



Kaunas University of Technology

Faculty of Mechanical Engineering and Design

Task Formulation, Supervision, and Implementation of Order Management Software in a Metal Manufacturing Company

Master's Final Degree Project

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Project author

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Supervisor

Kaunas, 2020



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Industrial Engineering and Management (6211EX018)

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Task Formulation, Supervision, and Implementation of Order Management Software in a Metal Manufacturing Company

Declaration of Academic Integrity

I confirm that the final project of mine, Lukas Kandrotas, on the topic "Task Formulation, Supervision, and Implementation of Order Management Software in a Metal Manufacturing Company" is written completely by myself; all the provided data and research results are correct and have been obtained honestly. None of the parts of this thesis have been plagiarised from any printed, Internet-based or otherwise recorded sources. All direct and indirect quotations from external resources are indicated in the list of references. No monetary funds (unless required by Law) have been paid to anyone for any contribution to this project.

I fully and completely understand that any discovery of any manifestations/case/facts of dishonesty inevitably results in me incurring a penalty according to the procedure(s) effective at Kaunas University of Technology.

Lukas Kandrotas

(name and surname filled in by hand)

(signature)



Kaunas University of Technology
Faculty of Mechanical Engineering and Design

Task of the Master's final degree project

Given to the student – Lukas Kandrotas

1. Title of the project

Task Formulation, Supervision, and Implementation of Order Management Software in a Metal Manufacturing Company

(In English)

Užsakymų valdymo programos užduočių formulavimas, priežiūra ir įgyvendinimas metalo apdirbimo įmonėje

(In Lithuanian)

2. Aim and tasks of the project

To improve order management processes in metal manufacturing company.

Tasks:

1. Investigate the need of changes in the company;
2. Check and compare order management software created specifically for the company with similar order and project management software;
3. Review existing order management solutions of the company;
4. Formulate tasks for developers and taking part in creation of the program, considering different modules for optimal results;
5. Prepare implementation plan.

3. Initial data of the project

N/A

4. Main requirements and conditions

Software design creation specifically for the medium sized metal manufacturing company;
Assurance of availability of the program for all levels of management and employees in the workshop.

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Summary

The project is aimed to improve order management processes in a metal manufacturing company. In Chapter 1, assumption stating that order management processes in JSC “Kagneta“ are not efficient was formed. It was checked and approved using questionnaire based on Likert’s scale.

In Chapter 2, analysis of current solutions of order management applied in the company are presented. Possibilities of using existing software (Microsoft Project, Asprova, MRPeasy, NetSuite Software) considered and compared with Custom Program. Based on advantages, in particular: abilities to use virtual environment for workshop and customization capabilities decision to develop Custom Program was made.

In Chapter 3, review of all modules needed for the software is presented. Eleven different modules are applied in the final version of the program: user roles, clients, suppliers, orders, processes, virtual environment, material flow, production defects, material locations, working schedule and machines modules. All modules was developed to be as user-friendly as possible to end users, concepts from different methodologies, such as, Lean, Six Sigma, JIT production, and warehousing optimization was applied.

In Chapter 4, process of program implementation to the organization is presented. It is introduced using four main phases: project planning, project execution, project monitoring, and project closeout phases. In the implementation possible risks in the use of the program, tasks needed to be performed within a team to implement the software, and tools for continuous improvement was imposed.

Six different conclusions, regarding different fields of the thesis, was developed and formed. It was found out, that current method and existing software does not provides required functionality, comparison of flowcharts represents possibilities of saving time and possibility of working remotely, implementation plan allows to prepare for possible risks of program implementation.

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Santrauka

Projekto tikslas yra pagerinti užsakymų valdymo procesus metalo apdirbimo įmonėje. Pirmame skyriuje buvo suformuotas teiginys, kad užsakymų valdymo procesai įmonėje UAB „Kagneta“ yra neefektyvus. Šis teiginys buvo patikrintas ir patvirtintas panaudojant klausimų anketą pagal Likerto skalę.

Antrame skyriuje yra išanalizuoti dabar įmonėje naudojami užsakymų valdymo sprendimai. Taip pat, pateikti pasvarstymai naudoti jau sukurtas programas (Microsoft Project, Asprova, MRPeasy, NetSuite Software), jos palyginamos su galimybe sukurti naują programą, pritaikytą pagal įmonės reikalavimus. Po palyginimo, dėl cecho virtualios aplinkos ir pritaikymo galimybių, buvo pasirinkta naudoti ir sukurti naują verslo valdymo programą.

Trečiame skyriuje yra pateikta visų reikalingų programos modulių apžvalga. Galutinėje programos versijoje yra naudojami vienuolika skirtingų modulių: naudotojų rolių, klientų, tiekėjų, užsakymų, procesų, virtualios aplinkos, medžiagų tiekimo, gamybos broko, medžiagų lokacijos, darbo laiko grafiko ir įrenginių moduliai. Visi moduliai buvo, kuriami taip, kad būtų kuo paprastesni naudoti galutiniam vartotojui, buvo pritaikytos Lean, Six Sigma, JIT ir sandėlio optimizavimo metodologijos.

Ketvirtame skyriuje pateiktas programos įgyvendinimo procesas. Diegiant programą buvo naudojami keturi pagrindiniai žingsniai: projekto planavimo, projekto vykdymo, projekto priežiūros ir projekto uždarymo. Įgyvendinimo proceso analizė padėjo suprasti didžiausias galimas rizikas, paskirstyti užduotis komandos nariams, bei apžvelgė galimybę nuolatiniam tobulinimui.

Darbe buvo priertos šešios išvados skirtinguose srityse. Buvo išsiaiškinta, kad dabartinis įmonėje naudojamas metodas neatitinkama įmonės keliamų reikalavimų. Struktūrinių schemų palyginimas įrodė naujos programos privalumas: sutaupyta laikas valdant užsakymus ir galimybė dirbti nuotoliniu būdu. Įgyvendinimo planas leido pasiruošti galimoms programos diegimo rizikoms.

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List of abbreviations and terms

Terms:

MRP - Material requirements planning is a production planning, scheduling, and inventory control system used to manage manufacturing processes.

ERP - Enterprise resource planning is the integrated management of main business processes, often in real time and mediated by software and technology.

Lead-paper – paper that is stapled to the drawing to provide requirements of the operations and manufacturing processes needed to be performed.

CRM - Customer relationship management is a technology for managing all your company's relationships and interactions with customers and potential customers.

Industry 4.0 - it is a name given to the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing.

Introduction

Order management is one of the most important process in manufacturing. To seek and achieve better results, it is important to automate manufacturing processes of the company. It is almost impossible to stay competitive in the current Industry 4.0 environment without functional and reliable order management program or an ERP. It can be overlooked by smaller or medium sized companies, because it can be implied, that smaller companies do not need advanced and automated programs. However, without a good order management processes in a company, it is hard to achieve optimal results. Such program can cover virtually every system within an organization. To have an ability of adequately completing planning schedules and use material resource planning tools effectively, all the data of order management and manufacturing processes must be analysed and well understood. Order management can also have external factors, for example, it can show how a customer perceives the company. Having a seamless workflow and updates of the order status can significantly improve the customer satisfaction, experience, and respect for the brand.

Creating and implementing a functional ERP to the culture of an organization requires understanding of the concepts present in lean manufacturing, it is important to create the software as efficient as possible. In this project, the implementation of changes in the company will be investigated. Furthermore, the project and order management software analysis will be presented. Existing solutions of the order management, required considerations, and the creation of the new program will be analysed.

Finally, after the creation of the program, the implementation process will be examined and investigated. The implementation of these novelties is usually the more difficult and challenging task to complete. In the thesis, a theoretical approach of risks and possible difficulties will be presented.

Aim of the project:

To improve the order management processes in a metal manufacturing company.

Tasks of the project:

- Investigate the need of changes in the company;
- Check and compare the order management software created specifically for the company with similar order and project management software options;
- Review the existing company order management solutions;
- Formulate tasks for the developers and take part in the creation process of the program, considering different modules for optimal results;
- Prepare the implementation plan.

1. Investigation of the Problem and Overview of the Company

JSC Kagneta is a medium sized company located in Kaunas, Lithuania. Machining of different metals and plastics are the main activities performed by the company. According to the data acquired from the State Social Insurance Fund Board Under the Ministry of Social Security and Labour on the 11th of March, 2020, there are 51 employees working in the company, which classifies it as a medium-sized company [1]. JSC Kagneta has capabilities of performing a variety of different manufacturing procedures: turning, milling, different types of welding, stamping, threading, drilling, metal sheet rolling and bending, cutting on a saw machine and production guillotine, coating, dying and hardening of metal. Kagneta performs multiple different types of production for all three manufacturing volume sizes: for mass production the company uses automatic turning machines, CNC machines and stamping dies mounted on hydraulic presses, for batch production, CNC turning and milling machines are used, for single-piece production company uses universal turning, milling, drilling and threading machines.

The company has problems regarding the order management, it can be seen and agreed by the CEO, the top management, and the plant employees. Based on the initial view, it is visible that the company has communication problems, employees are not sure what are the tasks and how the said tasks must be performed. It is also hard for the managers to provide adequate answers on the status of the clients' orders. There are variety of methods to perform the investigation: orders. There are variety of methods to perform the investigation:

- An interview with an employee, a line manager, or experts;
- A questionnaire survey (structured questionnaire) or The Likert Scale;
- The analysis of employment records (work diaries);
- Work tracking.

While every method has its advantages and disadvantages only one or few must be chosen to analyse the current situation. Interviews can range from completely unstructured (“tell me about your job”) to highly structured ones, containing hundreds of specific items to consider. Managers may conduct individual interviews with each employee group, interviews with groups of employees who have the same job, or supervisor interviews with one or more supervisors who know the job. The interview method is advantageous because it is a simple and quick way to collect information, on the other hand a disadvantage of such method could be the distortion of information. Moving forward to the questionnaires, some are very structured checklists of inventory, specific duties, or tasks, the worker is asked to indicate whether he or she performs each task and time spent to perform the said task. Contrarily, others can be open ended, asking the worker to “describe the major duties of the job”. A typical job analysis questionnaire might include several open-ended questions as well as structured questions.

Another method of investigation is a review and analysis of employment records. Workers keep a diary writing what they do during a day. For every completed activity, the employee records the activity (along with the time) in a log. A clear advantage is the complete picture of the job duties and processes, while disadvantage is that the method is time consuming for the employees (in traditional diaries employees need to remember at the end of the day his/her duties and the time they took them).

Direct observation is especially useful when the jobs consist mainly of observable physical activities e.g. assembly line worker. On the other hand, observation is not appropriate when the job entails a

lot of mental activity (design engineer), nor it is useful if the employee only occasionally engages in important activities. Advantage of such a method is objective data, while disadvantageous aspects of the method are lack of usefulness for all types of jobs and worker tendency to change their behaviour while being observed.

1.1. Execution of the Interviews and Results

The interviews were performed in a written format to assure worker anonymity. The questionnaire that was received by the employees of the company is presented below in the Table 1.

Table 1. Questionnaire for employees of JSC “Kagneta”

	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
It is always clear what tasks I have to perform					
Tasks that I had to perform in my workplace are clearly formulated					
There is always a person that I can ask for help when there is specific task that I cannot understand					
Working in teams is efficient and effective					
My colleagues from the other departments performs their duties perfectly					
I am satisfied with the order management processes in the company.					
I do not think there is a need to take an appropriate action to improve the management of a company's processes					
Company's vision and goals are well known for me					
Please answer following questions only if you had to communicate with clients due to your professional duties					
I have enough resources and knowledge about the client orders to efficiently communicate with clients					
I have all the information needed and can provide it to the client when needed					
Usually I do not have to deal with client dissatisfaction					

40 people from the different fields or structures of JSC Kagneta were questioned. Everyone had eight closed questions to answer, the statements had to be rated from 1 to 5. The employees who have a responsibility to communicate with clients got an additional set of three extra questions related to the topic of customer satisfaction.

