DEPARTMENT OF
MECHANICAL
AND INDUSTRIAL
ENGINEERING

DEVELOPMENT OF DIGITAL AUDITING FRAMEWORK FOR ANALYSING DIGITAL TRANSFORMATION POSSIBILITIES OF ENTERPRISE PLASTONE OÜ

DIGIAUDITEERIMISE RAAMISTIKU LOOMINE NING SELLE RAKENDAMINE JA DIGITAALSETE MUUDATUSVÕIMALUSTE LEIDMINE ETTEVÕTTES PLASTONE OÜ

MASTER THESIS

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Tallinn, 2019

AUTHOR'S DECLARATION

Hereby I declare, that I have written this thesis independently.
No academic degree has been applied for based on this material. All works, major viewpoints and data of the other authors used in this thesis have been referenced.

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THESIS TASK

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Thesis topic:

(in English) Development of digital auditing framework for analyzing digital transformation possibilities of enterprise Plastone OÜ

(in Estonian) Digiteerimise raamistiku loomine ning selle rakendamine ja digitaalsete muudatusvõimaluste leidmine ettevõttes Plastone OÜ

Thesis main objectives:

1. to develop digital auditing framework, based on existing methods of auditing, to assess the level of digitalization of small and medium-sized enterprises in Estonia
2. to find out in compliance of main strategical goals of the company Plastone OÜ fields of development in area digitalization
3. to perform experiment, in which digitalized application (sensor with help of program Dimusa) is applied in company Plastone OÜ

Thesis tasks and time schedule:

No	Task description	Deadline
1.	Company Plastone OÜ and importance of digitalization	26.10.2019
2.	Industry 4.0 framework and theoretical methodologies for research	02.03.2019
3.	Methodologies for research	09.11.2019
4.	Results of the research	30.11.2019
5.	Analysis of the research results	21.12.2019
6	Conclusions of the research results	30.12.2019
7	Digitalization actions and further developments	04.01.2020

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Tööstustehnika ja juhtimise
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07.01.2020

Palume kehtestada ***Tuuli Allasti*** lõputööle teemal ***Development of digital auditing framework for analysing digital transformation possibilities of enterprise Plastone OÜ*** avalikustamispiirang ning avalikustada **TalTech** raamatukogus ainult annotatsioon ja metaandmed, kuna lõputöö sisaldab firma Plastone OÜ ja konkreetse käimasoleva ettevõtte halduspro grammi vahetamise projekti kohta konfidentsiaalseid andmeid.

Allkiri

…….

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Tuuli Allast

Tudeng

Table of Contence

PREFACE

The Master Thesis was composed in co-operation with company Plastone OÜ. The research direction was stated and topic formulated with help of supervisor Tauno Otto. From company has been helping with consulting former Plastone Saue Plant Manager Heikki Läti. With materials and consulting has been much support by Plastone Managing Director Peeter Mõrd.

I dedicate the Master Thesis to my partner in life Allan Midri and to our two kids, who all have been enough patient to walk this road with me.

LIST OF ABBREVATIONS AND SYMBOLS

CADCAM – computer aided design and computer aided manufacture

CEO – chief executive officer

EAS – Enterprise Estonia

ERP – enterprise resource planning

FIG – figure

ICT – information and communication technology

KPI – key performance indicator

MVMM – manufacturing value modelling methodology

M2M – machine to machine

RAM – responsibility assignment matrix

R&D – research and development

SME – small and medium sized enterprises

SWOT – strengths, weaknesses, threats, opportunities

VDMA – German Engineering Federation

VOC – voice of the customers

2D – two dimensional

3D - three dimensional

5S – sort set shine standardize sustain

INTRODUCTION

The topic is timely, because production companies are striving towards more efficient work and higher competitiveness through new technological possibilities.

The purpose is to develop digital auditing framework, based on existing literature to assess the level of digitalization of small and medium-sized enterprises (SME:s) in Estonia. The questionnaire is applied on injection moulding service providing company Plastone OÜ. There is purpose to find out main strategical goals of the company in the area digitalization. Master thesis introduces plastic injection moulding company Plastone OÜ – its structure and main activities. There will be brought out currently applied programs and software applications in the company and analysed the companies main software strengths weaknesses threats and opportunities.

There are mapped the main reasons for injection moulding company Plastone OÜ to digitalize the company. The production company Plastone OÜ has applied during the thesis writing period several times for digital auditing support by Enterprise Estonia. During the early summer the application was approved and 10.06.2019 was the start of the project. The main finding of the auditing is, that there is need for modern enterprise resource planning (ERP) system. The new ERP implementation will start since the beginning of January 2020. In the master thesis is analysed employees expectations to new ERP system by evaluating the possible new functionalities in importance scale.

There has been as well performed an experiment in field Industry 4.0 in May 2019 by using one additional sensor and program Dimusa – to measure amperage changes of one injection moulding machine. The use of additional sensors to measure production efficiency is one element of Industry 4.0 principles. The gathered log of amperage changes is compared with production stops info gathered from setters. There will be concluded the main reasons for production stops at viewable period.

In the final part of the thesis is brought out action plan of company Plastone OÜ in ERP implementation and field of digitalization.

1 COMPANY PLASTONE OÜ AND IMPORTANCE OF DIGITALIZATION

1.1 Plastone company overview

Plastone is contracted to produce high quality plastic components by means of injection moulding. Plastone also offers comprehensive additional related services, either itself or through Plastone large network. Plastone mainly focuses on plastic products for the:

- health care sector
- electrical
- electronics industry

Quality evaluation and continuous improvement of products are the central values in Plastone value chain. Through direct honest and fast way of conducting business, Plastone wants to provide added value to customers and owners. [1]

Slogan of company Plastone has been for years: Your one-stop partner in thermo-plastics subcontracting. Plastone wishes to supply its customers injection moulding and related services from one source.

Down following in Fig 1.1 is picture of Plastone Saue factory building and in Fig 1.2 picture of injection moulding machines.

Fig 1.1 Plastone Saue factory

Fig 1.2 Plastone Saue factory injection moulding

Plastone actively develops its knowhow to provide its customers the best possible practices in the production of their products. Plastone strives to be amongst the first in exploring new technologies and utilizing them to benefit its customers.[1]

Down following in Fig 1.3 is picture of robot gripper transporting products to cooling line.

Fig 1.3 Robot gripper

Plastones aim is to be part of the product development as early as possible in the life cycle of the product. This way Plastone is capable to help its customer to choose solutions that are effective from the production and material technic perspective. The technical experts working in Plastones customer interface are at the disposal of our

customers research and development (R&D) departments. With the aid of computer aided design and computer aided manufacture (CAD/CAM) programs Plastone is capable to draw realistic three-dimensional (3D)-pictures and to create two-dimensional (2D)-pictures. The pictures and prototypes can be used in various simulating programs, for example: mass flow, visualizing possible weaknesses in a product or for choosing a more functional raw material for the product. With help of Plastones 3D printer, can be quickly printed visual prototypes. Plastone is capable to acquire an extensive range of materials through its network. There is as well possibility to produce small production ranges based on 3D printing through Plastones network.[1]

Mould manufacture is generally performed by Plastones partners. That is the reason, why Plastone is capable to deliver effective and competitively priced moulds for different types of products. Plastones own mould manufacture is focused on trimming, changing and repairing moulds, but Plastone also produces few moulds from start to finish on an annual basis. Plastones own mould manufacture guarantees a swift response to problematic situations.[1]

While purchasing moulds over the years, Plastone has selected a number of mould suppliers as good co-operation partners.[1]

After each series is finished the moulds are serviced, their condition is checked and after that each mould is stored in Plastones separate mould warehouse, awaiting the manufacturing of the next series.[1]

Down following in Fig 1.4 are pictures of injection moulding main tools - moulds.

Fig 1.4 Injection moulding moulds

Plastone has different possibilities of injection moulding of plastic parts:

- Micro injection moulding 0,1- 3 g. Babyplast injection moulding machine is ideal for the production of micro parts and it is suitable for all types of thermoplastic materials up to 420 °C.
- Standard injection moulding 3-700 g. Most of Plastones products are traditional injection moulding products, that have weight between 3 and 700 g.
- Large injection moulding up to 2,5 kg. Therefor are 2pc of 1000 T machines, 1pc of 900 T machine.
- Two component injection moulding
- Plastone manufactures liquid silicone products by our partners. Medical appliances and a variety of seals are typical examples of silicone products
- Hot melt moulding is a very suitable method for protecting connectors as well as electronic components. This technique can be used to encapsulate, for example, surface mount printed circuit boards containing the components of a product without harming it
- Clean room production – ISO-8 graded clean room in Nurmijärvi. In addition to clean room, Plastone has a capability to injection mould plastic parts, where separate isolation is built around injection moulding machine, reducing the risk of dust particles and other possible contamination. [1]

Down following in Fig 1.5 are pictures of injection moulded parts.

Fig 1.5 Injection moulded components

Post injection moulding activities are: assembling work, printing through tampo printing method and laser marking, gluing, welding, packing, sterilization by trustworthy partners in our network.[1]

Down following in Fig 1.6 is picture of assembly line, where next to handling of injection moulding parts, are made many other activities.

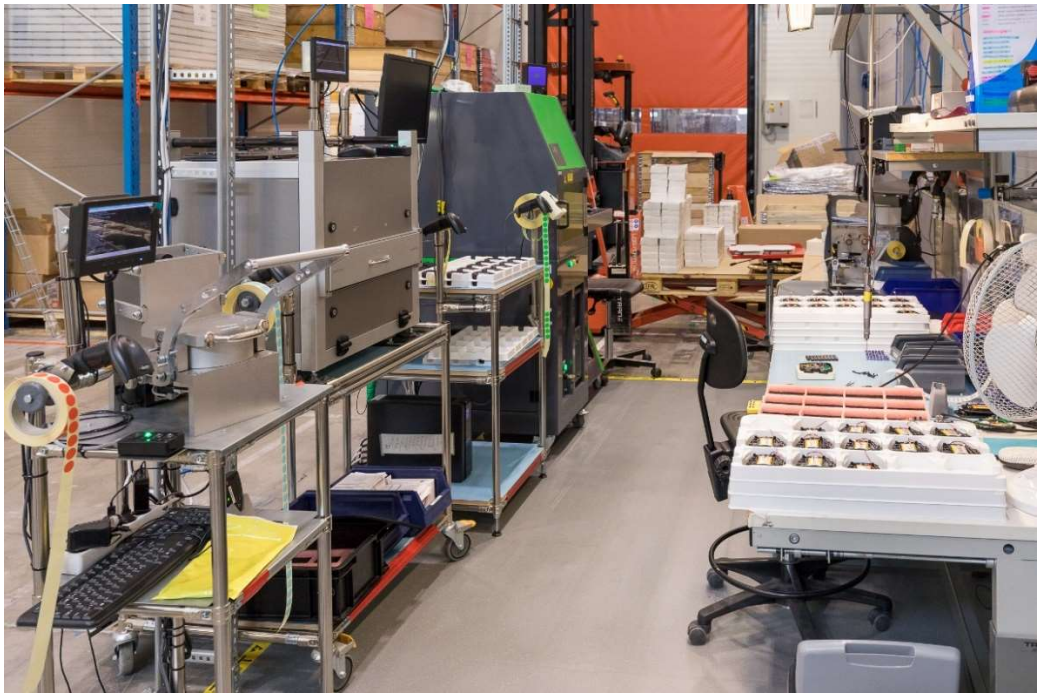


Fig 1.6 Assembly line

Down following in Fig 1.7 is brought out Plastone organization chart.

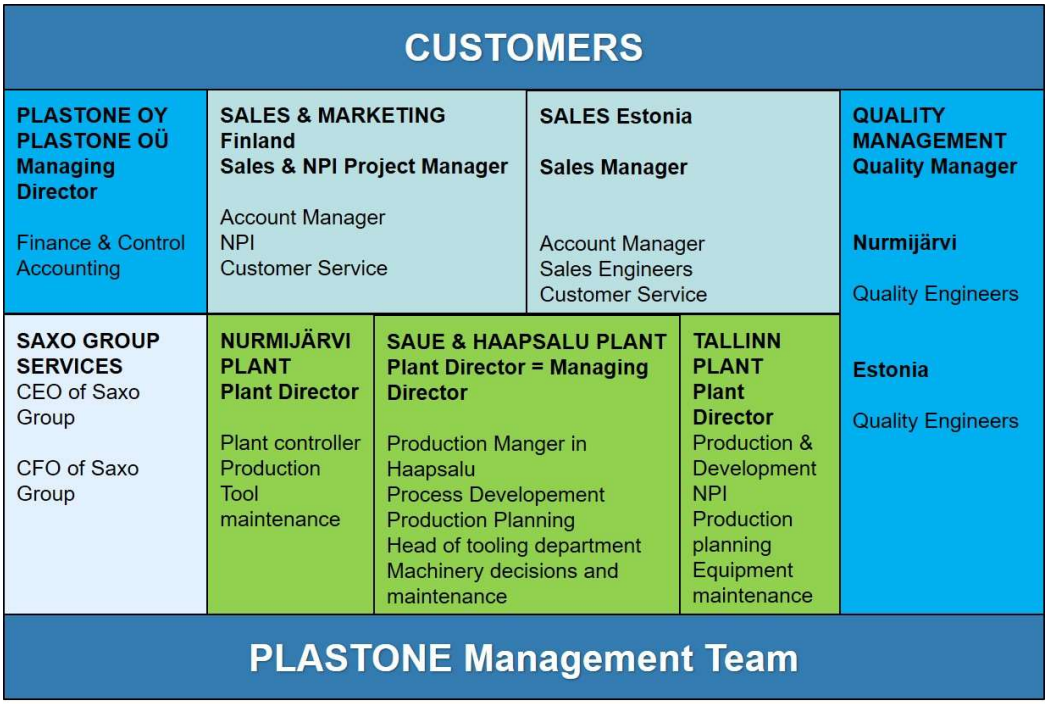


Fig 1.7 Plastone organization chart

Down following in Fig 1.8 is brought out value chain of the company Plastone OÜ.

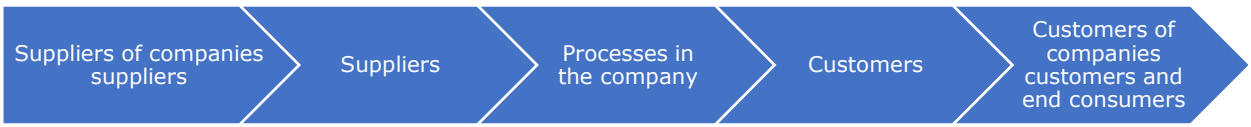


Fig 1.8 Horizontal value chain

Down following in Fig 1.9 are brought out main processes in the company Plastone OÜ.

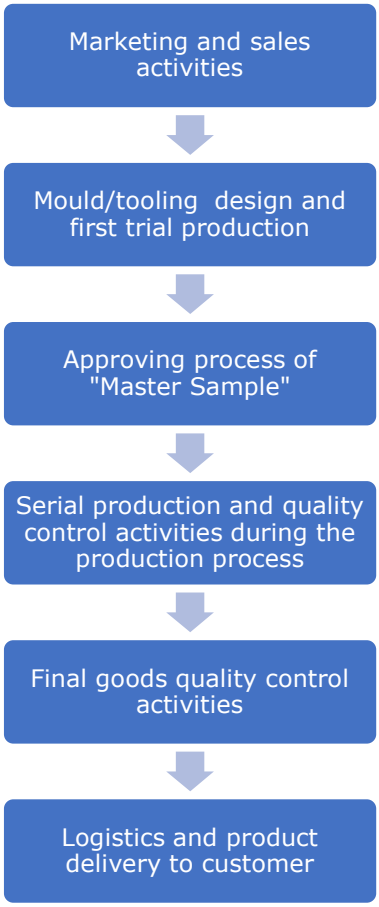


Fig 1.9 Processes in the company (vertical value chain)

In field of Information and Communication Technology (ICT) Plastone has many systems in use, which simplify daily work. There has been in use for a long time Finnish origin Enterprise Resource Planning (ERP) system Sonet. For design of plastic parts and moulds is used software Solidworks.

As the processes are in each Plastone factory a bit different, than to simplify the range of viewable programs, there has been taken in account programs used currently in Plastone Saue factory. Programs are described below in Table 1.1.

Table 1.1 Programs used in Plastone Saue factory

Program in use	Main users of the software
Sonet – Finnish origin Enterprise Resource Planning (ERP)	All managerial positions use the software. CEO, Sales Manager, Sales Assistant, Production Manager, Production Planner, Financial Manager, Accountant Less is used by: Head of tooling and mould department, Quality department
Intranet – By Plastone Saue former Production Manager self-developed software, for storage of newest drawings of products, mould and other tooling related information, trial works status related information, quality related information etc.	All managerial positions use the software. Sales Manager, Sales Assistant, Production Manager, Production Planner, Head of tooling and mould department, Quality Manager, Quality Engineer Less is used by: CEO, Financial Manager, Accountants
Solidworks – used for product and mould development	Main user: Head of tooling and mould department, view version used as well by: Sales Managers
Excel – in excel self-developed planning systems	Main user: Production Planner, Production Manager
Office – e-mails, power point (PP) and other applications	All Managerial positions use the software.

Plastone also follows ideologies and methodologies to reduce waste in production and environment generally. As the examples: Sort, Set, Shine, Standardize, Sustain (5S); Six Sigma. 5S is the name of workplace organization method, which describes, how to organize a workspace for efficiency and effectiveness. Six Sigma is a set of techniques and tools for process improvement as a part of quality management system. SWOT analysis of currently used ERP solution is described below in Table 1.2.

Table 1.2 SWOT table of current ERP solution

Strengths	**Weaknesses**
Sonet has been the main data source for the company for more than 10 years All main sales items and bill of materials are listed in the program All main customer and supplier delivery data and terms are listed in the program As having manually entered the main data/bill of material correctly, all components will be transferred out from the recipe by making the delivery note of the goods All companies delivery notes and invoices are handled through that program, there is backlog of sales and invoicing data There is possibility to generate some easier reports	The production planning module is difficult to use and out of date No possibility to block deliveries of bad quality products/items Need to make daily internally many transactions between stocks to keep the stock level right No automated order handling system – orders are entered manually Purchasing quantities following is partly made in Excel, partly in Sonet – all following activities can not be integrated into ERP Sales prices data does not change automatically as the price for components changes – need to hold double data in Excel sheets for price calculations No Customer Relations Management (CRM) possibility – data in folders for customers and in Outlook To get and to analyse reports is difficult and it requires much afterwork in Excel Reports do not reflect data totally correctly. For an example: as sales price will be changed, the price will be changed in sales history as well
Opportunities	**Threats**
To develop based on existing database of information in Sonet new up-to-date ERP system To integrate more side activities with new developed ERP system – production monitoring module, CRM etc – data will be concentrated into one source To have proper training and service possibility by ERP system provider More efficient work and other processes Through new ERP system easier to train employees and labor changes are not that difficult because of the uniform training program	Transfer of the data by the new ERP supplier will not be made that successfully an some of the data history might get lost Because of the tense changes period, some customer or other key-cooperation partner will leave the supply chain Cost of implementation of new ERP system will be higher than initially expected, there will be problems to find extra funding

From quality perspective Plastone OÜ is certified with quality management system standard ISO 9001 and with environmental management standard ISO 14001.

ISO-13485 for health care products is certified since 2009 in Finland and since 2016 in Estonian plants.

1.1 Main markets and financial results

Plastone markets and sites are currently located in the way described on Fig 1.10:

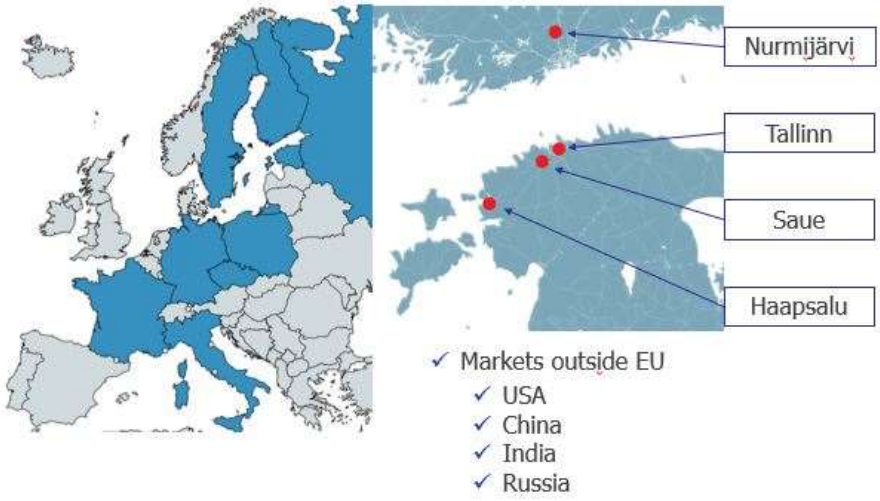


Fig 1.10 Plastone main markets

Voice of the Customers (VOC) analysis is described in Table 1.3.

Table 1.3 VOC analysis

Type of quality requirement	What does the customer expect?	Who is the customer?
more is better = specified demands and expectations	in time deliveries of high quality goods clean and modern production site advising customer with its product R&D activities by taking in account injection moulding specialities	Company, whose final products are belonging to health care, electrical or electronics sector, and who needs plastic components in its products final assembly
must be = absolute demands	good quality products, which meet the quality requirements set by final customer by taking in account purpose of the product – correct measures, sufficient surface quality etc. service providing – good communication through the whole process – starting with handling the order and ending mostly with final delivery of the goods (by some cases as well afterservice) as needed, meeting for their product applicable standards	Company, whose final products are belonging to health care, electrical or electronics sector, and who needs plastic components in its products final assembly
delighters = wishes and unknown delighters (surprises)	advise in side activities – as Plastone is not able to provide needed service themselves – there is sometimes possibility to suggest to clients suitable cooperation partner	Company, whose final products are belonging to health care, electrical or electronics sector

Plastone would like to expand its market share on existing markets and placing continuously main focus to health care sector and electrical and electronics industry. Scandinavia is the main target market, but as well central Europe is the potential growth area.

Predicted numbers are based on historical data and on scale of future developments. Expected growth in perspective of most important financial indicators is described in Table 1.4.

Table 1.4 Expected growth of financial indicators

Indicator	2018 (real value) (€)	2019 (prognosis) (€)	2020 (prognosis) (€)	2021 (prognosis) (€)	2022 (prognosis) (€)
Sales revenue	12 967 741	20 000 000	22 000 000	25 000 000	30 000 000
Labor costs	2 090 005	4 000 000	4 600 000	5 100 000	5 520 000
Depreciation of fixed assets	306 615	600 000	660 000	700 000	750 000
Operating profit or loss/result	140 380	25 000	400 000	1 000 000	1 300 000
Net profit	125 234	10 000	350 000	800 000	120 000
Average number of employees	88	160	180	190	200
Labor cost per employee	23 750	25 000	25 555	26 842	27 600
Added value per employee	28 829	28 906	31 444	35 789	37 850

Value	2018 (€)
Share or registered capital	51 129
Balance sheet total	5 765 939
Equity/net assets	3 665 146

1.2 Plastone need for Digitalization

Plastone does not have today Industry 4.0 applied in production. There are in use by many cases Industry 3.0 principles, but as well not fully applied. Still, there is need for improvements, because Plastone has been rapidly growing during last years.

All together there are by the end of the year 2019 four different factories:

- Plastone OY Nurmijärvi factory (established year 1980)
- Plastone OÜ Saue factory (established year 2005)
- Plastone OÜ Haapsalu factory (established year 2015)

- Plastone OÜ Tallinn factory (merged to Plastone January 2019)

Over the years there has been developed in different sites some different processes. Purpose is that digitalization will unite the work culture and make the processes in different factories more similar.

Plastone has several times applied as well for Enterprise Estonia (EAS) funding, that there would be carried through Digital Auditing. The application gave positive result year 2019 and 10.06.2019 was started the project.

Strategical long term drivers for companies digitalisation for years 2019-2023 are from Plastones management following:

- to increase sales
- to continue concentrating on customer oriented value adding processes
- to strengthen the co-operation and communication
- to improve and develop processes through mapping visualising and increase of transparency
- to choose and implement suitable ERP system and concentrate on digitalisation and implementation of new technologies.

1.3 Digital auditing of company Plastone OÜ

Plastone applied for digital diagnostics support by EAS offered support program. Application was approved and project start date was mid April 2019 and final date of the project mid July 2019.

As a result of digital diagnostics, the company received a process description associated with digital solutions, what the company is currently using and recommendations on what solutions to use in the future to digitize processes and automate. During the project, the business model of Plastone was mapped and based on the companies strategic goals 2019-2023 an action plan was drawn up for the digitization of key and supporting processes. The project also provided recommendations on standard ICT solutions for Plastone, ERP and the best production planning and real time monitoring solutions for the manufacturing company, with estimated cost and business benefit indication.

For analysis there was used as the main tool responsibility assignment matrix (RAM), which is also common as responsible, accountable, consulted, informed (RACI) matrix. It describes the different positions/roles in the company completing tasks for a business

process or certain project. There were mapped all the main processes in companies different units.

According to digital auditing report conclusions, the general level of the companies digitization is average, meaning that company has applied until some extent different information communication technology applications to automate different processes. As the main suggestion to reach to the next level, was to implement new ERP system.

As the key problem was brought out lack of the modern and with integration possibilities ERP software, which would as well have monitoring and evaluation systems (MES) possibilities.

There was offered in comparison three different software options:

- Monitor
- Epicor
- Microsoft Dynamics NAV

There was created in cooperation with Plastone list of criterions for comparison to evaluate, which of the suggested software is the most suitable. Of the suggested examples Monitor was chosen to be the most suitable.

There was possibility to apply for support activity by Enterprise Estonia: "Support for the use of digital technologies, robots and automation in manufacturing and mining".

According to Enterprise Estonia support measure for the use of digital technologies, robots and automation in manufacturing and mining the supported activities are following:

1. Provision of digital technologies, robots and automation training to its employees
2. Purchase of needed deploying intangible and tangible fixed assets for automation, digital technologies, robots in the applicant's supply chain
3. Developing comprehensive enterprise resource planning software
4. Development and integration of the production activities system
5. Acquisition and implementation of software licences for digital technologies
6. Connecting production equipment with each other and into network
7. Connecting production equipment and software with customers and suppliers software
8. Deployment of cloud technologies
9. Development of preventive care systems
10. Development of data analysis and machine learning systems

11. The acquisition and integration of collaborative robots with a resource planning and production activities system
12. Deployment and integration of software robots into business processes
13. Integration of virtual and augmented reality solutions into business processes
14. Building a three-dimensional prototype
15. Integration of sensors into business processes
16. Deployment of cyber security and data protection systems
17. Implementation of data visualization systems
18. Development and implementation of supply chain process planning and material flow forecasting solutions [2]

By Plastone the application is targeted to third bullet of the list – developing comprehensive resource planning software.

The main objective of the project for Plastone is to start to manage key processes in the supply chain (order management – production planning – purchasing – management supply of the products – invoicing) digitization and automation. Plastones basic production equipment – plastic moulding machines are equipped with process monitoring software and relevant industrial robots, but company is using ERP system, which is already 10 years old and there is need to make time consuming manual entries and use a lot of Excel tables. As a result of the implementation of the project, Plastone will implement a modern ERP solution for the manufacturing company, where modules for sales, production planning, inventory management, time reporting, and equipment maintenance are included. In addition, there is plan to implement real-time device monitoring solutions integrated with the new ERP. Plastone wishes to significantly reduce no-value-creating handicraft work in sales office, production planning, accounting, in discussion and business analysis. Plastone plans to increase sales by at least +10% per annum between 2020 and 2023, without hiring new employees into supply chain management processes, the profitability of a company is estimated to improve by + 100 000 MEUR per year.

As a result of the digitization project Plastone wishes to deploy devices in real time tracking solution for all 40 main production devices in Saue and Tallinn factories. According to estimations company can save 90000 € per year on equipment investments through improved equipment usage.

Project got approval for start by EAS in the first half of September 2019 and was approved by owners of Plastone in the end of October 2019. First steps of the implementation of the new ERP system will take place since first quarter of 2020.

3.1 Key Performance Indicators (KPI:s) measured in Plastone currently and future expectations

Plastones main metrics set in the beginning of 2019 are listed in Table 1.5.

Table 1.5. Plastones metrics in production

Metric / KPI	Equation/Explination	Unit	Frequency of measuring
Delivery reliability	Percentage of the number of deliveries made without any error to the total number of deliveries in a period of time	%	once per month
Delivery availability	% of a resource that is committable, operable upon demand to perform to fill the wished function. Ground for comparison is: by customer wished date compared to date, what will be confirmed to customer.	%	once per month
Quality cost	% into turnover – all costs, which production company is investing to be sure, that product has sufficient quality level	% into turnover	once per month
Parts per million (PPM)	quality performance measurement – one PPM is one defect in a million 1/1000000; complaint parts /sold parts 1 million	Number of parts	once per month
Supplier reliability	supply chain metric -% of deliveries delivered on time	%	once per month
Electricity consumption index	KWH/into turnover	KWH	once per month
Amount of household waste	Target is to hold household waste on the same level	Number of containers	once per year
Number of accidents at work	Occasion in the work situation, which will lead to physical or mental injury	Number of accidents	once per year
Labor mobility	Number of people, who have left the company on ones own will	Number of people	once per year
Labor satisfaction	metric is in the company in development stage (no outcome jet)	Satisfaction index	once in two years

The four key metrics are viewable as well on screen in the production, in Fig 1.11.

