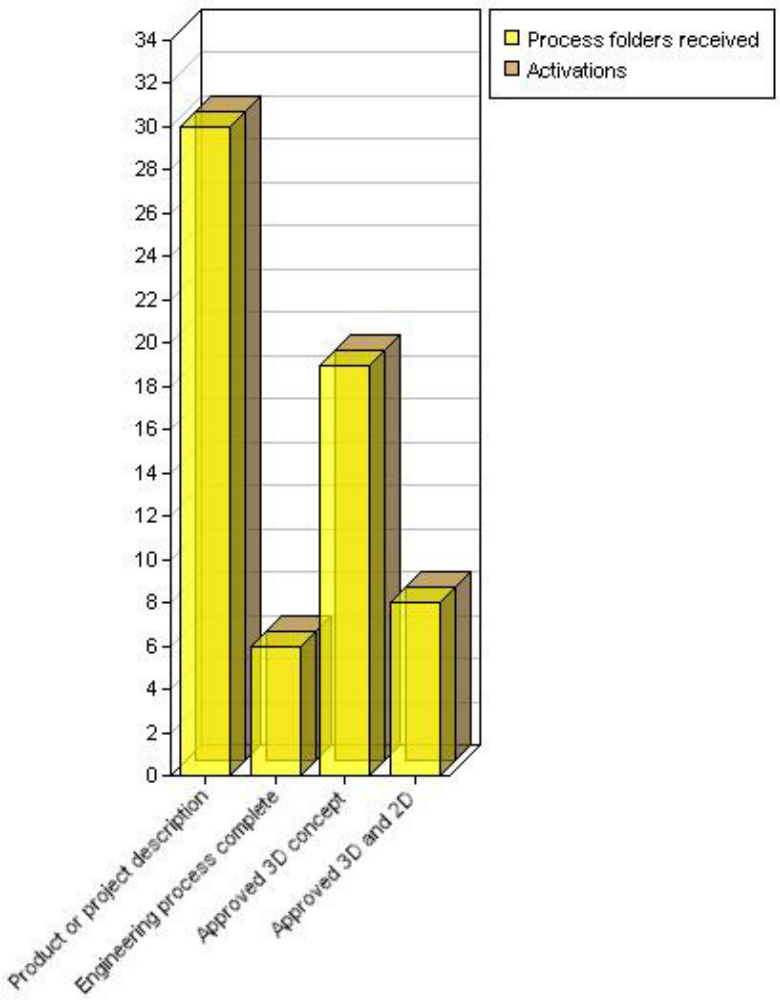


Figure 30. Event Process Folders Received and Activations TO-BE

Source: Author

The analyzes shown above only describe events. Thus, to see full overview about process we must identify changes under functions. Overall all functions are more leveled especially process folders processed. From Figure 31 is possible to note that "Finalize 3D and 2D" have changed with "EETT Engineering" according to Figure 26.