Based on these assumptions the Likert Scale type questionnaire was applied to find out whether the assumption about the order management problems in the company is correct. The purpose of the questionnaire is to ensure that every single worker assigned with various jobs is satisfied with their predefined occupation. Consecutively it denoted the boundary of least worker satisfaction. In this case, with the assistance of the arrangement given by workers, it would be highly advantageous for the organization to create and keep up its communication boundaries.

The obtained results should represent adequate information, because eighty percent of the people working in the company were questioned and all the professional groups starting from the CEO ending with auxiliary workers were involved.

All the questions are presented in the Table 1. All the questionnaires were taken in Lithuanian language, after completing questionnaires it was translated into English. Approximately, five minutes for each person were needed to complete the test and answer all the questions.

The entire scale can be divided in two categories: task formulation and communication problems with employees and communication with clients. The average result of all the questions related to the order management is 2.46/5, which is below average.

One of the key questions in the Likert's scale was the satisfaction of employees regarding the order management. The results are similar, to the results of the questionnaire – 2.3. 65 percent of the respondents marked negative results, 12 people marked as neutral and 2 people think that the order management processes are OK. The data is presented in the Figure 1.

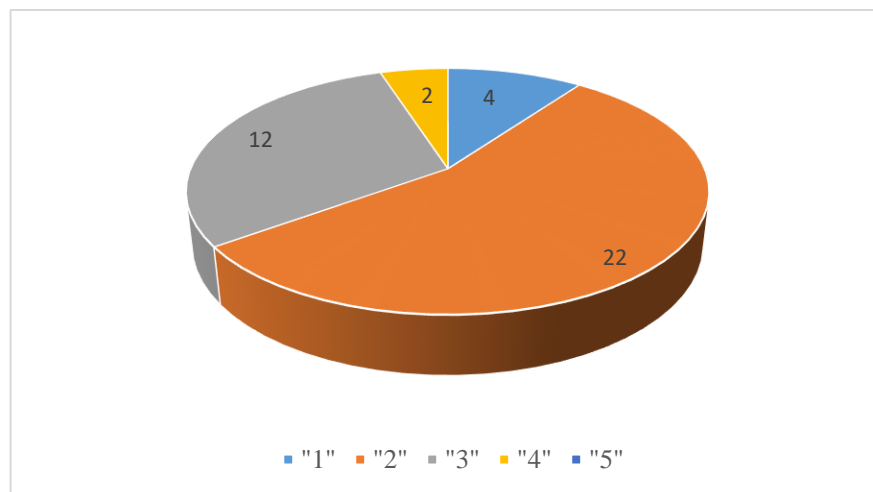


Fig. 1. Satisfaction of employees regarding order management processes. 1 – strongly disagree; 2 - disagree, 3 – neutral, 4 – agree, 5 – strongly agree.

The second segment regarding the client satisfaction also presents similar results. The sum average of all three questions is 2.25/5, which shows that client dissatisfaction is frequent or there is a lack of information that can be presented to the client.

There is no structure for orders and production times, that could help in building a production timetable which would contain production start and end times. The task of the new program is to eliminate all the factors that can lead to clients dissatisfaction: provide production time for each order and help to build timetables for each machine and processes, notify the manager when there is a failure in the plan caused by different factors, so there is a possibility to notify the client of a possible late production and have more visibility regarding every order or material flow.

Another task of the program is to create a virtual environment for employees and operators of the company, so they can check their tasks for the current and upcoming days using the tablet mounted on the wall or mobile phones.

All the necessary information must be presented in the virtual environment, so there is no communication barriers or unclear tasks that form when the employees are not sure how the task must be performed. All the results of the questionnaire are presented in Table 2.

Table 2. Average values of questionnaire

Assumption	Average Value
It is always clear what tasks I do have to perform	2.8
Tasks that I had to perform in my workplace are clearly formulated	2.4
There is always a person that I can ask for help when there is specific task, I cannot understand	2.6
Working in teams is efficient and effective	3.2
My colleagues from other departments performs their duties perfectly	2.6
I am satisfied with order management processes in the company.	2.3
I do not think there is a need to take appropriate action to improve the management of a company's processes	1.8
Company's vision and goals are well known for me	2
I have enough resources and knowledge about orders to efficiently communicate with the clients	2.25
I have all the information needed and can provide it to the client when needed	2.5
Usually I do not have to deal with client dissatisfaction	2

1.2. Organization Theory, Action, Reporting and Barriers

There is no one exact definition of working environment communication because it is a very complex term and every author defines it in a different way. According to the authors Shannon, Weaver, Stanulovic, Vrgovic and Keyton, “*Communication involves all the procedures by which people influence one another*“. [2] Furthermore, “*Communication is any exchange for the recipient of significant information involving one or more entities*“. According to Keyton “*Communication can be defined as the process of transmitting information and common understanding from one person to another*“ [3].

Organizational communication can be defined as the sending and receiving of messages among interrelated individuals within a particular environment or setting to achieve individual and common goals. The study of understanding the communication in JSC “Kagneta” is important because every function and activity in the company involves some form of direct or indirect communication. Whether it is planning and organizing or leading and monitoring, employees have to communicate with their colleagues, stakeholders, suppliers, clients, etc.

This implies that communication skills of every person effect both personal and organizational effectiveness [4]. Organizational communication can help the company in:

- accomplishment of tasks related to specific roles and responsibilities of sales, services, production and another process in the company;
- adapting to change, be prepared for it through individual and organizational creativity;
- completion of tasks through the maintenance of policy, procedures, or regulations that support daily and continuous operations;
- coordination, planning, and control of the organization operations through management [5].

Organizational communication can be defined as how organizations represent, present, and constitute their organizational climate and culture - the attitudes, values and goals that characterize the organization and its members [6]. It is possible that one side in a communication attempt is convinced that the said message is conveyed well, tasks are defined, and all the necessary information is transmitted to the client, but it might only be an assumption of one individual, and it does not mean that the other side has understood, comprehend or received the message at all.

The communication process is affected by many barriers, because of that, Robbins P. S. and Coleman M. have divided all the barriers that affect effective and efficient communication, and they occur regularly in companies. These barriers can be also applied in the JSC “Kagneta”:

Filtering - involves manipulating information in order to transform it to make it more attractive to the recipient. It is most noticeable when submitting employee reports to their managers, who are trying to present it as better than it really is, just to avoid, often, unpleasant communication.

Emotions - the meaning of a message that conveys dependencies on the emotional states in which the recipient of the message is. A single message does not have to carry the same meaning for the recipient when e.g. angry, happy, excited, or indifferent, a message conveyer should be careful about the emotional state of the recipient of the message or the importance of the message.

Language - the choice of words that one employee will use when conveying information to another depends on factors such as age, education, cultural affiliation, social status, as well as belonging to

different groups. Senders often think that the meaning of a word or phrase holds the same meaning to recipient of the message, which is unfortunately not often the case. Words and expressions used in communication should be modified and adapted to the given situation and the interlocutor for the the desired message to be successfully transmitted. Also, slang words and expressions that are known and nurtured by employees of one sector or department, and with whom the rest of the company, suppliers, customers are unfamiliar, also contribute to employee misunderstanding.

Culture - due to lack of information or ignorance, different cultural backgrounds can be a serious barrier to communication between employees, also with customers, suppliers, etc. especially if it is a multinational company. Tolerance but also knowledge of cultural customs and culture is the key to a better understanding and even better relationships among colleagues. This is achieved through joint education, spending quality time outside the workplace, etc. [7]

Lee Hopkins also made a breakdown of potential barriers within an organization, which can occur daily on organizational environment in the company:

A distracting environment - to convey the correct message, space can be one of the obstacles. It should be quiet, bright, and all the conditions according to the workplace environment standards should be assured to keep everyone comfortable. If all conditions are met, communication is more likely to be good. Currently when a JSC “Kagneta” employee is given a new task, the task is given in the workshop, where a lot of unnecessary noise occurs. It is hard for employee to listen with these conditions. Using a phone or a tablet and reading his or her task and seeing the drawing on the screen can help the employee to avoid being distracted by the environment and be more effective.

Poor organizational structure - it does not matter if the company is large, medium or small, if the structure is well defined and all employees know the structure, the message will always be received by the right person. It is very important for each employee to become familiar with the organizational structure in order for the employee to know where they stand in the organizational structure and who is responsible for the tasks performed. Currently, in the company the drawing is given to the person who must oversee the completion of the outlined task and give the material or blanks together with a drawing and the lead-paper to the other employees that are relevant to that process. It is an inefficient and ineffective way of using a workforce, because of the avoidable additional tasks that the employees have to perform. A new program can solve this problem, with processes assigned directly to every person and no need for carrying any physical objects to achieve continuous working.

Delivering a message to the wrong audience - it is important to know to whom this message is intended. There is too much information and too many messages, it is not necessary to present the workers with unnecessary things, to find a measure and to send the appropriate messages to the right people. With processes assigned directly to the employees it will be assured that the message or the tasks will be delivered to the correct person. Creating a digital environment can be a great tool to solve the wrong audience problem. Currently, there is a possibility of losing lead-paper in the workshop and losing all the traceability of the workpiece or a part, that can be avoided using the program.

A mixed message - defining tasks accurately is a big challenge, depending on many factors dependant on both the sender and the recipient of the message. From the noise generated by people, to having no feedback and not knowing if the other side understood due to some technological barriers. Obstacles will always exist since it is impossible to create the perfect space, but every effort should

be made to address as many potential problem factors as possible. A well-defined task facilitates work for everyone, increases efficiency and effectiveness, increases the work rate and reduces employee frustration.

Using the wrong medium - not every medium is suitable for every message, if you want that message to reach the right clients, employees, you need to find the right channel to convey the message besides having a well-defined message. The program can be one medium that everyone uses and understand.

1.3. Ineffective Communication and Information Required for the Clients

Last three questions of the scale were designed to understand basic information and feedback from the employees regarding the communication with clients. There are four people in the company that takes parts in communication with clients and all of them were involved in the questionnaire, that means that the last three questions reflect the company's real situation.

Referring the results of the questionnaires makes it clear that communication with the clients can be rated below average and that this field of communication needs a redesign. From the questionnaire we can assume that there is no information flow or information system of communication that could help to see common information for every employee of top management. Sometimes there is relevant information that could be provided to clients and stalling of communication occurs.

The last question about the client satisfaction can show the problems regarding clients, usually clients appear to be unhappy because of late production or bad communication. For a manager it is always challenging to deal with an unhappy client, it takes a lot of energy and a lot of motivation.

As manufacturers, satisfying the client is one of the most, if not the most, important things to do. Sometimes in JSC "Kagneta" production times are not known and it is hard to provide the client with specific information about deadlines or the prices of production, because of no clear process of price calculation the project and team members not aware of it. Usually, the procedure adapted by the company begins with a proposition of the project price and possible production time.

After the confirmation with a client, the second stage is to start the production process and share the project costs with team members. Setting up production budget correctly at the beginning of a project is a critical step, it helps to avoid further problems. Every team member in the team should be aware of the project costs and budget. It is a responsibility of a project manager to conduct regular meetings to make the team understand where the project stands in terms of costs. Also, make the team understand how any individual effort contributes to the cost of the project. If the actual price exceeds the planned price, discuss the ways to manage the price changes. Having the program for the order management can help the team to be more efficient, see the information in the timetable, prepare the cost plan for any order and have everything in one place.

2. Current Method Company Uses to Manage Purchase Orders and Possible Alternative Programs

While most of the biggest companies in the market have the goal to increase its efficiency using innovative methods and becoming a part of Industry 4.0, some smaller companies have troubles in understanding basic management and planning concepts and completing their tasks before the set deadlines. The clients are usually not satisfied with experiences mentioned above, thus companies lose beneficial clients, money, and reputation. This can usually be avoided with more careful planning and better communication with clients about the status and difficulties faced in manufacturing processes and possible changes on due dates and deadlines. To avoid these problems and improve client satisfaction company started using MS Excel as a main tool to add all the orders and control manufacturing processes. It became evident that this method lacks the needed functionality after a year of use and improvement, however, it provided great fundamentals for a new order management program.