Fig 1.11 main KPI:s on screen in production

2 INDUSTRY 4.0 FRAMEWORK AND THEORETICAL METHODOLOGIES FOR RESEARCH

2.1 Industry 4.0 framework historic development

The term "Industry 4.0" originates from a project in the high-tech strategy of German government, which promotes the computerization of manufacturing and was first presented 2011 at the Hannover Fair.[3]

There are many definitions to clarify content of Industry 4.0. One which covers all aspects is following: Industry 4.0 is new industrial paradigm, which brings together the digital and physical worlds through the Cyber-Physical Systems reinforced by Internet of Things and it is expected that this novel has consequences on industry, markets and economy, improving production processes and increasing productivity, affecting the whole product lifecycle, creating new business models, reorganising the work environment and changing the labor market.[4]

Ideology of the Industry 4.0 is closely involved to technological changes, which are named "industrial revolutions". [5]

Down following in Fig 2.1 are described in chronological order all industrial revolutions

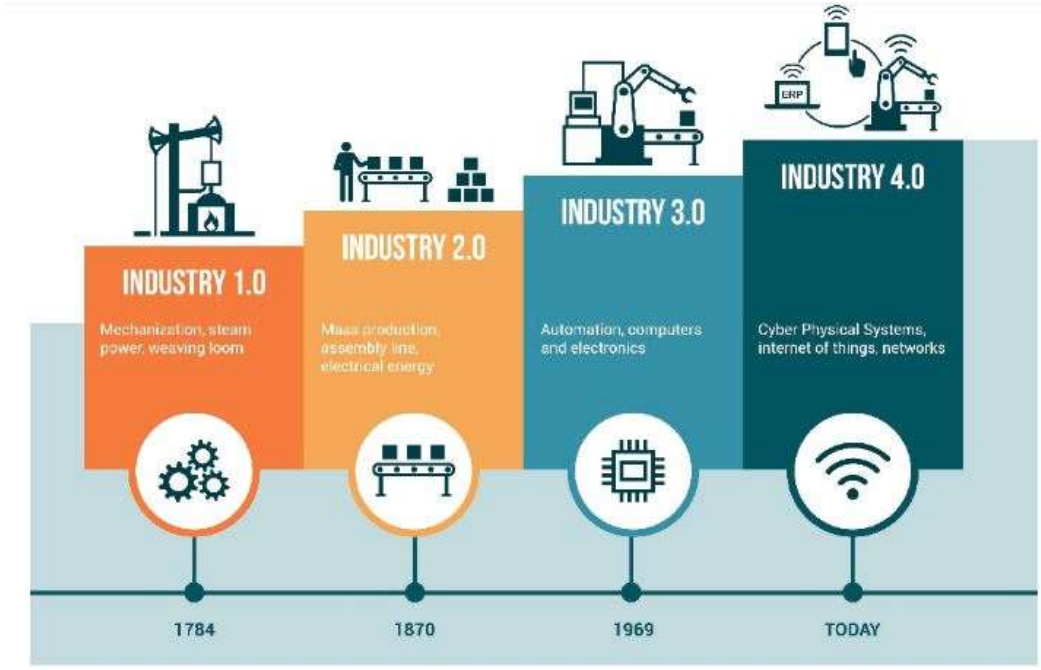
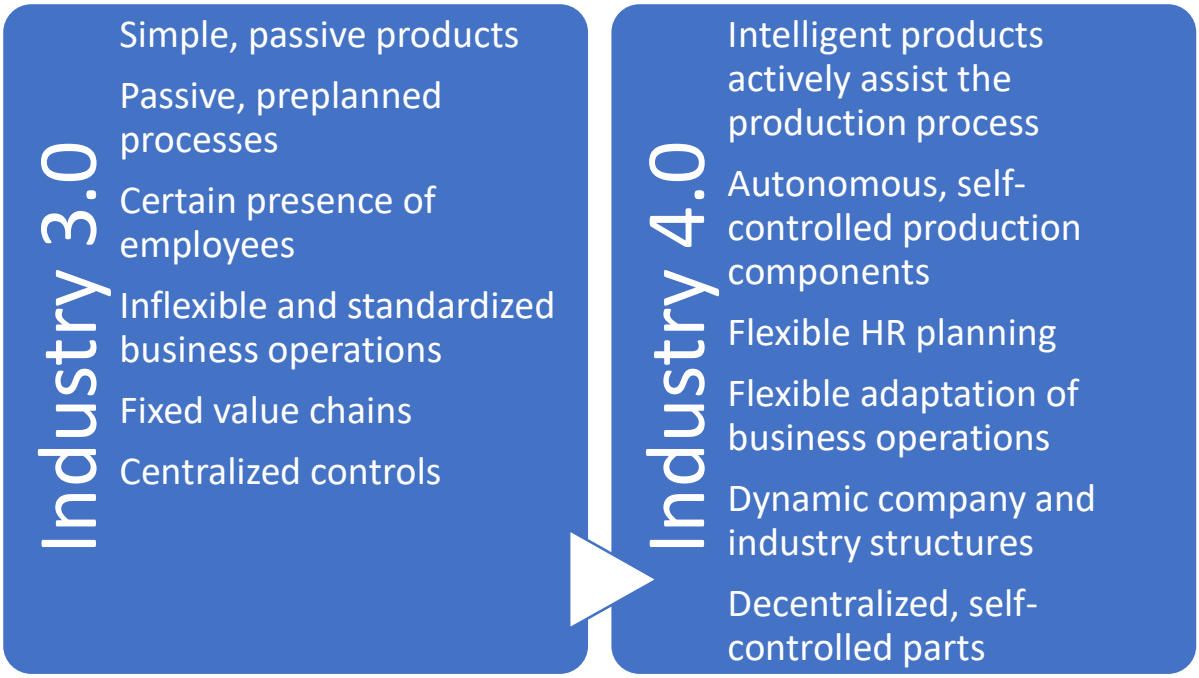


Fig 2.1 Industrial Revolutions [6]

Industrial Revolutions since 18th century until today. Beforehand to this fourth major development in manufacturing, was the lean revolution of the 1970s, the outsourcing trend of the 1990s, and the automation boom that began in the 2000s. [6]

The idea of future manufacturing is consisting of modular and efficient production systems and includes vision in which items control their own production process.[5]



A radical paradigm shift. [7]

Industry 4.0 is the superposition of several technological developments that adopts both products and processes.[8]

1.1 Industry 4.0 fundamental concepts

- Smart Factory: manufacturing will completely be equipped with sensors, actors, and autonomous systems. By using "smart technology" so-called "smart factories" are developed, which are autonomously controlled. [3]
- Cyber-physical Systems: The physical and the digital level merge. Physical and digital representation cannot be differentiated in a reasonable way anymore. An example can be observed in the area of preventive maintenance: Process parameters (stress, productive time etc.) of mechanical components underlying a (physical) wear and tear are recorded digitally. The real condition of the system results from the physical object and its digital process parameters. [3]
- Self-organization: existing manufacturing systems are becoming progressively decentralized. This comes along with a collapse of classic production hierarchy and a change towards decentralized self-organization. [3]

- New approach in distribution and procurement: Distribution and procurement will be more individualized. Connected processes will be handled by using different channels. [3]
- New systems in the development of products and services: Product and service development will be individualized. In this context, approaches of open innovation and product intelligence as well as product memory are of outstanding importance. [3]
- Adaption to human needs: new manufacturing systems should be shaped to keep track of human needs instead of the reverse. [3]
- Corporate social responsibility: sustainability and resource-efficiency are in the focus of the design of industrial manufacturing processes. These factors are the key-factors for successful products. [5]

Emphasis is on value creation. Value creation on evaluation processes are extremely important. Vertical value chain takes in account companies hierarchical structure and value created inside of the company. Horizontal value chain describes the value created in the whole supply chain – starting with suppliers and ending with final customers. In the last years there has been trend to emphasize the concept of value creation supported by ICT. It represents a key resource to analyse and evaluate the immaterial drivers and process improvements of manufacturing company. The article provides value assessment model: The Manufacturing Value Modeling Methodology (MVMM), which is based on 5 steps: Value Map, Maturity Model, Gap and Process Analysis, Validation and Improvement Areas Definition. Described approach allows analysing the complexity of value drivers and value creation. The suggested method needs improvements, that the company following the model could develop its business and to achieve its strategic objectives. [9]

Under the manufacturing process perspective, two main research themes are:

- Vertical integration with Internet of Thing and Cyber-Physical Systems
- Horizontal integration with worldwide value chains.[10]

There has been created *Plattform Industrie 4.0.,* which is coordinating the digital transformation process of industrial sector. It brings together more than 300 stakeholders from over 150 companies, business associations, trade unions, sciences and politics. The platform cooperates with the Chambers of Industry and Commerce, the Electrical and Electronic Manufacturers, Mechanical and Plant Engineering and digital associations (ZVEI, VDMA, Bitkom). [11]

2.2 Challenges of the new concept

Regarding Industry 4.0, there are still many opened issues. Companies are facing the following problem: how do you digitalise production whilst maintaining operations and links with suppliers and clients if everyone is using different hardware and software? Interoperability and transparency in Industry 4.0 standardisation is needed to ensure digital ecosystems. [12]

One sceptical view is presented as well in article, which brings out new treats existing in general through very wide use of cloud and internet. It is said that by now, most people have heard of the "Internet of Things" – often referred to as the "Internet of Everything". The term referres to the inevitable connection of almost everything electronic to the Internet using wireless or using wireline means. By Roy Isbell, the publisher of Digital Forensics magazine has made twist of the term, which he called "The Interconnection of Everything".[13]

2.3 Digitalization in world and Europe

Industry 4.0 is a cross-border phenomenon, and this is good ground for the platform to operate not only within Germany, but also on a European and global basis. There has been established the Platform *Industrie 4.0* in Germany to bring forward thinking and practical solutions for the future environment. The platform makes active cooperation worldwide, with countries such as: United States of America, China and Japan. [12]

The main activity fields of the organization are:

- to drive (international) standardisation
- to define IT security as a quality standard for Industry 4.0
- to shape laws for Industry 4.0 – who owns data from machines
- to analyse new trends worldwide
- to shape work and skills
- to support with practical implementation tools

[12]

In 2015, Japan responded by launching a largely industry-led initiative (IVI). One of the aims of IVI, is to create common standards for technologies, that can connect factories, and to internationalize Japanese industrial standards.[14]

There has been carried through many studies to make clear state of digitalization worldwide. PWC, has carried through: "Global Digital Operations Study 2018", to make

sure, which companies have clear strategy regarding Industry 4.0 – these industrial companies were called: Digital Champions. There were interviewed 1,155 manufacturing executives from 26 countries. 10 percent of global manufacturing companies met the requirements to be called Digital Champions. The automotive and electronics industry have the most Digital Champions, with 20 percent of automotive and 14 percent of electronics companies are implementing innovative solutions across their marketplace and facilities. In the process industries, consumer goods, and industrial manufacturing sectors, only a few companies have emerged as Digital Champions so far.[15]

The European Commission's Digitising European Industry initiative organises the networking of the 30-plus national initiatives to digitise industry in Europe. The focus is not only the national initiatives, but also on a presentation of the European funding for digital innovation hubs, which are to be built up as a core element of the strategy to digitise European industry. There was set up working group on standardisation at EU level to advise the European Commission on this issue.[12]

There has been worked out by European Commission Digital Transformation Scoreboard, which is part of the Digital Transformation Monitor (DTM). The DTM aims to foster the knowledge base on the state of play and evolution of digital transformation in Europe. It enables a monitoring mechanism to examine key trends in digital transformation and provides numerical results.[16]

The European Commission launched the new contractual Public-Private Partnership (PPP) on "Factories of the Future (FoF), in 2014. It belongs to the Horizon 2020 programme that plans to provide nearly 80 billion euros of available funding over 7 years (from 2014 to 2020) in favour to support Industry 4.0 initiative.[17]

2.4 Digitalization of industry in Estonia

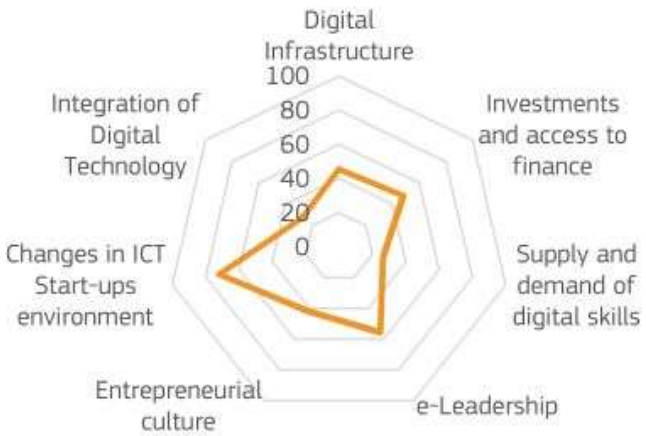
There are two main quite contradictory studies about Estonia's state of digitalization. McKinsey & Company is a global management consultancy firm. Their report "Shaping the future of work in Europe's digital front-runners" focuses on employment of companies. The viewable period is up to 2030. McKinsey and Company report is focused on nine "digital front-runners" in Northern Europe. These nine countries are - Belgium, Denmark, Estonia, Finland, Ireland, Luxembourg, Netherlands, Norway and Sweden. The chosen countries are relatively enthusiastic adopters of digital technology. Mentioned countries are ahead in the use of robotics, machine learning and artificial intelligence.[18]

The report gathers the results of nine countries and compares the results with EU average. About Estonia is brought out, that Estonia drafted legislation for testing of self-driving cars and delivery robots, based on which can be formed future laws. E-Estonia carries a range of public services online, including access to healthcare data. As a positive pattern is brought out, that Estonia began including programming in its curriculum in 2012 for schoolchildren as young as six. Program name is ProgeTiger. The report gives view on, how automation technologies and Industry 4.0 framework will affect employment labor demand and supply in the nine digital front-runner countries. [18]

There are given as well country specific results, including Estonia in **Appendix nr 1**.

Digital Transformation Scoreboard Estonia's record shows significant polarisation. Estonia's performance is relatively good in relation to ICT start-ups, e-leadership and investments and access to finance. Challenges are noticeable in the field of digital transformation, digital infrastructure and supply and demand of digital skills. In fact, this is where Estonia receives the lowest marks. Estonia performs above the EU average in two out of seven dimensions. Estonia is focusing in the enhancement of professional skills and in the development of innovative products and the penetration of new foreign markets.[16]

Down following in Fig 2.2 are described Digital Transformation Scoreboard results for Estonia.



Note: Based on the average of the latest imputed values. Where no data available, the EU average was used.

Fig 2.2 Digital Transformation Scoreboard results for Estonia

- **Strengths**

Estonia's strong performance in ICT start-ups relies mainly on the full employment of its ICT workforce. In addition, the share of its ICT sector in the total GDP underscores the high result of this dimension. ICT start-ups are scoring 24% higher than the EU average.

Estonia's solid e-leadership score is rather due to this skills obtained through academic education, than through in-work training provided by companies. Its e-leadership stays in line with the EU average.[16]

- **Areas for improvement**

In spite of the high performance in ICT start-ups, Estonia's entrepreneurial culture is below the EU average. Estonia's performance in the supply and demand of digital skills shows significant room for improvement. Estonia's weakest point is the supply and demand of digital skills, where scores 14% below EU average. The data available also indicates that the percentage of high-tech patent applications is rather low. Moreover, a substantial number of companies encounter problems when hiring ICT specialist. [16]

Another key challenge for Estonia is the need to improve its digital infrastructure. The use of integrated management software solutions could be enhanced. [16]

Down following in Fig 2.3 are described Digital Transformation Scoreboard results for Estonia.

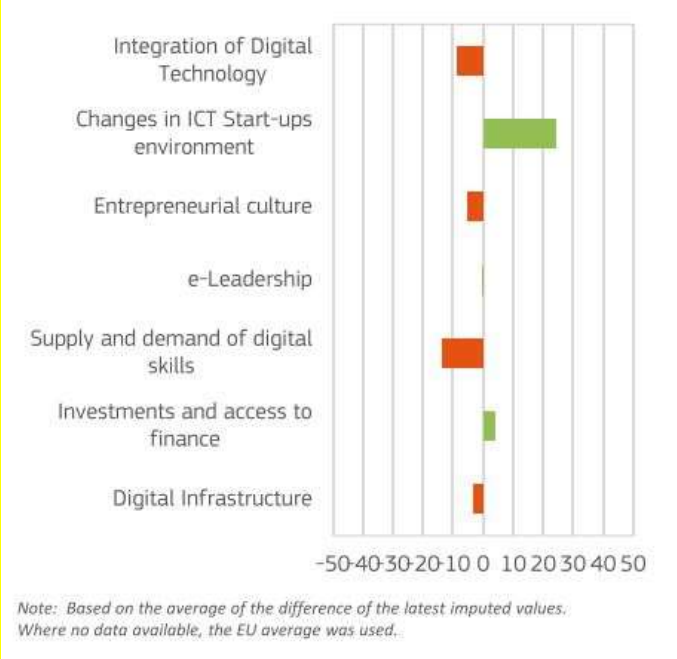


Fig 2.3 Digital Transformation Scoreboard results for Estonia

Estonia is not mentioned in Global Industry 4.0 Survey, which investigated 2000+ companies from nine major industrial sectors in 26 countries. Including our neighbouring countries Finland and Sweden. [19]

4.2 Interesting policy practices in Estonia

- Enterprise Estonia (EAS) has implemented Enterprise Development Programme. The programme is not conceived as a mere financial instrument. The instrument was launched 2015 and assists the companies during the three phases of product development. The programme also seeks to foster the penetration of new markets. This includes the identification of the company's willingness to change as well as the preparation of a development plan and its implementation. There will be provided grants of up to 500000€ of which up to 200000€ can be used to invest in modern technology. The grants are subject to different degrees of co-financing: For small companies required co-financing amounts to 55% of costs, whereas for medium-sized and large enterprises 65% and 75% of own capital is needed. The programme's targets to support 150 companies to commercialise 100 new products, of which at least 20 should be unique in the world, by 2020.[16]

- OSKA system – Estonia set up the Coordination System of surveillance and forecasting of the labour market and the development of skills in 2015, as part of the Estonian competitiveness strategy "Eesti 2020". The system seeks to ensure the match between the labour market needs and the education curricula. With an overall budget of 4400000 until 2020, OSKA system is supported by financing from European Social Fund. The system is based on a comprehensive monitoring mechanism. This mechanism involves regular cooperation with the private sector, in-depth analysis of the labour market, economic trends analysis and forecast to map the skills needs in each sector. Five economic sectors are analysed each year with a view to present a state of play and recommendations for training for the next 10 years. Each economic sector is analysed once every 5 or 6 years, and the implementation of recommendations monitored during the intervention period.[16]

Because of the poor level of digital technology applications in Estonian industry, there is need to:

- Implement the methodology to access the level of digitalisation in Estonian SME:s

- Is need to measure results of qualitative analysis based on SME Plastone and make some practical experiments in field of digitalization to make analysis and based on results to make conclusions and recommendations for future developments

2.5 Existing Theoretical base and Methodologies for assessing the level of digitalization SME's

5.1 SME's and Industry 4.0

In Estonia there is definition about enterprises according to following metrics in Table 3.1.

Table 3.1 Estonian companies classification according company size

Category of Company	**Number of Employees (yearly work unit)**	**Turnover (yearly)***	**Total annual balance***
Medium	Less than 250	Does not exceed 50 million €	Does not exceed 43 million €
Small	Less than 50	Does not exceed 10 million €	Does not exceed 10 million €
Micro	Less than 10	Does not exceed 2 million €	Does not exceed 2 million €

The company may choose for itself a more favourable option, whether it considers the balance sheet or annual turnover. It is not necessary to satisfy both financial indicators, but one. VAT and other indirect taxes must be excluded from annual turnover. As calculating the above mentioned figures, the data from the last approved annual report must be used.[20]

There are investigated in many scientific articles Industry 4.0 phenomena influence on SME:s.

SMEs provide the good research base, as those represent over 99% of the companies located in the EU and hire between 50 and 70% of the full time equivalent of persons employed. With a gross value added share of over 50% of the European economy. SMEs require research that helps them sustain their economic significance in times of unrelating technological developments.[21]

Unlike large firms, SMEs have lower productivity, higher costs and less on-time delivery performance. As the business strategy of SMEs is often based on flexibility, reactivity

and customer proximity, the Industry 4.0 concept appears appealing with regard to potentially providing a more streamlined flow of information (and thus better planning and control processes). Cloud Computing is the most used means of implementation of Industry 4.0 practices in SMEs. Article, which investigated publications, found, that 65% of selected publications reported its use.[22]

One of them compares Industry 4.0 with approach of computer integrated manufacturing (CIM) of the 1980s and the human role in the production environment. Whereas CIM considered the workerless production, the human role in Industry 4.0 is still very important and essential.[23]

By SME, which is production company, there are several areas to take in consideration within Industry 4.0. There are frequently investigated Human-Machine-Interface (HMI) and the connectivity bundle. The HMI bundle includes devices for assisting operators in manufacturing activities, such as touchscreens, augmented reality and collaborative robots. The connectivity- bundle includes systems for connecting devices, collecting and analysing data from the digitalized factory. [24]

2.6 Assessing Industry 4.0 readiness in manufacturing companies

Manufacturing companies have got the challenge to manage their whole value-chain in agile and responsive manner.[25]

Based on literature, there are three manufacturing company maturity assessment ways, depends, how the framework is proposed:

- Descriptive purpose: maturity models with this purpose, want to assess the as-is situation of the organization/process;
- Prescriptive purpose: a perspective model focuses on the domain relationships to performance and indicates how to approach maturity improvement in order to positively affect business value;
- Comparative purpose: a comparative model enables benchmarking across companies; in particular, a model of this nature would be able to compare similar practices across organizations in order to benchmark maturity within different industries.[26]

Regard to the domain of Industry 4.0 the following models and tools for assessing readiness or maturity have been published in Table 3.2.

Table 3.2. Methodologies for assessment of maturity of the company for Industry 4.0

Model Name	**Institution/ Source**	**Assessment Approach**
IMPULS – Industrie 4.0 Readiness (2015)	VDMA, RWTH Aachen, IW Consult	Assessment in 6 dimension including 18 items to indicate readiness in 5 levels; barriers for progressing to the next stage are defined as well as advice how to overcome them
Empowered and Implementation Strategy for Industry 4.0 (2016)	Lanza et al.	Assessment of Industry 4.0 maturity as a quick check and part of a process model for realization; gap-analyses and toolbox for overcoming maturity-barriers are intended; no details about items and development process offered
Industry 4.0 / Digital Operations Self Assessment (2016)	PricewaterhouseCoopers	Online-self assessment in 6 dimensions; focus on digital maturity in 4 levels; application as consulting tool as fee for assessment is required in 3 of the 6 dimensions; no details about items and development process offered
The Connected Enterprise Maturity Model (2014)	Rockwell Automation	Maturity model as part of a five-stage approach to realize Industry 4.0; technology focussed assessment in 4 dimensions; no details about items and development process offered (white paper)
I 4.0 Reifegradmodell (2015)	FH – Oberösterreich	Assessment of maturity in 3 dimensions including 13 items for maturity indication; maturity is assessed in 10 levels; no details about items and development process offered (development process not finished)

[25]

There has been created (Roadmap Industry 4.0) procedure model, which contains of three major phases: analysis goal setting and implementation. It is divided into 6 steps, which will be passed sequentially. This ensures a systematic identification of the current maturity of Industry 4.0 and the existing competences as well as the definition of targets.

Down following in Fig 3.1 is the roadmap, which is at the same time basis for self-assessment and guide for implementation of an industry 4.0 strategy.[27]

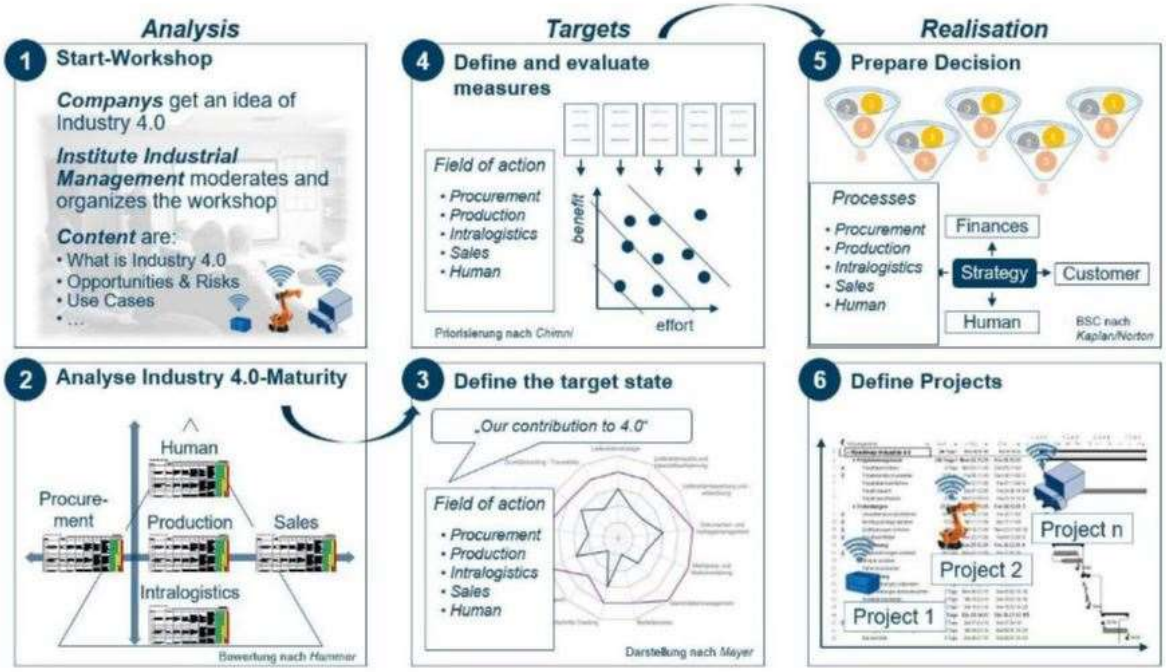


Fig 3.1 Roadmap Industry 4.0 [27]

Article defines readiness measurement for Industry 4.0 into categories:

- Comparative Industry 4.0 readiness measurement on macro level and micro level
- Non-comparative Industry 4.0 readiness measurement [28]

More in deeply is investigated second option. The measurement method is a questioner in which many questions and topics in the above listed aspects are asked from the key, typically functional and general management people of the analysed company. Each question is measured in two aspects by a discrete scale:

- Rating of level of completion
- Rating of relevance for successful implementation

This measuring technique results in qualitative values of the individual questions. Areas for questions state from following categories:

- Strategy
- Leadership
- Offered Products and Services
- Customers
- Company Culture
- People

- The following three technical aspects are personalized:
    - Production Support
    - Production Execution
    - Digital Production
- Critical areas of intervention[28]

An interesting option for evaluating the maturity of company is as well "The Singapore Smart Industry Readiness Index". Down following in Fig 3.2 is the scheme of the method. [29]

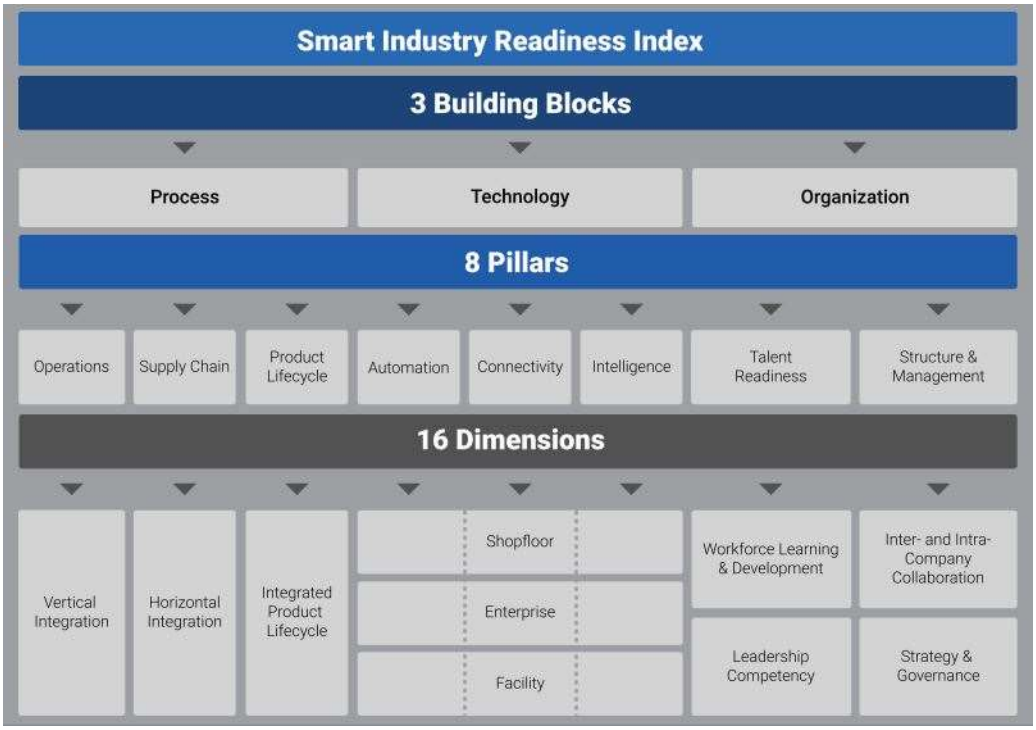


Fig 3.2 The Singapore Smart Industry Readiness Index [29]

As a weak side is, that except concept itself, isn't given many guidelines, how to prepare the questionnaire or samples of questions, which give as the result "Smart Industry Readiness Index". Still, it gives hints, how to categorise measurable aspects.

3 METHODOLOGIES FOR RESEARCH

3.1 Background for building up the Industry 4.0 related questionnaire

German Engineering Federation (VDMA) has implemented Industrie 4.0 guideline. It is practical tool for the identification and implementation of company-specific approaches to Industry 4.0. The VDMA guideline shall also encourage and arouse curiosity to see Industrie 4.0 as an opportunity for the own company.[30]

I have used by compilation of questionnaire for assessing existing and favourable maturity level for Industry 4.0 in Estonian SME's, structure of VDMA matrix – both Toolbox Industry 4.0 for Products and Toolbox Industry 4.0 for Production. As viewable company Plastone OÜ is service providing company, Toolbox Industry 4.0 for Products is reviewed to be suitable in frames of Toolbox Industry 4.0 for Service, in that extent, which was possible to make.