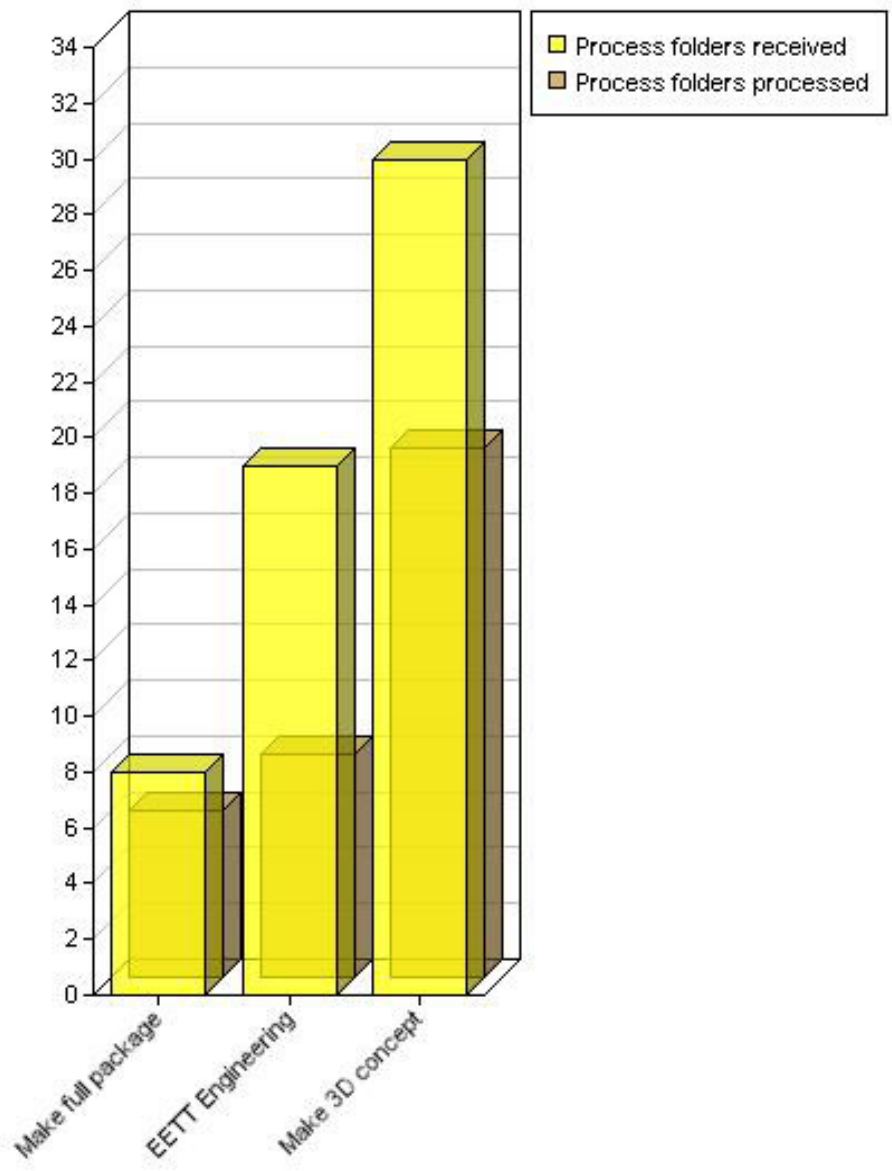


Figure 31. Functions Process Folders Received and Process Folders Processed TO-BE

Source: Author

6. FINANCIAL PART

Organization is an economically working environment where financial decisions must be justified. Possible investment into a development project should earn value and pay back after certain period of time. When organization invests into particular project, management should keep in mind main objective of investment.

Most well know formula for evaluation of investment is described as return of investment (ROI). ROI will be base for calculations in current paper as well. For instance, is reasonable to set up payback time and track what is the success factor of the project. Author will find all needed variables in ROI calculations according to financials based on organization. ROI will be determined by formula as following:

ROI = (Gain from Investment – Cost of Investment) / Cost of Investment

6.1 Costs in Apeco

Currently Apeco does have 2 CAD Engineers who cover all needed operations under engineering department. All calculations are made based on Estonian law what state that average number of working hours in one month is 167 hours [22]. It makes in total with two engineers 334 hours. Based on Apeco internal hour rate policy, sell organization engineering with price 25 EUR/hour. The rate is base for all budgets which need engineering service. Totally organization can sell engineering hours in one month 8350 EUR what makes in one year 100 200 EUR. It will be maximum potential what organization is capable to sell. Normally, organization does not exceed 100% of utilization rate. Fulfillment rate varies due to work description and mainly engineering period what extend longer than planned. And this is the major root problem for engineering.

For good overview about ratio between incomes and expenses, author calculates break-even point (BEP) under engineering. Break-even point describe situation where total costs and revenues are equal. Under the point, all sold hour are loss and below that point, all sold hours are profit. Based on Apeco engineering department cost structure will total costs consist of following items:

- labor cost;
- CAD software cost;

- CAD software service pack cost;
- other costs.

In financial figures overheads under engineering department are divided as showed in Table 5.