2.1. Management of Orders and Processes Using Current Method

Every company is different in its own way and it is not possible to apply one CRM that could work for all the companies. However, there are some rules that can be applied for everyone that is involved in manufacturing of different production that is based on external orders.

First and the most important task is to set all the orders in one place, one software. For the smaller enterprises, a simple method like MS Excel can be applied. It requires certain knowledge of basic programming to make fields of the table automated, otherwise everything must be filled by users which is not reliable, not efficient, and not user friendly. The table of orders should contain only the most important information.

The first information, that should be represented in the table of orders is the order number. It is important that every part of every order has a unique code, it cannot be repeated at any given time, because same codes will cause confusion and employee mistakes. Usually codes are designed in a way that provides useful information. There are various ways to write different codes. In the Figure 2 examples of an order code number can be seen. Three letters at the start of the code represents the initials of the company. Second and third segments of the code lets the receiver understand approximate confirmation of the order. Other solution for this information can be adding extra column for confirmation date, but it can make table of order too crowded and complex. Last digits of the code are numbers of order in a week. Combination of this code assures that the code cannot repeat itself. Possibility of the same code appears only after a century of use; however, it can be resolved using three digits in the second segment of the code instead of two digits. As it was mentioned before, the code can give different information based on the activity of the company and based on the information that is needed at the given situation. Since this code has proven to be useful, it can also be used in the future software.

It is also important to understand that even if the order gets cancelled or there are some changes in the order, other orders cannot take a number that has been used before. These occurrences usually have high possibility of interference. Finally, it is important to mention that this code is the internal code for the JSC “Kagneta”. There is no need to give the order number to the client, since the clients usually have their own order number that should be added to the order management table.

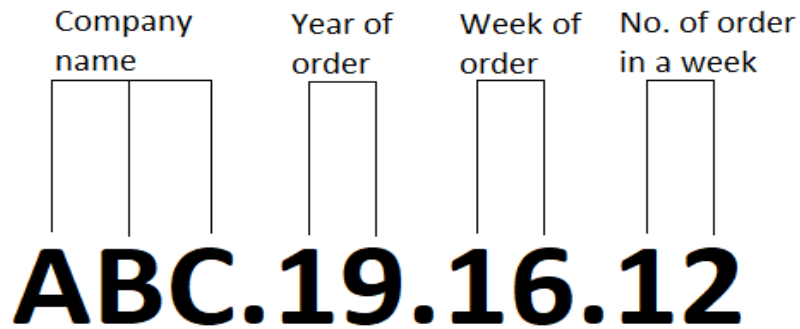


Fig. 2. Example of code of order number

Second column of the table of order is company name (“Įmonė“) in Figure 6. In the table below information is blurred, due to the confidentiality of the information.

Third column represents name of the part (“Detalė pav.“) in Figure 6. Usually it is better to write the code of the part if it is provided by the customer. Normally, it can be seen in the title block of the drawing. Example provided in Figure 3.

Furthermore, names of the part, for example shaft, collet or bushing, does not provide enough information, therefore, codes are unique and should be used in the table. There is also a possibility of using both, the name, and the code, however it can make the table too crowded and complex.

Nenurodytos matmenų, padėties ir formos nuokrypis pagal H14; h14; ±IT14/2				<i>DOV19.01.03.01.002</i>				
<i>Revizija</i>	<i>Atliko</i>	<i>Parasas</i>	<i>Data</i>	<i>Stebule</i>		<i>Litera</i>	<i>Masė</i>	<i>Mastelis</i>
A-06			2015.01.20				0.31	2.5:1
<i>Braiže</i>			2008.09.12	<i>Plienais 45</i>		<i>Lapas 1</i>		<i>Lapų 1</i>
<i>Tikrino</i>								
<i>Tvirtino</i>								

Fig. 3. Title block of a drawing (in Lithuanian)

Fourth and fifth columns in the table represent the quantity (“Kiekis“) in Figure 6 and the deadline. It shows when the tasks must be completed and how many of the specific parts had to be done to complete the order.

The sixth column should provide information about the material (“Medžiaga“) in Figure 6. Usually, when material for the order is needed it consists of three parameters: class of the material, dimensions, and quantity of the material. It can also be split into two, three or even four columns. Material column should provide information about the name of the material, for example: AISI 304, S355, X40, etc. It should also represent the main dimensions of the blank, for example: Ø100 rod, 40x40x2 tube, 100x200x1 sheet.

Another two columns should show the information regarding from where the material is ordered and when it will arrive to the given destination. Usually, this is not a necessity, but for a better traceability it is advised to check this information.

Finally, the operation columns are needed. In our case, 7 fields are used, however for different companies, different number of fields might be needed, some might need just 3 or 4, other, for more complex parts might need up to 20. In most metal and plastic manufacturing companies, same operations are used: CNC or universal turning and milling, drilling, stamping, metal bars and metal sheets cutting, threading, bending or rolling of metal sheets or pipes, grinding, painting, casting, packing, etc. This is the hardest information to fill.

All the operations must have sequence and only highly skilled engineer can decide on the best and most efficient way of completing the manufacturing process. The operations can also be switched places if rearranging of production is needed, because of failures caused by machines, or errors of parts.

The colours in the table of orders indicates different actions completed. Red colour indicates that no action were performed, blue colour means, that the operation is in progress, but not yet completed, green colour means, that the operation is already completed.



Fig. 4. Meanings of colours in the table of orders in operations section

In material section we have similar, but different meanings. Red colour means, that no actions were done, and material is not yet ordered. Yellow – the material is ordered, but not yet received. Green colour indicates that material is already received.



Fig. 5. Meanings of colours in the table of orders in material section

Representation of current order management method is presented in the Figure 6. List of twenty one order is presented in the table of orders in the current model of order management overview window, company currently uses. After completion of every operation, administrator manually greens-out the window of the operation that has been completed.

In the order KAG.19.16.12 we can see that CNC turning in operation number one has already been completed, while operation number two CNC milling has not yet been started. To have more visibility of order completion, after the order is completed, instead of green colour in the status column, all the line should be greened-out. Good example of completed orders are presented in orders KAG.19.16.13, KAG.19.16.14 and KAG.19.16.15. The only operation that was needed to complete the orders was universal turning. The material was available from the warehouse.

Fig. 6. Representation of order management in the old model (in Lithuanian)

Užsakymo nr.	Įmonė	Detalės pav.	Kiekis, vnt.	Deadline	Medžiaga	Op.1	Op.2	Op.3	Op.4	Op.5	Op.6	Op.7	Būsena
KAG.19.16.12		FD.80.03	200	24-bal	308 d35 3metrai Schmolz	CNC tekinimas	CNC frezavimas						
KAG.19.16.13		NE0109.03.07.00.11	20		Sandėlis	Tekinimas							
KAG.19.16.14		NE0109.03.07.00.09	2/4/16/16/16		Sandėlis	Tekinimas							
KAG.19.16.15		NE0109.03.02.012A	20		Sandėlis	Tekinimas							
KAG.19.16.16		60x60x3	200+		Vamzdis 60x60x3 24 metrai	piovimas	CNC gręžimas						
KAG.19.16.17		80x60x3	200+		Vamzdis 80x60x3 60 metrai	piovimas	CNC gręžimas						
KAG.19.16.18		Purškikliai	20 kompl.	09-geg									
KAG.19.16.19		3-L-2055A 01.01	20	09-geg	D20x2,2,1m AISI 304	Tekinimas	Gręžimas						
KAG.19.16.20		3-L-2055A 01.02	20	09-geg	Lazeris AISI 304	Zenkavimas							
KAG.19.16.21		3-L-2055A 01S8	20	09-geg		Suvirinimas							
KAG.19.16.22		3-L-2055A 01	20	09-geg	D20 0,8m AISI 304	Tekinimas	Frezavimas						
KAG.19.16.23		3-L-2055A 02	20	09-geg	D3 0,5m AISI 304	Tekinimas							
KAG.19.16.24		3-L-2055A 03	20	09-geg	Šešiakampis	Tekinimas							
KAG.19.16.25		NE0109.03.02.019	8		Sandėlis	Tekinimas	Gręžimas	Zenkavimas					
KAG.19.16.26		KGN22.03.102	100			piovimas	CNC Frezavimas						
KAG.19.16.27		KGN22.03.101	100			piovimas	CNC Frezavimas						
KAG.19.16.28		KGN22.03.103	200			piovimas	CNC Frezavimas						
KAG.19.17.01		Kampas	30000	10-geg	Egvilvira 04-29	Karpymas glijotina	Štampavimas						
KAG.19.17.03		LK-95GE40-30	210		D100 9m sandėlis	piovimas po 35	Tekinimas	Tekinimas 2	Pakavimas				
KAG.19.17.04		TK-80-90-45BSP/8	1140		D95 57m sandėlis	piovimas po 50	Tekinimas	Tekinimas 2	Frezavimas	Gręžimas	Zenkavimas	Valymas/Pakavimas	
KAG.19.17.05			27047		5 lakštai 2,5x1,25x0,001	Karpymas	Štampavimas	Sriegimas	Pakavimas	Lenkimas			

2.2. Role of Lead Paper Using Current Method

Lead paper is the paper that travels throughout the manufacturing process together with blank material and drawings from one operation to another. Blank example of lead paper created for the production can be seen in Figure 7.

		Lydraštis				
Užsakymo Kodas/код	KAG.19.18.06					
Užsakovas/клиент						
prav./название	Pohi 90/100 - V2					
vnt./количество	38					
Terminas/срок		Data/дата				
Medžiaga/материал	D95	Pradžia/начало	Pabaiga/конец	Kiekis/количество	Darbo trukmė/продолжительность	Atliekos/отходы
Op. 1	Pjovimas po 45					
Op. 2	Tekinimas 1					
Op. 3	Tekinimas 2					
Op. 4	Frezavimas					
Op. 5	Zenkavimas					
Op. 6	Valymas					
Op. 7	Pakavimas					

Pjovimas	резка
Tekinimas	точение
Frezavimas	фрезерование
Gręžimas	сверление
Sriegimas	нарезания резьбы
Pakavimas	упаковка
Lenkimas	гибка
Štampavimas	штамповка

Fig. 7. Lead-Paper (in Lithuanian)

Filling this paper by hand takes a lot of time and is not efficient. To be more efficient more programming and automation is needed. Using simple software like MS Excel can create simple, but very good and effective tool for manufacturing companies. The main advantages of lead paper:

- Traceability;
- Pricing;
- Planning;
- All information in one place.

In case of inaccuracies or errors it is possible to know who performed certain processes for the part, when it was done and what caused the error. Knowing such information, it is possible to apply quality assurance system to eliminate future errors. After the identification of errors, the quality management team should take the situation to further applications. In manufacturing, miscommunication between management and operators is a common factor in workflow inefficiency. Theoretically, calculation of time to produce a part might differ from practical time, in that case price is usually lower than it is supposed to be. Using lead-paper it is easier to identify this problem, because every person that is involved in the production must fill up the time spent on producing the part.

Having the new, real, practical time values of production helps planning more careful and with higher precision. It usually also helps that information is in one place and there is no need for any extra material or information.