Questionnaire was delivered to 5 management level employees. Channel of distribution of the survey was cloud based Google Forms questionnaire blank, modified in the needed way. The whole content of questionnaire is in **Appendix nr 2**.

3.2 Methodology for building up the new ERP solution features importance assessment questionnaire

There are listed KPIs, which is interest to have in new ERP solution Monitor. There were categorized by Plastone 10 Functionality areas for ERP and there under as well sub-categories and asked, if the features are integrated into standard solution or new ERP or not.
Main categories are following:

1. Sales and client relationship management
2. Production
3. Quality and traceability
4. Management reporting
5. Other supporting functionalities
6. Accounting / Financial Management
7. Data security requirements
8. Integration and interfaces

9. User interface

Based on these category sublevel criterions, I performed questionnaire to evaluate, which of the functionalities are important to employees. From viewable categories were left aside from focus:

- Management reporting
- Data security requirements
- Integration and interfaces
- User interface

which functionalities will be described separately in the end of analysis of the questionnaire results.

Title of the questionnaire is: Expectations to functionalities of new Enterprise Resource Planning (ERP) system - Monitor. Questionnaire was performed among management level employees, purchasing sales, production and quality level specialists. All together answered to questionnaire 12 employees. Exact content of questionnaire is in **Appendix nr 3**.

3.3 Experiment with sensor and program Dimusa in field of digitalization in Plastone OÜ

In field of Industry 4.0 all experiments are mostly requiring big investments, there was only option to run through small scale experiment. The experiment is carried through within Plastone main production function – injection moulding.

3.1 Injection moulding description

The injection moulding industry consumes about 32 weight percent (wt%) of all plastics. It is in second place to extrusion, which consumes approximately 36%. The injection moulding machine is one of the most significant and rational forming methods existing for processing plastic materials. A simplified general layout for an injection moulding machine is shown below: [31]

Down following in Fig 3.1 is picture of general layout for an injection moulding machine.

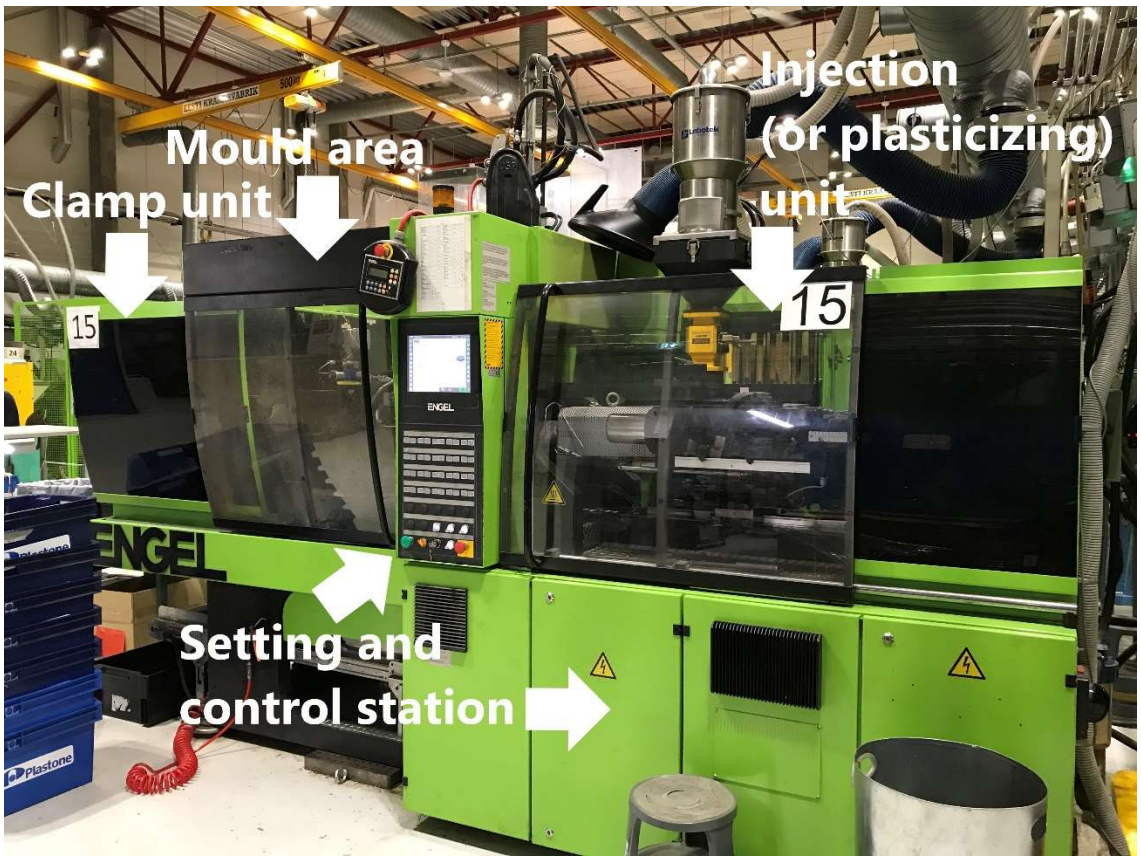
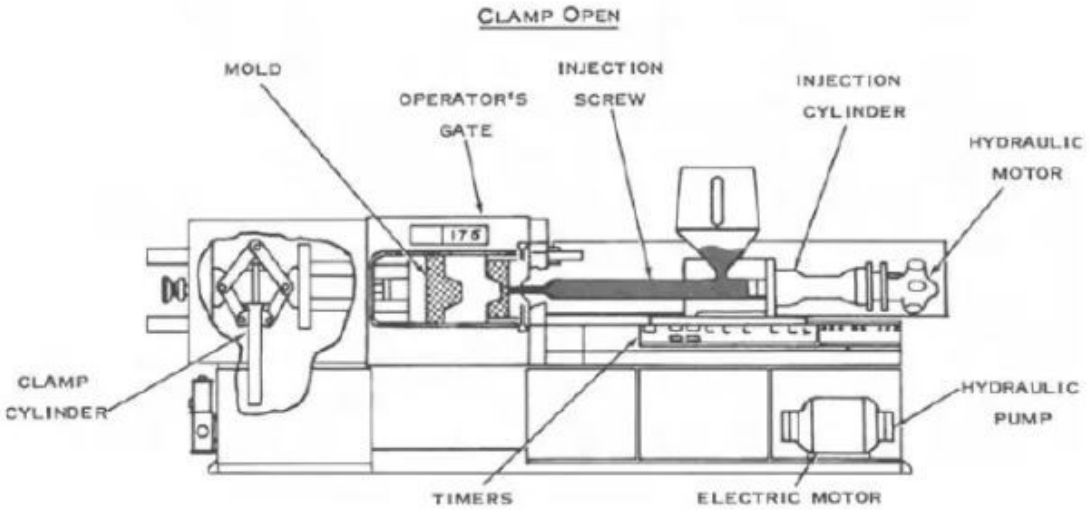


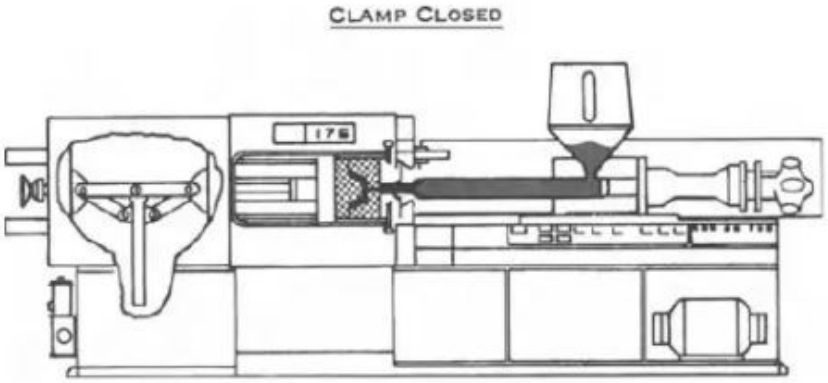
Fig 3.1 Injection moulding machine

The injection moulding machine has three basic components: the injection unit, the mould, and the clamping system. The injection unit, also called the plasticator, prepares the proper plastic melt and via the injection unit transfers the melt into the next component that is the mould. The clamping system closes and opens the mould.[31] These machines all perform certain essential functions: (1) plasticizing: heating and melting of the plastic in the plasticator, (2) injection: injecting from the plasticator under pressure a controlled-volume shot of melt into a closed mould, with solidification of the plastics beginning on the moulds cavity wall, (3) afterfilling: maintaining the injected material under pressure for a specified time to prevent back flow of melt and to compensate for the decrease in volume of melt and to compensate for the decrease in volume of melt during solidification, (4) cooling: cooling the thermoplastic (TP) moulded part in the mould until it is sufficiently rigid to be ejected, or heating: heating the thermoset (TS) moulded part in the mould until it is sufficiently rigid to be ejected, and (5) moulded part release: opening the mould, ejecting the part and closing the mould so it is ready to start the next cycle with a shot of melt. [31]

Down following in Fig 3.2 is picture of the complete injection moulding process:



	ELECTRICAL	HYDRAULIC	MECHANICAL
1.	MOTOR SWITCH ON	PUMP PRESSURIZES SYSTEM	
2.	CLOSE OPERATOR'S GATE AND START CYCLE	OIL FLOWS TO CLAMP CYLINDER FROM HYDRAULIC MANIFOLD	CLAMP CLOSES
3.	CLOSING CLAMP TRIPS LIMIT SWITCH DIRECTING OIL TO INJECT	OIL FLOWS TO INJECTION CYLINDER	INJECTION RAM FORWARD TO INJECT



4.	INJECTION TIMES OUT	OIL FLOWS TO SCREW DRIVE MOTOR	SCREW PUMPS ITSELF BACK AS PARTS COOL IN MOLD
5.	CLAMP COOLING TIMES OUT AND SCREW TRIPS SHOT SIZE LIMIT SWITCH	OIL FLOWS TO CLAMP CYLINDER ROD	SCREW STOPS ROTATING AND CLAMP OPENS
6.	EJECTION LIMIT SWITCH IS TRIPPED	OIL FLOWS TO EJECTOR CYLINDER	PART IS EJECTED FROM MOLD
7.	RECYCLE TIMER TIMES OUT	START CYCLE ETC.	

Fig 3.2 Injection moulding process [31]

3.2 Experiment Description

The content of the experiment is: using the additional sensor in production process and gathering data directly from the machine and to be able to analyse the data with help of the program Dimusa.

There was chosen the biggest machine in Plastone Saue factory, with clamping force 300T.

There was measured during the May 2019 using Tallinn Technical University provided sensor and help of program Dimusa:

- amperage changes of viewable injection moulding machine
- availability of the machine
- machining time
- short stops, long stops, off time
- time of the machine and compared it with results measured the efficiency of regular monthly average.

Content of the experiment is described below:

Down following in Fig 3.3 and Fig 3.4 is picture of the 300T injection moulding machine

Fig 3.3 300T injection moulding machine

Fig 3.4 300T opened injection moulding machine

Down following in Fig 3.5 are the sensor and the plug, where the sensor was connected.

Fig 3.5 Sensor, sensor in work and the plug

The data of the reasons, why occurred production stopping was collected by the machine. As the project would be continuing and production plan related rows continuously added into the program Dimusa, the reasons for production stopping and statistics can be collected with help of pop-up window occurring as there is machine stop.

Setting the sensor

1. Sensor was applied on the injection moulding machine
2. Sensor clamp attached around second phase conductor of the injection moulding machine

3. There was created special WIFI network to connect the sensor with the network
4. Connection was created according to manual
5. Connecting the sensor with WIFI did not succeed at first attempt, because machine pulled for the first time the settings away from their place.

Down following in Fig 3.6 is the injection moulding control panel and additional data gathering sheet

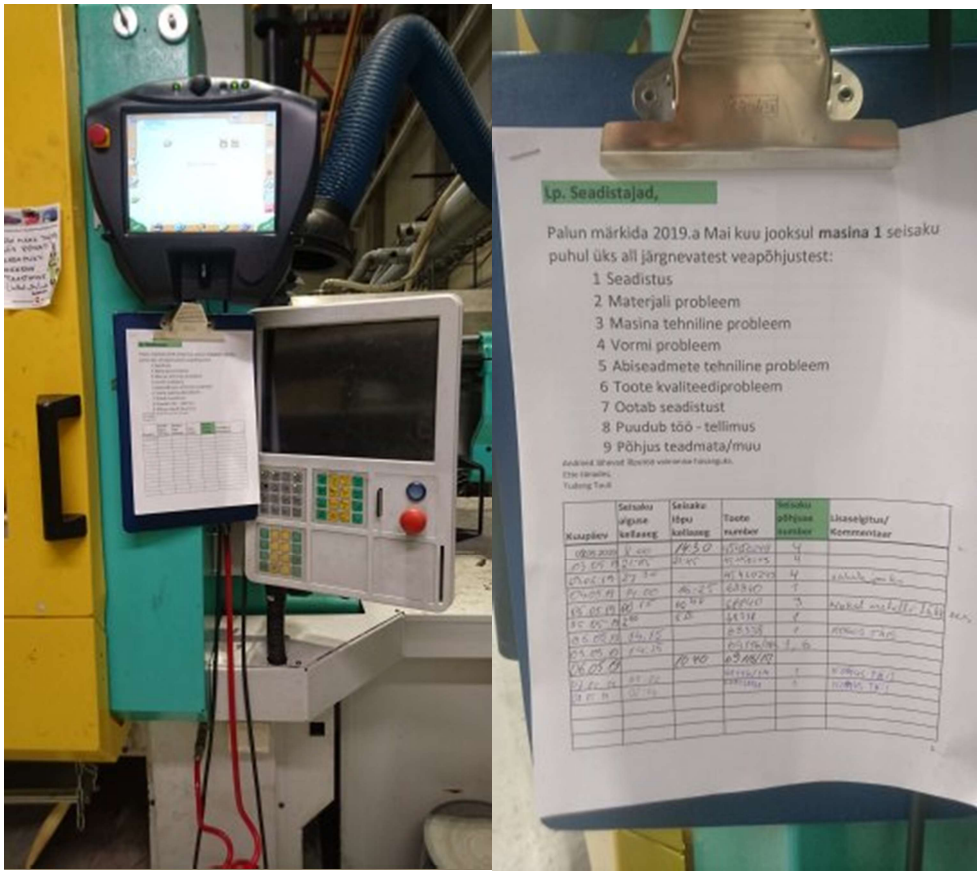


Fig 3.6. The injection moulding control panel and additional data gathering sheet

Down following in Fig 3.7 is the pop-up window with different stop reasons

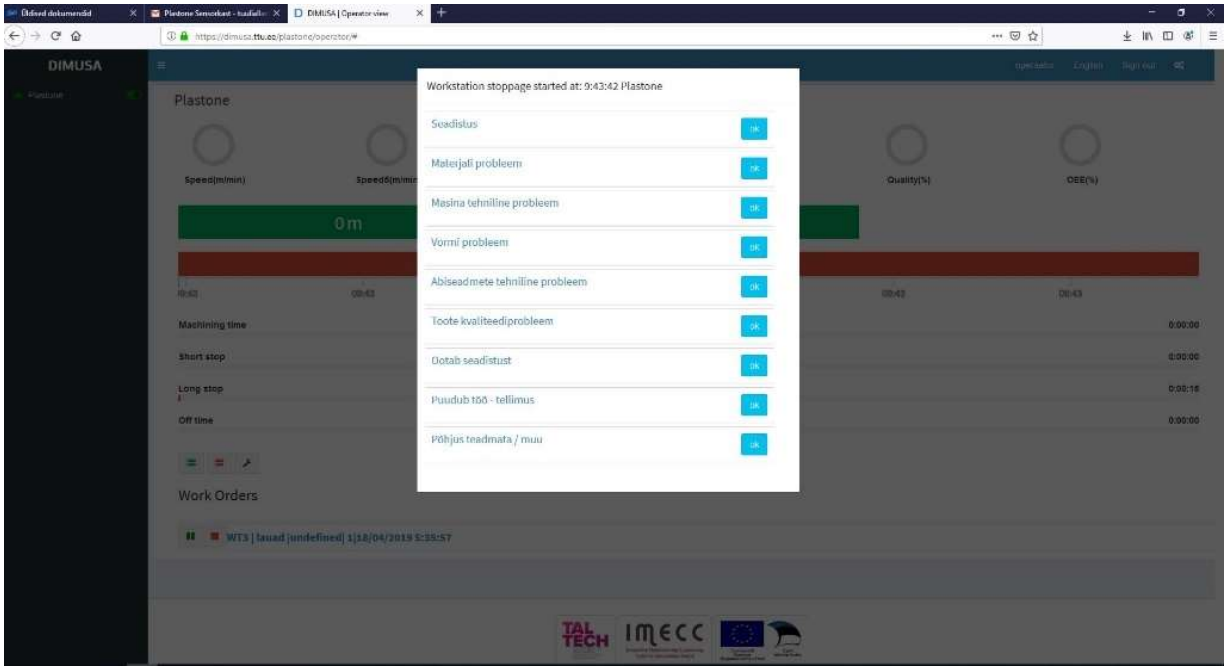


Fig 3.7 is the pop-up window of program Dimusa

The reasons for the production stop were discussed with former Saue factory plant manager and listed following:

1. Setup
2. Material problem
3. Technical problem of the machine
4. Mould problem
5. Technical problem of additional helping devices
6. Quality problem of the product
7. Waiting time for the setting
8. Missing work – waiting for the order
9. Reason unknown/other

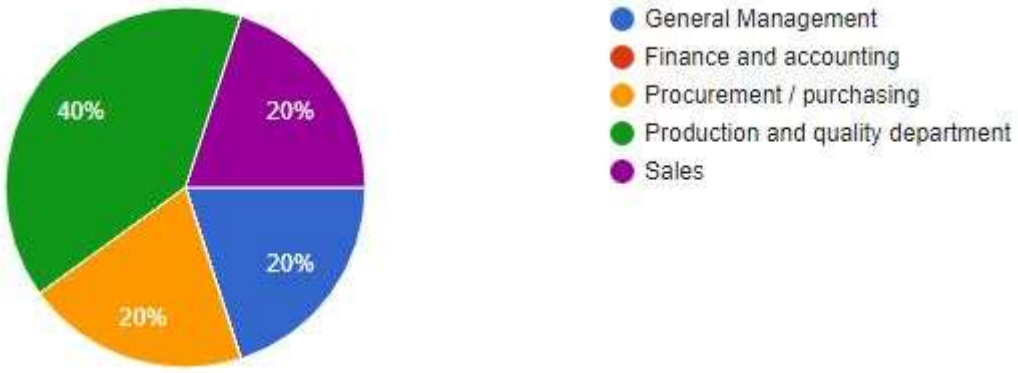
4 RESULTS OF THE RESEARCH

4.1 Results of the Industry 4.0 questionnaire

I constructed questionnaire, which bases on VDMA analysis guiding principles:

- Toolbox Industrie 4.0 for products
- Toolbox Industrie 4.0 for production
- and added some questions describing Estonian context and certain production company regarding the topic

As general questions were asked, into which department employee belongs to and how long he/she has worked in the company.



1 year
6mo
5+ Years
14
15 years

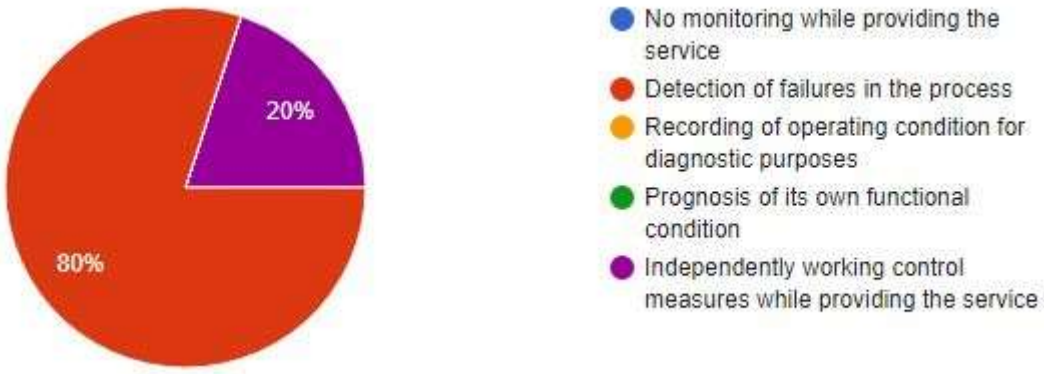
Average seniority of employees, who answered the questionnaire is approximately 7,1 years.

1.1 Toolbox industry 4.0. Section Product

Assess the Functionalities for data storage by service providing and information exchange?

Statement	Number of votes
No functionalities	0
Possibility of individual identification	2
Service providing data has a passive data store	4
Data storage for autonomous information exchange	0

Assess monitoring level of service providing procedure?



Assess the business models around the service provision?

Statement	Number of votes
Gaining profits from selling standardized injection moulding service	1
Sales and consulting together with the service provision	0
Sales consulting and adaption of the service to meet customer specifications	3
Additional sale of service related services	1
Sales of service concept	1

Which of the below mentioned functionalities of Industry 4.0 could have in your opinion the most potential in providing service for companies customers?

Statement	Number of votes
Integration of sensors / actuators into service providing	2
Improving communication / connectivity	3
Improving functionalities for data storage and information exchange	3
Improving service providing monitoring processes	2
Improving service related IT services	2
Improving business models	2

1.2 Toolbox Industry 4.0. Section Production

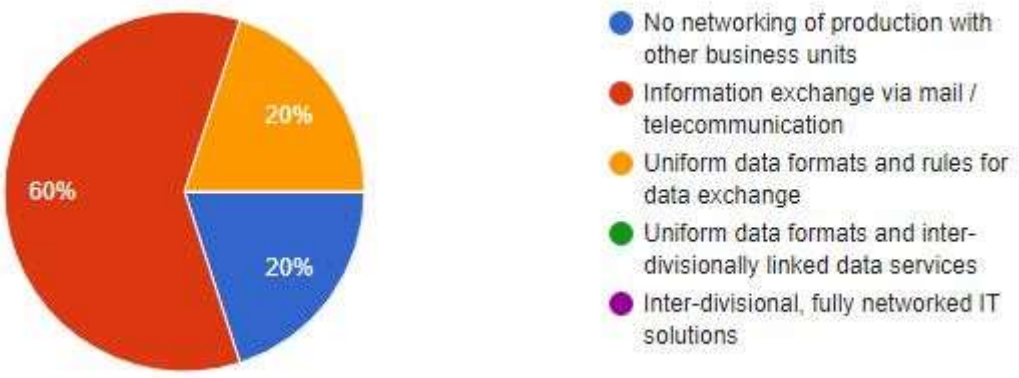
Assess data processing level in the production?

Statement	Number of votes
No processing of data	0
Storage of data for documentation	5
Analyzing data for process monitoring	2
Evaluation for process planning / control	2
Automatic process planning /control	0

Assess the machine-to-machine Communication (M2M) level?

Statement	Number of votes
No communication	4
Field bus interfaces (industrial computer network)	1
Industrial ethernet interfaces (is the physical cable network, over which the data travels)	1
M2M communication	0
WEB services (M2M software)	0

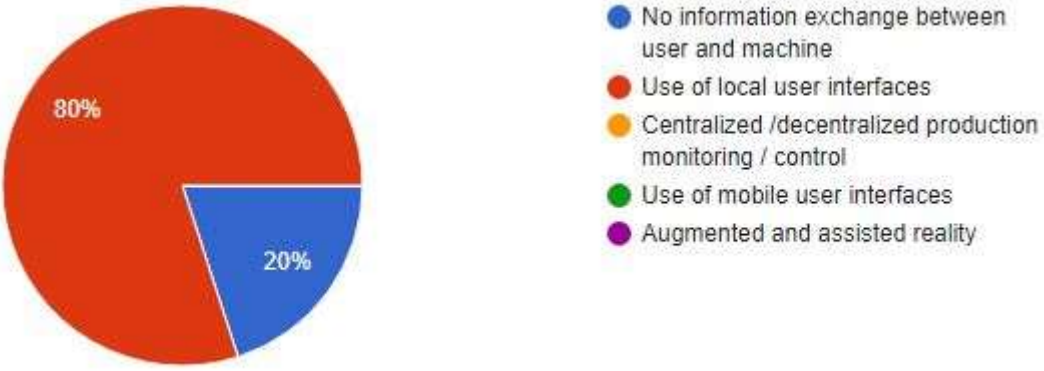
Assess company wide networking with the production?



Assess ICT infrastructure in production?

Statement	**Number of votes**
Information exchange via mail/telecommunication	4
Central data servers in production	3
Internet-based portals with data sharing	4
Automated information exchange (e.g order tracking)	0
Suppliers/customers are fully integrated into the process design	0

Assess the level of Man-machine interfaces?



Which of the below mentioned functionalities of Industry 4.0 could have in your opinion the most potential in improving current production systems?

Statement	Number of votes
Improving data processing in the production	3
Improving machine-to-machine communication (M2M)	4
Improving company-wide networking with the production	4
Improving ICT infrastructure in production	2
Improving man-machine interfaces	2
Improving efficiency with small batches	1

1.3 General questions section about Industry 4.0

- What would be the main goal for Estonia by implementing Industry 4.0 principles?

Higher competitive advantage, smarter people, more profitable companies, victory, smart industry, rise productivity to same level as Germany. There is a great need for continuous monitoring of production, forecasting and analysing situations, and making wise decisions at different levels of production.

- What would be the main goal for production company in which you are working by implementing Industry 4.0 principles?

To decrease non-value adding work in entire company, especially in office level. Profit, more precise resource management, rise productivity and profitability. Same as general goal, which is continuous monitoring of production, forecasting, and analysing situation, making wise decisions and be more competitive.

- What advantages could following of Industry 4.0 principles bring along in your position in production company Plastone OÜ?

Management decisions based on timely and pre-analysed data – today will be 50% of the time used for seeking the information, instead of guiding the people. Easier prioritization and control. Detailed and in real-time feedback from current situation, through monitoring solutions. Reduction of data collection time and increasing efficiency. Better opportunities to forecast needs and improve the purchasing process.

Do you belong to General Management or Finance and accounting department? 3 - Yes votes.

Question. Answers in 1 to 5 points scale (1 for Low, 5 for High)	Number of scale		
How do you evaluate available measures / resources offered by Estonian government for improving Industry 4.0 related activities in production companies?	3	4	3
How do you evaluate companies resources for Industry 4.0 related activities?	3	2	3
How do you evaluate openness of employees to new technology?	4	1	4
How do you rate ICT competence of employees?	2	2	3
How do you evaluate compability of Industry 4.0 with company strategies?	2	4	4
How do you position company in Industry 4.0 activities in relation to area specific competitors?	3	2	3
How do you evaluate adaptability of the company culture to Industry 4.0?	3	2	4
How do you rate expected inclusion of employees into change process?	3	2	4

- Which side of Industry 4.0 should be developed in the company in your responsibility area?

New functional ERP system, which covers all main processes together with machine integration.

Business Intelligence.

Forecasting and process stability, better traceability of processes, faster information sharing.

- Additional comments

Different Business Model applying companies have different level needs and possibilities to move towards Industry 4.0. Full ERP solution is lacking.

Do you belong to Procurement / Purchasing department? 2 – Yes votes.

Question. Answers in 1 to 5 points scale (1 for Low, 5 for High) or Yes/No answers	Number or Yes/No	
How do you evaluate openness and readiness of "average supplier" to new technology?	3	4
How do you evaluate "average supplier" competence in digital solutions?	3	4
How do you evaluate our company digital maturity compared to our "average supplier" digital maturity?	2	3
Is there in use production plan information sharing (for suppliers)?	No	No

- Which side of Industry 4.0 should be developed in the company in your responsibility area?

Forecasting and process stability, better traceability of process, faster information sharing inside company and also with our suppliers.

Do you belong to Production or Quality department? 2 – Yes votes.

Question. Answers in 1 to 5 points scale (1 for Low, 5 for High) or Yes/No answers	Number or Yes/No	
How do you evaluate openness of employees to new technology?	2	2
How do you rate ICT competence of employees?	3	3
How do you rate early failure detection solutions?	2	2
Is there in use production plan information sharing (for suppliers)?	No	No
Is there in use raw material and final products tracking systems?	Yes	Yes
Is it used digital simulation of the production environment and different scenarios?	No	No
Is there in use software support to follow and apply lean techniques?	No	No
Is there used digital forecasting in the production, which bases on simulated data?	No	No

Do you belong to Sales department? 2 – Yes votes.

Question. Answers in 1 to 5 points scale (1 for Low, 5 for High)	Number or Yes/No	
How do you evaluate openness and readiness of "average customer" to new technology?	4	3
How do you evaluate "average customer" competence in digital solutions?	4	4
How do you evaluate our company digital maturity compared to our "average customer" digital maturity?	2	2
How do you evaluate our company digital maturity compared to our "average competitor" digital maturity?	3	2

- Which side of Industry 4.0 should be developed in the company in your responsibility area?

Business Intelligence

1.4 Summarising section

Mark the expected positive outcomes of more digitalized production company - which are most important to you - 3 marks?