Table 5. Costs in Euros Under Engineering Department

	Month	**Year**
Labour Costs	3 710 €	44 520 €
CAD Software + service packs	567 €	6 804 €
Other costs	100 €	1 200 €
SUM:	**4 377 €**	**52 524 €**

Source: Author

Apeco products are often unique and project based. It will set certain limitations to budgeting, e.g. difficulties to see actual costs due to poor knowledge base. As organization internal policy defines, Sales Manager is responsible for project budget creation. Budget must include planned engineering cost what means cost for all components which affect one or another way whole cost structure. According to that, plan will set certain limits to resources. Although plan is made based on organization experience from previous times. As a fact, normally utilization rate does not exceed target. In real life, that kind of situation means costs under target budget and that way real loss for organization will occur.

Root cause under engineering is ration between planned time VS actual time. For instance, Sales Manager planned for engineering 100 hour, but actually engineering spend 130 hours. From organization point of view, it means 30% of unplanned time. Moreover, engineer cannot perform next task before previous work has been done. If this pattern occurs regularly, it will affect financial result seriously. Today, based on organization experiences engineers perform tasks more than 25%...50% than actually was planned. It will make approx. 1/4...2/4 from their working time.

For better analyze author finds following working hours in one month:

- Average (AVG) working hours;
- Maximum (MAX) working hours;
- Break-even point (BEP) working hours.

For BEP in units (working hours) author perform equation where total costs are divided with sold unit price. Calculation has been done as following:

$$BEP = 4377 / 25 = 175 \text{ hours}$$

Maximum working hours are determined before in total 334 hours.

Average working hours are calculated with average percent from experiences. If average percent of overdone hours varies from 25% to 50% then average percent is 37,5 %. It will add in total 16, 27% to BEP hours. In numbers, AVG will be 209 hours.

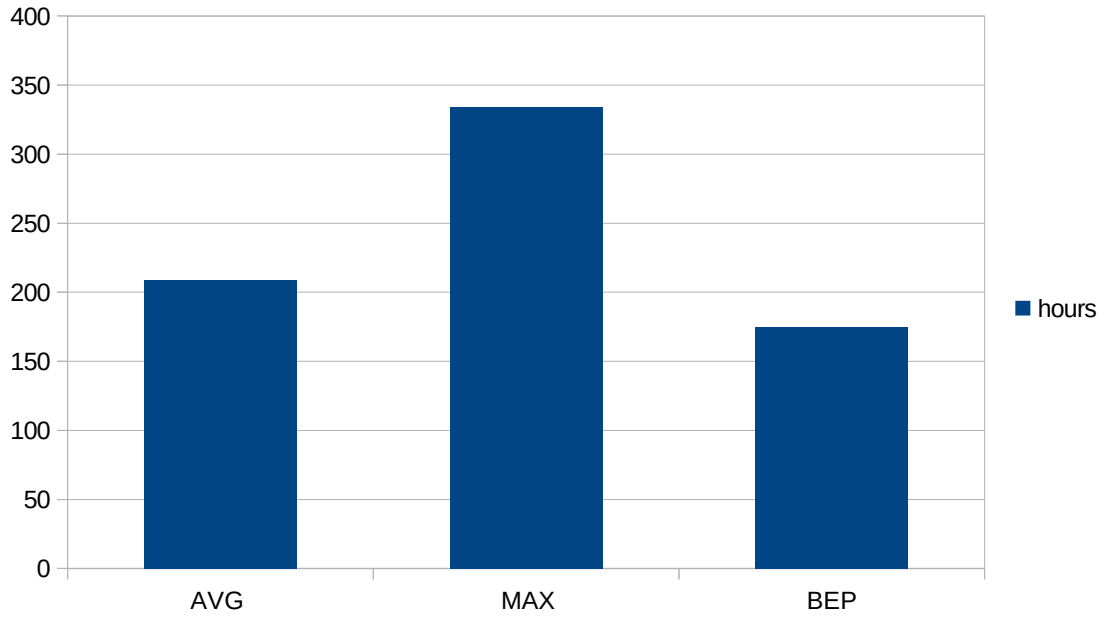


Figure 32. Comparison of Engineering Hours

Source: Author

As a result from Figure 32 is easy to note that AVG hours are slightly bigger than BEP hours. All in all, organization make profit surprisingly approx. (209x25) – (175x25) = 850 EUR. Potential maximum profit will be about (334x25) – (175x25) = 3975 EUR.