In the company, the lead paper consists of the main information needed for the production. It provides all the main information for the employees, for example the number of the order, customer name, name or the code of the part, quantity needed to produce, the deadline or due date and all the needed information about the material. Since employees do not want and usually are not satisfied with a lot of paperwork, it is advised to refrain from making them fill too much information. In company JSC “Kagneta” there are only five fields to fill. First one is the date that the production started. Second one is the date that production has ended. Fourth field must be filled with information on working time and duration. Third column is responsible for the quantity of the parts. It is also important, because it is possible to check where some of the parts might have been broken. The last field is left for the initials of the employee. It does not take a lot of time which does not lead in the loss of time and efficiency. For the bigger companies, usually it is more complex, it shows more information. The lead paper also has the Russian language implication because in company Kagneta there are operators that do not speak Lithuanian as native language and providing information in multiple languages so everyone would understand is beneficial.

Even though, excel with all its possibilities is a good starting tool for a small enterprise, its functionality is very restricted. There are no possibilities of planning production for every machine, it is impossible to conveniently share all the information with employees, a lot of printed papers needed, for defected parts new orders must be created, which is also unreliable, there is no environment for employees, there is not possibility to attach list of the materials. This method did not perform well in the long term and was considered to be changed by management of the company.

2.3. Planning of Manufacturing Using the Current Method

After everything is filled into the table of orders further actions of planning can be applied. For the CRM to be effective many different people from different fields within the company must be

involved. Starting from the managers, ending with the production workers and the warehouse keepers – everyone must do their part. In the table below planning of machine Emco can be seen. Using MS Excel, every order is added to the specific machine, according to the plan from the main planning sheet. In the table below five columns to provide main information are used. First column is used to identify order number, second column represents the company that made an order. Third and fourth columns provides information regarding part number or name and quantity of order that needs to be produced. Fifth column provides a deadline for a specific operation, this number has to be filled by planning department after CAM calculations or checking database of orders performed in the past. In the last column of the table we can see three indications of colours named status, different colours have different meanings. Green colour indicates that operation is completed, and no actions needed to perform in the stage of the production. Yellow colour means that the process is ready to be performed for the specific machine. Red colour indicates that it is not yet possible to perform actions for the products. For example, KGN.22.02.002 from the table cannot be turned on machine Emco, because cutting operation was not yet performed, and material is not ready.

Užsakymo nr.	Įmonė	Detalės pav.	Kiekis	Deadline	Būsena
KAG.19.29.17		Įvorė	5000	4/20/2020	
KAG.19.29.18		Varžtas02	4000	4/20/2020	
KAG.19.29.15		Pin D4x4.5	1000	4/20/2020	
KAG.19.29.20		37-0409	100	4/26/2020	
KAG.19.29.21		39-0018	100	4/26/2020	
KAG.19.29.22		38-0416	100	4/26/2020	
KAG.19.29.23		38-0288	100	4/26/2020	
KAG.19.29.25		DWG29-0018-01	100	4/26/2020	
KAG.19.29.26		DWG29-0018-02	100	4/26/2020	
KAG.19.29.27		DWG29-0018-03	100	4/26/2020	
KAG.19.28.13		N.P. Varžtas	50	5/13/2020	
KAG.19.30.15		LN2	500	5/13/2020	
KAG.19.30.16		LN4	300	5/13/2020	
KGN.19.30.18		KGN22.02.001	1000	5/14/2020	
KGN.19.30.19		KGN22.02.002	250	5/14/2020	

Fig. 8. Representation of planning table for turning machine Emco (in Lithuanian)

Planning operations was not added manually to all the machines, it was added using vlookup excel functions. However, the colour indications were not synced with the main window, that made a lot of excessive managerial work that could be avoided by a better system. Adding sync between sheets is possible, however it requires programming knowledge and does not provide abilities to create virtual environment that could be user friendly.

2.4. Evaluation of the Current Program and Need for Improvements

After using current method for more than one year, it became evident that the processes of order management needs improvements. One of the best things MS Excel provided was the main sheet, that could be used for the company overview. This practice proved to be useful and similar design can be used in the development of the new program if needed. The colour indications of each process provided quick visual information that could be used in communication with clients, employees or internal meetings in the company. It also provided information for material resource planning operations and helped to keep track of the ordered materials. It provided all the necessary information regarding purchase orders and was not overcrowded by excessive information. Lead paper proved to be useful, not reliable. Some situations occurred where lead paper just got lost in the process of

manufacturing. Additionally, after every order is completed it must be manually added to the data sheet. It required manual labour and was not effective. It also proved to be inefficient regarding employee interaction with the datasheet. Instead of the time that could be used to complete their daily tasks, operators had to fill the papers and waste time. Planning was the weakest link of the current order management program. Manual work for the managers and no correlations between program and operators made planning difficult and ineffective. It was too hard to keep track of many processes in the workshop and some of the orders were not filled in time, thus long-term planning was incorrect, completed operations were considered as not yet started. After evaluation of the current method, two possible methods were considered.

The first method is to check existing order management programs and check their suitability to the company culture and functionality of the company needs. Another method is to hire software development team to create a program regarding requirements of the company. Both methods are widely applied in the industry. Usually, bigger companies or corporations tend to choose existing solutions, because of complexity of the tasks that has to be performed, while smaller and medium sized companies are choosing between simpler, less expensive software or creates order management and planning tools themselves or with the help of information technology team.

2.5. Current Process Flowchart of the Order Management

To evaluate results and improvements, flowchart of the order management can be analysed. It can be a good tool to measure management processes needed to complete the order and time needed for completion. To finish all the procedures and processes of the order management 10 different processes are needed. Every process takes different amount of time and travel distance.

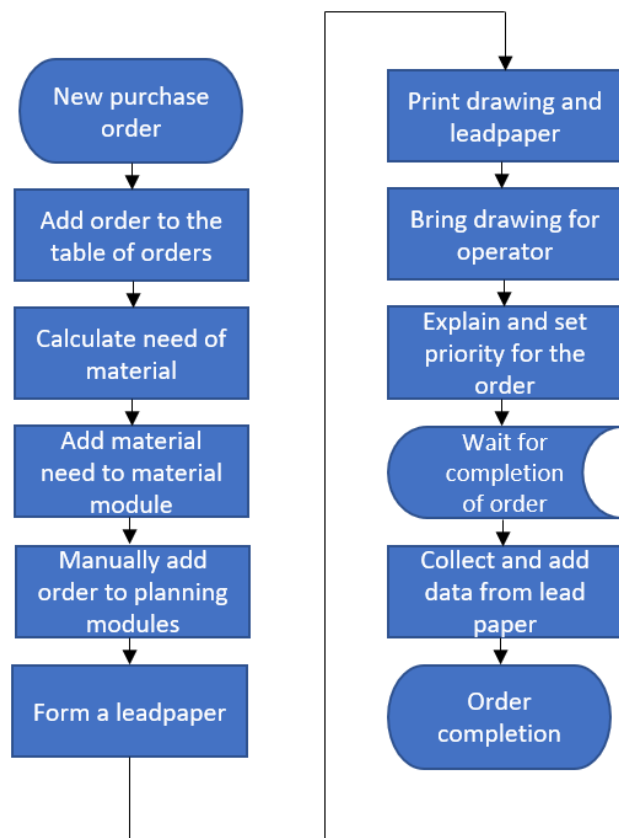
















































































Fig. 9. Flowchart of order management using the current method

According to the summary 9 operations, 1 transportation and 1 delay event is needed. Time required to complete the operations and travel distances needed to cover by administrator of the software are presented below in Table 3.

Table 3. Table of the current order management process flowchart

Location: JSC Kagneta		Summary							
Activity: Order Management		Event	Present						
Purpose: Time calculation for project		Preparation		0					
Date: 2020.04.11		Operation		9					
Name:	Lukas Kandrotas	Transportation		1					
Remarks:		Delay		1					
Analysis of current order management process. Evaluation of time needed to add it to the system.		Inspection		0					
		Storage		0					
		Time (s)		1005					
		Distance (m)		75					
Event Description	Symbol						Time (s)	Distance (m)	Comments
New purchase order							-	-	
Add order to the table of orders							90	-	
Calculate need of material							180	-	
Add material need to material module							60	-	
Manually add order to planning modules							300	-	
Form a leadpaper							30	-	
Print a drawing and a leadpaper							45	5	Staple both sheets
Bring a drawing for an operator							60	70	
Explain and set a priority for an order							120	-	
Wait for completion of an order							-	-	Time calculations not needed
Collect and add data from a lead paper							120	-	Add it to master data sheet
Order completion							-	-	

According to the flowchart and the table, 16 minutes and 45 seconds are needed to finish the given order. Most of the excessive time is used to manually add an order to the planning modules, explaining the priority of the order to the operator, calculating the material need and collecting the data needed from the lead paper. Total distance travelled by the administrator is around 75 meters, it is used to collect printed papers and to bring the drawings for the operator that has to perform the first operation.

As it can be seen from the flowchart there are processes that can be avoided by more advanced software and technology.

The first process that can be automated is adding order to the planning modules, forming and lead-paper can be avoided if all the data is digitalized, bringing drawings and explaining tasks of the orders can be performed in the first stage, where adding all the information to the table of orders is performed. Collecting and adding data from the lead paper is also manual labour, that can be changed to more modern solutions.

2.6. Existing Order Management Programs and Their Comparison

Usually, companies try to use existing products to save money and have lower expenses on maintenance and basic functions of the program. Based on the lean practices, standardization and usage of existing programs are one of the components to success and continuous improvement. [8] However, at some cases different circumstances dictate different results and rules. There are thousands of different software that can be applied in the activities of JSC “Kagneta”. It is impossible to review every program. The selection of the programs for the review is based on personal experience, popularity of the program and recommendations. In this chapter four different programs and their relevance to the company’s goals and tasks will be reviewed. The names of the programs to be reviewed in the further sections are Microsoft Project, Asprova, MRPeasy and NetSuite Software.

2.6.1. Consideration of Microsoft Project for the Order Management

Microsoft Project is on the most popular order management software in the world. It is sold by Microsoft and used to manage projects. It can help managers to perform many different tasks related to the order management and perform supplementary tasks. Planning is one of the strongest modules in the program, it is possible to prepare schedules of the tasks or processes and to plan according to the given data.

Advantages of the Microsoft Project software:

- It integrates with Microsoft Software Suite;
- It is a veteran in the programming industry;
- It has great reliability and support;
- It can be used for financial management;
- It is a desktop application;
- It allows using templates that are ready to use. [9]

Disadvantages of the Microsoft Project software:

- It is desktop-installed;
- It has a steep learning curve;
- It is expensive;
- It has issues with compatibility;
- Its focus is general. [9]

2.6.2. Consideration of Asprova for the Order Management

Asprova is an online production management software that takes care of the inventory, purchase and sales orders, warehouses. It is a software designed for small or medium enterprises to improve order management processes. Asprova software allows such features like estimating of built-in shipments, adding confirmations of orders and deliveries, tracking of orders, sending and creating the invoices, shipping of final goods. Users of the programs are allowed to create or adjust purchase orders or drop shipments. One of the most advanced module of the program is traceability, where program creates serial numbers and batch numbers for every product and material. [10]

Asprova is a user-friendly program. It can be integrated with most of the ERP system company uses, it also provides many different lean tools and methods. One of the most important modules in the program is planning, after creation the orders and adding them to list, program prepares schedules for different machines and processes. It can prepare overview of the production plan and resource usage plan. With automatic planning after adding the order, it reduces the labour time required to prepare time schedules, however if you want to change the production plan Asprova created, it is not reliable to do so. Asprova is a software created for manufacturers of many different kinds, it can also be easily applied for metal manufacturing. Even though it is a user friendly program, it has a lot of different functions, so mastering the program is a difficult task. Finally, Asprova can be functionally combined with MES, ERP and DB systems. It can be useful for companies that are making transactions from one program to another.