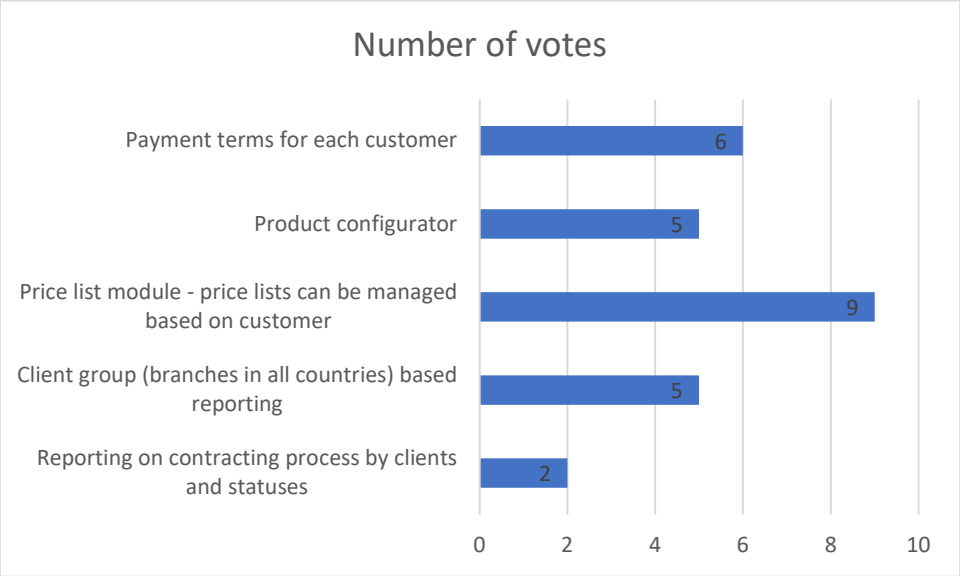
Statement	Number of votes
Innovation growth	3
Simplifies current production processes	4
Consumer / customer centralized production (Made-to-me products)	1
Human interface as machine calls for action	2
Future cost savings	4
Globalized value chains	2

4.2 Results for the new ERP solution features importance assessment questionnaire

The questionnaire was built up in a manner, that all employees evaluated the level of importance of new ERP system Monitor functionalities on 1 to 5 level scale. Down following is brought out the table of results.

	Sales	Total number of answers	Number of answers. Importance of functionality 1 to 5 scale. 1 - not important 5 - important				
			1	2	3	4	5
1	Client related data management - contact data, contact persons data	11	0	1	0	1	9
2	Defining client related additional attributes - setting preferred language, setting preferred communication channel (e-mail, post, ...)	11	1	0	2	3	5
3	Sharing client related data between Plastone offices and different countries	11	1	0	1	3	6
4	Registering of sales activities related to client relationship (phone calls, e-mails, information exchange, client meetings, requests)	11	1	0	2	3	5
5	Defining deadlines for agreed activities related to client and assigning the calendar reminders to these activities	11	0	0	1	3	7
6	Registering of the pursuing, proposing and contracting process phases	11	1	1	3	4	2
7	Attaching client related electronic documents to the client record	11	1	1	0	1	8
8	Reminders of various client activities (client related activity deadline etc)	11	0	0	2	3	6

Each answerer chose 3 most important sales reporting functionalities out of the list below:



What functionalities more would be in Your opinion important in Monitor regarding sales and sales reporting?

- Price calculation system should be much better compared to the current one – the component price change automatically influences the final price of the product
- More precise margin analysis
- Customer billing reporting
- Customer data archiving
- Measuring client satisfaction

Production	Total number of answers	Number of answers. Importance of functionality 1 to 5 scale. 1 - not important 5 - important				
		1	2	3	4	5

1	ERP system will include New Product Introduction (NPI) module	11	0	0	0	2	9
2	NPI module includes possibility for product structures (incl. alternative materials / alternative structures, components + assigned human / machine times)	11	0	0	0	3	8
3	Option to integrate machines with ERP system	11	0	0	0	2	9
4	Machine maintenance and tool maintenance module	11	0	0	1	1	9
5	Product/production stages and time consumption reporting to ERP (machine, operator, product based)	11	0	0	0	2	9
6	Product costing (routes, materials, work centers, machine centers)	11	0	0	1	3	7
7	Possibility for sales order transfer to production orders (or suggestion for production)	11	0	0	0	1	10
8	ERP automatically orders materials based on stock parameters	11	1	0	0	2	8
9	Hourly production planning (possibility to use daily planning if needed as well)	11	0	1	2	2	6
10	Planning schedule suggestions based on material availability	11	1	0	0	0	10
11	Work tasks and production schedule (also in printable layout). Ability to add custom data (incl. necessary set-up tools/equipment, photos, inspection reports etc.)	11	0	0	1	2	8
12	Possibility to see the status of a Work Task (Shop Order) when planning a production. Status could be - Planned, Started, Finished etc.	11	0	0	2	2	7
13	Possibility to see tool/machine status when planning (ready or under maintenance)	11	0	0	2	0	9
14	Possibility to make notes in every Work Task (Shop Order)	11	0	1	2	2	6
15	Daily/weekly prognosis of needed materials	11	0	1	1	0	9

16	The location of the materials in the dryer are displayed graphically	11	0	2	1	1	7
17	In case of open supplier complaint, automatic warning before particular part/material purchasing order confirmation	11	0	0	0	2	9
18	When entering item delivery deadline, ERP calculates the time it takes to prepare the product for delivery	11	0	0	0	1	10
19	General search over all objects	11	0	0	0	3	8
20	The material requirements of the products are calculated automatically, possibility to change manually if necessary	11	0	0	0	1	10
21	Employee based work/work hours recording	11	0	1	1	2	7
22	Possibility to link photographs and other possible drawings and pictures to product-related instructions	11	0	0	1	2	8
23	Defective products/components/materials handling - not available for production planning (blocked), but status visible for planners/purchases	11	0	0	1	2	8
24	Late components report	11	0	1	0	2	8
25	Management of production planning KPI-s	11	0	0	2	3	6
26	Supply metrics is manageable for both customers and suppliers, possibility to retrieve reports	11	0	0	1	5	5

What functionalities more would be in Your opinion important in Monitor regarding production and production planning?

- Better visibility about machines, which allows increase efficiency
- Dryers monitoring (drying time, work order is done – need cleaning), maintenance schedule
- In addition to in production and should ERP in correspondence to production plan guide, what material has to go into, which dryer. Taking in account availability of dryer, size, material need in hour and as well needed drying time

- Converting predictions from product pieces to kilos of material

Stock module/logistics and purchase		Total number of answers	Number of answers. Importance of functionality 1 to 5 scale. 1 - not important 5 - important				
			1	2	3	4	5
1	Goods receiving and transfers between warehouses and product dispatching using RFID/Barcode systems	7	0	0	0	2	5
2	With incoming materials user is able to see related documents and link documents, including certificates, purchase invoices etc	7	0	0	1	0	6
3	It is possible to print out barcodes for labels, packing lists for boxes and pallets	7	0	0	0	0	7
4	It is possible for the warehouse to send in the goods for input control; it is possible to inform the input control and assign the task	7	0	0	0	4	3
5	When the order is completed and shipped from the warehouse, the product and order statuses are changed automatically	7	0	0	0	1	6
6	Different warehouses in different sites are managed	7	0	0	1	0	6
7	Searching by stock location is possible	7	0	0	0	1	6
8	FIFO method integration	7	0	0	0	1	6
9	History of any change of location of material/component	7	0	0	1	1	5
10	Component-by-component reports to track material and component needs	7	0	0	0	3	4
11	The size of the package - dimensions, weight - is calculated according to the product specification	7	0	0	1	2	4

12	It is possible to integrate or connect to logistic company system to organize transportation ordering automatically	7	0	0	1	1	5
13	Package weights and units are generated automatically on the invoice	7	0	0	0	1	6
14	In case of material/component/product transfer between different warehouses it is possible to generate document (delivery note)	7	0	0	0	1	6
15	It is possible to add to one product different prices for different batches	7	0	0	0	3	4
16	Possibility to track logistical cost separately	7	0	0	0	1	6
17	Possibility to generate and send customer invoices/orders directly from system	7	0	0	0	1	6
18	Possibility to add different dates for delivery or order (produced, ready for shipment, arrival date etc.)	7	0	0	0	2	5
19	System can handle price changes (for material, components, packaging etc.) and show impact to final product price	7	0	0	0	0	7
20	Automatic system for approving invoices (no need to personal handling , only in case if the system can find error between invoice and order/system)	7	0	0	0	2	5
21	Possibility to add different prices/pricelists for the same product (different clients or suppliers or MOQ)	7	0	0	0	1	6
22	Product version handling	7	0	0	0	2	5
23	Ordering suggestions for raw materials with alarms	7	0	0	0	1	6
24	Possibility to follow different trends (DA, late rows, price trends, availability, supplier evaluation etc.)	7	0	0	1	0	6

25	Possibility to produce end product forecasts automatically (raw material, components, packaging etc.)	7	0	1	0	1	5
26	Stock level is in real time	7	0	0	0	1	6
27	Reasonable amount of space in text modules (for description of components, contact information , version information etc.)	7	0	1	1	0	5
28	Document management - possibility to attach all documents related to the material/component (reclamations, certificates, drawings, invoices, PO, confirmations etc.)	7	0	0	0	1	6
29	Packaging reports are managed	7	0	0	1	1	5

	Inventory module	**Total number of answers**	**Number of answers. Importance of functionality 1 to 5 scale. 1 - not important 5 - important**				
			1	**2**	**3**	**4**	**5**
1	Inventory Planning	10	0	0	1		9
2	Shelf Management	10	0	0	0	2	8
3	Product Analysis	10	0	0	1	2	7
4	Product drawings and revision (when have been changed)	10	0	0	0	1	9
5	Availability planning for every item (visualized demands and orders)	10	0	0	1	0	9
6	Inventory items must have LOT/batch number and/or serial numbers	10	0	0	2	1	7
7	Inventory items with limited usage lifetime should have described with latest permitted usage date	10	0	0	0	2	8

What functionalities more would be in Your opinion important in Monitor regarding Inventory module?

Any write-offs in stock would be visible and justified

Quality and traceability	**Total number of answers**	**Number of answers. Importance of functionality 1 to 5 scale. 1 - not important 5 - important**

			1	2	3	4	5
1	Complaint/reclamation management, including possibility to send complaints directly from ERP to supplier	8	0	0	0	1	7
2	Customer/supplier related certificates storaging	8	0	0	1	1	6
3	All quality related data sorting according to the production location/site	8	0	0	1	2	5
4	Possibility to maintaining 8D/CAPA report (tasks with due date, task reminders to task owners)	8	0	0	1	2	5
5	Quality control dashboard, where you can insert the results of quality control and manage the results	8	0	0	0	1	7
6	Product quality (good/bad/defects overview) trends availability	8	0	0	0	2	6
7	Possibility to create and assign incoming or final inspection plan(s) to product/material	8	0	0	1	2	5
8	Product/material with quality inspection obligation is blocked for production planning till quality inspection is done	8	0	0	1	0	7
9	Recording of incoming inspection results (measurement data)	8	0	0	2	1	5
10	Quality inspection reports integration to measurement equipment (equipment ID appear on the measurement report)	8	0	0	1	4	3
11	Quality KPI -s like "first-passed-yield report"	8	0	0	0	3	5
12	Possibility to set different quality control methods for products (like sampling inspection)l based on product quality history and customer needs	8	0	0	1	3	4
13	Possibility to access from product master data to all product/material related drawings/documents/certificates and assembly instructions	8	0	0	1	2	5

14	Possibility to store product/material related certificates	8	0	0	1	1	6
15	Management of measurement equipment: equipment ID number, maintenance/calibration data available, next maintenance/calibration notification + task assignment, calibration certificate and maintenance instruction retention/recording	8	0	0	0	3	5
16	Possibility to integrate CNC measurement equipment with ERP (mesurement results automatic transfer to ERP Quality Module)	8	0	0	0	3	5

Accounting /Financial Management		**Total number of answers**	**Number of answers. Importance of functionality 1 to 5 scale. 1 - not important 5 - important**				
			1	**2**	**3**	**4**	**5**
1	Automatic handling of orders (purchase order - invoice matching)	8	0	0	0	0	8
2	Electronic Invoice Management (EIM)	8	0	0	0	1	7
3	Estonian and Finnish accounting law integration	8	0	0	0	1	7
4	Cash Flow Forecast	8	0	0	2	0	6
5	Chart of accounts, several dimensions (department, project etc.)	8	0	0	0	0	8
6	Fixed assets management (It must be possible to set and calculate depreciation automatically)	8	0	0	0	2	6
7	Budgeting	8	0	0	0	2	6
8	Simple cost periodization	8	0	0	0	2	6
9	Split of invoice between accounts and cost centers is configurable and is automatically linked	8	0	0	0	2	6
10	Automatic VAT reporting	8	0	0	0	1	7
11	Intrastat reports	8	0	0	0	1	7
12	VIES reporting	8	0	0	1	2	4
13	Packaging reporting	8	0	0	2	1	5

14	Consolidation possibility	8	0	0	0	2	6
15	The cost calculation for the product is based on real batch sizes and cycle times	8	0	0	0	1	7
16	The Product Profitability Report is available to the Sales Department	8	0	0	0	0	8
17	While calculating working time, it is possible to manage bonuses, holidays etc.	8	0	0	0	2	6
18	It is possible to enter working time digitally; The employee should be able to sign in and out	8	0	0	1	2	5

What functionalities more would be in Your opinion important in Monitor regarding Accounting / Financial Management module?

- Different Business Intelligence (BI) reports

What kind of positive outcomes You personally expect for Plastone after implementation of ERP system Monitor?

Expectation is that the work will go much faster, there will be more resource to find new customers and leads. Business will grow.
Less time for searching the data and more time for supervision of people and meeting customers
Much better visibility and efficiency
Hopefully everyone's job is easier and you don't have to make any unnecessary moves
Better report options
Cost and time saving
We can get all the small pieces to the one system, so the all picture will be clear/transparent for each department
Huge benefits in office efficency
Improve productivity
All information can be found in one place
So I can work more productively, quickly get the right data, reduce manual work, and work paperless
Less handicraft
Easier data access and management, significant resource savings

4.3 Results in practical experiment with sensor and program Dimusa

The results about production stops duration and content described by setters is listed in scanned mode in the **Appendix nr 4**.

Down following in Fig 4.8 are the production stop reasons distributed in the following way:

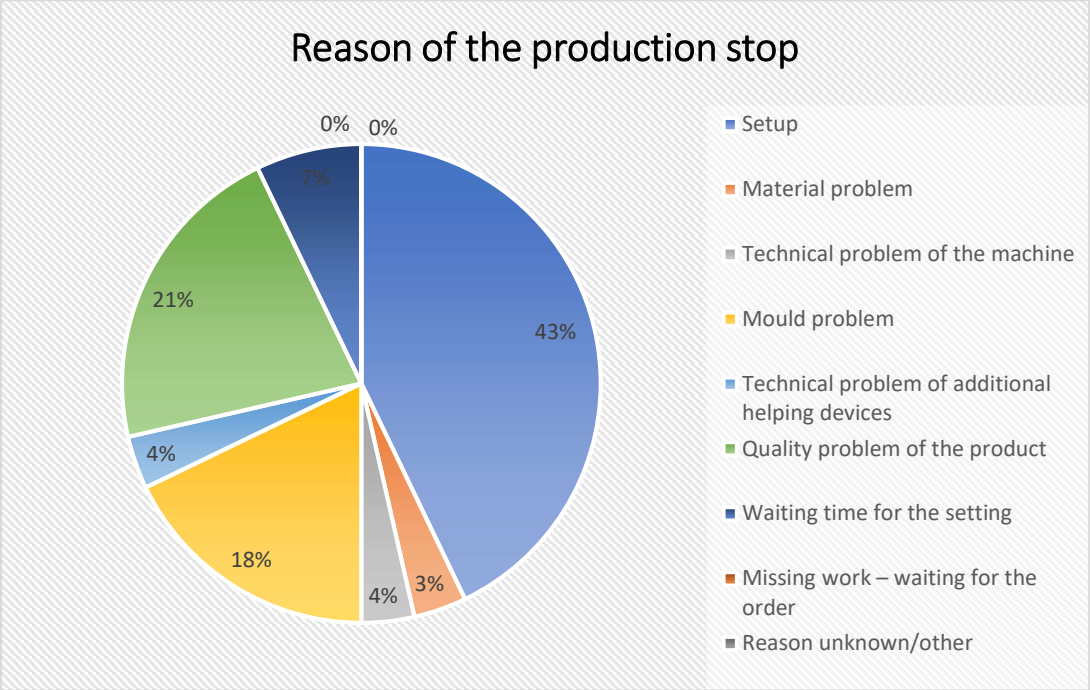


Fig 4.8 Production stops

Reasons from product perspective for the longest stops during the viewed period May 2019 are brought out in Table. 4.1.

Table 4.1 Reasons of the production stops

Products, with what occured the production stops most frequently	**Problem occuring frequency**	**Time spent to solve the problem**	**Content of the problem**
A	9	14h35min	There was according to customer request material change, but afterwards product got stuck in the mould. Changes of the mould were done and the setting parameters did not help. As the final solution there was implemented hydraulic pump squirting release agent between cycles. Account manager explained to the customer new process and there was made price change according to longer cycle time.
D	5	35h35min	There were planned other works on the machine because of these long stops, so that time does not reflect real stopping time. By one stop there occured quality problem, but by second stop there was problem with human resource.
K	4	22h25min	There were planned other works on that machine because of the long stops, so the time does not reflect real stopping time. Regular setting procedure, but inbetween came issue with mould. Mould was repaired and there was possibility to continue the production.

Dimusa views

Down following in Fig 4.9 is brought out production managers view:

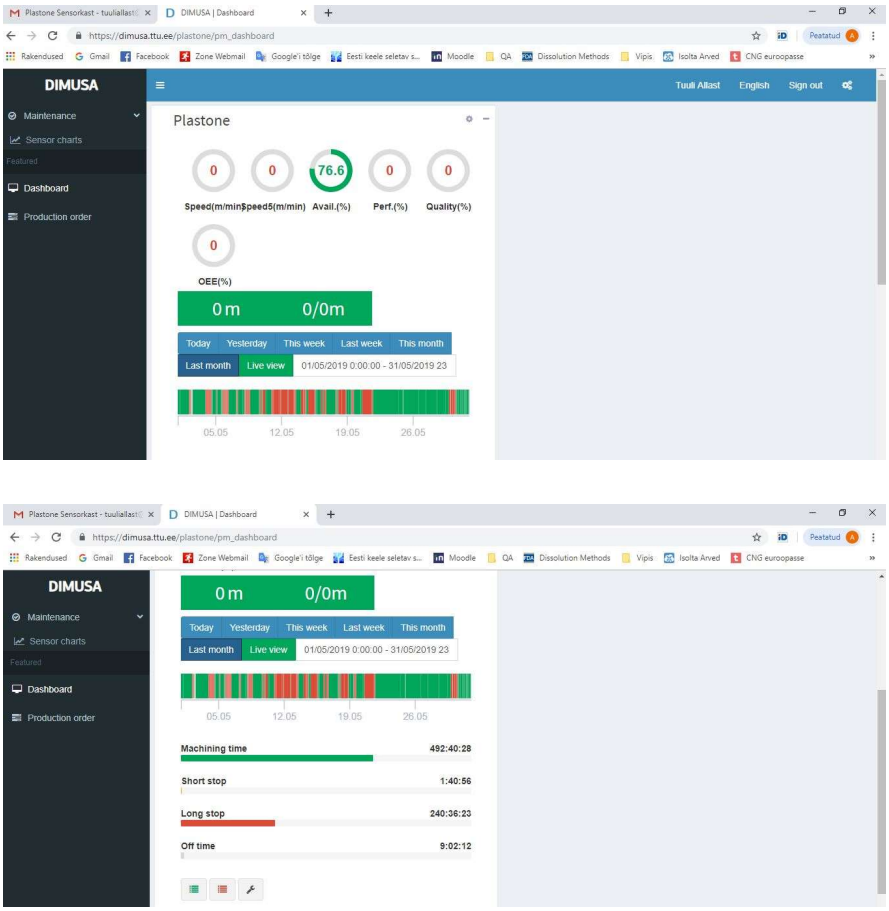


Fig 4.9 Production Managers view in Dimusa

Down following in Fig 4.10 is brought out operators view.

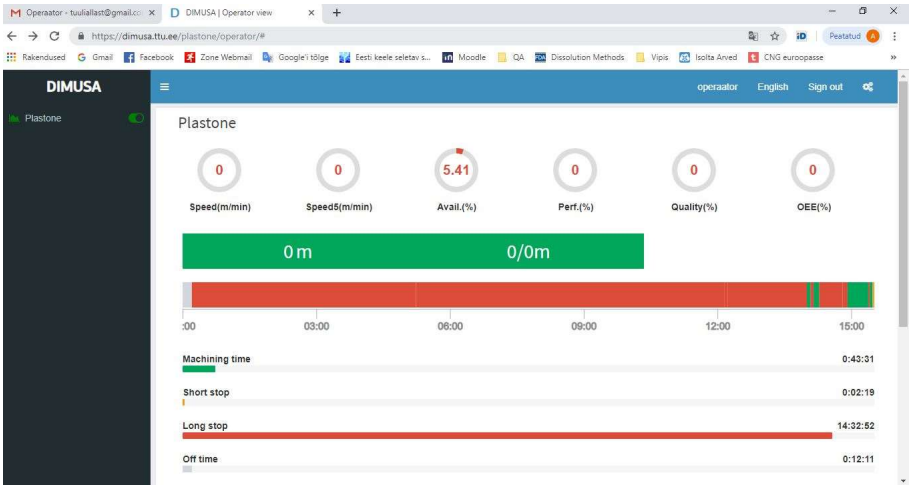


Fig 4.10 is Operators view in Dimusa

Conclusion. According to program Dimusa, there was overall availability in time period of 01.05 - 31.05.2019 of the 300T machine 76,6%.

- Total Machining time was 429h 40min 28sec
- Short stop 1h 40min 56sec
- Long stop 240h 36min 23sec
- Off time 9h 2min 12sec

For comparison: in production generally measured metrics in May 2019 were:

Availability 87%

Machines overall application rate 59,8%

Interval choices were done in the following way:

- Below 24h is minute interval
- As 60 days, than one hour interval
- Above it than day interval
- Raw data is the whole package of data

The amperage changes report with added stop times is in **Appendix nr 5**.

The listed stop times by setters was compared with the amperage table and it draws out that the stop times are recognizable from the whole table, summary is in Table 4.2.

Table 4.2 Reasons of the production stops

Metric	Amperage (A)
Total average amperage	30,9272
Average amperage of working injection moulding machine	39,3989
Average amperage of non-working injection moulding machine	13,2681

Down following in Fig 4.11 is brought out graphic amperage changes of viewable one phase of the injection moulding machine.

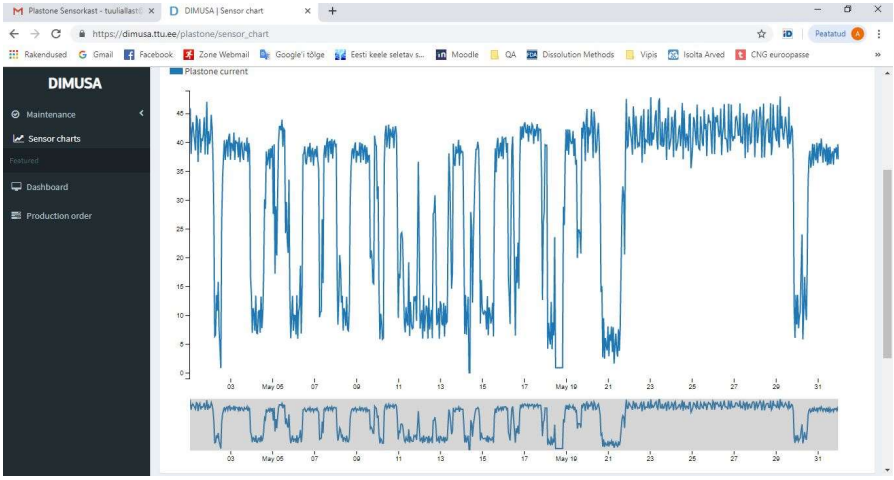


Fig 4.11 Amperage Changes of 300T machine during May 2019

Program Dimusa was in use during the period May 2019 - Production Managers and Operators view. There is possibility to monitor amperage changes and make out of it conclusions, when was the production running and when there were production stops and what were their durations. There is option to add cycle time controlling module to program Dimusa. It gives the option to measure one important characteristic OEE index, which is currently in Plastone not measured. The most simplified way to explain content of OEE index is: ratio of Fully Productive Time to Planned Productive Time. Ideal Cycle Time is pre-measured. There is at the moment no proper tool to calculate the OOE index automatically. That is one of the KPI:s, which is as a target set to be in new ERP solution.

3.1 OEE index calculation

Based on monthly bases from machine gathered data, there was possibility to calculate for 300T machine applying OEE index for May 2019.

The initial data for calculations is in Table 4.3.

Table 4.3 Data for OEE index calculation

No	Product	Work order number	P_Q Quantity (pc)	T_p / CT_P Planned production time (h)	CT_A Worktime real duration (h)	Run time (h)	TL_{ST} Predicted and real difference (h)
1		26938	17850	79,33	115,50	43,17	36,17
2		26877	36480	146,93	201,67	92,20	54,74
3		26962	1320	7,33	7,42	7,25	0,09
4	B	27082	200	6,89	9,58	4,20	2,69
5	A	26204	2880	30,72	31,17	30,27	0,45
6	D	26755	1000	14,44	17,83	11,06	3,39
7	E	27114	864	12,00	13,08	10,92	1,08
8	F	26477	1000	16,11	22,00	10,22	5,89
9	G	27050	3600	17,50	26,25	8,75	8,75
10		27062	476	5,95	14,58	-2,68	8,63
11	H	27186	200	7,88	4,17	11,59	-3,71
12	A	27123	1296	13,82	20,70	6,95	6,88
13	I	27128	6000	9,58	10,25	8,92	0,67
14	I	27206	6000	9,58	10,50	8,67	0,92
15	J	27038	6800	12,04	42,75	-18,67	30,71
16	K	27110	36000	145,00	211,17	78,83	66,17
17		27163	5760	23,20	29,33	17,07	6,13
18	D	27201	1935	27,95	40,58	15,32	12,63
19		27226	1320	7,33	13,83	0,84	6,50
	SUM		130981	593,61	842,36	344,86	248,75

$\boldsymbol{P_A}$ - Number of initially planned products was in total 139649 pc.

OEE is calculated by multiplying the three OEE factors: Availability (*A*), Performance (*P*) and Quality (*Q*).

$$OEE = A \times P \times Q \qquad (4.1)$$

Availability takes in account all events that stop planned production long enough where it makes sense to track a reason for being down (typically several minutes).[32]

$$A = \frac{T_A}{T_P} = \frac{T_P - TL_{ST}}{T_P} \qquad (4.2)$$

where

T_A - operating time, h,

T_P – planned operating time, h,

TL_{ST} – unplanned production losses, h [33]

$$A = \frac{593{,}61 - 248{,}75}{593{,}61} = \mathbf{0{,}581}$$

Performance *P* indicates the performance efficiency and it is the ratio of the planned cycle time CT_P to the realized average cycle time CT_A.[33]

$$P = \frac{CT_P}{CT_A} \qquad (4.3)$$

where

CT_P – planned cycle time, h

CT_A – average cycle time, h [33]

$$P = \frac{593{,}61}{842{,}36} = \mathbf{0{,}705}$$

Speed losses, like idling and minor stop losses, occur when the production is interrupted by a machines functioning or when a machine is idling. If the equipment design speed and actual operating speed are different, the speed losses are reduced.[34]

Quality takes into account produced parts that do not meet quality standards, including parts that need rework. OEE Quality defines Good Parts as parts that successfully pass through the manufacturing process the first time without needing any rework. [32]

Quality Q is the ratio of the qualified products number P_Q to P_A and indicates the quality losses. [33]

$$Q = \frac{P_Q}{P_A} \qquad (4.4)$$

where

P_Q – is qualified products number, pc

P_A – qualified products number together with quality losses, pc

$$Q = \frac{130981}{139649} = \mathbf{0,938}$$

OEE Factor	**May 2019 / Plastone 300T injection moulding machine**
OEE	0,384 (38,4%)
Availability	58,1%
Performance	70,5%
Quality	93,8%

$$A \times P \times Q = OEE \qquad (4.5)$$

$$OEE = 0{,}581 \times 0{,}705 \times 0{,}938 = 0{,}384$$

Availability according to program Dimusa was at viewable period 76,6%

$$OEE_{Dimusa} = 0{,}766 \times 0{,}705 \times 0{,}938 = 0{,}506$$

OEE scores provide a very valuable insight – an accurate picture of how effectively your manufacturing process is running. And, it makes it easy to follow improvements in that process over time. What your OEE core doesn't provide is any insights as to the underlying causes of lost productivity. This is the role of Availability, Performance and Quality. [32]

OEE index will give valuable information, as it is measured periodically, and there is comparison possibility with previous months results.

Setting the sensor

1. Sensor was applied on the injection moulding machine
2. Sensor clamp attached around second phase conductor of the injection moulding machine
3. There was created special WIFI network to connect the sensor with the network
4. Connection was created according to manual

5. Connecting the sensor with WIFI did not succeed at first attempt, because machine pulled for the first time the settings away from their place.

Dimusa views. Down following in Fig 4.9 is brought out production managers view.