6.2 Costs in EETT

Partner cost calculations are made based on regular Apeco Belt Conveyor product series. EETT receive from Apeco initial data with technical calculations and 3D Models. According to that provide partner following input data:

- average processing time for detail drawings;
- average processing time for assembly drawings;
- total average waiting time;
- cost for whole package.

According to gathered information engineering lead time of EETT is 9 working days . 20% of that time is Avg. waiting, what will make in numbers 1, 8 days. Total lead time for EETT engineering is approx. 11 days (88 hours). Engineering will be done by 4 engineers and cost of one hour engineering will be 35 EUR. Based on given data will cost engineering:

$$\text{Engineering Cost} = 88 \times 35 = 3080 \text{ EUR}$$

For Apeco will be cost of engineering 3080 EUR + VAT. This cost does not include time for technical calculations and 3D Models.

Technical calculations and basic 3D model will be made by Apeco. In contrast, Apeco have lower engineering hour price, but longer process time. For instance, EETT generate whole package with 11 days, but Apeco could do same amount of work with 15 to 18 days. For better overview about work allocation and price differences will give following table:

Table 6. Engineering Process Comparison With EETT

Process	Organization	Days	Hours	Hour Price	Hour Price SUM
Work description	Apeco	2	16	25,00 €	400,00 €
Technical Calculations	Apeco	2	16	25,00 €	400,00 €
3D Model	Apeco	11	88	25,00 €	2 200,00 €
2D Model	Apeco	17	136	25,00 €	3 400,00 €
Documentation	Apeco, EETT	2	16	25,00 €	400,00 €
	SUM:	**34**	**272**		**6 800,00 €**

Process	Organization	Days	Hours	Hour Price	Hour Price SUM
Work description	Apeco	2	16	25,00 €	400,00 €
Technical Calculations	Apeco	2	16	25,00 €	400,00 €
3D Model	Apeco	11	88	25,00 €	2 200,00 €
2D Model	EETT	11	88	35,00 €	3 080,00 €
Documentation	Apeco, EETT	2	16	25,00 €	400,00 €
	SUM:	**28**	**224**		**6 480,00 €**

Source: Author

The comparison shown on Table 6 emphasizes differences between two possible ways to solve engineering. First scenario is only based on Apeco, where total cost for engineering is 6800 EUR. Second scenario use help of EETT, where total cost of engineer is 6480 EUR. Differences are 5%. Main differences are cost and process time. Surprisingly, always not all internal operations are economically profitable compare to outsourced services.

Author assume that ARIS Cloud software will help to arrange process more effective way by setting up systematic approach. As current paper focus on Apeco process improvement cycle and tools what should be implemented in order to gain objectives. Then all investment calculations are based on ARIS Cloud software because it is easy to integrate it into Apeco business operations. Produced data by ARIS will be stored in cloud and responsible members of organization can make changes if needed.

Author suggest firstly to use 2 designer licenses and 5 viewer licenses. Comparable software packages from ARIS are basic and advanced version. As name of software package indicates have advanced version more capabilities, e.g. customized reports, permission management, etc. Therefore, in reasonable to compare mentioned packages. Indeed, there are one package more called ARIS Cloud Enterprise, but author finds it will be too expensive for SMEs. Based on ARIS local representative quotation are prices of software as showed in appendix 1 and 2.