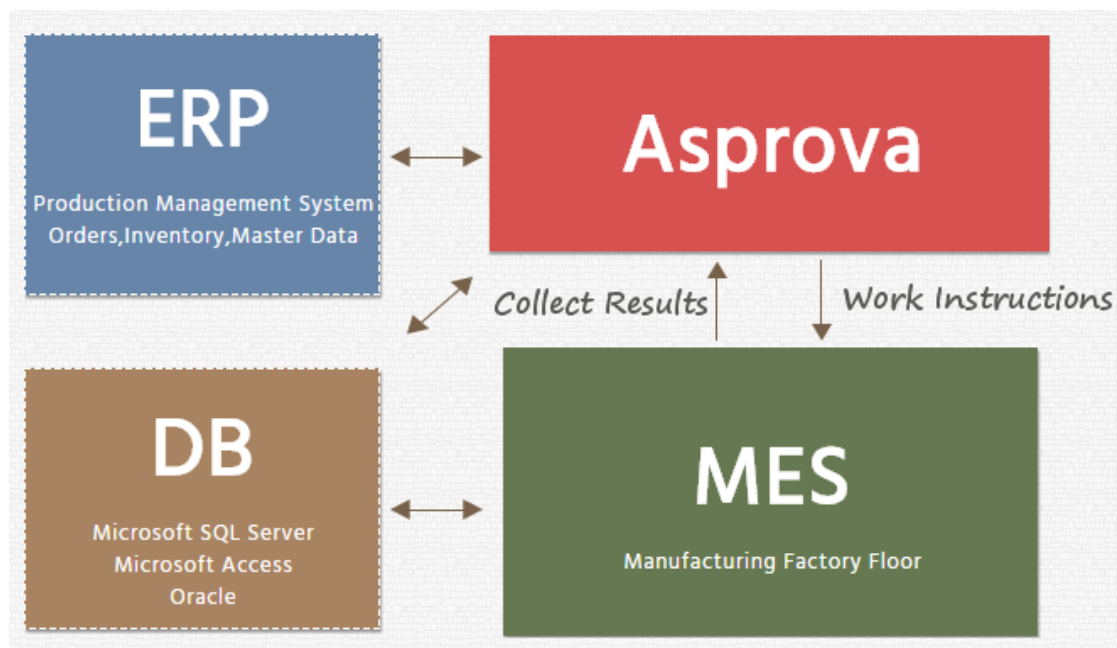


Fig. 10. System flow planning process [11]

Even though the developers are recommending this software for all size of the companies, it feels that it was designed for large manufacturers, with complex functions and many production lines and employees. The Asprova also does not have virtual environment for operators of the workshop. Another con of the program is that it is not cloud-based program and it has to be manually installed to the computers. The design of the software is old and unpleasant, it has old interface, with old-style

windows. It is one of the biggest downsides of the software, because in everyday use, it is important to use a user-friendly and convenient program.

2.6.3. Consideration of MRPeasy for the Order Management

MRPeasy is a software that can be used for small-medium manufacturers. The developers recommend the range from ten to two hundred employees. It offers production management, warehousing modules, customer and client modules and accounting modules as well. According to the website the program can also provide precise production planning – it is important to provide correct lead time for the client. It can also provide inventory overview at the current moment, however this tool is not necessary for JSC “Kagneta”, since the company is trying to implement JIT. MRPeasy also ensures the information and communication flow between the different departments: production, management, sales, finances, etc. MRPeasy provides implementation guides, tutorials, user manuals and demo videos for every module of the program.

There is a feel that interface of the program was made with simplistic approach. [12] After 7 days of evaluation process, no lagging or any signs of software being slow occurred. After using the program for a while, it can be said that the program is intuitive and it is possible to get used to it relatively fast. There are a different variety of features, but to access all the features that the program provides, the most expensive plan for each person must be chosen. There is a possibility to apply bill of materials for different products, however there is no possibility to add semi-finished goods in the bill of material. The program allows to choose distinct production resources, fields on items can be customizable, there is possibility of adding photos or images to the items. Items can be broken down to stocked and non-stocked. There is a possibility for safety stock of the materials, safety stock can be adjusted according to the demand of the production. There is also a possibility to add locations of the material according to the allocation of the warehouse. There is an order sheet, that can be adjusted by the manager or administrator of the software. For client purchase order interface – purchase order can be added easily, all the needed documents such as proforma invoice, regular invoice or CMR can be formed in the program. Customer support is available, but usually when any questions appear, MRPeasy uses tutorials and other tools to help instead of person to person communication. Sometimes it feels that the functions offered by the program were designed for many different areas instead of manufacturing and machining. Some functions are not designed for different processes, additionally, one employee can be assigned only to one machine and one process, that limit flexibility of work planning and does not let you prepare realistic plan regarding the demand of the orders. It is also not possible to have all the data in a cloud storage, all the backup information must be download manually from the database. There is no possibility to restore the case of system malfunction if it has not been manually downloaded. One of the biggest downsides of the program is that it cannot be bought with one payment, there is only subscription method available. Subscription method is applied for each person and user created for the program.

2.6.4. Consideration of NetSuite Software for the Order Management

Fourth program that was tested and analyzed is the NetSuite software. According to the developers it is an inventory management program that was created for manufacturing companies with needs for basic operation management. It is an application that works from the cloud storage and no installation of the program to the hard drive is needed. The program lets businesses to take care of the orders, use warehousing functions and assign planning operations to the given tasks.

NetSuite also lets to check real-time availability of the materials as it is one of the fundamental warehousing operations. Using NetSuite Software helps employees to get visibility of management processes and production processes according to the given conditions in the workshop. Using all the information provided by the application can help the company to use the data for communication with operators inside the company or external clients. NetSuite's manufacturing section focuses on eight sections: CRM, Marketing, Commerce, Order Management, Supply Chain Management, Financials, Support, Global. CRM or customer relationship management can help management of the company to provide necessary communication channels and to achieve best results with the clients. It provides order and partner management. For marketing, NetSuite can offer preparation, execution, and creation of email campaigns to improve entire marketing processes in the company. Commerce lets to sell production through both channels: businesses to businesses and businesses to customer. It can also provide ability to link website of the company to the program to improve commercial results. NetSuite can also help accounting activities in the company easier. All the financing operations can be related to the manufacturing, administrative or other activities. [13]

Implementation of the program due to its complexity will probably be a long and expensive process. The costs consist of a few components. There is a standard cost of the program that had to be paid. Additionally, there is a subscription for every user, that had to be paid monthly. Lastly, implementation process is usually performed with a service of an additional person from NetSuite's company. Since it is a complex problem it will most likely need additional employee to manage and administrate daily activities in the program. NetSuite can be a great tool to have all the information in one place since it has many different modules. It can also bring transparency to the processes performed in the company and highlight possible bottlenecks.

During, seven days period of testing the program, there were situations where programming errors did not allow the use all the functions program can provide. Support team was involved to solve the problems. The support team performed all the required services fast, correctly and professionally. One of the biggest downsides of the program is that is not intuitive at all. The program has no icons, dragging and dropping of functions are not applied in the software menu, it is generally not user friendly. Exporting of data is difficult and cannot be done quickly, it is hard to export all the information to other software such as MS excel. Extraction of data is also demanding a lot of programming knowledge and cannot be done with a few mouse clicks as compared to other programs. There is no possibility of changing anything in the software, it is rigid and cannot be changed.

The program is not convenient to use when working with a large number of data. There is a need to export all the files to other programs. It is not efficient and effective way of process the information. The biggest disadvantage of the NetSuite is complexity of use. It is hard to teach others to use it, and it requires special studies to perform all the procedures in order management and other processes. There is also no possibility of adding additional information about the supplier and clients, that can be used for other actions. Even though the program is highly functional and can perform many different tasks in many different modules for different departments of the company, the downsides of the program outweigh the advantages. One of the most important goals of the program that is used by the company to manage the order and processes in daily activities is convenience.

2.6.5. Evaluation and Comparison of The Programs

After testing every program evaluation must be made. Nine criteria for evaluation of programs were selected regarding the need of the company. Based on the ease of use, interface, features, customer support, customization, virtual environment for operators, planning features, backup safety, base and subscription prices evaluations has been made. Custom program is just a concept of a program, it was evaluated as a concept and real situation after implementation can differ. All the criteria are presented below in the Table 4.

Table 4. Comparison of existing programs for management of orders

	Microsoft Projects	Asprova	MRPeasy	NetSuite Software	Custom Program
Ease of use	Fair	Poor	Good	Poor	Good
Interface	Good	Poor	Good	Good	Good
Features	Good	Excellent	Good	Excellent	Excellent
Customer Support	Fair	Good	Poor	Good	Good
Customization	-	-	-	-	Excellent
Virtual Environment	-	-	-	-	Good
Planning Features	Good	Excellent	Good	Fair	Good
Backup Safety	Excellent	Fair	Poor	Good	Good
Base Price	Good	Fair	Good	Good	Fair
Subscription Price	Good	-	Poor	Fair	Excellent

After evaluation of every program regarding the chosen criteria decisions can be made. The results in the comparison table only represents expectations of the software. The most user-friendly programs are MRPeasy and Custom Program, while Microsoft Project have average difficulty level. Asprova and NetSuite software are hard to master and hard to start with. They need a lot of specialized training and is not intuitive. All the programs have similar quality interface, except for Asprova. The worst features of Asprova are interface and ease of using, it feels like it has been created 15 years ago and no improvements regarding these criteria have been made. Features are one of the most important criteria, however too many features can make a program too complex and too expensive. It is important to have specific features that is needed to complete processes and tasks. All the programs provide good functionality, however Asprova, NetSuite Software and Custom Program provides excellent quantity and quality of features.

As it can be seen in the table there is a correlation between ease of use and features. There easier the program is, the less features it provides. Custom program is exception, because it could provide only features that company needs and no extra characteristics are needed. Customization and virtual environment for the program are one of the most important features. However, none of the programs can provide these properties. It is a rare case, that a program can be adjusted regarding the needs of the client, so custom program is ahead of the competition. The best planning modules are provided by company Asprova, however since it is difficult to use, it is hardly usable. Custom Program, MRPeasy and Microsoft Project are also good tools for planning of production and can be functionally used. The worst program for planning is NetSuite Software.

Microsoft is one of the biggest companies in the world, so there is no surprise it provides excellent backup safety of the company files. It also provides great protection of internal information. NetSuite and Custom Program are based on cloud storage, so backup can be restored regarding the given date and time. Asprova have individual servers to store information, while MRPeasy does not provide any safety for the information and no safety is assured. The last two criteria are base and monthly prices of the programs. Most of the programs except Asprova provides monthly subscriptions price per users. Since Kagneta is planning to add around 50 people to the program, it is important to choose price quality option regarding subscription price. The best option for monthly price is Asprova, however after other negative criteria it was not considered as a reliable option for order management and other processes in the company.

Custom Program have high base price, however subscription price is not based on the monthly user quantity, there is just a need to maintain servers. MRPeasy offers low base price of the program, however every operator that has to be added to the program comes with an addition to the total price. Microsoft projects do not charge for number of users, so any number of users can be evaluated. Lastly, NetSuite Software is a good price-quality option, however it does not provide ease of use. After all the programs were evaluated in the company, decision was made to create and develop custom program with an IT team. Customization of the program opens opportunities and possibilities to create a specific and concrete software that could be used purposefully and correctly. Also, none of the programs provides virtual environment which is one of the most important modules that must be implemented in the culture of the company. To have successful implementation of the program, consideration of involving as many people as possible is important and crucial. In the next chapter formulation of tasks and required modules for the order management program will analysed, needs for each specific module will be presented and examined. Experience with old MS Excel method was a good practice to understand what exactly is needed to implement in the new program, analyses of four different programs also gave knowledge and understanding of what modules, features and functions are the most useful and the most necessary for the custom software.

3. Formulation of Tasks and Required Modules for The Order Management Program

Planning and tracking of production processes was done using MS Excel tool. Changes to order and process statuses in production were performed manually. The task of the new program is to create an ability of using planning information system conveniently for managers and employees of the plant. It is also important to have an ability to have centralized management of production processes and to track their status on computer, mobile and tablet. Architecture and technology of the planned system is based on:

- PHP (Laravel >=5.8)
- MySql >=5.6
- Nginx
- Vue.js
- Material Design

The practice with old system that was based on MS Excel shown the key points of imperfections in the program that can improved. After an analysis of current data and a discussion with the company officials, solutions and results were made. The planned modules and work are presented below.