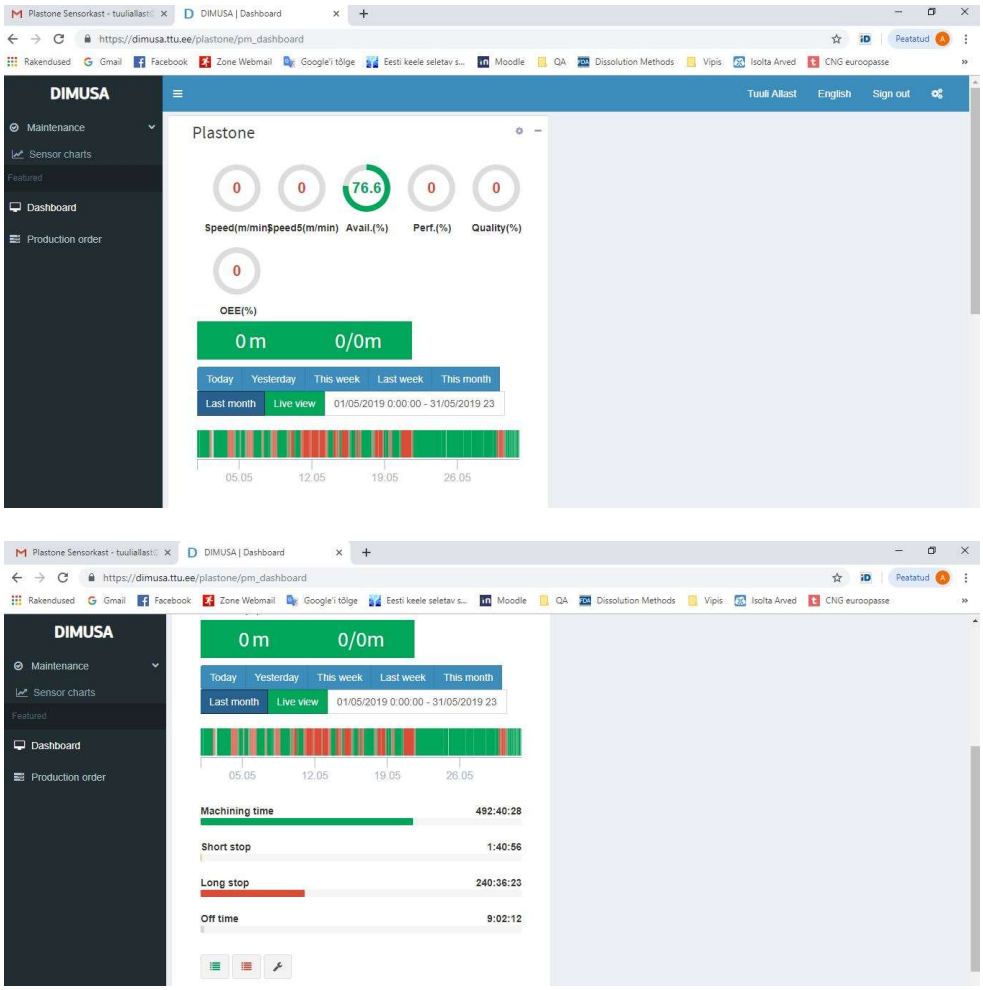


Fig 4.9 Production Managers view in Dimusa

Down following in Fig 4.10 is brought out operators view.

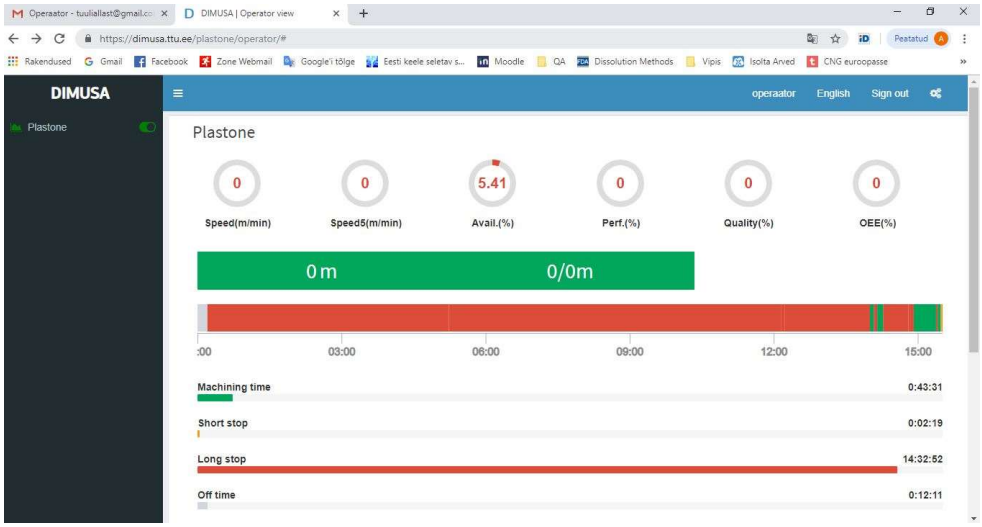


Fig 4.10 is Operators view in Dimusa

5 ANALYSIS OF THE RESEARCH RESULTS

5.1 Analysis of the Industry 4.0 questionnaire results

Toolbox Industry 4.0 section Product was modified until that extent, that it can be used for assessing service. Viewable company Plastone OÜ is plastic injection moulding service providing company.

- The companies data storage functionalities were assessed, that Plastone has possibilities to individual identification and service providing data has a passive data store.
- Monitoring possibilities enable to detect failures in the process and there are in use as well some independently working control measures while providing the service.
- There has been brought out as main business model of the company: sales consulting and adaption of the service to meet customer specifications (3 votes). As other options are mentioned as well: gaining profits from selling standardized injection moulding service, additional sale of service related services, sales of service concept.
- The functionalities of Industry 4.0 which would bring the highest benefits for companies customers are improvements in communication / connectivity and improvements in functionalities of data storage and information exchange.

Toolbox Industry 4.0 Section Production

- Data processing level in production is assessed on level, that there is capability to storage the data for documentation (5 votes), but as well to analyze data for process monitoring (2 votes) and evaluation for process planning / control (2 votes)
- There is no machine-to-machine (M2M) communication (4 votes), but are mentioned existence of field bus interfaces (industrial computer network) (1 vote) and industrial ethernet interfaces (the physical cable network, over which the data travels) (1 vote)
- Company wide networking with the production is mainly made via mail /telecommunication (60%). There are existing as well uniform data formats and rules for data Exchange (20%). There is no networking of production with other business units – 20% of the answers.
- ICT infrastructure in production – information will be exchanged via mail/telecommunication. There exist internet-based portals with data sharing.

- The level of Man-machine interfaces were assessed in the way that there is in use local user interfaces (80%), 20% of the answers said, that there is no information Exchange between user and machine.
- The functionalities of Industry 4.0, which would have the most potential in improving current production systems are: improving the machine-to-machine communication (M2M) and to improve the company-wide networking with the production.

General Management or Finance accounting department answers were following (3 answers):

- Available measures /resources offered by Estonian government for improving Industry 4.0 related activities in production companies are in average rated with 3,33 in 1 to 5 points scale. Companies resources for Industry 4.0 related activities are in average rated with 2,67 in 1 to 5 points scale. The openness of employees to new technology is in average rated with 3,00 in 1 to 5 points scale. ICT competence of employees is rated in average with 2,33 in 1 to 5 points scale. Compatibility of Industry 4.0 is evaluated in company strategy in average with 3,33 in 1 to 5 points scale. The companies position is evaluated in relation to area specific competitors with 2,67 in 1 to 5 points scale. The adaptability of the company culture to Industry 4.0 is rated in average with 3,00 in 1 to 5 points scale. Expected inclusion of employees into change process is rated in average with 3,00 in 1 to 5 points scale.

From General Management or Finance accounting department answers can say as conclusion, that all the Industry 4.0 statements readiness is rated in average with 2,92 points in 1 to 5 points scale.

Procurement / Purchasing department answers were following (2 answers):

- Readiness of „average supplier" to new technology is rated in average with 3,50 in 1 to 5 points scale. „Average supplier" competence in digital solutions is rated in average with 3,50 in 1 to 5 points scale. Our company digital maturity is compared to our „average suppliers" digital maturity rated in average with 2,5 in 1 to 5 points scale. There is not in use production plan information sharing towards our suppliers.

From Procurement / Purchasing department answers can be said as conclusion, that all the Industry 4.0 statements readiness is rated in average with 3,17 points in 1 to 5 points scale.

Production / Quality department answers were following (2 answers):

- Openness of employees to new technology is in average rated with 2,0 in 1 to 5 points scale. ICT competence of employees is in average rated with 3,0 in 1 to 5 points scale. Early failure detection solutions is in average rated with 2,0 in 1 to 5 points scale.
  There is in use raw material and final products tracking systems. There is not used production plan information sharing (for suppliers). There is not used digital simulation of the production environment and different scenarios. There is not used software support to follow and apply lean techniques. There is not used digital forecasting in the production, which bases on simulated data.

From Production / Quality department answers can be said as conclusion, that all the Industry 4.0 statements readiness is rated in average with 2,33 points in 1 to 5 points scale.

Sales department answers were following (2 answers):

- The „average customer" readiness to new technology is rated in average with 3,5 points in 1 to 5 points scale. „Average customer" competence in digital solutions is rated in average with 4,0 points in 1 to 5 points scale. The companies digital maturity is rated compared in „average customer" digital maturity with 2,0 points in 1 to 5 points scale. The companies digital maturity is rated compared to „average competitor" digital maturity with 2,5 points in 1 to 5 points scale.

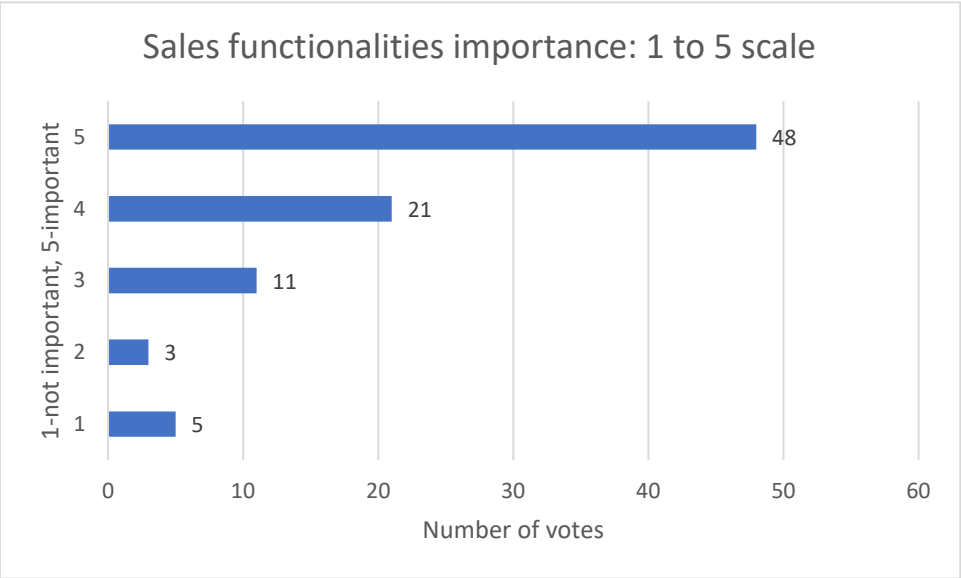
From Sales department answers can be said as conclusion, that all the Industry 4.0 statements readiness is rated in average with 3,0 points in 1 to 5 points scale.

From the listed expected positive outcomes of more digitalized production company got the most votes:

- Simplifies current production processes
- Future cost savings
- Innovation growth

5.2 Analysis of the new ERP solution features importance assessment questionnaire

The sales section questions were rated the following way:



For the sales section questionnaire total number of answerers was 11. Number of questions is 8. As the conclusion, all listed functionalities are rated to be important and by 80 votes out of 88, were given only votes from 3 to 5.

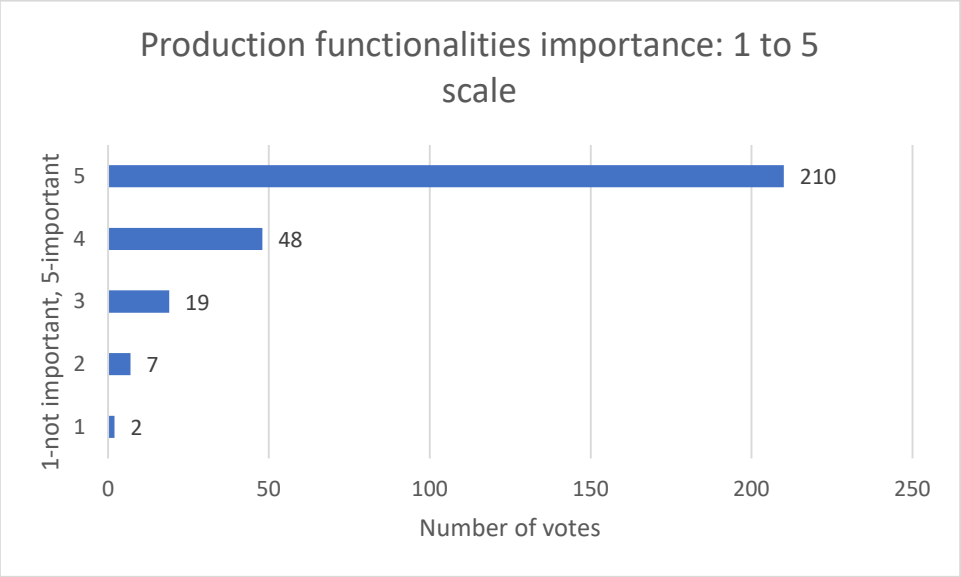
As very important were valued following functionalities:

1. Client related data management – contact data, contact persons data
2. Defining deadlines for agreed activities related to client and assigning the calendar reminders to these activities

As less important was valued following functionality:

1. Registering of the pursuing, proposing and contracting process phases

The production section questions were rated the following way:



For the production section questionnaire total number of answerers was 11. Number of questions is 26. As the conclusion, all listed functionalities are rated to be important and by 277 votes out of 286, were given only votes from 3 to 5.

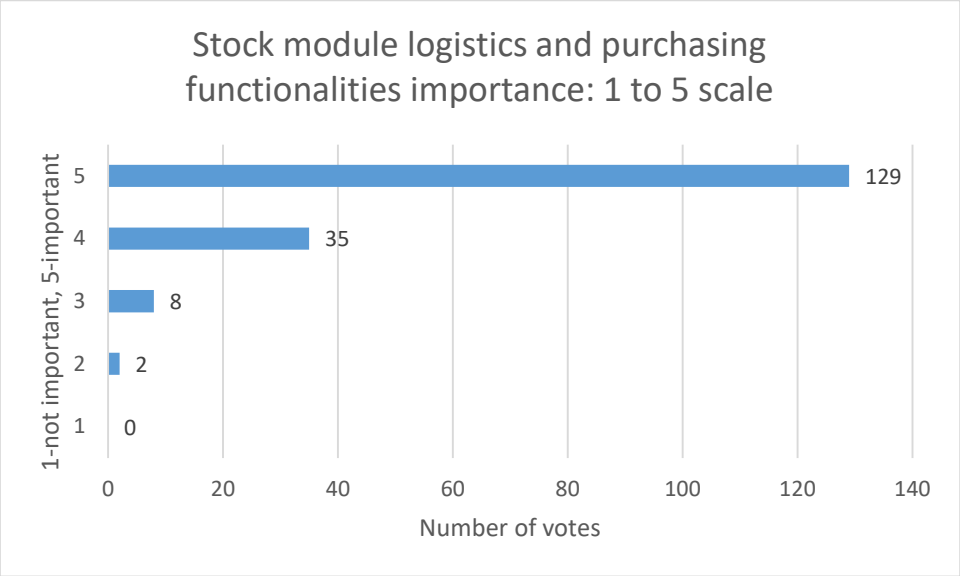
As very important were valued following functionalities:

1. Possibility for sales order transfer to production orders (or suggestion for production)
2. When entering item delivery deadline, ERP calculates the time it takes to prepare the product for delivery
3. The material requirements of the products are calculated automatically, possibility to change manually if necessary

As less important was valued following functionality:

1. Hourly production planning (possibility to use daily planning if needed as well)

The stock module logistics and purchasing section questions were rated the following way:



For the stock module logistics and purchasing section questionnaire total number of answerers was 6. Number of questions is 29. As the conclusion, all listed functionalities are rated to be important and by 172 votes out of 174, were given only votes from 3 to 5.

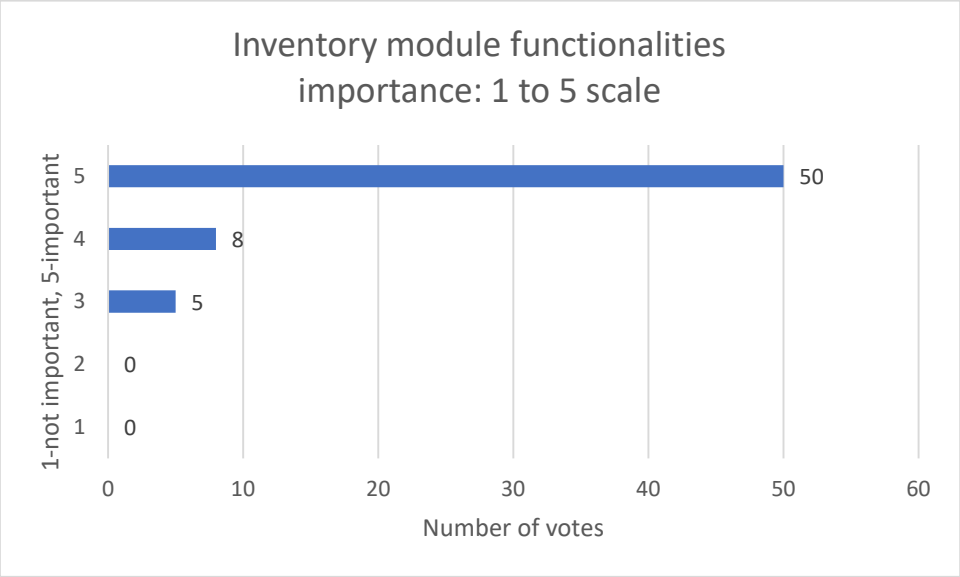
As very important were valued following functionalities:

1. It is possible to print out barcodes for labels, packing lists for boxes and pallets
2. Possibility to add different prices/pricelists for the same product (different clients or suppliers or MOQ)
3. Ordering suggestions for raw materials with alarms

As less important was valued following functionality:

1. Possibility to produce end product forecasts automatically (raw material, components, packing etc.)
2. Reasonable amount of space in text modules (for description of components, contact information, version information etc.)

The inventory module questions were rated the following way:



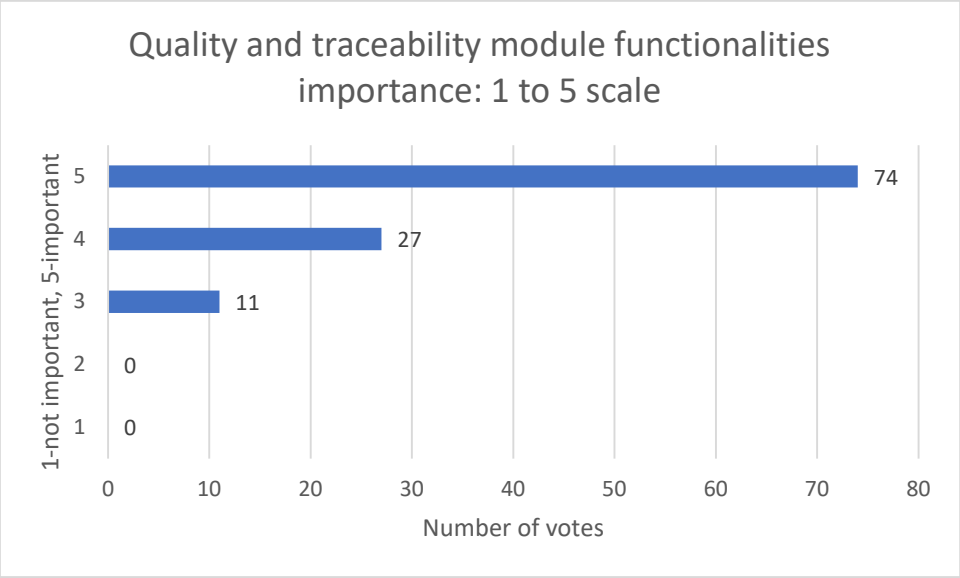
For the inventory section questionnaire total number of answerers was 9. Number of questions is 7. As the conclusion, all listed functionalities are rated to be important and by 63 votes out of 63, were given votes from 3 to 5.

As very important were valued following functionalities:

1. Inventory Planning
2. Product drawings and revision (when have been changed)
3. Availability planning for every item (visualized demands and orders)

There are no less important functionalities to mention.

The quality and traceability module questions were rated the following way:



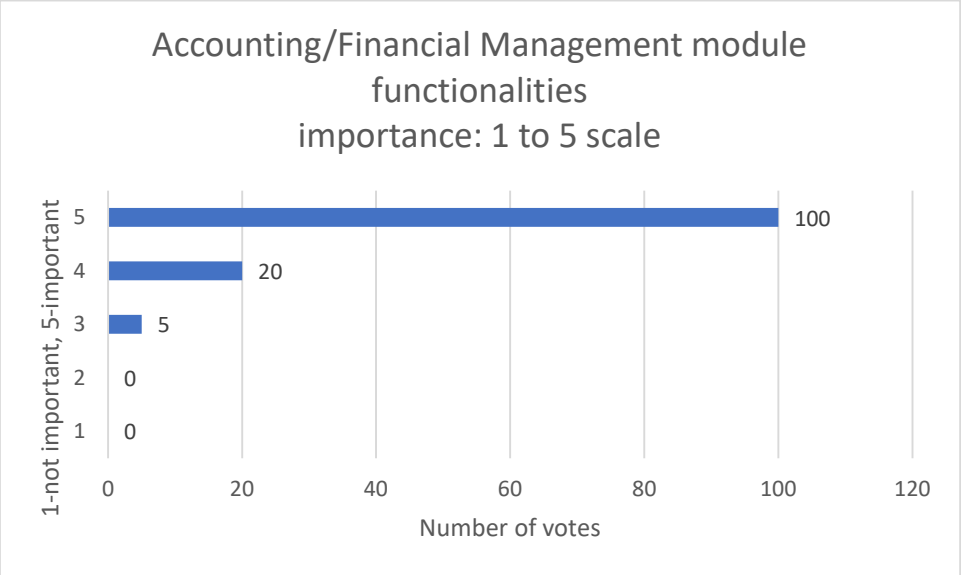
For the quality and traceability section questionnaire total number of answerers was 7. Number of questions is 16. As the conclusion, all listed functionalities are rated to be important and by 112 votes out of 112, were given votes from 3 to 5.

As very important were valued following functionalities:

1. Complaint/reclamation management, including possibility to send complaints directly from ERP to supplier
2. Quality control dashboard, where you can insert the results of quality control and manage the results

There are no less important functionalities to mention.

The Accounting/Financial Management module questions were rated the following way:



For the Accounting/Financial Management module questionnaire total number of answerers was 7. Number of questions is 18. As the conclusion, all listed functionalities are rated to be important and by 125 votes out of 125, were given votes from 3 to 5.

As very important were valued following functionalities:

1. Automatic handling of orders (purchase order – invoice matching)
2. Chart of accounts, several dimensions (department, project etc.)
3. The Product Profitability Report is available to the Sales Department

There are no less important functionalities to mention.

Management reporting functionalities in new ERP system:

There will be existing:

- key performance indicators (KPI) and business intelligence (BI) reports function
- sales and operations planning (S&OP)
- reporting by subsidiaries, reporting by cost items/groups, marketing expenses, utilities costs
- exporting the reports to MS Excel and PDF format

Data security requirements for new ERP system:

The system must support:

- defining personal user accounts with authentication mechanism and authorization profiles
- the integration with directory services for user authorization and authentication
- logging critical user activities in the system
- define flexible user profiles, grant and restrict access to specific data or functional elements
- must provide the data backup and restore procedures

Integration and interfaces in new ERP system:

- SEPA bank interfaces (automatic payment/receipt matching)
- possibility to export reports to Statistics Estonia
- automatic rate report
- E-invoice handling
- possibility to import and export standard file formats (.txt, .xls)
- possibility to print and export system transactions and reports to various file formats (at least text file, MS Excel, PDF)

Unfortunately there will be no local tax office interface

User interfaces in new ERP system:

The system must have:

- intuitive user interface with logical setup
- online context sensitive help system with meaningful error messages
- the error messaging system with meaningful error messages
- enable to define validation controls for manually entered values

5.3 Analysis of practical experiment with sensor and program Dimusa

According to program Dimusa, there was overall availability in time period of 01.05 - 31.05.2019 of the 300T machine 76,6%.

Total Machining time was 429h 40min 28sec

Short stop 1h 40min 56sec

Long stop 240h 36min 23sec

Off time 9h 2min 12sec

For comparison: in production generally measured metrics in May 2019 were:

Availability 87%

Machines overall application rate 59,8%

Interval choices were done in the following way:

- Below 24h is minute interval
- As 60 days, than one hour interval
- Above it than day interval
- Raw data is the whole package of data

The amperage changes report with added stop times is in **Appendix nr 5.**
The listed stop times by setters was compared with the amperage table and it draws out that the stop times are recognizable from the whole table.
As conclusion:

Metric	Amperage (A)
Total average amperage	30,9272
Average amperage of working injection moulding machine	39,3989
Average amperage of non-working injection moulding machine	13,2681

Down following in Fig 5.1 is brought out graphic amperage changes of viewable one phase of the injection moulding machine.

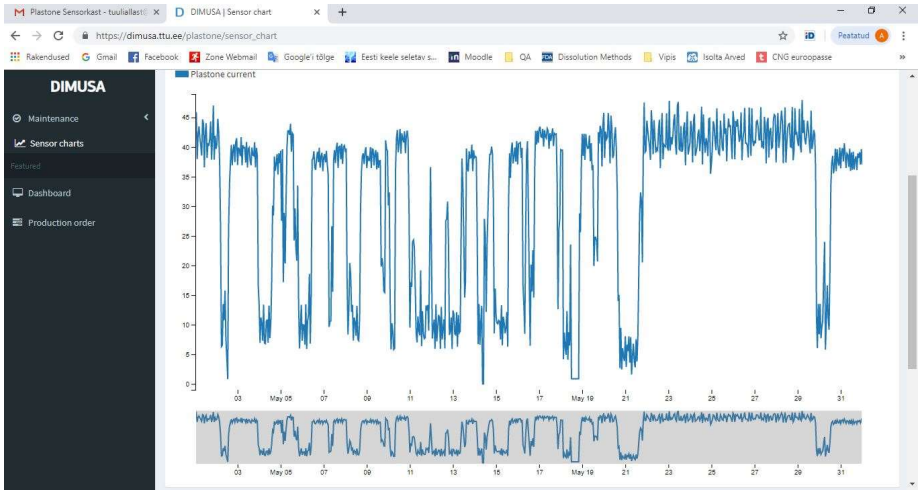


Fig 5.1 Amperage Changes of 300T machine during May 2019

6 CONCLUSIONS OF THE RESEARCH RESULTS

6.1 Conclusions of the Industry 4.0 questionnaire results

Digital auditing framework, based on existing methods of auditing, to assess the level of digitalization of small and medium sized enterprises in Estonia was developed.

The managing level employees admit that the company development level is on the level of having passive data storing option. There is detection of failures in the process, but there is no option to prognose its own functional condition. The most potential to gain benefits from is by improving communication and connectivity and at the same time improving functionalities for data storage and information exchange. In production is stored the data for documentation. There is no M2M communication. There is no automated information exchange. The most success is expected of improvements in company-wide networking. In general can be said that communication and communication technology improvements is seen as one of the main fields, which improvements can bring along success.
As main goal for Estonia in Industry 4.0 is seen to be making in future more wise decisions and increase of efficiency. In Plastone is seen as the main target to continuously be competitive. People personally in their work expect easier prioritization and control possibilities.

Measures offered by the Estonian government to Implement Industry 4.0 possibilities in Estonian production are rated to be average. As the most important factor to develop Industry 4.0 principles is to simplify production processes and to gain future cost savings.

6.2 Conclusions of the new ERP solution features importance assessment questionnaire

Compliance of main strategical goals of the company Plastone OÜ fields of development in area digitalization was analysed. In the work was more focus at the plan to implement in upcoming year new ERP system Monitor. The importance of different ERP system Monitor functionalities assessment gave result, that generally all functionalities assessed were rated to be important. In sales department are important customer relations management (CRM) functionalities. As well is important price list module – price lists can be managed based on customers.

In production is rated to be important sales order transfer to production orders (or suggestions for production). There is important, that would be possibility to integrate machines with ERP system. The material requirements of the products are calculated automatically, but that there would exist possibility to change manually, as needed.

In stock and logistics module is possible to print out barcodes for lables and packing lists for boxes and pallets. It is rated to be important that there would be possibility to track logistical costs separately. Possibility to generate and send customer invoices/orders directly from system.System can handle price changes (for material, components, packing etc.) and show impact to final product price.

In inventory is important to have inventory module as one part of the ERP. In quality it is important to have complaint/reclamation management, which includes possibility to send complaints directly from ERP to supplier. Financial department finds as well very important handling of orders – purchase order and invoice matching.

Employees expect that there will be more visibility and efficiency cost and time savings in their work.

The questionnaire gave overview, that all listed functionalities are very important, and got high grade results from employees. There were no functionalities, which were rated low.

6.3 Conclusions of practical experiment with sensor and program Dimusa

An experiment was performed, in which digitalized application (sensor with help of program Dimusa) was applied in company Plastone OÜ to analyse production stops. As the result there was found out, that there is possibility to bring together electricity consumption changes and process stops. As program Dimusa would have been in use for longer time, there would have been possibility to optimise the work on one machine, and carry these results over as well to other machines. To gain higher efficiency.

7 DIGITALIZATION ACTIONS AND FURTHER DEVELOPMENTS

Targets are following:

With modern interfaced ERP solution is possibility to increase turnover 10% in the year 2020. As new solution is efficient, it can be made with same amount of people – it is measured as value per employee.

Target is set to be increased added value per employee, which can be finally measured in two years since the project start. Target level is to have added value growth per employee 31% by the year 2022. In level 37850€.

- Growth of turnover approximately 1,8 M€ yearly, growth of profit approximately 100 000 € yearly
- The efficiency increase of basic equipment use will improve 10% in 2021
- Savings on equipment investments 50000€ in year 2021
- The efficiency increase of basic equipment use will improve 10% in 2022
- Savings on equipment investments 40000€ in year 2022

With state of December 2019 there is built out initial digitalization plan, which contains following actions:

1. January 2020 will start implementation of new ERP system Monitor
2. September 2020 will be in Plastone Estonian factories in use new ERP system Monitor
3. Since autumn 2020 will be current ERP system Sonet replaced

Actions are listed more precise in Table 7.2.