One year of Basic software license cost in total 3242,76 EUR and for Advanced software 4864,56 EUR. According to monthly based costing cost software for Basic

270,23 EUR and Advanced 405, 38 EUR. The cost of software acquisition is not the only component. ARIS Implementation cost structure includes:

- ARIS software price = 270, 23 EUR/month
- Trainings and consultation (32 hours x 25 EUR) /12 = 67 EUR
- Total cost 337,23 EUR/month

From organization point of view have ARIS software only value then when it have economical outcome. Ideally, it should increase effectiveness. Earned value should be bigger than invested money. To analyze real effect of investment, we should understand how much is possible to gain with EETT and ARIS. ROI calculations are based on one year period and shows following results:

Gain from investment = 320 x 12 = 3840 EUR
Cost of investment = 337,23 x 12 = 4046,76 EUR
ROI = (3840 – 4047) / 4047 = - 0,05

Above made calculations shows that in 1 year period organization manage to hold almost same level. Author assumes that second year will earn back investment and make economical effect.

CONCLUSION

The objective of current thesis was to research BPM opportunities in SMEs. Specifically, research focuses on small organization Apeco problems on the basis of the theory that process management concept allow to bring in processes clarity and transparency which in future help to do improvements. In order to discover all opportunities for process improvement, is important that changes interacts all members of organization from different levels. Different departments have different needs and therefore should improvements be constant.

Following paper starts with introduction to the topic and describes organization what will be the base for research. Problems are stated at the beginning with relevant information that connects with research question. Theoretical part describes generally theory about business process management and different modeling languages. Author draws main focus to ARIS software what enables to implement improvements based on organization. All main processes under VAC and EPC level are described in ARIS as a AS-IS model. Previously mentioned model is baseline for the model with improvements. Hence, improvements will be done in ARIS Simulation and defined as TO-BE model under EPC level. It is model what describes how process look like in future.

One part or paper analyses collaborative project management framework for partner network initiation. As a real case, Apeco who is the base organization in thesis (and also focal player), plan to use external help from Eesti Energia Tehnoloogiatööstuse (EETT) to perform task. Cooperation has planned to be done under engineering activity what turned out to be the biggest bottleneck among other processes in Apeco. New framework enables not only to send and receive feedback about processes faster, but also help to increase utilization rate inside organization.

As Apeco is small organization with already working market and growth potential, should be essential to consider various improvement frameworks. Already described partner network imitative allow increasing overall competitiveness in a way that give positive effect. Author compare processes under EPC level and find relevant results what supporting the theory. Business process management and ARIS software decrease cost of engineering and lower the cumulative process time.

The study was set up on BPM models what are relevant to quality management. Dynamic processes enable to use process approach for achieving better results in quality

management. Applying obtained result from future perspective is possible to establish solid foundation for quality management system. As one of the organization future plans are ISO 9000 obtainment. Topics covered in paper create input for implementation. All this serves one of the main target to increase overall customer satisfaction.

Another important topic covered in study where CSFs what are closely related with TQM. The factors what are essential for the organization in order to improve operations. All CSFs were created based on problems in organization. All set CSFs are strong input for Apeco in future. As they are factors what organization members must follow and understand. As a result increases problems awareness inside organization.

Process approach needs efforts towards implementation. By structuring gradually author uses combination of TQM, BPM and ARIS. That kind of approach should be applicable to other SMEs as well. The implementation process itself need right mindset by organization personnel and management. Possible investments into people and software need reasonable time and result can be achievable after certain time of period. The organization who is implementing it has to follow systematic and continuous approach in order to be successful.

Future opportunities related with paper in case of SMEs are structuring issues and implementation after improvement. Future improvements gets input after implementation where is possible to analyze results.

To conclude, process variations are common for any organization and reflect problems what must be solved. Calculations in thesis showed sufficiently good results in order to encourage organization to continue to use framework. Objectives of work where accomplished.

KOKKUVÕTE

Antud magistritöö eesmärk oli uurida äriprotsesside kasutamise võimalusi väikese ja keskmise suurusega ettevõtetes. Täpsemalt keskendub teadustöö väkeettevõtte Apeco probleemidele lähtudes teooriast, et protsessi juhtimise kontseptsioon muudab organisatsiooni eelkõige arusaadavamaks ja läbipaistvamaks, mis omakorda võimaldab tulevikus muudatusi ellu viia. Et avastada kõik võimalused protsesside parendamiseks, on oluline, et muudatustesse oleks kaasatud organisatsiooni kõik liikmed eritasanditel. Erinevatel osakondadel on erinevad vajadused ning seetõttu peavad muudatused toimuma pidevalt.