3.1. Users and Roles

The main idea of the program should be an ability to have different availabilities for different users. Two main type of users must be administrators and operators. Administrators will be able to control everything – adding new users, adding orders and managing them, adding new processes, adding and managing new clients and suppliers, etc. Operators will be able to see a simplistic window with orders that has to be done specifically for the machines they operate. A different number of machines for an individual employee should have an availability to be adjusted. The information that has to be filled for the new and existing users are name, surname, e-mail address, living address, phone number, role and machining processes that has to be completed (for operators). Users should have an ability to be added, deleted, or suspended.

Table 5. Requirements for the users and roles module

No	Name of the Column	Type	Outcomes/Options
1	Name	Informative Text	-
2	Surname	Informative Text	-
3	Phone Number	Informative Text	-
4	E-Mail	Informative Text	-
5	Address	Informative Text	-
6	Role	Informative Text	Operator, Administrator
7	Status	Informative Text	Active, Suspended
8	Edit	Button (Pop-up)	New Window to Edit Data
9	More Actions	Button (List)	Activate, Impersonate, Restore Password

3.2. Clients and Suppliers

The old version of the client list that JSC “Kagneta” used was filled in MS Excel. Based on the lean principle the optimal and least resource demanding option of the program is when all the different

aspects are in one place, a program. The list must show all the needed information, but it should not be overloaded, only what is useful should be present, too much information can make the program not convenient to use.

The requirements for the companies and suppliers should have only the company name and address. Every company should have an ability to add different number of people with additional information: name, surname, responsibility, e-mail, phone number and comment. Another important addition to the client module is the logos of the companies.

Table 6. Requirements for clients and suppliers modules

No	Name of the Column	Type	Outcomes/Options
1	Name	Informative Text	-
2	Logo	Informative Text	-
3	Address	Informative Text	-
4	Website	Informative Text	-
5	Client	Tick-box	Yes, No
6	Supplier	Tick-box	Yes, No
7	Edit	Button (Pop-up)	New Window to Edit Data
8	Delete	Button (Pop-up)	Delete Client or Supplier

Based on effects of rejuvenation of the brand logos, it is proven that visual information can help to identify and find information person is looking for in the list. Visual literacy is a component of picture reading, in this context – logos. Getting all the needed information from the working environment can be done in many different ways, one of the best one is visual literacy. [14]

3.3. Orders

Order module is the most important module in the program. It must show all the main information that consists of order number, client name, product, product name, administrator of the order, status, tick-boxes for order transportation and invoice sent and comments. In Table 7 all the necessary columns, rows and buttons are added.

Table 7. Requirements for the orders module

No	Name of the Column	Type	Outcomes/Options
1	Order No	Button (Drop-down)	-
2	Client	Button (Pop-up)	Provides Client Information
3	Product name	Informative Text	-
4	Material	Order Icons	Grey - Not Ordered, Blue - Ordered, Green - Arrived
5	Created by	Informative Text	-
6	Order Shipped	Tick-box	Yes, No
7	Invoice Sent	Tick-box	Yes, No
8	Comment	Informative Text	-
9	Create a Part of The Order	Button (Pop-up)	New Window to Add Part of The Order
10	More Actions	Button (List)	New Scrap, Create Copy, Edit, Delete

The representation of the order module in the program after completion presented below in Figure 11 (appendix 2).

Užsakymo nr.	Užsakovas	Gaminys	Medžiagos	Sukūrė	Būsena	Užsakymas išvežtas	Sąskaita išrašyta	Komentaras
KAG.20.14.19		Detalė 1684405		2020-04-03	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	
KAG.20.14.16		Detalė 0654680		2020-04-03	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	
KAG.20.14.17		Detalė 0654580		2020-04-03	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	
KAG.20.14.11		LK-80GE30-30(45+45)		2020-04-01	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	
KAG.20.14.12		LK-95GE40-30		2020-04-01	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	

Fig. 11. Representation of the order window (in Lithuanian)

The first four columns must be extremely informative and clear. They are needed for understanding and knowing what orders can be found in the specific lines. The fifth column is for an administrator of the order. Since there will be two or three employees managing the order system every order must have a person that administrates and checks the situation with an order. The sixth column is the status of an order. There are three possible statuses: not started, in progress and completed. There are also two tick-boxes, one of them can ticked when shipment is sent, other can ticked when invoice is written. Company had occurrences where writing of an invoice was forgotten, it might be hard to believe that when most of the companies are advanced and tries to achieve industry 4.0 and achieve best lean results, there are companies that does not have any systematic order management software and once in a while these situations occur. Tick-box is an option to solve this problem. Finally, column for the comments is presented. In this box all the extra or the most important information can be presented. Another tick-box for transportation is also extremely important because some of the late purchase orders happened just because production was finished on time, but transportation was not planned on time.

After the order is created all the necessary parts of the order should be added. It should be possible to choose all the processes that must be performed, quantity of the part that needs to be produced, due date and deadline of the order, material, quantity of the material. Since company is trying to implement JIT production, usually material is not stored. There should be a material window when creating every order. The administrator of the order must fill in the blanks: material, quantity of the material, supplier, price of the material, availability of the material, lead time of the material and after the material is received there is a blank where it can be chosen, where the material will be stored. There should also be an option to choose who is responsible for the transportation of the material: the company itself, supplier, client, or other option. Status of the material required for the program: ordered, not ordered, completed. After the order is created the program should have an ability to upload technical drawing or drawings that will be available for the employees to check and analyse before producing the product. The finished window of the part of the order is presented below in Figure 12 (appendix 3).

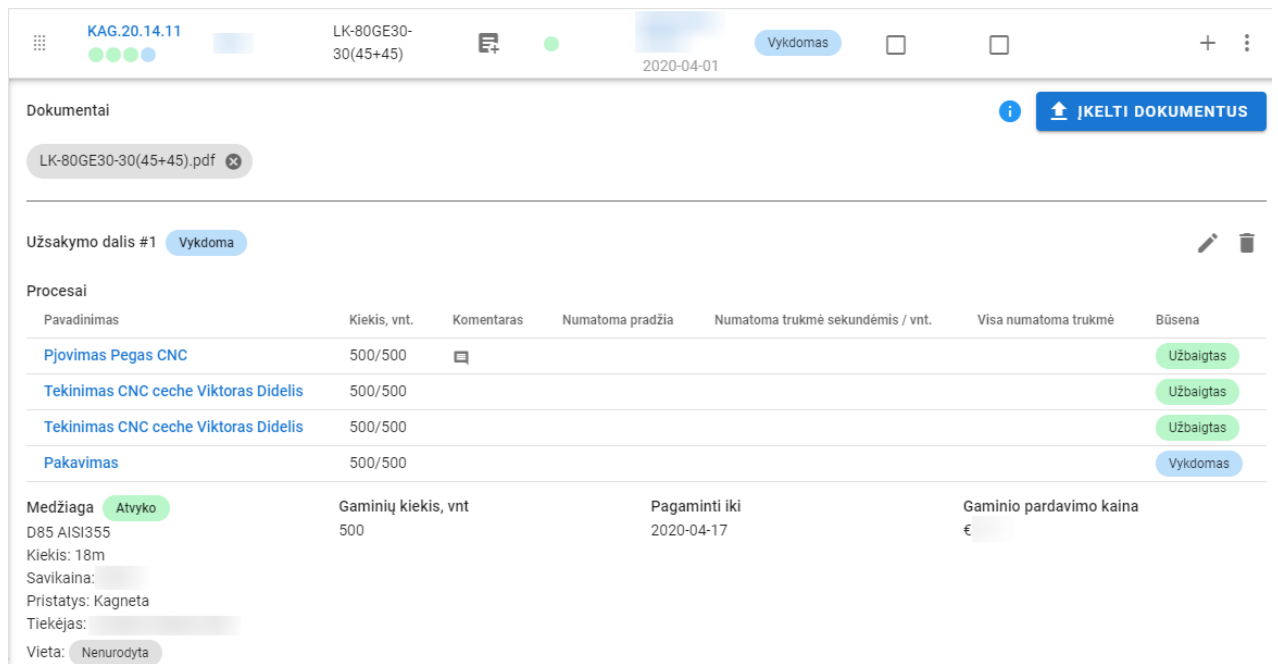


Fig. 12. Created window of the part of the order (in Lithuanian)

3.4. Processes

Processes is another important module in the program. Every person is responsible for specific actions, processes or machines. Every process has its own tools, machines and people who are responsible for these processes are assigned to these tools and machines. Process window should be designed with a simplistic approach. All the possible processes must be presented in the process module and administrator should have an ability to create a new one without extra permissions.

Table 8. Requirements for processes module

No	Name of the Column	Type	Outcomes/Options
1	Name	Informative Text	-
2	Group	Informative Text	-
3	Status	Informative Text	Active, Not Active
4	Edit	Button (Pop-up)	Change of Name and Group

Current processes that are being used in the company JSC “Kagneta” are divided into different groups: coating, cutting, milling, stamping, turning, tool working, welding and management. Dividing processes into different groups lets the production planners see availability of different machines or operations when preparing the workflow for a new order. The idea of having sections is to have an easier option to apply processes for employees from groups instead of choosing operations from the list.

Cutting Processes

Cutting processes in the company can be performed by eleven different options. All the options that must be added to the program are presented in the Table 11. When the processes are added to the software of the company the operators of the machines should have visibility of specific tasks designed for their workplace. Some of the processes can be performed by the workshop operators, other tasks have an ability to be done by third-party companies since JSC “Kagneta” does not have

abilities to perform specific tasks due to available machinery. Subcontracting on cutting operations can be used for gas cutting, laser cutting, plasma cutting and water jet cutting. Subcontracting operations should have additional price window with proposed price from the subcontractor that added to the final prime cost of the product. The subcontractor operations should be completed by an engineer or a manager responsible for a specific order. The subcontractor in the process must have an ability to choose the supplier from the list in client/supplier module.

Table 9. Processes of cutting

Process Name	Code of Process	Location	Group	Status
Production Guillotine	KAG-P.01.01	Loc 1	Cutting	Active
Production Guillotine "Manual"	KAG-P.01.02	Loc 1	Cutting	Active
Production Guillotine "2mm"	KAG-P.01.03	Loc 1	Cutting	Active
Production Guillotine "3mm"	KAG-P.01.04	Loc 1	Cutting	Active
Disc Cutting	KAG-P.01.05	Loc 4	Cutting	Active
Gas Cutting	KAG-P.01.06	Subcontractors	Cutting	Active
Laser Cutting	KAG-P.01.07	Subcontractors	Cutting	Active
Bandsaw Cutting "Pegas"	KAG-P.01.08	Loc 1	Cutting	Active
Bandsaw Cutting "Pegas CNC"	KAG-P.01.09	Loc 1	Cutting	Active
Plasma Cutting	KAG-P.01.10	Subcontractors	Cutting	Active
Water Jet Cutting	KAG-P.01.11	Subcontractors	Cutting	Active

Coating Processes

Coating is another group of processes that company uses internally and externally – buying service from the subcontractors. JSC “Kagneta” is capable of performing conservative spraying that is usually used for spraying black steel parts that must be warehoused and kept for longer than 7 days. Sand blasting is another procedure that company is performing, however due to possible corrosion, company only applies this process for aluminium and stainless steel. If any dust of black metal enters the chamfer area, other stainless metals might corrode. Hot and cold galvanizing, chemical blackening, hardening, dyeing, and vibro-polishing are performed by external companies. Coating is one of the finishing procedures, before cleaning and packing processes. The list of the procedures that should be added to the program in the coating group are presented in the Table 10 below.