Table 7.2 Action plan for implementation of ERP system.

Action	Expected result of the action
1. **Sourcing of comprehensive resource planning software (ERP)**	Supply contract signing and general implementation plan agreeing with best ERP solution provider
2. **Project team forming and detailed project plan compilation**	Project team and project plan formed
3. **Installing a new ERP and initial user training**	New ERP is installed in Plastone server and project team is ready to use it
4. **Data transfer of existing storage media into the new ERP system, following processes and modules**	All the necessary data is available and transferred into the new ERP system

5. **ERP main users training**	All main users in Plastone are trained to use new ERP
6. **New ERP system parameters setup**	The new ERP is set up according to Plastone needs
7. **New ERP performance module testing**	All new ERP modules functions work
8. **End-user training**	All end users are trained
9. **Deployment of the new ERP Plastones (Go Live)**	The new ERP can be used in full functionality
10. **Project team support for the new ERP users**	The project team solves the ERP users problems continuously
11. **To choose out real-time tracking software of machines and implement it in Plastone Tallinn and Saue factories**	Plastone Tallinn and Saue factories machines work in production is in real time traceable and integrated into ERP production planning module

For the company Plastone is the main target to start to gather better quality data, to make based on it processes improvement decisions and consider based on it the further developments in area Industry 4.0.

Changes in the company can be divided as well in a way described in Table 7.3.

Table 7.3 Expectations for results regarding digitalization.

Changes in the company Plastone OÜ		
Automation – reducing the need for human interaction in production through development and upgrading of machines	Digitization – gathering information from machines and using it through the supply chain, increasing supply chain efficiency, including ERP	Finding new business models and markets – becoming more attractive supplier, partner, service provider

I personally would assess the new ERP highest advantage as the much better data source compared to the existing one. There will be analysing possibilities for data in the ERP, which we do not have at the moment. That data and analysing results are a ground for further developments in area Industry 4.0.

SUMMARY

Master thesis introduced injection moulding service offering company Plastone OÜ and summarised the targets for further developments in digital transformation journey.

The first purpose of the master thesis was to develop framework to assess the level of digitalization of small and medium-sized enterprises (SME:s) in Estonia. There was composed questionnaire. It was applied among managerial level leads in injection moulding company Plastone OÜ. The main purpose was to find out areas, where to develop Industry 4.0 principles and, how is evaluated current development level. There were assessed applied programs and software applications. It was stressed in the questionnaire, that there is need for modern enterprise resource planning (ERP) system.

During the thesis writing period company Plastone OÜ applied for digital auditing and for new enterprise resource planning (ERP) development support by Enterprise Estonia. Applications were approved and implementation of new ERP system Monitor will start in the beginning of 2020. **Secondly** was in master thesis investigated and analysed employees expectations to new ERP system by evaluation of possible new functionalities. As a result can be stated, that all listed new possibilities are highly valued.

Thirdly there was performed in field of Industry 4.0 experiment with one additional sensor and program Dimusa. Time of the experiment was: May 2019. There were measured amperage changes of one injection moulding machine. The gathered log of amperage changes was compared with production stops info from setters. Based on that info, was calculated OEE index. There is future purpose to have that calculation in new ERP system automatically.

In the last section of the work was brought out further agenda for company developments, for company Plastone OÜ, in field of digitalization.

KOKKUVÕTE

Magistritöö tutvustas survevalu teenust pakkuvat firmat Plastone OÜ ja koondas ettevõtte edasised eesmärgid digitaalsete muudatuste teel.

Esmane magistritöö eesmärk oli arendada raamistik hindamaks digitaliseerituse taset eesti väike-ja keskmise suurusega ettevõtetes (VKE:des). Koostatud sai küsimustik. Seda rakendati juhtivtöötajate seas survevalu ettevõttes Plastone OÜ. Peamine eesmärk oli välja selgitada põhivaldkonnad, kus arendada Tööstus 4.0 põhimõtteid ja kuidas hinnatakse hetke arengutaset. Vaadeldi nüüdseid kasutatavaid programmi ja tarkvara rakendusi. Küsitluse vastustest selgus, et on vajadus kaasaegse ettevõtte haldus programmi järele.

Magistritöö kirjutamise ajal kandideeris ettevõte Plastone OÜ Ettevõtluse Arendamise Sihtasutuse poolt eraldatava digiauditi ja kaasaegse ettevõtte haldus programmi arendamise toetusele. Taotlused rahuldati ja programmi Monitor arendus algab 2020 aasta algusest. **Teiseks** oli magistritöös uuritud ja analüüsitud töötajate ootusi Monitorile ja võimalikele uutele omadustele. Lõpptulemusena võib väita, et kõik loetletud uued funktsionaalsused olid kõrgelt väärtustatud.

Kolmandaks viidi läbi eksperiment Tööstus 4.0 valdkonnas kasutades täiendavat sensorit ja programmi Dimusa. Eksperimendi läbi viimise aeg oli Mai 2019. Mõõdeti amprite kõikumisi ühel survevalu masinal. Kogutud infot võrreldi tootmiskatkestuste infoga, kogutud seadistajatelt. Selle info baasilt arvutati OEE indeks. Tuleviku eesmärk on, et see info oleks uues programmis automaatselt.

Viimases osas toodi välja edasine tegevuskava digitaliseerimise valdkonnas.

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APPENDICES

1. McKinsey & Company report "Shaping the future of work in Europe's digital front-runners"[18]
2. Industry 4.0 questionnaire for Estonian SME:s. Example: Plastone OÜ
3. Expectations to functionalities of new Enterprise Resource Planning (ERP) system – Monitor
4. Original Document of 300T Injection Moulding machine stop reasons during May 2019
5. Amperage report from program Dimusa – May 2019 – 300T machine

Appendix 1

McKinsey & Company report "Shaping the future of work in Europe's digital front-runners"[18]

Overview of impact on the economy

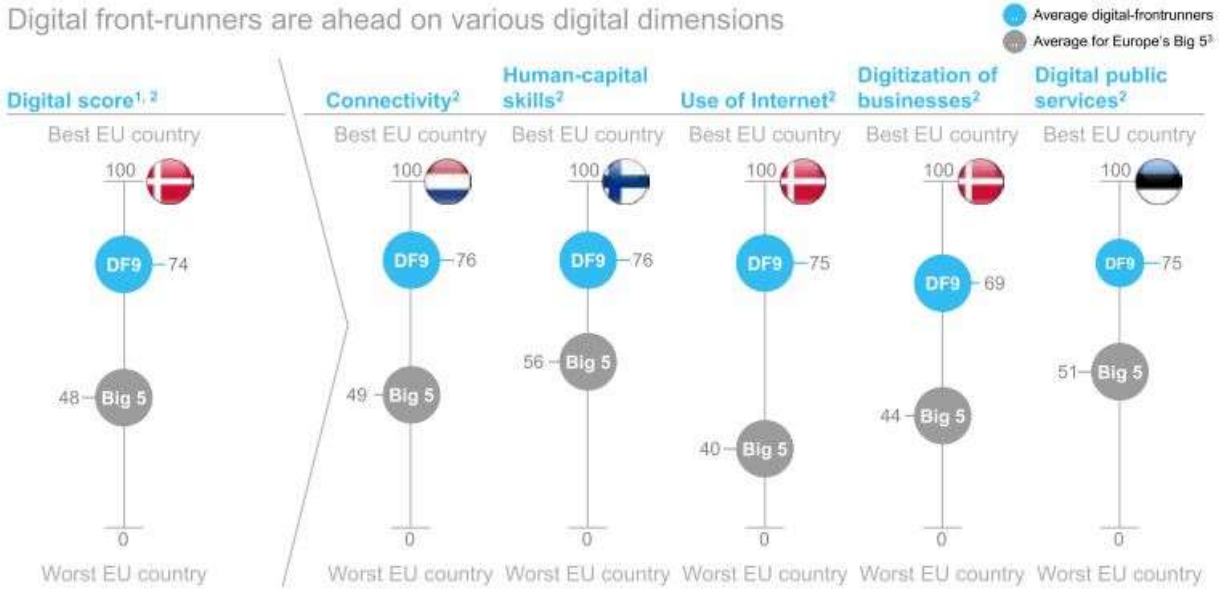
MIDPOINT SCENARIO

Country		GDP BnEUR, real	GDP/capita growth[1] % p.a.	Unemployment % of employees	Public sector % of employees	Automation potential % of work activities, 2016	Automated % of work activities, 2030	Impact towards 2030: Job substitution % of job base	Impact towards 2030: Jobs from spill over effects % of job base	Impact towards 2030: New job creation % of job base	Digital jobs % of employees	High-educated labor % of employees
BEL	2016	420	1.2%	~8%	30%	42%					5%	43%
	2030	570	1.7%	~7%			25%	-15%	+10%	+6%	10%	48%
DEN	2016	280	1.2%	~6%	30%	40%					7%	35%
	2030	380	2.0%	~7%			25%	-17%	+12%	+6%	12%	39%
EST	2016	20	4.3%	~7%	21%	46%					7%	40%
	2030	30	1.8%	~6%			24%	-13%	+10%	+5%	11%	47%
IRE	2016	280	4.3%	~8%	23%	43%					7%	48%
	2030	400	2.1%	~5%			24%	-15%	+10%	+8%	13%	54%
LUX	2016	50	2.2%	~6%	29%	38%					5%	49%
	2030	80	1.6%	~5%			23%	-13%	+10%	+5%	9%	56%
NET	2016	700	1.5%	~6%	28%	45%					5%	36%
	2030	950	1.9%	~5%			28%	-17%	+12%	+7%	11%	39%
FIN	2016	220	1.2%	~9%	26%	44%					7%	44%
	2030	290	1.8%	~8%			25%	-15%	+11%	+5%	11%	51%
SWE	2016	460	1.6%	~7%	31%	46%					7%	40%
	2030	670	2.0%	~5%			28%	-17%	+12%	+6%	12%	45%
NOR	2016	340	1.5%	~5%	36%	42%					3%	43%
	2030	500	2.0%	~5%			27%	-18%	+11%	+6%	8%	45%

1 GDP/capita growth in 2016 is based on the period 1990-2015. GDP/capita growth in 2030 based on the period in 2016-2030

Source: OECD, Eurostat, McKinsey Global Institute, McKinsey analysis

Digital front-runners are ahead on various digital dimensions



1 Digital score is average score across the five dimensions shown at right.
2 Differences between best and worst scoring country on each original scale are 9 (connectivity), 11 (human-capital skills), 6 (use of Internet), 9 (digitization of businesses), and 9 (digital public services).
3 Big 5 defined as France, Germany, Italy, Spain, and the United Kingdom

Source: Digital Economy and Society Index 2017, European Commission; McKinsey

Appendix 2

Industry 4.0 questionnaire for Estonian SME:s. Example: Plastone OÜ

Industry 4.0 questionnaire for Plastone OÜ.

This questionnaire is developed in frames of Master work in Tallinn University of Technology: "Developement of digital auditing framework for small-medium sized enterprises in Estonia and digital transformation possibilities of enterprise Plastone OÜ". By student Tuuli Allast, Industrial Engineering and Management (MARM) studyprogramm. Questionnaire bases mainly on VDMA (German Engineering Federation) matrix Toolbox structure, which regards itself as a practical tool for implementation of company-specific approaches to Industrie 4.0. Toolbox demonstrates levels of applications of Industry 4.0 approaches and demonstrates developement stages. Toolbox is divided into the part "Products" (services) and "Production".

Below are questions for assessment of current state of digitalization of company. There are as well some questions regarding future targets. Target group of the questionnaire in company Plastone OÜ: the different area managerial level employees.

The term "Industry 4.0" originates from a project in the high-tech strategy of German government, which promotes the computerization of manufacturing and was first presented 2011 at the Hannover Fair. [1]
There are many definitions to clarify content of Industry 4.0. One which covers all aspects is following: Industry 4.0 is new industrial paradigm, which brings together the digital and physical worlds through the Cyber-Physical Systems enhanced by Internet of Things and it is expected that this novel has consequences on industry, markets and economy, improving production processes and increasing productivity, affecting the whole product lifecycle, creating new business models, changing the work environment and restructuring the labor market. [2]
Ideology of the Industry 4.0 is closely related to technological leaps, which are named "industrial revolutions". Industry 1.0 - mechanization, steam power, weaving loom; Industry 2.0 - mass production, assembly line, electrical energy; Industry 3.0 - automation, computers and electronics; Industry 4.0 - cyber physical systems, internet of things, networks [3]

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What is your gender?

- ◯ Female
- ◯ Male

Into which age group you belong to?

- ◯ 18-30
- ◯ 31-40
- ◯ 41-50
- ◯ 51-60
- ◯ 61-70
- ◯ Over 70 years

Into which department of the production company you belong to?

- ◯ General Management
- ◯ Finance and accounting
- ◯ Procurement / purchasing
- ◯ Production and quality department
- ◯ Sales

How long have you been working in the company?

Your answer

Toolbox industry 4.0. Section Product.

Product of company Plastone OÜ is not physically injection moulded part but the injection moulding service, which company offers to its customers.

Are there by service quoting in use sensors or actuators in some level?

- ◯ No use of sensors / actuators
- ◯ Sensors / actuators are integrated in the service quoting process
- ◯ Sensor readings are processed by the service
- ◯ Data is evaluated for analyses by the service
- ◯ The service independently responds based on the gained data

Assess the current level of service communication /connectivity?

	1	2	3	4	5	
The service has no interfaces	◯	◯	◯	◯	◯	The service has access to the internet

Assess the Functionalities for data storage by service providing and information exchange?

- ☐ No functionalities
- ☐ Possibility of individual identification
- ☐ Service providing data has a passive data store
- ☐ Service providing with data storage for autonomous information exchange
- ☐ Data and information exchange as integral part

Assess monitoring level of service providing procedure?

- ◯ No monitoring by the service
- ◯ Detection of failures in the process
- ◯ Recording of operating condition for diagnostic purposes
- ◯ Prognosis of its own functional condition
- ◯ Independently adopted control measures by the service providing

Assess the level of service providing related IT services?

- ◯ No related services
- ◯ Helping services via online portals
- ◯ Service execution directly via the injection moulding service provision
- ◯ Independently performed services
- ◯ Complete integration into an infrastructure of IT services

Assess the business models around the service provision?

- ☐ Gaining profits from selling standardized injection moulding service
- ☐ Sales and consulting regarding the service provision
- ☐ Sales, consulting and adaption of the service to meet customer specifications
- ☐ Additional sale of service related services
- ☐ Sale of service functions

Which of the below mentioned functionalities of Industry 4.0 could have in your opinion the most potential in providing service the companies customers?

- [ ] Integration of sensors / actuators in providing service
- [ ] Improving communication / connectivity by providing service
- [ ] Improving functionalities for data storage and information exchange
- [ ] Improving service providing monitoring processes
- [ ] Improving service related IT services
- [ ] Improving business models around the providing of services

General questions section about Industry 4.0

Following section contains general questions and department specific questions.

What would be the main goal for Estonia by implementing Industry 4.0 principles?

Your answer

What would be the main goal for production company in which you are working by implementing Industry 4.0 principles?

Your answer

What advantages could following of Industry 4.0 principles bring along in your position of production company?

Your answer

General Management or Finance and accounting department

Do you belong to General Management or Finance and accounting department?

- ◯ Yes
- ◯ No

How do you evaluate available measures / resources offered by Estonian government for improving Industry 4.0 related activities in production companies?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you evaluate companies resources for Industry 4.0 related activities?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you evaluate openness of employees to new technology?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you evaluate ICT competence of employees?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you evaluate compability of Industry 4.0 with company strategies?

	1	2	3	4	5	
Low	○	○	○	○	○	High

How do you position company in Industry 4.0 activities in relation to area specific competitors?

	1	2	3	4	5	
Low	○	○	○	○	○	High

How do you evaluate management competences and methods to realize and implement Industry 4.0 activities?

	1	2	3	4	5	
Low	○	○	○	○	○	High

Does there exist central coordination for implementing of Industry 4.0 activities?

	1	2	3	4	5	
Low	○	○	○	○	○	High

How do you evaluate adaptability of the company culture to Industry 4.0?

	1	2	3	4	5	
Low	○	○	○	○	○	High

How do you rate expected inclusion of employees into change process?

	1	2	3	4	5	
Low	○	○	○	○	○	High

Which side of Industry 4.0 should be developed in the company in your responsibility area?

Your answer

Additional comments

Your answer

Procurement / Purchasing department

Do you belong to Procurement / Purchasing department?

- ◯ Yes
- ◯ No

How do you evaluate openness and readiness of "average supplier" plants to new technology?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you evaluate "average supplier" competence in digital solutions?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you evaluate our company digital maturity compared to our "average supplier" digital maturity?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

Is there in use production plan information sharing (for suppliers)?

- ◯ Yes
- ◯ No

Which side of Industry 4.0 should be developed in the company in your responsibility area?

Your answer

Additional comments

Your answer

Production or Quality department

Do you belong to Production or Quality department?

- ◯ Yes
- ◯ No

How do you evaluate openness of employees to new technology?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you evaluate ICT competence of employees?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you rate early failure detection solutions?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

Is there in use production plan information sharing (for suppliers)?

- ◯ Yes
- ◯ No

Is there in use raw material and final products tracking systems?

- ◯ Yes
- ◯ No

Is it used digital simulation of the production environment and different scenarios?

- ◯ Yes
- ◯ No

Is there in use software support to follow and apply lean techniques?

- ◯ Yes
- ◯ No

Is there used digital forecasting in the production, which bases on simulated data?

- ◯ Yes
- ◯ No

Which side of Industry 4.0 should be developed in the company in your responsibility area?

Your answer

Additional comments

Your answer

Sales department

Do you belong to Sales department?

- ◯ Yes
- ◯ No

How do you evaluate openness and readiness of "average customer" plants to new technology?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you evaluate "average customer" competence in digital solutions?

	1	2	3	4	5	
Low	◯	◯	◯	◯	◯	High

How do you evaluate our company digital maturity compared to our "average customer" digital maturity?

	1	2	3	4	5	
Low	○	○	○	○	○	High

How do you evaluate our company digital maturity compared to our "average competitor" digital maturity?

	1	2	3	4	5	
Low	○	○	○	○	○	High

Which side of Industry 4.0 should be developed in the company in your responsibility area?

Your answer

Additional comments

Your answer

Summarising section

Mark the expected positive outcomes of more digitalized production company - which are most important to you - 3 marks?

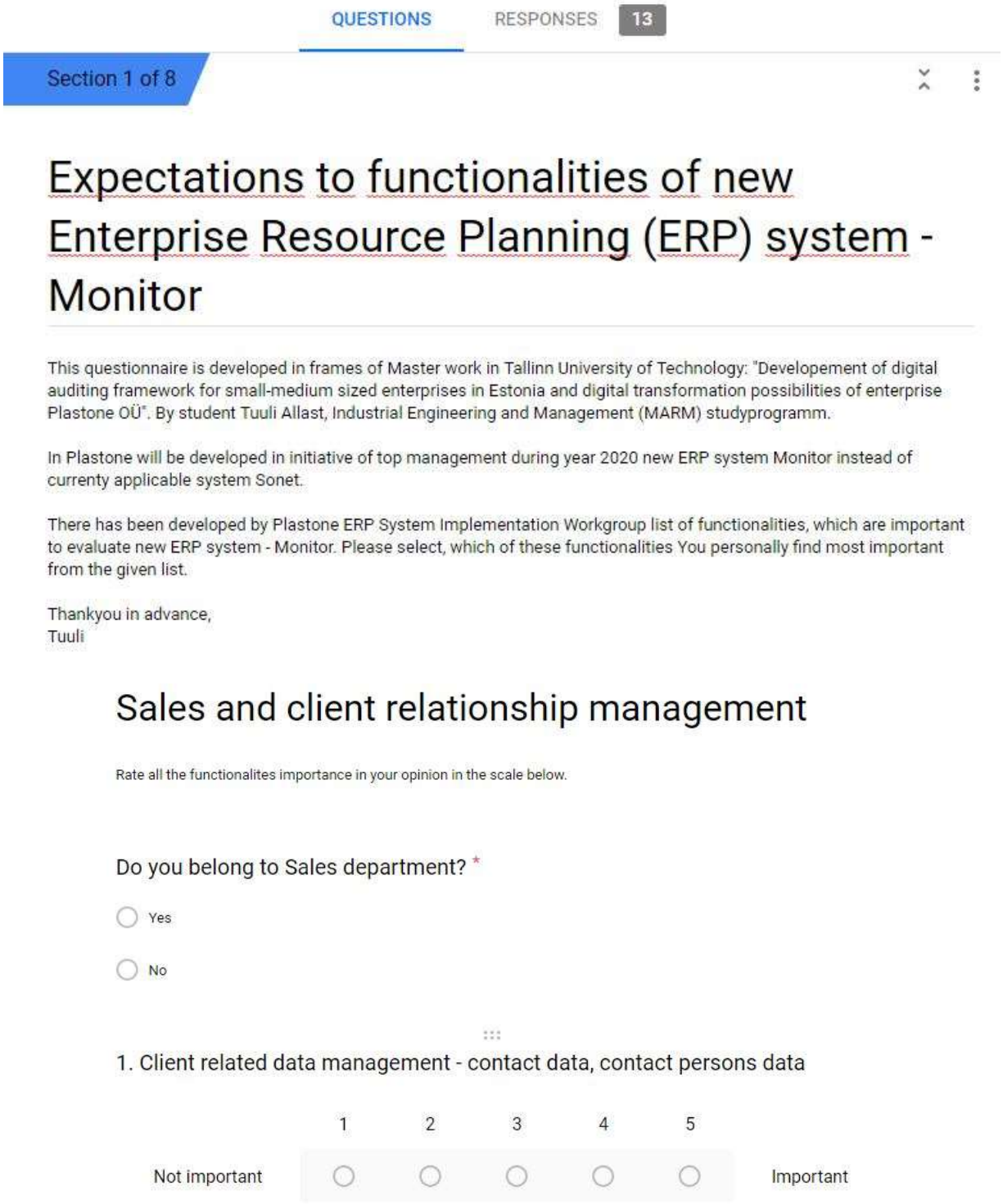
- [ ] Innovation growth
- [ ] Simplifies current production processes
- [ ] Consumer / customer centralized production (Made-to-me products)
- [ ] Human interface as machine calls for action
- [ ] Future cost savings
- [ ] Globalized value chains

Additional comments

Your answer

Appendix 3

Expectations to functionalities of new Enterprise Resource Planning (ERP) system - Monitor



QUESTIONS RESPONSES 13

Section 1 of 8

Expectations to functionalities of new Enterprise Resource Planning (ERP) system - Monitor

This questionnaire is developed in frames of Master work in Tallinn University of Technology: "Developement of digital auditing framework for small-medium sized enterprises in Estonia and digital transformation possibilities of enterprise Plastone OÜ". By student Tuuli Allast, Industrial Engineering and Management (MARM) studyprogramm.

In Plastone will be developed in initiative of top management during year 2020 new ERP system Monitor instead of currenty applicable system Sonet.

There has been developed by Plastone ERP System Implementation Workgroup list of functionalities, which are important to evaluate new ERP system - Monitor. Please select, which of these functionalities You personally find most important from the given list.

Thankyou in advance,
Tuuli

Sales and client relationship management

Rate all the functionalites importance in your opinion in the scale below.

Do you belong to Sales department? *

- Yes
- No

1. Client related data management - contact data, contact persons data

	1	2	3	4	5	
Not important						Important

2. Defining client related additional attributes - setting preferred language, setting preferred communication channel (e-mail, post, ...)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

3. Sharing client related data between Plastone offices and different countries

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

4. Registering of sales activities related to client relationship (phone calls, e-mails, information exchange, client meetings, requests)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

5. Defining deadlines for agreed activities related to client and assigning the calendar reminders to these activities

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

6. Registering of the pursuing, proposing and contracting process phases

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

7. Attaching client related electronic documents to the client record

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

8. Reminders of various client activities (client related activity deadline etc)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

Production.

Rate all the functionalites importance in your opinion in the scale below.

Do you belong to Production department? *

- Yes
- No

1. ERP system will include New Product Introduction (NPI) module

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

2. NPI module includes possibility for product structures (incl. alternative materials / alternative structures, components + assigned human / machine times)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

3. Option to integrate machines with ERP system

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

4. Machine maintenance and tool maintenance module

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

5. Product/production stages and time consumption reporting to ERP (machine, operator, product based)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

6. Product costing (routes, materials, work centers, machine centers)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

7. Possibility for sales order transfer to production orders (or suggestion for production)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

8. ERP automatically orders materials based on stock parameters

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

9. Hourly production planning (possibility to use daily planning if needed as well)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

10. Planning schedule suggestions based on material availability

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

11. Work tasks and production schedule (also in printable layout). Ability to add custom data (incl. necessary set-up tools/equipment, photos, inspection reports etc.)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

12. Possibility to see the status of a Work Task (Shop Order) when planning a production. Status could be - Planned, Started, Finished etc.

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

13. Possibility to see tool/machine status when planning (ready or under maintenance)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

14. Possibility to make notes in every Work Task (Shop Order)

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

15. Daily/weekly prognosis of needed materials

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

16. The location of the materials in the dryer are displayed graphically

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

17. In case of open supplier complaint, automatic warning before particular part/material purchasing order confirmation

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

18. When entering item delivery deadline, ERP calculates the time it takes to prepare the product for delivery

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

19. General search over all objects

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

20. The material requirements of the products are calculated automatically, possibility to change manually if necessary

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

21. Employee based work/work hours recording

	1	2	3	4	5	
Not important	○	○	○	○	○	Important

22. Possibility to link photographs and other possible drawings and pictures to product-related instructions

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

23. Defective products/components/materials handling - not available for production planning (blocked), but status visible for planners/purchases

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

24. Late components report

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

25. Management of production planning KPI-s

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

26. Supply metrics is manageable for both customers and suppliers, possibility to retrieve reports

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

What functionalities more would be in Your opinion important in Monitor regarding production and production planning?

Long answer text

Stock module/logistics and purchase

Rate all the functionalites importance in your opinion in the scale below.

Do you belong to Purchasing department? *

- ○ Yes
- ○ No

1. Goods receiving and transfers between warehouses and product dispatching using RFID/Barcode systems

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

2. With incoming materials user is able to see related documents and link documents, including certificates, purchase invoices etc

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

3. It is possible to print out barcodes for labels, packing lists for boxes and pallets

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

4. It is possible for the warehouse to send in the goods for input control; it is possible to inform the input control and assign the task

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

5. When the order is completed and shipped from the warehouse, the product and order statuses are changed automatically

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

6. Different warehouses in different sites are managed

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

7. Searching by stock location is possible

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

8. FIFO method integration

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

9. History of any change of location of material/component

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

10. Component-by-component reports to track material and component needs

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

11. The size of the package - dimensions, weight - is calculated according to the product specification

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

12. It is possible to integrate or connect to logistic company system to organize transportation ordering automatically

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

13. Package weights and units are generated automatically on the invoice

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

14. In case of material/component/product transfer between different warehouses it is possible to generate document (delivery note)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

15. It is possible to add to one product different prices for different batches

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

16. Possibility to track logistical cost separately

	1	2	3	4	5	
Not importnte	○	○	○	○	○	Importante

17. Possibility to generate and send customer invoices/orders directly from system

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

18. Possibility to add different dates for delivery or order (produced, ready for shipment, arrival date etc.)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

19. System can handle price changes (for material, components, packaging etc.) and show impact to final product price

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

20. Automatic system for approving invoices (no need to personal handling , only in case if the system can find error between invoice and order/system)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

21. Possibility to add different prices/pricelists for the same product (different clients or suppliers or MOQ)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

22. Product version handling

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

23. Ordering suggestions for raw materials with alarms

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

24. Possibility to follow different trends (DA, late rows, price trends, availability, supplier evaluation etc.)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

25. Possibility to produce end product forecasts automatically (raw material, components, packaging etc.)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

26. Stock level is in real time

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

27. Reasonable amount of space in text modules (for description of components, contact information , version information etc.)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

28. Document management - possibility to attach all documents related to the material/component (reclamations, certificates, drawings, invoices, PO, confirmations etc.)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

29. Packaging reports are managed

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

30. What functionalities more would be in Your opinion important in Monitor regarding stock module/logistics and purchase?

Long answer text

Inventory module

Rate all the functionalites importance in your opinion in the scale below.

Do you belong to production or purchasing department? *

- ◯ Yes
- ◯ No

1. Inventory Planning

	1	2	3	4	5	
Not importante	◯	◯	◯	◯	◯	Importante

2. Shelf Management

	1	2	3	4	5	
Not importante	◯	◯	◯	◯	◯	Importante

3. Product Analysis

	1	2	3	4	5	
Not importante	◯	◯	◯	◯	◯	Importante

4. Product drawings and revision(when have been changed)

	1	2	3	4	5	
Not importante	◯	◯	◯	◯	◯	Importante

5. Availability planning for every item (visualized demands and orders)

	1	2	3	4	5	
Not importante	◯	◯	◯	◯	◯	Importante

6. Inventory items must have LOT/batch number and/or serial numbers

	1	2	3	4	5	
Not importante	◯	◯	◯	◯	◯	Importante

7. Inventory items with limited usage lifetime should have described with latest permitted usage date

	1	2	3	4	5	
Not importante	◯	◯	◯	◯	◯	Importante

What functionalities more would be in Your opinion important in Monitor regarding Inventory module?

Long answer text

Quality and tracability

Rate all the functionalites importance in your opinion in the scale below.