Magistritöö eesmärgiks on:

- parendada Apeco äriprotsesse ARIS tarkvara abil;
- leida ettevõttes Apeco võimalus koostööprojekti juhtimise raamistiku kasutamiseks, et luua partnervõrgustik;
- rakendada ning analüüsida EPC (Event-Driven Process Chains) modelleerimise keelt, mida hiljem oleks võimalik ettevõttes Apeco juurutada.

Suurem osa väikse ja keskmise suurusega ettevõtetest ei ole teadlikud protsessi juhtimise võimalustest. Juhul, kui ollakse teadlikud, kasutatakse tihtipeale staatilisi protsesse, mida muuta on keeruline ja aeganõudev. Autor pakub käesolevas magistritöös välja alternatiivi dünaamiliste protsesside näol, mis baseeruvad konkreetsel tarkvaral. Antud uurimustöös on kasutatud protsesside modelleerimise tarkvara ARIS.

Käesolev töö algab organisatsiooni, mis on antud teadustöö baasiks, kirjeldamisega. Kõik olulisemad probleemid koos asjakohase informatsiooniga on ära mainitud ning loovad pinna uurimuseks. Teoreetiline osa annab ülevaate äriprotsesside juhtimisest ning erinevatest modelleerimiskeeltest. Autor on fookusesse seadnud ARIS tarkvara, mis võimaldab kirjeldada ja simuleerida erinevaid äriprotsesse. Sealjuures on kõik põhilised protsessid VAC ja EPC tasandil, mis on kirjeldatud ARISe abiga AS IS mudelina. AS IS mudeli all on mõeldud eelkõige baasprotsessi, mille alusel parendada tulevikumudelit. Kõik parendused on tehtud ARIS simuleerimise tarkvara abil ning seejärel on loodud TO BE mudel. TO BE mudel kirjeldab, milline võiks protsess tulevikus olla.

Üks osa tööst keskendub koostööprojekti juhtimise raamistikule partner võrgustiku alusatmiseks. Projekteerimise protsessi lähemalt analüüsides selgus, et antud protsessi puhul on tegemist kõige aeganõudvama tegevusega kogu protsesside ahelas, mistõttu kasutas Apeco oma projekteerimise protsessis TO BE mudelis Eesti Energia Tehnoloogiatööstust (EETT). Koostööd on planeeritud teha mainitud ettevõtte projekteerimise osakonnaga. Uus raamistik võimaldab mitte ainult saata ja saada tagasisidet protsesside kohta, vaid ka kiiremini suurendada tootlikkust organisatsiooni sees. Antud raamistikku plaanitakse rakendada tulevikus aset leidvates projektides, eriti projektide müügis, kus võimalike variatsioonide arv toodetes on keskmisest suurem.

Käesolevas magistritöös on Apeco puhul tegemist juba töötava väikeettevõttega, mis omab kasvupotentsiaali ning seetõttu on äärmiselt oluline leida tegevusi toetavaid raamistikke, et kasvu toetada ning jätkata. Partnerite koostöövõrgustik võimaldab suurendada üleüldist konkurentsivõimet viisil, mis omab positiivset mõju kogu tarneahelale. Autori eesmärgiks on võrrelda uurimustöös erinevaid protsesse EPC tasemel ning jõuda tulemusteni, mis toetuksid teooriale. Äriprotsesside juhtimise ja ARIS tarkvara kombineerimise tulemusena vähenevad nii kulud konstureerimisele kui ka kumulatiivse protsessi aeg.