Table 10. Processes of coating

Process Name	Code of Process	Location	Group	Status
Chemical Blackening	KAG-P.02.01	Subcontractors	Coating	Active
Cold Galvanizing	KAG-P.02.02	Subcontractors	Coating	Active
Hot Galvanizing	KAG-P.02.03	Subcontractors	Coating	Active
Dyeing	KAG-P.02.04	Subcontractors	Coating	Active
Conservative Spraying	KAG-P.02.05	Loc 4	Coating	Active
Sand Blasting	KAG-P.02.06	Loc 5	Coating	Active
Vibro-Polishing	KAG-P.02.07	Loc 5	Coating	Active
Hardening	KAG-P.02.08	Subcontractors	Coating	Active

Milling Processes

Milling is the procedure that company performs without using any subcontractors. JSC “Kagneta” has three CNC milling machines for batch and mass production and one universal milling machine for the single piece production, prototyping and spare parts for the maintenance. Different classes of stainless and black steel, aluminium, brass, copper and plastic are the mostly machined materials. All the operations presented in Table 11 must be added to the milling group of the program.

Table 11. Processes of milling

Process Name	Code of Process	Location	Group	Status
CNC Milling Cinninnati M	KAG-P.03.01	Loc 2	Milling	Active
CNC Milling HAAS_1	KAG-P.03.02	Loc 2	Milling	Active
CNC Milling HAAS_2	KAG-P.03.03	Loc 2	Milling	Active
Universal Milling Machine	KAG-P.03.04	Loc 1	Milling	Active

Turning Processes

Turning is another process that the company performs without using any subcontractors. With variety of turning machines company mainly specializes in turning operations. For single piece production, prototyping and spare parts for maintenance company uses two universal turning machines K16 with two operators. Automatic lathes are used for mass production, starting from 10000 pcs. for small, up to 25 millimeters diameter parts, since it is CAM based automatic turning machines, only one operator is needed for 6 machines. Emco, Victor “S” and Victor “B” are CNC turning machines for different size of the parts. Operations presented below in Table 12 must be added to the program and assigned to the turning processes group.

Table 12. Processes of turning

Process Name	Code of Process	Location	Group	Status
EMCO	KAG-P.04.01	Loc 2	Turning	Active
Automatic Lathe "1"	KAG-P.04.02	Loc 1	Turning	Active
Automatic Lathe "2"	KAG-P.04.03	Loc 1	Turning	Active
Automatic Lathe "3"	KAG-P.04.04	Loc 1	Turning	Active
Automatic Lathe "4"	KAG-P.04.05	Loc 1	Turning	Active
Automatic Lathe "5"	KAG-P.04.06	Loc 1	Turning	Active
Automatic Lathe "6"	KAG-P.04.07	Loc 1	Turning	Active
Automatic Cutting Lathe "D16"	KAG-P.04.08	Loc 1	Turning	Active
Victor "S"	KAG-P.04.09	Loc 2	Turning	Active
Victor "B"	KAG-P.04.10	Loc 2	Turning	Active
Universal Turning K16_1	KAG-P.04.11	Loc 1	Turning	Active
Universal Turning K16_2	KAG-P.04.12	Loc 1	Turning	Active

Welding Processes

Welding is another process JSC “Kagneta” can perform. There are three possible options of welding. TIG (Tungsten Inert Gas) and MIG (Metal Inert Gas) in welding stations 1-3 and spot welding. Most of the welding orders and operations contains black steel, but there is an ability to weld aluminium and stainless steel as well. All the operations presented below in Table 13 must be attached to the program – welding process group.

Table 13. Processes of welding

Process Name	Code of Process	Location	Group	Status
Welding Station 1	KAG-P.05.01	Loc 1	Welding	Active
Welding Station 2	KAG-P.05.02	Loc 1	Welding	Active
Welding Station 3	KAG-P.05.03	Loc 1	Welding	Active
Spot Welding	KAG-P.05.04	Loc 3	Welding	Active

Tool Working Processes

Tool working processes are the processes that are performed by metal-workers with hand tools or small machines. Even though the lean methodology requires to eliminate all the excessive work, sometimes is not possible to eliminate everything. Edge cleaning is usually required after rough milling or turning operations, it is usually cleaned with specific hand-tool. Drilling, threading, and hole chamfering is performed on the electrical drilling machine with a handle. All these and other operations are presented in Table 14 below, the list from the table must be added to the program.

Table 14. Processes of tool working

Process Name	Code of Process	Location	Group	Status
Edge Cleaning	KAG-P.06.01	Loc 1	Tool Working	Active
Drilling	KAG-P.06.02	Loc 1	Tool Working	Active
Riveting	KAG-P.06.03	Loc 3	Tool Working	Active
Hexagonal Forming	KAG-P.06.04	Loc 1	Tool Working	Active
Threading	KAG-P.06.05	Loc 1	Tool Working	Active
Thread Rolling	KAG-P.06.06	Loc 1	Tool Working	Active
Assembling	KAG-P.06.07	Loc 3	Tool Working	Active
Rolling	KAG-P.06.08	Loc 1	Tool Working	Active
Hole Chamfering	KAG-P.06.09	Loc 1	Tool Working	Active

Stamping Processes

Stamping is another process company specializes in besides turning. Stamping is mainly used for mass production for the products in the construction field. Company mainly performs stamping operations on stainless steel and aluminium. With great experience in this process, company can also design, provide engineering solutions and machine dies for the stamps. The table of required processes for the program are presented below in the Table 15.

Table 15. Processes of stamping

Process Name	Code of Process	Location	Group	Status
Punch Press	KAG-P.07.01	Loc 1	Stamping	Active
Hydraulic Press	KAG-P.07.02	Loc 1	Stamping	Active
Bending Machine	KAG-P.07.03	Loc 1	Stamping	Active
Press "KAG_P_1"	KAG-P.07.04	Loc 1	Stamping	Active
Press "KAG_P_2"	KAG-P.07.05	Loc 1	Stamping	Active
Stamping Press "1" 125T	KAG-P.07.06	Loc 1	Stamping	Active
Stamping Press "10" 16T	KAG-P.07.07	Loc 1	Stamping	Active
Stamping Press "11" 16T	KAG-P.07.08	Loc 1	Stamping	Active
Stamping Press "12" 40T	KAG-P.07.09	Loc 1	Stamping	Active
Stamping Press "1" 125T	KAG-P.07.10	Loc 1	Stamping	Active
Stamping Press "2" 16T	KAG-P.07.11	Loc 1	Stamping	Active
Stamping Press "3" 25T	KAG-P.07.12	Loc 1	Stamping	Active
Stamping Press "4" 16T	KAG-P.07.13	Loc 1	Stamping	Active
Stamping Press "5" 50T	KAG-P.07.14	Loc 1	Stamping	Active
Stamping Press "6" 25T	KAG-P.07.15	Loc 1	Stamping	Active
Stamping Press "7" 40T	KAG-P.07.16	Loc 1	Stamping	Active
Stamping Press "8" 40T	KAG-P.07.17	Loc 1	Stamping	Active
Stamping Press "9" 16T	KAG-P.07.18	Loc 1	Stamping	Active
Setting Up of The Stamp	KAG-P.07.19	Loc 1	Stamping	Active
"TVC" + Hydraulic Press	KAG-P.07.20	Loc 1	Stamping	Active

Final Procedures

The last group of processes in the company is final procedure group. As it can be seen in the table there are three final procedures: cleaning, packing and rotational washing machine. Cleaning is usually used for the stamped parts, to clean the oil after stamping operations, packing is used for all the finished goods as the last operation, rotational washing machine is used for small parts that needs cleaning, but is not big enough to be efficiently cleaned be hands. All these procedures must be added to the final program.

Table 16. Processes of final procedures

Process Name	Code of Process	Location	Group	Status
Cleaning	KAG-P.07.01	Loc 1	Final Procedure	Active
Packing	KAG-P.07.02	Loc 4	Final Procedure	Active
Rotational Washing Machine	KAG-P.07.03	Loc 4	Final Procedure	Active

3.5. Virtual Environment for the Operators of the Plant

Virtual environment for operators is one of the most important modules of the program. It must help in optimizing resources and solve communication problems of unclear tasks for the employees. The main idea of the virtual environment is keeping it as simple as possible. Every employee should be

assigned processes that he can perform from the process groups. After operator joins the program, unique PIN code should be provided which enables the visibility of the processes he is responsible for and gives accessibility to join the program. All the orders that can be performed and the priority of said orders should be visible on the main screen. Additionally, visibility of processes that must be completed before current process must be presented. In Figure 13 we can see the finished main screen of the virtual environment.

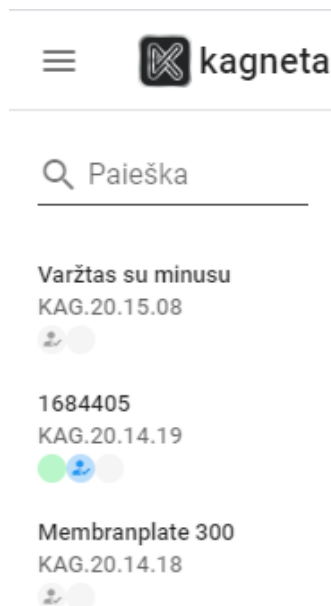


Fig. 13. Main screen of the virtual environment (in Lithuanian)

After the operator opens the main window of the program, main information required for him to complete the task should be visible. The required information is the material availability, class, quantity, status, and place, required quantity of production, due production date. All the other processes that was completed before or must be completed after should also be visible to have better material and blank flow of the finished good. In the Figure 14 (appendix 4) we can see that the material of blanks cutting operation is completed and next operation after turning is CNC milling.

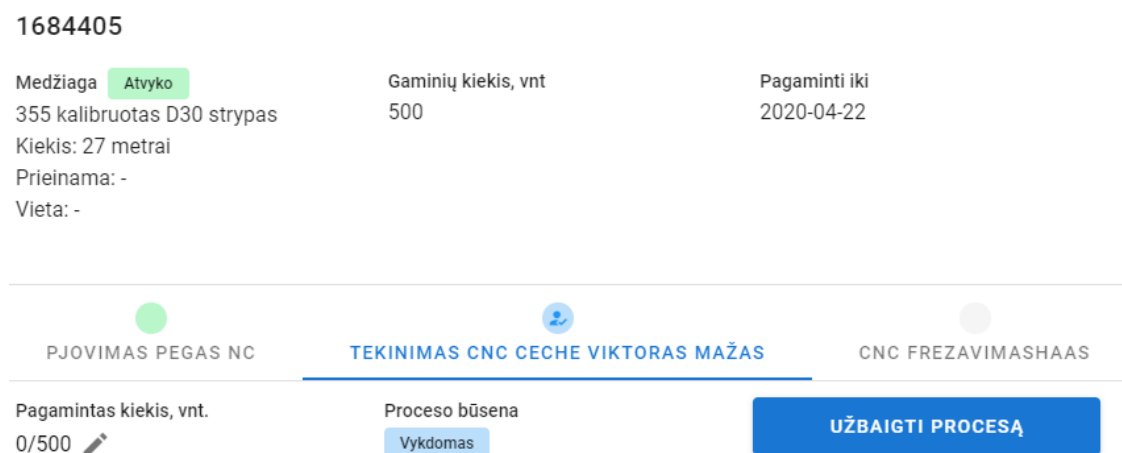


Fig. 14. Main information required for order KAG.20.14.19 in virtual environment (in Lithuanian)

Lastly, in the virtual environment of the operators there should be an ability to update the status of the machine. After the manager creates the order and adds the machines to a specific order, operator should have an ability to change the condition of the machine and after it is updated, maintenance team must get the notification about the status of the machine and comments what is wrong with the machine. Additionally, to avoid a lot of scraps and blocked production, measuring protocol should be added to the orders, where additional measuring is needed. A quality engineer must add the dimension that has to be checked, frequency of measurements and results windows are filled by the operators. Figure of the bottom of the finished virtual environment window is presented below in Figure 15.