Do you belong to Quality department? *

- Yes
- No

1. Complaint/reclamation management, including possibility to send complaints directly from ERP to supplier

	1	2	3	4	5	
Not importante						Importante

2. Customer/supplier related certificates storaging

	1	2	3	4	5	
Not importante						Importante

3. All quality related data sorting according to the production location/site

	1	2	3	4	5	
Not importante						Importante

4. Possibility to maintaining 8D/CAPA report (tasks with due date, task reminders to task owners)

	1	2	3	4	5	
Not importante						Importante

5. Quality control dashboard, where you can insert the results of quality control and manage the results

	1	2	3	4	5	
Not importante						Importante

6. Product quality (good/bad/defects overview) trends availability

	1	2	3	4	5	
Not importante						Importante

7. Possibility to create and assign incoming or final inspection plan(s) to product/material

	1	2	3	4	5	
Not importante						Importante

8. Product/material with quality inspection obligation is blocked for production planning till quality inspection is done

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

9. Recording of incoming inspection results (measurement data)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

10. Quality inspection reports integration to measurement equipment (equipment ID appear on the measurement report)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

11. Quality KPI -s like "first-passed-yield report"

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

12. Possibility to set different quality control methods for products (like sampling inspection)l based on product quality history and customer needs

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

13. Possibility to access from product master data to all product/material related drawings/documents/certificates and assembly instructions

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

14. Possibility to store product/material related certificates

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

15. Management of measurement equipment: equipment ID number, maintenance/calibration data available, next maintenance/calibration notification + task assignment, calibration certificate and maintenance instruction retention/recording

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

16. Possibility to integrate CNC measurement equipment with ERP (mesurement results automatic transfer to ERP Quality Module)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

What functionalities more would be in Your opinion important in Monitor regarding quality and traceability module?

Long answer text

Accounting / Financial Management

Rate all the functionalites importance in your opinion in the scale below.

Do you belong to Accounting / Financial Management department? *

- ○ Yes
- ○ No

Automatic handling of orders (purchase order - invoice matching)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Electronic Invoice Management (EIM)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Estonian and Finnish accounting law integration

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Cash Flow Forecast

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Chart of accounts, several dimensions (department, project etc.)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Fixed assets management (It must be possible to set and calculate depreciation automatically)

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Budgeting

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Simple cost periodization

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Split of invoice between accounts and cost centers is configurable and is automatically linked

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Automatic VAT reporting

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Intrastat reports

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

VIES reporting

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Packaging reporting

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

Consolidation possibility

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

The cost calculation for the product is based on real batch sizes and cycle times

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

The Product Profitability Report is available to the Sales Department

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

While calculating working time, it is possible to manage bonuses, holidays etc.

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

It is possible to enter working time digitally; The employee should be able to sign in and out

	1	2	3	4	5	
Not importante	○	○	○	○	○	Importante

What functionalities more would be in Your opinion important in Monitor regarding Accounting / Financial Management module?

Long answer text

Conclusion

Description (optional)

What kind of positive outcomes You personally expect for Plastone after implementation of ERP system Monitor?

Long answer text

Appendix 4

Original Document of 300T Injection Mouldin machine stop reasons during May 2019

Lp. Seadistajad,

Palun märkida 2019.a mai kuu jooksul **masina 1** seisaku puhul üks all järgnevatest veapõhjustest:

1 Seadistus
2 Materjali probleem
3 Masina tehniline probleem
4 Vormi probleem
5 Abiseadmete tehniline probleem
6 Toote kvaliteediprobleem
7 Ootab seadistust
8 Puudub töö - tellimus
9 Põhjus teadmata/muu

Andmed lähevad lõputöö valmimise hüvanguks.
Ette tänades,
Tudeng Tuuli

Kuupäev	Seisaku alguse kellaaeg	Seisaku lõpu kellaaeg	Toote number	Seisaku põhjuse number	Lisaselgitus/ Kommentaar
02.05.2019	8.00	14:30	45450249	4	
03.05.19	21:45	21:45	45450249	4	
03.05.19	22 30	.	45450249	4	vahele joo ks
04.05.19	14:00	16:25	68840	1	
05.05.19	00 15	00 40	68840	3	Nokal metalli lükk ees
05.05.19	2.00	5 15	68338	1	
05.05.19	14.15		68338	1	KOGUS TÄIS
05.05.19	14:15		69116/1M	1, 6	
06.05.19		10 40	69116/1M		
07.05.19	05:00		69116/1M	1	KOGUS TÄIS
08.05.19	02:00		[illegible]	1	KOGUS TÄIS
9.05.19	15 30		100266501001818608		Kogus täis
10.05.19	00:10	7:25	70CRM00225	7	
10.05.19	22:33			1	KOGUS TÄIS

1

Kuupäev	Seisaku alguse kellaaeg	Seisaku lõpu kellaaeg	Toote number	Seisaku põhjuse number	Lisaselgitus/ Kommentaar
11.05.19	05:10			1, 5	PUUDUB ROBOTI KÄPP
11.05.19	23:00			6	OOTAB KVALITEEDI OTSUST.
13.05.19		13^{00}			Rene
14.05.19	02:30	~~[illegible]~~ 22^{00}	CXBY68839	7.	KOGUS TÄIS.
14.05.19	22^{00}		~~[illegible]~~		~~KOGUS TÄIS~~ OOTAB VORMI
15.05.19		14 30	45450249		
15.05.19	17^{20}	17^{45}	—"—	6 & 1	
15.05.19	19^{39}	20^{10}	—"—	6	
16.05.19	5^{00}		—"—	4	DETAILITÜKID SEES
16.05.19		09^{00}	—"—	4 & 1	käivitus
16.05.19a.		11^{35}	—"—		Tellimuse lõpp
16.05.19		18^{20}	PHR 395.1	(1)	
16.05.19	18^{20}	20^{00}	PHR 395.1	2,6	Teo puhastustöö käigus 100% prank
19.05.19	11:55		PHR 395	6	vorm läheb remonti;
15.05.13		18:20	CXBY-68604	1	[illegible]
20.05.19	16:00	21.05 16^{45}	CXBY68604	4	VORM REMONDIS.
[illegible].05.19	19:45		CXBY68604		kogus täis
[illegible].05.19	6^{00}	30.05. 14:00	CXBY 69116114	1	OOTAB OPERAATOR[illegible]

2

Appendix 5

Amperage report from program Dimusa – May 2019 – 300T machine

Not translated	Not translated	Not translated	Not translated	
Plastone current	44.03	2019/05/01 0:59:59	00:00:00	
Plastone current	45.88	2019/05/01 1:59:59	01:00:00	
Plastone current	37.97	2019/05/01 2:59:59	01:00:00	
Plastone current	42	2019/05/01 3:59:59	01:00:00	
Plastone current	43.48	2019/05/01 4:59:59	01:00:00	
Plastone current	41.57	2019/05/01 5:59:59	01:00:00	
Plastone current	40.23	2019/05/01 6:59:59	01:00:00	
Plastone current	38.56	2019/05/01 7:59:59	01:00:00	
Plastone current	44.68	2019/05/01 8:59:59	01:00:00	
Plastone current	43.92	2019/05/01 9:59:59	01:00:00	
Plastone current	36.57	2019/05/01 10:59:59	01:00:00	
Plastone current	42.47	2019/05/01 11:59:59	01:00:00	
Plastone current	44.04	2019/05/01 12:59:59	01:00:00	
Plastone current	38.18	2019/05/01 13:59:59	01:00:00	
Plastone current	40.67	2019/05/01 14:59:59	01:00:00	
Plastone current	40.22	2019/05/01 15:59:59	01:00:00	
Plastone current	41.37	2019/05/01 16:59:59	01:00:00	
Plastone current	44.33	2019/05/01 17:59:59	01:00:00	
Plastone current	37.88	2019/05/01 18:59:59	01:00:00	
Plastone current	41.38	2019/05/01 19:59:59	01:00:00	
Plastone current	47.01	2019/05/01 20:59:59	01:00:00	
Plastone current	37.87	2019/05/01 21:59:59	01:00:00	
Plastone current	41.91	2019/05/01 22:59:59	01:00:00	
Plastone current	39.7	2019/05/01 23:59:59	01:00:00	
Plastone current	40.5	2019/05/02 0:59:59	01:00:00	
Plastone current	44.77	2019/05/02 1:59:59	01:00:00	
Plastone current	42.48	2019/05/02 2:59:59	01:00:00	
Plastone current	37.24	2019/05/02 3:59:59	01:00:00	
Plastone current	27.07	2019/05/02 4:59:59	01:00:00	
Plastone current	6.31	2019/05/02 5:59:59	01:00:00	Stop number 1
Plastone current	6.54	2019/05/02 6:59:59	01:00:00	
Plastone current	13.49	2019/05/02 7:59:59	01:00:00	

Plastone current	10.74	2019/05/02 8:59:59	01:00:00
Plastone current	15.76	2019/05/02 9:59:59	01:00:00
Plastone current	7.57	2019/05/02 10:59:59	01:00:00
Plastone current	4.55	2019/05/02 11:59:59	01:00:00
Plastone current	0.83	2019/05/02 12:59:59	01:00:00
Plastone current	26.04	2019/05/02 13:59:59	01:00:00
Plastone current	33.81	2019/05/02 14:59:59	01:00:00
Plastone current	37.27	2019/05/02 15:59:59	01:00:00
Plastone current	40.38	2019/05/02 16:59:59	01:00:00
Plastone current	36.92	2019/05/02 17:59:59	01:00:00
Plastone current	39.47	2019/05/02 18:59:59	01:00:00
Plastone current	40.48	2019/05/02 19:59:59	01:00:00
Plastone current	37.44	2019/05/02 20:59:59	01:00:00
Plastone current	40.87	2019/05/02 21:59:59	01:00:00
Plastone current	41.49	2019/05/02 22:59:59	01:00:00
Plastone current	36.95	2019/05/02 23:59:59	01:00:00
Plastone current	39.91	2019/05/03 0:59:59	01:00:00
Plastone current	39.55	2019/05/03 1:59:59	01:00:00
Plastone current	38.45	2019/05/03 2:59:59	01:00:00
Plastone current	41.68	2019/05/03 3:59:59	01:00:00
Plastone current	36.93	2019/05/03 4:59:59	01:00:00
Plastone current	40.3	2019/05/03 5:59:59	01:00:00
Plastone current	39.86	2019/05/03 6:59:59	01:00:00
Plastone current	39.92	2019/05/03 7:59:59	01:00:00
Plastone current	37.39	2019/05/03 8:59:59	01:00:00
Plastone current	40.86	2019/05/03 9:59:59	01:00:00
Plastone current	36.56	2019/05/03 10:59:59	01:00:00
Plastone current	39.72	2019/05/03 11:59:59	01:00:00
Plastone current	39.94	2019/05/03 12:59:59	01:00:00
Plastone current	37.66	2019/05/03 13:59:59	01:00:00
Plastone current	36.92	2019/05/03 14:59:59	01:00:00
Plastone current	39.93	2019/05/03 15:59:59	01:00:00

Plastone current	38.65	2019/05/03 16:59:59	01:00:00	
Plastone current	38.51	2019/05/03 17:59:59	01:00:00	
Plastone current	40.83	2019/05/03 18:59:59	01:00:00	
Plastone current	36.59	2019/05/03 19:59:59	01:00:00	
Plastone current	39.85	2019/05/03 20:59:59	01:00:00	
Plastone current	38.57	2019/05/03 21:59:59	01:00:00	
Plastone current	16.67	2019/05/03 22:59:59	01:00:00	
Plastone current	13.48	2019/05/03 23:59:59	01:00:00	
Plastone current	6.92	2019/05/04 0:59:59	01:00:00	
Plastone current	11.22	2019/05/04 1:59:59	01:00:00	
Plastone current	10.29	2019/05/04 2:59:59	01:00:00	
Plastone current	7.29	2019/05/04 3:59:59	01:00:00	
Plastone current	13.38	2019/05/04 4:59:59	01:00:00	
Plastone current	6.9	2019/05/04 5:59:59	01:00:00	Stop number 2
Plastone current	6.8	2019/05/04 6:59:59	01:00:00	
Plastone current	10.53	2019/05/04 7:59:59	01:00:00	
Plastone current	10.87	2019/05/04 8:59:59	01:00:00	
Plastone current	6.96	2019/05/04 9:59:59	01:00:00	
Plastone current	13.22	2019/05/04 10:59:59	01:00:00	
Plastone current	7.74	2019/05/04 11:59:59	01:00:00	
Plastone current	10.32	2019/05/04 12:59:59	01:00:00	
Plastone current	16.89	2019/05/04 13:59:59	01:00:00	
Plastone current	30.11	2019/05/04 14:59:59	01:00:00	Stop number 3
Plastone current	28.45	2019/05/04 15:59:59	01:00:00	
Plastone current	38.41	2019/05/04 16:59:59	01:00:00	
Plastone current	36	2019/05/04 17:59:59	01:00:00	
Plastone current	37.19	2019/05/04 18:59:59	01:00:00	
Plastone current	38.81	2019/05/04 19:59:59	01:00:00	
Plastone current	35.37	2019/05/04 20:59:59	01:00:00	
Plastone current	38.96	2019/05/04 21:59:59	01:00:00	
Plastone current	37.28	2019/05/04 22:59:59	01:00:00	

Plastone current	39.39	2019/05/04 23:59:59	01:00:00	
Plastone current	27.56	2019/05/05 0:59:59	01:00:00	Stop number 4-5
Plastone current	39.65	2019/05/05 1:59:59	01:00:00	
Plastone current	17.18	2019/05/05 2:59:59	01:00:00	
Plastone current	28.88	2019/05/05 3:59:59	01:00:00	
Plastone current	20.34	2019/05/05 4:59:59	01:00:00	
Plastone current	31.15	2019/05/05 5:59:59	01:00:00	
Plastone current	39.85	2019/05/05 6:59:59	01:00:00	
Plastone current	42.74	2019/05/05 7:59:59	01:00:00	
Plastone current	42.76	2019/05/05 8:59:59	01:00:00	
Plastone current	42.03	2019/05/05 9:59:59	01:00:00	
Plastone current	43.91	2019/05/05 10:59:59	01:00:00	
Plastone current	39.21	2019/05/05 11:59:59	01:00:00	
Plastone current	42.37	2019/05/05 12:59:59	01:00:00	
Plastone current	42.07	2019/05/05 13:59:59	01:00:00	
Plastone current	24.22	2019/05/05 14:59:59	01:00:00	Stop number 6
Plastone current	29.66	2019/05/05 15:59:59	01:00:00	
Plastone current	22.9	2019/05/05 16:59:59	01:00:00	
Plastone current	20.8	2019/05/05 17:59:59	01:00:00	
Plastone current	33.5	2019/05/05 18:59:59	01:00:00	
Plastone current	13.38	2019/05/05 19:59:59	01:00:00	
Plastone current	5.98	2019/05/05 20:59:59	01:00:00	
Plastone current	9.77	2019/05/05 21:59:59	01:00:00	
Plastone current	13.37	2019/05/05 22:59:59	01:00:00	
Plastone current	7.29	2019/05/05 23:59:59	01:00:00	
Plastone current	9.97	2019/05/06 0:59:59	01:00:00	
Plastone current	9.93	2019/05/06 1:59:59	01:00:00	
Plastone current	6.64	2019/05/06 2:59:59	01:00:00	
Plastone current	13.45	2019/05/06 3:59:59	01:00:00	
Plastone current	5.89	2019/05/06 4:59:59	01:00:00	
Plastone current	10.61	2019/05/06 5:59:59	01:00:00	
Plastone current	11.63	2019/05/06 6:59:59	01:00:00	
Plastone current	18.57	2019/05/06 7:59:59	01:00:00	
Plastone current	6.81	2019/05/06 8:59:59	01:00:00	
Plastone current	14.81	2019/05/06 9:59:59	01:00:00	

Plastone current	37.85	2019/05/06 10:59:59	01:00:00	
Plastone current	38.06	2019/05/06 11:59:59	01:00:00	
Plastone current	39.29	2019/05/06 12:59:59	01:00:00	
Plastone current	36.52	2019/05/06 13:59:59	01:00:00	
Plastone current	36.16	2019/05/06 14:59:59	01:00:00	
Plastone current	38.16	2019/05/06 15:59:59	01:00:00	
Plastone current	39.24	2019/05/06 16:59:59	01:00:00	
Plastone current	37.45	2019/05/06 17:59:59	01:00:00	
Plastone current	39.9	2019/05/06 18:59:59	01:00:00	
Plastone current	36.53	2019/05/06 19:59:59	01:00:00	
Plastone current	38.46	2019/05/06 20:59:59	01:00:00	
Plastone current	39.02	2019/05/06 21:59:59	01:00:00	
Plastone current	35.94	2019/05/06 22:59:59	01:00:00	
Plastone current	38.26	2019/05/06 23:59:59	01:00:00	
Plastone current	38.82	2019/05/07 0:59:59	01:00:00	
Plastone current	37.41	2019/05/07 1:59:59	01:00:00	
Plastone current	39.35	2019/05/07 2:59:59	01:00:00	
Plastone current	36.87	2019/05/07 3:59:59	01:00:00	
Plastone current	35.3	2019/05/07 4:59:59	01:00:00	
Plastone current	9.62	2019/05/07 5:59:59	01:00:00	
Plastone current	10.57	2019/05/07 6:59:59	01:00:00	Stop number 7
Plastone current	10.63	2019/05/07 7:59:59	01:00:00	
Plastone current	26.65	2019/05/07 8:59:59	01:00:00	
Plastone current	15.55	2019/05/07 9:59:59	01:00:00	
Plastone current	37.77	2019/05/07 10:59:59	01:00:00	
Plastone current	39.49	2019/05/07 11:59:59	01:00:00	
Plastone current	37.28	2019/05/07 12:59:59	01:00:00	
Plastone current	39.77	2019/05/07 13:59:59	01:00:00	
Plastone current	40.73	2019/05/07 14:59:59	01:00:00	
Plastone current	36.46	2019/05/07 15:59:59	01:00:00	
Plastone current	40.05	2019/05/07 16:59:59	01:00:00	
Plastone current	40.16	2019/05/07 17:59:59	01:00:00	

Plastone current	37.93	2019/05/07 18:59:59	01:00:00	
Plastone current	40.57	2019/05/07 19:59:59	01:00:00	
Plastone current	37.14	2019/05/07 20:59:59	01:00:00	
Plastone current	40.04	2019/05/07 21:59:59	01:00:00	
Plastone current	40.27	2019/05/07 22:59:59	01:00:00	
Plastone current	39.38	2019/05/07 23:59:59	01:00:00	
Plastone current	39.74	2019/05/08 0:59:59	01:00:00	
Plastone current	17.84	2019/05/08 1:59:59	01:00:00	Stop number 8
Plastone current	8.34	2019/05/08 2:59:59	01:00:00	
Plastone current	12.82	2019/05/08 3:59:59	01:00:00	
Plastone current	20.41	2019/05/08 4:59:59	01:00:00	
Plastone current	18.44	2019/05/08 5:59:59	01:00:00	
Plastone current	12.14	2019/05/08 6:59:59	01:00:00	
Plastone current	13.35	2019/05/08 7:59:59	01:00:00	
Plastone current	7.31	2019/05/08 8:59:59	01:00:00	
Plastone current	11.22	2019/05/08 9:59:59	01:00:00	
Plastone current	10.31	2019/05/08 10:59:59	01:00:00	
Plastone current	8.13	2019/05/08 11:59:59	01:00:00	
Plastone current	13.18	2019/05/08 12:59:59	01:00:00	
Plastone current	7.52	2019/05/08 13:59:59	01:00:00	
Plastone current	7.31	2019/05/08 14:59:59	01:00:00	
Plastone current	11.07	2019/05/08 15:59:59	01:00:00	
Plastone current	29.46	2019/05/08 16:59:59	01:00:00	
Plastone current	35.68	2019/05/08 17:59:59	01:00:00	
Plastone current	38.44	2019/05/08 18:59:59	01:00:00	
Plastone current	38.93	2019/05/08 19:59:59	01:00:00	
Plastone current	37.12	2019/05/08 20:59:59	01:00:00	
Plastone current	39.22	2019/05/08 21:59:59	01:00:00	
Plastone current	39.97	2019/05/08 22:59:59	01:00:00	
Plastone current	36.44	2019/05/08 23:59:59	01:00:00	
Plastone current	38.53	2019/05/09 0:59:59	01:00:00	
Plastone current	37.76	2019/05/09 1:59:59	01:00:00	
Plastone current	37.74	2019/05/09 2:59:59	01:00:00	

Plastone current	39.97	2019/05/09 3:59:59	01:00:00	
Plastone current	36.47	2019/05/09 4:59:59	01:00:00	
Plastone current	39.68	2019/05/09 5:59:59	01:00:00	
Plastone current	39.6	2019/05/09 6:59:59	01:00:00	
Plastone current	36.9	2019/05/09 7:59:59	01:00:00	
Plastone current	38.85	2019/05/09 8:59:59	01:00:00	
Plastone current	39.48	2019/05/09 9:59:59	01:00:00	
Plastone current	36.24	2019/05/09 10:59:59	01:00:00	
Plastone current	39.16	2019/05/09 11:59:59	01:00:00	
Plastone current	36.46	2019/05/09 12:59:59	01:00:00	
Plastone current	37.65	2019/05/09 13:59:59	01:00:00	
Plastone current	37.72	2019/05/09 14:59:59	01:00:00	
Plastone current	19.8	2019/05/09 15:59:59	01:00:00	Stop number 9
Plastone current	21.25	2019/05/09 16:59:59	01:00:00	
Plastone current	19.87	2019/05/09 17:59:59	01:00:00	
Plastone current	15.63	2019/05/09 18:59:59	01:00:00	
Plastone current	15.44	2019/05/09 19:59:59	01:00:00	
Plastone current	41.13	2019/05/09 20:59:59	01:00:00	
Plastone current	39.67	2019/05/09 21:59:59	01:00:00	
Plastone current	39.34	2019/05/09 22:59:59	01:00:00	
Plastone current	30.15	2019/05/09 23:59:59	01:00:00	
Plastone current	32.35	2019/05/10 0:59:59	01:00:00	
Plastone current	14.17	2019/05/10 1:59:59	01:00:00	Stop number 10
Plastone current	5.85	2019/05/10 2:59:59	01:00:00	
Plastone current	10.23	2019/05/10 3:59:59	01:00:00	
Plastone current	8.72	2019/05/10 4:59:59	01:00:00	
Plastone current	5.81	2019/05/10 5:59:59	01:00:00	
Plastone current	6.01	2019/05/10 6:59:59	01:00:00	
Plastone current	36.16	2019/05/10 7:59:59	01:00:00	
Plastone current	41.46	2019/05/10 8:59:59	01:00:00	
Plastone current	42.9	2019/05/10 9:59:59	01:00:00	
Plastone current	39.12	2019/05/10 10:59:59	01:00:00	
Plastone current	40.93	2019/05/10 11:59:59	01:00:00	
Plastone current	43.03	2019/05/10 12:59:59	01:00:00	

Plastone current	38.89	2019/05/10 13:59:59	01:00:00	
Plastone current	42.32	2019/05/10 14:59:59	01:00:00	
Plastone current	41.42	2019/05/10 15:59:59	01:00:00	
Plastone current	40.79	2019/05/10 16:59:59	01:00:00	
Plastone current	42.66	2019/05/10 17:59:59	01:00:00	
Plastone current	38.96	2019/05/10 18:59:59	01:00:00	
Plastone current	41.87	2019/05/10 19:59:59	01:00:00	
Plastone current	42.79	2019/05/10 20:59:59	01:00:00	
Plastone current	41.21	2019/05/10 21:59:59	01:00:00	
Plastone current	29.51	2019/05/10 22:59:59	01:00:00	
Plastone current	9.49	2019/05/10 23:59:59	01:00:00	
Plastone current	17.19	2019/05/11 0:59:59	01:00:00	
Plastone current	16.37	2019/05/11 1:59:59	01:00:00	
Plastone current	24.02	2019/05/11 2:59:59	01:00:00	
Plastone current	24.31	2019/05/11 3:59:59	01:00:00	
Plastone current	23.01	2019/05/11 4:59:59	01:00:00	
Plastone current	15.87	2019/05/11 5:59:59	01:00:00	
Plastone current	8.55	2019/05/11 6:59:59	01:00:00	
Plastone current	7.01	2019/05/11 7:59:59	01:00:00	
Plastone current	11.43	2019/05/11 8:59:59	01:00:00	
Plastone current	8.99	2019/05/11 9:59:59	01:00:00	
Plastone current	8.2	2019/05/11 10:59:59	01:00:00	Stop number 11
Plastone current	19.19	2019/05/11 11:59:59	01:00:00	
Plastone current	6.39	2019/05/11 12:59:59	01:00:00	
Plastone current	12.28	2019/05/11 13:59:59	01:00:00	
Plastone current	8.53	2019/05/11 14:59:59	01:00:00	
Plastone current	7.65	2019/05/11 15:59:59	01:00:00	
Plastone current	7.8	2019/05/11 16:59:59	01:00:00	
Plastone current	13.27	2019/05/11 17:59:59	01:00:00	
Plastone current	12.4	2019/05/11 18:59:59	01:00:00	
Plastone current	13.34	2019/05/11 19:59:59	01:00:00	

Plastone current	8.99	2019/05/11 20:59:59	01:00:00
Plastone current	21.64	2019/05/11 21:59:59	01:00:00
Plastone current	36.64	2019/05/11 22:59:59	01:00:00
Plastone current	22.42	2019/05/11 23:59:59	01:00:00
Plastone current	7.67	2019/05/12 0:59:59	01:00:00
Plastone current	9.48	2019/05/12 1:59:59	01:00:00
Plastone current	10.88	2019/05/12 2:59:59	01:00:00
Plastone current	5.93	2019/05/12 3:59:59	01:00:00
Plastone current	13.45	2019/05/12 4:59:59	01:00:00
Plastone current	7.19	2019/05/12 5:59:59	01:00:00
Plastone current	9.44	2019/05/12 6:59:59	01:00:00
Plastone current	11.66	2019/05/12 7:59:59	01:00:00
Plastone current	11.23	2019/05/12 8:59:59	01:00:00
Plastone current	5.93	2019/05/12 9:59:59	01:00:00
Plastone current	13.02	2019/05/12 10:59:59	01:00:00
Plastone current	7.52	2019/05/12 11:59:59	01:00:00
Plastone current	9.29	2019/05/12 12:59:59	01:00:00
Plastone current	10.92	2019/05/12 13:59:59	01:00:00
Plastone current	5.99	2019/05/12 14:59:59	01:00:00
Plastone current	27.55	2019/05/12 15:59:59	01:00:00
Plastone current	27.91	2019/05/12 16:59:59	01:00:00
Plastone current	30.81	2019/05/12 17:59:59	01:00:00
Plastone current	23.51	2019/05/12 18:59:59	01:00:00
Plastone current	8.26	2019/05/12 19:59:59	01:00:00
Plastone current	8.95	2019/05/12 20:59:59	01:00:00
Plastone current	11.23	2019/05/12 21:59:59	01:00:00
Plastone current	5.89	2019/05/12 22:59:59	01:00:00
Plastone current	12.41	2019/05/12 23:59:59	01:00:00
Plastone current	11.81	2019/05/13 0:59:59	01:00:00
Plastone current	8.45	2019/05/13 1:59:59	01:00:00
Plastone current	8.3	2019/05/13 2:59:59	01:00:00
Plastone current	12.1	2019/05/13 3:59:59	01:00:00

Plastone current	6.29	2019/05/13 4:59:59	01:00:00	
Plastone current	11.66	2019/05/13 5:59:59	01:00:00	
Plastone current	8.62	2019/05/13 6:59:59	01:00:00	
Plastone current	8.87	2019/05/13 7:59:59	01:00:00	
Plastone current	24.31	2019/05/13 8:59:59	01:00:00	
Plastone current	38.09	2019/05/13 9:59:59	01:00:00	
Plastone current	33.68	2019/05/13 10:59:59	01:00:00	
Plastone current	25.16	2019/05/13 11:59:59	01:00:00	
Plastone current	14.59	2019/05/13 12:59:59	01:00:00	
Plastone current	17.37	2019/05/13 13:59:59	01:00:00	
Plastone current	39.76	2019/05/13 14:59:59	01:00:00	
Plastone current	36.42	2019/05/13 15:59:59	01:00:00	
Plastone current	35.88	2019/05/13 16:59:59	01:00:00	
Plastone current	39.28	2019/05/13 17:59:59	01:00:00	
Plastone current	38.13	2019/05/13 18:59:59	01:00:00	
Plastone current	38.25	2019/05/13 19:59:59	01:00:00	
Plastone current	40.4	2019/05/13 20:59:59	01:00:00	
Plastone current	35.94	2019/05/13 21:59:59	01:00:00	
Plastone current	39.46	2019/05/13 22:59:59	01:00:00	
Plastone current	38.21	2019/05/13 23:59:59	01:00:00	
Plastone current	38.42	2019/05/14 0:59:59	01:00:00	
Plastone current	38.27	2019/05/14 1:59:59	01:00:00	
Plastone current	24.59	2019/05/14 2:59:59	01:00:00	
Plastone current	6.72	2019/05/14 3:59:59	01:00:00	
Plastone current	13.49	2019/05/14 4:59:59	01:00:00	
Plastone current	6.62	2019/05/14 5:59:59	01:00:00	
Plastone current	10.25	2019/05/14 6:59:59	01:00:00	
Plastone current	13.19	2019/05/14 7:59:59	01:00:00	Stop number 12
Plastone current		2019/05/14 8:59:59	01:00:00	
Plastone current		2019/05/14 9:59:59	01:00:00	
Plastone current	27.88	2019/05/14 10:59:59	01:00:00	
Plastone current	25.09	2019/05/14 11:59:59	01:00:00	
Plastone current	12.15	2019/05/14 12:59:59	01:00:00	