Uuringus loodi äriprotsesside mudelid, mis seostuvad kvaliteedijuhtimisega. Dünaamilised protsessid võimaldavad efektiivselt kasutada protsessi lähenemist, et saavutada paremaid tulemusi kvaliteedijuhtimises. Saadud tulemusi tulevikus rakendades on võimalik luua kindel vundament kvaliteedijuhtimise süsteemile. Ühtlasi on magistritöös käsitletud teemad heaks lähtepunktiks ISO 9000 taotlemisele, mis on ettevõttel tulevikus kindlasti plaanis. Kõik see teenib ühte peamist eesmärki, milleks on kliendi rahulolu suurendamine.

Ühe olulise teemana on magistritöös käsitletud kriitilisi edutegureid (KE), mis on tihedalt seotud tervikliku kvaliteedijuhtimisega (TQM). Need on tegurid, mis on olulised organisatsioonile tervikuna, et parandada kvaliteediprotsessi. Kõik loodud KE baseeruvad Apecos esinevatel probleemidel. Need on tegurid, mida organisatsiooni liikmed peavad probleemide ennetamiseks ja lahendamiseks mõistma ja järgima.

Lõputöö on üles ehitatud järk järgult kasutades erinevaid raamistikke nagu TQM, BPM ja ARIS. Tehtud arvutused näitasid, et eelnevalt käsitletud raamistikku on võimalik kasutada, kuid selle rakendamisel peab Apeco tulevikus vaeva nägema. Antud lähenemist on võimalik kasutada ka teistel väikestel ja keskmise suurusega ettevõtetel. Protsess vajab eelkõige õiget mõttelaadi organisatsiooni juhtkonna poolt ning üleüldist valmisolekut

meeskonnalt. Investeerides inimestesse ja tarkvarasse tuleb arvestada sellega, et tulemused on kättesaadavad alles mõne aja möödudes. Selleks, et olla edukas on oluline, et organisatsioon, mis juurutab antud lähenemist, teeks seda süstemaatiliselt ja järjepidevalt.

Kokkuvõttes on protsesside sisene varieeruvus, mis aitab peegeldada probleeme, millega tuleb tegeleda, ühine kõikidele organisatsioonidele. Tekkivaid pudelikaelu ning kitsaskohti tuleb käsitleda kui loomulikult esile kerkivaid nähtusi. Organisatsiooni ülesanne on antud protsessidega toime tulla ning suurendada kohanemisvõimet. Tehtud kalkulatsioonid lõputöös näitasid piisavalt häid tulemusi, et julgustada organisatsiooni liikuma edasi antud raamistiku juurutamisel. Töös seatud eesmärgid said täidetud.

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APPENDICES

Appendix 1. ARIS Cloud Basic Quotation

Environment	Product Name	Product Code	Usage	Qty	Price Model	Operating System	License Fee (incl.EAUR)	Maintenance Fee Annual	Maintenance Duration (in month)	Maintenance Fee Duration	Subscription Fee	Subscription Duration	Subscription Duration Unit
Production													
Production	ARIS Cloud Basic - Design (Hosted in EU)	YPLDE	Production	2	Named User cumulative	Hosted Software	0,00	0,00	0	0,00	2 937,36	12,00	M
Production	ARIS Cloud Basic - Vwr (Hosted in EU)	YPLCE	Production	5	Viewer	Hosted Software	0,00	0,00	0	0,00	305,40	12,00	M
						Totals	**0,00**	**0,00**		**Totals**	**3 242,76**		

Appendix 2. ARIS Cloud Advanced Quotation

Environment	Product Name	Product Code	Usage	Qty	Price Model	Operating System	License Fee (incl.ExUR)	Maintenance Fee Annual	Maintenance Duration (in month)	Maintenance Fee Duration	Subscription Fee in EUR	Subscription Duration	Subscription Duration Unit
Production													
Production	ARIS Cloud Adv - Desgn (Hosted in EU)	YPLEE	Production	2	Named User cumulative	Hosted Software	0,00	0,00	0	0,00	4 406,16	12,00 M	
Production	ARIS Cloud Adv - Vwr (Hosted in EU)	YPLBE	Production	5	Viewer	Hosted Software	0,00	0,00	0	0,00	458,40	12,00 M	
						Totals	**0,00**	**0,00**		**Totals**	**4 864,56**		