Plastone current	23.57	2019/05/14 13:59:59	01:00:00	
Plastone current	29.42	2019/05/14 14:59:59	01:00:00	
Plastone current	35.39	2019/05/14 15:59:59	01:00:00	
Plastone current	38.78	2019/05/14 16:59:59	01:00:00	
Plastone current	38.79	2019/05/14 17:59:59	01:00:00	
Plastone current	40.07	2019/05/14 18:59:59	01:00:00	
Plastone current	38.92	2019/05/14 19:59:59	01:00:00	
Plastone current	31.01	2019/05/14 20:59:59	01:00:00	
Plastone current	8.54	2019/05/14 21:59:59	01:00:00	Stop number 13
Plastone current	16.12	2019/05/14 22:59:59	01:00:00	
Plastone current	11.48	2019/05/14 23:59:59	01:00:00	
Plastone current	10.29	2019/05/15 0:59:59	01:00:00	
Plastone current	10.15	2019/05/15 1:59:59	01:00:00	
Plastone current	10.73	2019/05/15 2:59:59	01:00:00	
Plastone current	10.57	2019/05/15 3:59:59	01:00:00	
Plastone current	7.51	2019/05/15 4:59:59	01:00:00	
Plastone current	13.31	2019/05/15 5:59:59	01:00:00	
Plastone current	6.52	2019/05/15 6:59:59	01:00:00	
Plastone current	11.37	2019/05/15 7:59:59	01:00:00	
Plastone current	10.38	2019/05/15 8:59:59	01:00:00	
Plastone current	8.56	2019/05/15 9:59:59	01:00:00	
Plastone current	9.38	2019/05/15 10:59:59	01:00:00	
Plastone current	12.15	2019/05/15 11:59:59	01:00:00	
Plastone current	6.29	2019/05/15 12:59:59	01:00:00	
Plastone current	30.87	2019/05/15 13:59:59	01:00:00	
Plastone current	38.97	2019/05/15 14:59:59	01:00:00	
Plastone current	34.78	2019/05/15 15:59:59	01:00:00	
Plastone current	39.56	2019/05/15 16:59:59	01:00:00	
Plastone current	40.78	2019/05/15 17:59:59	01:00:00	
Plastone current	37.24	2019/05/15 18:59:59	01:00:00	
Plastone current	38.49	2019/05/15 19:59:59	01:00:00	

Plastone current	39.95	2019/05/15 20:59:59	01:00:00	
Plastone current	37.55	2019/05/15 21:59:59	01:00:00	
Plastone current	41.04	2019/05/15 22:59:59	01:00:00	
Plastone current	37.07	2019/05/15 23:59:59	01:00:00	
Plastone current	40.59	2019/05/16 0:59:59	01:00:00	
Plastone current	40.64	2019/05/16 1:59:59	01:00:00	
Plastone current	40.77	2019/05/16 2:59:59	01:00:00	
Plastone current	38.18	2019/05/16 3:59:59	01:00:00	
Plastone current	39.86	2019/05/16 4:59:59	01:00:00	
Plastone current	16.63	2019/05/16 5:59:59	01:00:00	Stop number 14
Plastone current	13.31	2019/05/16 6:59:59	01:00:00	
Plastone current	8.44	2019/05/16 7:59:59	01:00:00	
Plastone current	26.23	2019/05/16 8:59:59	01:00:00	
Plastone current	38.89	2019/05/16 9:59:59	01:00:00	
Plastone current	41.01	2019/05/16 10:59:59	01:00:00	
Plastone current	29.55	2019/05/16 11:59:59	01:00:00	Stop number 15
Plastone current	17.61	2019/05/16 12:59:59	01:00:00	
Plastone current	6.43	2019/05/16 13:59:59	01:00:00	
Plastone current	20.18	2019/05/16 14:59:59	01:00:00	
Plastone current	15.6	2019/05/16 15:59:59	01:00:00	
Plastone current	22.58	2019/05/16 16:59:59	01:00:00	
Plastone current	14.58	2019/05/16 17:59:59	01:00:00	
Plastone current	35.76	2019/05/16 18:59:59	01:00:00	
Plastone current	42.76	2019/05/16 19:59:59	01:00:00	
Plastone current	40.42	2019/05/16 20:59:59	01:00:00	
Plastone current	42.78	2019/05/16 21:59:59	01:00:00	
Plastone current	40.69	2019/05/16 22:59:59	01:00:00	
Plastone current	43.07	2019/05/16 23:59:59	01:00:00	
Plastone current	43.46	2019/05/17 0:59:59	01:00:00	
Plastone current	41.74	2019/05/17 1:59:59	01:00:00	
Plastone current	41.64	2019/05/17 2:59:59	01:00:00	
Plastone current	43.06	2019/05/17 3:59:59	01:00:00	
Plastone current	40.06	2019/05/17 4:59:59	01:00:00	
Plastone current	42.85	2019/05/17 5:59:59	01:00:00	

Plastone current	41.77	2019/05/17 6:59:59	01:00:00	
Plastone current	41.49	2019/05/17 7:59:59	01:00:00	
Plastone current	43.14	2019/05/17 8:59:59	01:00:00	
Plastone current	42.8	2019/05/17 9:59:59	01:00:00	
Plastone current	39.71	2019/05/17 10:59:59	01:00:00	
Plastone current	42.34	2019/05/17 11:59:59	01:00:00	
Plastone current	41.04	2019/05/17 12:59:59	01:00:00	
Plastone current	42.15	2019/05/17 13:59:59	01:00:00	
Plastone current	43.16	2019/05/17 14:59:59	01:00:00	
Plastone current	40.15	2019/05/17 15:59:59	01:00:00	
Plastone current	42.31	2019/05/17 16:59:59	01:00:00	
Plastone current	42.11	2019/05/17 17:59:59	01:00:00	
Plastone current	42.21	2019/05/17 18:59:59	01:00:00	
Plastone current	34.49	2019/05/17 19:59:59	01:00:00	
Plastone current	12.63	2019/05/17 20:59:59	01:00:00	Unlisted stop (by setters)
Plastone current	26.18	2019/05/17 21:59:59	01:00:00	
Plastone current	27.77	2019/05/17 22:59:59	01:00:00	
Plastone current	39.56	2019/05/17 23:59:59	01:00:00	
Plastone current	39.45	2019/05/18 0:59:59	01:00:00	
Plastone current	39.49	2019/05/18 1:59:59	01:00:00	
Plastone current	4.17	2019/05/18 2:59:59	01:00:00	
Plastone current	8.67	2019/05/18 3:59:59	01:00:00	
Plastone current	6.22	2019/05/18 4:59:59	01:00:00	
Plastone current	4.9	2019/05/18 5:59:59	01:00:00	
Plastone current	12.31	2019/05/18 6:59:59	01:00:00	
Plastone current	4.09	2019/05/18 7:59:59	01:00:00	
Plastone current	8.73	2019/05/18 8:59:59	01:00:00	
Plastone current	6.46	2019/05/18 9:59:59	01:00:00	
Plastone current	23.56	2019/05/18 10:59:59	01:00:00	
Plastone current	0.89	2019/05/18 11:59:59	01:00:00	
Plastone current	0.86	2019/05/18 12:59:59	01:00:00	
Plastone current	0.85	2019/05/18 13:59:59	01:00:00	
Plastone current	0.89	2019/05/18 14:59:59	01:00:00	

Plastone current	0.85	2019/05/18 15:59:59	01:00:00	
Plastone current	0.86	2019/05/18 16:59:59	01:00:00	
Plastone current	0.86	2019/05/18 17:59:59	01:00:00	
Plastone current	0.86	2019/05/18 18:59:59	01:00:00	
Plastone current	0.87	2019/05/18 19:59:59	01:00:00	
Plastone current	28.79	2019/05/18 20:59:59	01:00:00	
Plastone current	25.6	2019/05/18 21:59:59	01:00:00	
Plastone current	37.05	2019/05/18 22:59:59	01:00:00	
Plastone current	42.21	2019/05/18 23:59:59	01:00:00	
Plastone current	38.52	2019/05/19 0:59:59	01:00:00	
Plastone current	42.24	2019/05/19 1:59:59	01:00:00	
Plastone current	37.82	2019/05/19 2:59:59	01:00:00	
Plastone current	42.19	2019/05/19 3:59:59	01:00:00	
Plastone current	40.38	2019/05/19 4:59:59	01:00:00	
Plastone current	39.79	2019/05/19 5:59:59	01:00:00	
Plastone current	39.81	2019/05/19 6:59:59	01:00:00	
Plastone current	41.97	2019/05/19 7:59:59	01:00:00	
Plastone current	37.6	2019/05/19 8:59:59	01:00:00	
Plastone current	40.65	2019/05/19 9:59:59	01:00:00	
Plastone current	36.07	2019/05/19 10:59:59	01:00:00	
Plastone current	36.97	2019/05/19 11:59:59	01:00:00	
Plastone current	19.91	2019/05/19 12:59:59	01:00:00	
Plastone current	24.77	2019/05/19 13:59:59	01:00:00	
Plastone current	24.76	2019/05/19 14:59:59	01:00:00	
Plastone current	24	2019/05/19 15:59:59	01:00:00	Stop number 16
Plastone current	20.68	2019/05/19 16:59:59	01:00:00	
Plastone current	42.52	2019/05/19 17:59:59	01:00:00	
Plastone current	40.61	2019/05/19 18:59:59	01:00:00	
Plastone current	43.59	2019/05/19 19:59:59	01:00:00	
Plastone current	42.96	2019/05/19 20:59:59	01:00:00	
Plastone current	36.73	2019/05/19 21:59:59	01:00:00	

Plastone current	43.74	2019/05/19 22:59:59	01:00:00	
Plastone current	45.78	2019/05/19 23:59:59	01:00:00	
Plastone current	38.16	2019/05/20 0:59:59	01:00:00	
Plastone current	42.62	2019/05/20 1:59:59	01:00:00	
Plastone current	41.32	2019/05/20 2:59:59	01:00:00	
Plastone current	41.62	2019/05/20 3:59:59	01:00:00	
Plastone current	45.76	2019/05/20 4:59:59	01:00:00	
Plastone current	42.77	2019/05/20 5:59:59	01:00:00	
Plastone current	37.26	2019/05/20 6:59:59	01:00:00	
Plastone current	45.32	2019/05/20 7:59:59	01:00:00	
Plastone current	43.37	2019/05/20 8:59:59	01:00:00	
Plastone current	38.14	2019/05/20 9:59:59	01:00:00	
Plastone current	38.61	2019/05/20 10:59:59	01:00:00	
Plastone current	41.77	2019/05/20 11:59:59	01:00:00	
Plastone current	43.36	2019/05/20 12:59:59	01:00:00	
Plastone current	39.67	2019/05/20 13:59:59	01:00:00	
Plastone current	32.71	2019/05/20 14:59:59	01:00:00	
Plastone current	13.99	2019/05/20 15:59:59	01:00:00	
Plastone current	15.04	2019/05/20 16:59:59	01:00:00	
Plastone current	2.67	2019/05/20 17:59:59	01:00:00	
Plastone current	9.47	2019/05/20 18:59:59	01:00:00	
Plastone current	2.44	2019/05/20 19:59:59	01:00:00	
Plastone current	6.04	2019/05/20 20:59:59	01:00:00	
Plastone current	4.59	2019/05/20 21:59:59	01:00:00	
Plastone current	3.85	2019/05/20 22:59:59	01:00:00	Stop number 17
Plastone current	8.04	2019/05/20 23:59:59	01:00:00	
Plastone current	2.86	2019/05/21 0:59:59	01:00:00	
Plastone current	6.64	2019/05/21 1:59:59	01:00:00	
Plastone current	5.54	2019/05/21 2:59:59	01:00:00	
Plastone current	8.04	2019/05/21 3:59:59	01:00:00	
Plastone current	3.61	2019/05/21 4:59:59	01:00:00	
Plastone current	7.91	2019/05/21 5:59:59	01:00:00	
Plastone current	1.59	2019/05/21 6:59:59	01:00:00	
Plastone current	4.75	2019/05/21 7:59:59	01:00:00	
Plastone current	6.81	2019/05/21 8:59:59	01:00:00	

Plastone current	3.85	2019/05/21 9:59:59	01:00:00
Plastone current	2.8	2019/05/21 10:59:59	01:00:00
Plastone current	7.56	2019/05/21 11:59:59	01:00:00
Plastone current	3.79	2019/05/21 12:59:59	01:00:00
Plastone current	8.08	2019/05/21 13:59:59	01:00:00
Plastone current	18.73	2019/05/21 14:59:59	01:00:00
Plastone current	28.74	2019/05/21 15:59:59	01:00:00
Plastone current	32.33	2019/05/21 16:59:59	01:00:00
Plastone current	30.82	2019/05/21 17:59:59	01:00:00
Plastone current	20.5	2019/05/21 18:59:59	01:00:00
Plastone current	38.8	2019/05/21 19:59:59	01:00:00
Plastone current	47.53	2019/05/21 20:59:59	01:00:00
Plastone current	39.14	2019/05/21 21:59:59	01:00:00
Plastone current	39.38	2019/05/21 22:59:59	01:00:00
Plastone current	44.47	2019/05/21 23:59:59	01:00:00
Plastone current	42.91	2019/05/22 0:59:59	01:00:00
Plastone current	41.36	2019/05/22 1:59:59	01:00:00
Plastone current	40.15	2019/05/22 2:59:59	01:00:00
Plastone current	37.84	2019/05/22 3:59:59	01:00:00
Plastone current	46.22	2019/05/22 4:59:59	01:00:00
Plastone current	43.47	2019/05/22 5:59:59	01:00:00
Plastone current	38.8	2019/05/22 6:59:59	01:00:00
Plastone current	44.55	2019/05/22 7:59:59	01:00:00
Plastone current	41.63	2019/05/22 8:59:59	01:00:00
Plastone current	39.07	2019/05/22 9:59:59	01:00:00
Plastone current	39.78	2019/05/22 10:59:59	01:00:00
Plastone current	39.49	2019/05/22 11:59:59	01:00:00
Plastone current	43.01	2019/05/22 12:59:59	01:00:00
Plastone current	44.61	2019/05/22 13:59:59	01:00:00
Plastone current	36.44	2019/05/22 14:59:59	01:00:00
Plastone current	42.11	2019/05/22 15:59:59	01:00:00
Plastone current	45.75	2019/05/22 16:59:59	01:00:00

Plastone current	37.94	2019/05/22 17:59:59	01:00:00
Plastone current	40.43	2019/05/22 18:59:59	01:00:00
Plastone current	40.19	2019/05/22 19:59:59	01:00:00
Plastone current	40.03	2019/05/22 20:59:59	01:00:00
Plastone current	45.7	2019/05/22 21:59:59	01:00:00
Plastone current	39.84	2019/05/22 22:59:59	01:00:00
Plastone current	39.4	2019/05/22 23:59:59	01:00:00
Plastone current	47.81	2019/05/23 0:59:59	01:00:00
Plastone current	39.41	2019/05/23 1:59:59	01:00:00
Plastone current	41.69	2019/05/23 2:59:59	01:00:00
Plastone current	40.45	2019/05/23 3:59:59	01:00:00
Plastone current	41.92	2019/05/23 4:59:59	01:00:00
Plastone current	44.51	2019/05/23 5:59:59	01:00:00
Plastone current	45.57	2019/05/23 6:59:59	01:00:00
Plastone current	40.26	2019/05/23 7:59:59	01:00:00
Plastone current	38.71	2019/05/23 8:59:59	01:00:00
Plastone current	47	2019/05/23 9:59:59	01:00:00
Plastone current	47.62	2019/05/23 10:59:59	01:00:00
Plastone current	39.65	2019/05/23 11:59:59	01:00:00
Plastone current	39.47	2019/05/23 12:59:59	01:00:00
Plastone current	43.56	2019/05/23 13:59:59	01:00:00
Plastone current	39.2	2019/05/23 14:59:59	01:00:00
Plastone current	39.54	2019/05/23 15:59:59	01:00:00
Plastone current	43.19	2019/05/23 16:59:59	01:00:00
Plastone current	44.17	2019/05/23 17:59:59	01:00:00
Plastone current	36.91	2019/05/23 18:59:59	01:00:00
Plastone current	42.57	2019/05/23 19:59:59	01:00:00
Plastone current	46.02	2019/05/23 20:59:59	01:00:00
Plastone current	38.75	2019/05/23 21:59:59	01:00:00
Plastone current	39.6	2019/05/23 22:59:59	01:00:00
Plastone current	40.67	2019/05/23 23:59:59	01:00:00
Plastone current	44.43	2019/05/24 0:59:59	01:00:00
Plastone current	42.89	2019/05/24 1:59:59	01:00:00

Plastone current	37.4	2019/05/24 2:59:59	01:00:00
Plastone current	44.45	2019/05/24 3:59:59	01:00:00
Plastone current	45.59	2019/05/24 4:59:59	01:00:00
Plastone current	38.5	2019/05/24 5:59:59	01:00:00
Plastone current	39.23	2019/05/24 6:59:59	01:00:00
Plastone current	40.15	2019/05/24 7:59:59	01:00:00
Plastone current	42.27	2019/05/24 8:59:59	01:00:00
Plastone current	42.96	2019/05/24 9:59:59	01:00:00
Plastone current	39.32	2019/05/24 10:59:59	01:00:00
Plastone current	41.48	2019/05/24 11:59:59	01:00:00
Plastone current	46.82	2019/05/24 12:59:59	01:00:00
Plastone current	37.05	2019/05/24 13:59:59	01:00:00
Plastone current	45.52	2019/05/24 14:59:59	01:00:00
Plastone current	40.99	2019/05/24 15:59:59	01:00:00
Plastone current	39.04	2019/05/24 16:59:59	01:00:00
Plastone current	41.51	2019/05/24 17:59:59	01:00:00
Plastone current	40.81	2019/05/24 18:59:59	01:00:00
Plastone current	38.48	2019/05/24 19:59:59	01:00:00
Plastone current	44.77	2019/05/24 20:59:59	01:00:00
Plastone current	44.87	2019/05/24 21:59:59	01:00:00
Plastone current	35.49	2019/05/24 22:59:59	01:00:00
Plastone current	37.31	2019/05/24 23:59:59	01:00:00
Plastone current	39.88	2019/05/25 0:59:59	01:00:00
Plastone current	44.36	2019/05/25 1:59:59	01:00:00
Plastone current	43.64	2019/05/25 2:59:59	01:00:00
Plastone current	40.98	2019/05/25 3:59:59	01:00:00
Plastone current	39.48	2019/05/25 4:59:59	01:00:00
Plastone current	46.54	2019/05/25 5:59:59	01:00:00
Plastone current	40.47	2019/05/25 6:59:59	01:00:00
Plastone current	38.89	2019/05/25 7:59:59	01:00:00
Plastone current	38.71	2019/05/25 8:59:59	01:00:00
Plastone current	44.49	2019/05/25 9:59:59	01:00:00
Plastone current	42.33	2019/05/25 10:59:59	01:00:00
Plastone current	39.95	2019/05/25 11:59:59	01:00:00
Plastone current	39.34	2019/05/25 12:59:59	01:00:00

Plastone current	45.65	2019/05/25 13:59:59	01:00:00
Plastone current	42.27	2019/05/25 14:59:59	01:00:00
Plastone current	43.18	2019/05/25 15:59:59	01:00:00
Plastone current	37.61	2019/05/25 16:59:59	01:00:00
Plastone current	42.63	2019/05/25 17:59:59	01:00:00
Plastone current	44.83	2019/05/25 18:59:59	01:00:00
Plastone current	43.35	2019/05/25 19:59:59	01:00:00
Plastone current	43.74	2019/05/25 20:59:59	01:00:00
Plastone current	41	2019/05/25 21:59:59	01:00:00
Plastone current	37.98	2019/05/25 22:59:59	01:00:00
Plastone current	46.07	2019/05/25 23:59:59	01:00:00
Plastone current	44.51	2019/05/26 0:59:59	01:00:00
Plastone current	37.93	2019/05/26 1:59:59	01:00:00
Plastone current	44.4	2019/05/26 2:59:59	01:00:00
Plastone current	43.43	2019/05/26 3:59:59	01:00:00
Plastone current	44.72	2019/05/26 4:59:59	01:00:00
Plastone current	42.79	2019/05/26 5:59:59	01:00:00
Plastone current	40.89	2019/05/26 6:59:59	01:00:00
Plastone current	41.66	2019/05/26 7:59:59	01:00:00
Plastone current	45.85	2019/05/26 8:59:59	01:00:00
Plastone current	37.76	2019/05/26 9:59:59	01:00:00
Plastone current	41.26	2019/05/26 10:59:59	01:00:00
Plastone current	42.49	2019/05/26 11:59:59	01:00:00
Plastone current	46.61	2019/05/26 12:59:59	01:00:00
Plastone current	40.66	2019/05/26 13:59:59	01:00:00
Plastone current	40.68	2019/05/26 14:59:59	01:00:00
Plastone current	40.27	2019/05/26 15:59:59	01:00:00
Plastone current	38.22	2019/05/26 16:59:59	01:00:00
Plastone current	46.68	2019/05/26 17:59:59	01:00:00
Plastone current	42.02	2019/05/26 18:59:59	01:00:00
Plastone current	38.52	2019/05/26 19:59:59	01:00:00
Plastone current	46.54	2019/05/26 20:59:59	01:00:00

Plastone current	41.17	2019/05/26 21:59:59	01:00:00
Plastone current	40.16	2019/05/26 22:59:59	01:00:00
Plastone current	41.09	2019/05/26 23:59:59	01:00:00
Plastone current	40.63	2019/05/27 0:59:59	01:00:00
Plastone current	44.29	2019/05/27 1:59:59	01:00:00
Plastone current	44.48	2019/05/27 2:59:59	01:00:00
Plastone current	43.36	2019/05/27 3:59:59	01:00:00
Plastone current	41.22	2019/05/27 4:59:59	01:00:00
Plastone current	41.23	2019/05/27 5:59:59	01:00:00
Plastone current	46.72	2019/05/27 6:59:59	01:00:00
Plastone current	39.91	2019/05/27 7:59:59	01:00:00
Plastone current	41.02	2019/05/27 8:59:59	01:00:00
Plastone current	39.72	2019/05/27 9:59:59	01:00:00
Plastone current	45.1	2019/05/27 10:59:59	01:00:00
Plastone current	43.5	2019/05/27 11:59:59	01:00:00
Plastone current	37.25	2019/05/27 12:59:59	01:00:00
Plastone current	44.17	2019/05/27 13:59:59	01:00:00
Plastone current	44.93	2019/05/27 14:59:59	01:00:00
Plastone current	38.22	2019/05/27 15:59:59	01:00:00
Plastone current	42.74	2019/05/27 16:59:59	01:00:00
Plastone current	43.23	2019/05/27 17:59:59	01:00:00
Plastone current	39.78	2019/05/27 18:59:59	01:00:00
Plastone current	39.94	2019/05/27 19:59:59	01:00:00
Plastone current	44.58	2019/05/27 20:59:59	01:00:00
Plastone current	45.48	2019/05/27 21:59:59	01:00:00
Plastone current	45.3	2019/05/27 22:59:59	01:00:00
Plastone current	37.4	2019/05/27 23:59:59	01:00:00
Plastone current	42.42	2019/05/28 0:59:59	01:00:00
Plastone current	45.75	2019/05/28 1:59:59	01:00:00
Plastone current	39.85	2019/05/28 2:59:59	01:00:00
Plastone current	41.4	2019/05/28 3:59:59	01:00:00
Plastone current	44.07	2019/05/28 4:59:59	01:00:00
Plastone current	46.16	2019/05/28 5:59:59	01:00:00
Plastone current	44.26	2019/05/28 6:59:59	01:00:00
Plastone current	37.28	2019/05/28 7:59:59	01:00:00

Plastone current	42.53	2019/05/28 8:59:59	01:00:00
Plastone current	46.7	2019/05/28 9:59:59	01:00:00
Plastone current	37.38	2019/05/28 10:59:59	01:00:00
Plastone current	40.65	2019/05/28 11:59:59	01:00:00
Plastone current	43.22	2019/05/28 12:59:59	01:00:00
Plastone current	43.88	2019/05/28 13:59:59	01:00:00
Plastone current	43.98	2019/05/28 14:59:59	01:00:00
Plastone current	40.08	2019/05/28 15:59:59	01:00:00
Plastone current	39.96	2019/05/28 16:59:59	01:00:00
Plastone current	46.75	2019/05/28 17:59:59	01:00:00
Plastone current	37.77	2019/05/28 18:59:59	01:00:00
Plastone current	39.47	2019/05/28 19:59:59	01:00:00
Plastone current	46.57	2019/05/28 20:59:59	01:00:00
Plastone current	42.24	2019/05/28 21:59:59	01:00:00
Plastone current	42.41	2019/05/28 22:59:59	01:00:00
Plastone current	40.93	2019/05/28 23:59:59	01:00:00
Plastone current	40.19	2019/05/29 0:59:59	01:00:00
Plastone current	46.49	2019/05/29 1:59:59	01:00:00
Plastone current	40.14	2019/05/29 2:59:59	01:00:00
Plastone current	39.1	2019/05/29 3:59:59	01:00:00
Plastone current	47.95	2019/05/29 4:59:59	01:00:00
Plastone current	42.34	2019/05/29 5:59:59	01:00:00
Plastone current	44.55	2019/05/29 6:59:59	01:00:00
Plastone current	41.33	2019/05/29 7:59:59	01:00:00
Plastone current	40.44	2019/05/29 8:59:59	01:00:00
Plastone current	42.25	2019/05/29 9:59:59	01:00:00
Plastone current	44.46	2019/05/29 10:59:59	01:00:00
Plastone current	42.85	2019/05/29 11:59:59	01:00:00
Plastone current	40.82	2019/05/29 12:59:59	01:00:00
Plastone current	38.94	2019/05/29 13:59:59	01:00:00
Plastone current	46.17	2019/05/29 14:59:59	01:00:00
Plastone current	39.65	2019/05/29 15:59:59	01:00:00
Plastone current	40.63	2019/05/29 16:59:59	01:00:00

Plastone current	42.89	2019/05/29 17:59:59	01:00:00	
Plastone current	42.1	2019/05/29 18:59:59	01:00:00	
Plastone current	36.76	2019/05/29 19:59:59	01:00:00	
Plastone current	11.5	2019/05/29 20:59:59	01:00:00	
Plastone current	6.05	2019/05/29 21:59:59	01:00:00	
Plastone current	13.5	2019/05/29 22:59:59	01:00:00	
Plastone current	8.37	2019/05/29 23:59:59	01:00:00	
Plastone current	13.54	2019/05/30 0:59:59	01:00:00	
Plastone current	7.72	2019/05/30 1:59:59	01:00:00	
Plastone current	9.6	2019/05/30 2:59:59	01:00:00	Stop number 18
Plastone current	10.76	2019/05/30 3:59:59	01:00:00	
Plastone current	17.84	2019/05/30 4:59:59	01:00:00	
Plastone current	23.99	2019/05/30 5:59:59	01:00:00	
Plastone current	5.79	2019/05/30 6:59:59	01:00:00	
Plastone current	10.63	2019/05/30 7:59:59	01:00:00	
Plastone current	16.61	2019/05/30 8:59:59	01:00:00	
Plastone current	11.33	2019/05/30 9:59:59	01:00:00	
Plastone current	9.15	2019/05/30 10:59:59	01:00:00	
Plastone current	18.83	2019/05/30 11:59:59	01:00:00	
Plastone current	33.39	2019/05/30 12:59:59	01:00:00	
Plastone current	37.31	2019/05/30 13:59:59	01:00:00	
Plastone current	38.51	2019/05/30 14:59:59	01:00:00	
Plastone current	35.55	2019/05/30 15:59:59	01:00:00	
Plastone current	36.71	2019/05/30 16:59:59	01:00:00	
Plastone current	39.72	2019/05/30 17:59:59	01:00:00	
Plastone current	35.94	2019/05/30 18:59:59	01:00:00	
Plastone current	39.63	2019/05/30 19:59:59	01:00:00	
Plastone current	37.58	2019/05/30 20:59:59	01:00:00	
Plastone current	36.86	2019/05/30 21:59:59	01:00:00	
Plastone current	39.92	2019/05/30 22:59:59	01:00:00	
Plastone current	36.4	2019/05/30 23:59:59	01:00:00	
Plastone current	39.26	2019/05/31 0:59:59	01:00:00	

Plastone current	39.83	2019/05/31 1:59:59	01:00:00
Plastone current	37.58	2019/05/31 2:59:59	01:00:00
Plastone current	40.65	2019/05/31 3:59:59	01:00:00
Plastone current	38.78	2019/05/31 4:59:59	01:00:00
Plastone current	36.47	2019/05/31 5:59:59	01:00:00
Plastone current	38.94	2019/05/31 6:59:59	01:00:00
Plastone current	38.66	2019/05/31 7:59:59	01:00:00
Plastone current	36.65	2019/05/31 8:59:59	01:00:00
Plastone current	39.73	2019/05/31 9:59:59	01:00:00
Plastone current	35.99	2019/05/31 10:59:59	01:00:00
Plastone current	39.11	2019/05/31 11:59:59	01:00:00
Plastone current	36.16	2019/05/31 12:59:59	01:00:00
Plastone current	39.21	2019/05/31 13:59:59	01:00:00
Plastone current	36.2	2019/05/31 14:59:59	01:00:00
Plastone current	37.89	2019/05/31 15:59:59	01:00:00
Plastone current	38.44	2019/05/31 16:59:59	01:00:00
Plastone current	36.11	2019/05/31 17:59:59	01:00:00
Plastone current	38.91	2019/05/31 18:59:59	01:00:00
Plastone current	38.17	2019/05/31 19:59:59	01:00:00
Plastone current	39.13	2019/05/31 20:59:59	01:00:00
Plastone current	37.05	2019/05/31 21:59:59	01:00:00
Plastone current	39.66	2019/05/31 22:59:59	01:00:00
Plastone current	37.03	2019/05/31 23:59:59	01:00:00

Total average amperage	**30.9272**	**A**	
Average amperage of working injection moulding machine	**39.3989**	**A**	
Average amperage of non working injection moulding machine	**13.2681**	**A**	