The screenshot displays a virtual environment order window with the following elements:

- Machine Information:**
 - Irengimas:** CNC tekinimas
 - Irengimo būseną:** Veikiantis (Working)
 - Buttons:** KEISTI IRENGIMO BŪSENĄ (Change Machine Status), IRENGIMO KOMENTARAI (Machine Comments)
- Cost Information:**
 - Minutės kaina darbuotojui:** € [input field]
- Measurements Table (Matavimai):**

Pavadinimas	Kiek kartų matuoti	Rezultatai
Nėra duomenų		
- Document Link:** [MEMBRANPLATTA 1200.PDF](#)

Fig. 15. Additional information in virtual Environment order window (in Lithuanian)

3.6. List and Module of Material Flow

After the order is created, in a different module “Material Flow” the material needed for the specific order should appear. After this action occurs, material-planner and buyer can decide when order of material is needed and check the availability of materials that is needed according to the given circumstances. Usually, the best option and time to order material is just before it is needed for production, however in practice it is usually a hard task to do. To achieve maximum results, JSC “Kagneta” tried to use and implement Just in Time production before implementation of the new program and plans to use it after the program is launched. In Just in Time production it is important to know that all the flow of materials should be visible and traceable. It has been implemented in Japan for the last 20 years and it can be applied for variety of different strategic businesses. It is a philosophy and technique that guides a manufacturing plant to organize workflow more efficiently. It is a tool to improve and optimize flow of the material and supply chain. The objectives of the JIT:

- to have more responsiveness;
- to have more flexibility;
- to decrease cost of production;
- to improve communication between departments of the company and suppliers.

Just in Time production can be implemented in the Material Resource Planning activities of the company and take a part of controlling environment of MRP. Different companies can apply this

methodology according to their standards and environments. Manufacturing environment can be adjusted according to the control system in order to reach higher efficiency. [15]

In the environment of JSC “Kagneta”, the supplier can be changed based on availability since the products are usually simple class steels and not components that require a lot of negotiations and special agreements. The material module should follow main guidelines of the program and be made with a simplistic approach, in which case it is user-friendly. With a simplistic design and an idea of the program it should not require a lot of skill or knowledge of the program to use, it should be intuitive and should not be complex like other order management software, so it is easier to access editing and ordering of new materials. In the material window needed columns are order NO, status of the material with options: (Ordered, Not Ordered, Completed) arrival or availability date, material class, material quantity, incoterms, warehouse location, supplier and price of the material.

Table 17. Requirements for list and module of the material flow module

No	Name of the Column	Type	Outcomes/Options
1	Order No	Button (Pop-up)	Shows Order Information
2	Status	Button (Pop-up)	Provides Client Information
3	Stated Delivery Date	Informative Text	-
4	Material	Informative Text	-
5	Quantity	Informative Text	-
6	Incoterms	Informative Text	-
7	Storing Place	Button (Drop-down)	Possibility to Choose from Drop-down List
8	Supplier Name	Button (Pop-up)	Provides Supplier Information
9	Supplier Code	Informative Text	-
10	Material Price	Informative Text	-

The last column should have an ability to be changed after the arrival of a material and receipt of the invoice. The figure of the finished material module is presented below in the Figure 16.

Medžiagos ☰ SLĖPTI FILTR

Užsakymas	Būsena	Medžiaga atvyksta	Medžiaga	Medžiagos kiekis	Medžiagą pristatys	Vieta sandėlyje
KAG.20.15.09	Užsakyta	2020-04-10 !	AlSi304 D6	90 metrų	Kagneta	Nenurodyta
KAG.20.15.08	Užsakyta	2020-04-14	Žalvaris D16	6 metrai	Kagneta	Nenurodyta
KAG.20.15.02	Užsakyta	2020-04-15	Žalvaris D5	90m	Kagneta	Nenurodyta
KAG.20.14.18	Neužsakyta		3mm D72 apskritimas	1000 vnt.	Kagneta	Nenurodyta

Fig. 16. Material flow module of the program (in Lithuanian)

3.7. Production Defect or Scrap Module

Defects can appear during the processing, transportation or even packing of materials or finished goods. A defect in the early stage may transit to other stages and cause a lot of harm and damage to the final product, it is important to identify defects as soon as possible. Quality should be number one priority for every company, but no company is safe from defects. It is important that program could react to the orders that are defected so the defect module must be created. Below every order or part of the order there should be a button “create defect”. The window of the defects is simple, since the company does not have its own quality department, all the decisions on solving the defects and improvement the quality is made by the engineering and managers. In the window there should be a few options for selection, an ability to identify and comment whether the defect fixable must be present.

Table 18. Requirements for production defect or scrap module

No	Name of the Column	Type	Outcomes/Options
1	Order No	Button (Pop-up)	Shows Order Information
2	Comment	Informative Text	-
3	Edit	Button (Pop-up)	Change of Comment
4	Delete	Button (Pop-up)	Delete Scrap

If a defect is fixable it is created as a new partial order in the order system and must be fixed, if it is not fixed, investigation must be performed, and an order must be recreated. Additionally, to improve quality and have more traceability of the quality management it is important to have more tools and more possibilities of reducing scrap in the production of the orders and partial orders.

Quality management functionality should be able to complete these tasks:

- external and internal defect, its management and classification;
- defect fixation according to defined criteria;
- possibility of analysing causes of defects, accumulate the history of defects;
- possible claims management;
- management of employees, suppliers, information related to defects;
- review of defects by raw materials and printing of the blank document for claim.

3.8. List of Material Locations

The company does not have warehouse management software solutions so the program should perform the basic functions and provide needed information. One of the problems company had was not knowing where are the materials that were received.

If the order is rescheduled and material stays in the warehouse for a longer amount of time, it is being moved from one place to another, because of lack of space in the warehouse. The requirements for the module are presented below in Table 19.

Table 19. Requirements for the material location module

No	Name of the Column	Type	Outcomes/Options
1	Name	Informative Text	-
2	Edit	Button (Pop-up)	Change of Name
3	Delete	Button (Pop-up)	Delete Location

The new program must solve this issue and provide solutions to the existing problem. The warehouse must be divided to the different sections and zones with special abbreviations. These abbreviations must be visible in the physical warehouse and after stock-keeper receives the material he must attach sticker formed by the program and add the location for the material in the software. [16]

According to the authors of the article by Erhan Musaoglu “Warehouse Locations: 2019 Guide (Code Generator)”, the method presented in the Figure 15, is good for small-medium businesses to generate codes for the warehouse management. The code consists of four main elements:

- sector;
- rack;
- bay;
- level.

Sector, racks, bays, and levels can come from letter, numbers and signs. If there are more than one warehouse, one more variable can be added to the code.

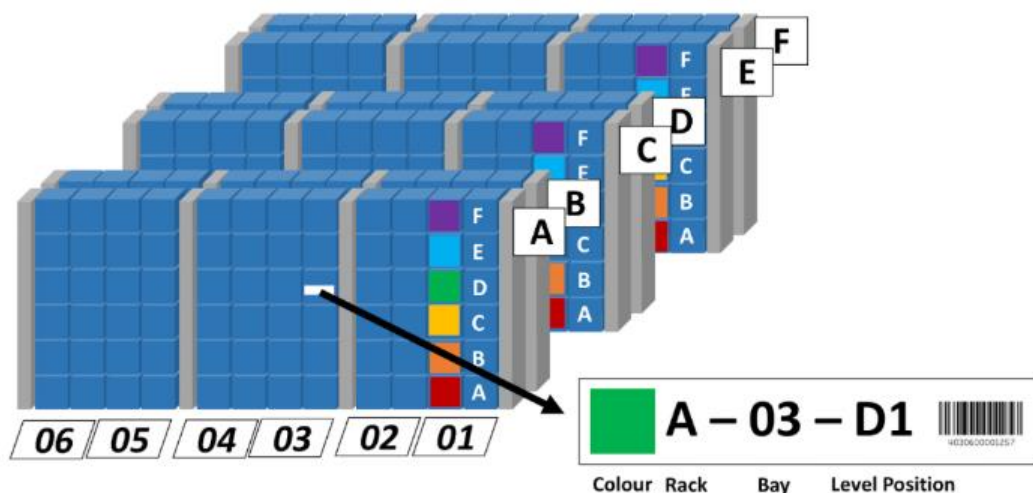


Fig. 17. Example of the code generation [17]

Firstly, the company must define how many sections they have. In JSC “Kagneta” we can find 4 different sections where the material can be stored. The biggest warehousing section have 8 racks, it means it can vary from A to H if it is translated to the letters. The biggest possible number of bays in the rack in Kagneta is five. Lastly the level position can be translated into two rows and four columns.

Warehouse Section	Rack	Bay	Level Position
1-4	A - H	1-5	A-B / 1-4

Fig. 18. Possible variations of the code generation for JSC Kagneta

During the implementation process employees must be taught that if there is a need to change location of the material it is needed to change the location in the program as well. Every machine has its own place where material can be placed, so all the machines must have warehouse location in the system as well. Employees who are given the material to perform processes must change the existing location of the material.

3.9. Working Schedule of the Employees Module

Another module that can be added to the program is working schedule of the employees. Currently, company uses excel tables to fill in the schedule, however, to achieve more efficiency everything can be translated into the new software. This window should have a list of all the employees, it should be adjustable manually, possibility of adding or removing employees should be available. The module should also have a filter to have possibility of filtering employees by current position, time worked in a certain period of time and other parameters. The list of all the requirements are presented below in the Table 20:

Table 20. Requirements for the working schedule of the employees module

No	Name of the Column	Type	Outcomes/Options
1	Name	Informative Text	-
2	Started Shift	Informative Text	-
3	Ended Shift	Informative Text	-
4	Total hours worked	Informative Text	-
5	Status	Informative Text	Working, Sick Leave, Paid Time Off, Not Paid Time Off

For the future improvement, employee cards can be used, to avoid manual filling of the working schedule, however this practice has its own positive and negatives affects. Advantages of such a method can be saved employee working time, by monitoring arrival and leaving times, thus employees tend to avoid cutting working time, and prevention of unauthorized access of an outsider.

The disadvantage of such a method can be loss of trust of the employees. Monitoring of workers of the company will likely be welcomed with negative reactions, depending on the culture of organization it can have negative affects with communication with employees. Additionally, monitoring can reduce motivation of the workers. Lastly, NFC card reader and the system can be expensive and difficult to implement.

3.10. Machines Module

Another module that is mainly focused on the activities of maintenance personal is a machines module. In order to see availability and status of the machines in the same program machines module is needed. Required data in the window: name of the machine, processes performed by the machine,

status of the machine (working, failure), price of the minute for client (can be used when calculating prices of the new orders), price of the minute paid for employee (can be used when calculating salaries of the employees), date of the failure, running time and employment of the machine. All the requirements are presented below in Table 21:

Table 21. Requirements for the machine module

No	Name of the Column	Type	Outcomes/Options
1	Name	Informative Text	-
2	Processes	Informative Text	-
3	Status	Informative Text	Working, Not Working
4	Price per Minute	Informative Text	-
5	Salary per Minute	Informative Text	-
6	Date and Time of Failure	Informative Text	-
7	Operating Time per Week	Button (Drop-down)	Operating Time per Day List
8	Busy Until	Informative Text	-
9	Edit	Button (Pop-up)	Change Data
10	Delete	Button (Pop-up)	Delete Machine

After the machine breaks-down maintenance, material resource planning and buying and production planning teams must get the notification with the comments from the operators. The maintenance team should be able to check is it possible to fix it as soon as possible and is there a need of spare parts, material resource planning team must check for the spare parts availability and order spare parts if it is needed, production team can adjust their production and change workplaces of the employees regarding to the broken machine. Additionally, there should be a graph and statistics that can show what is the real running time of the machine daily, weekly, and monthly. At the end of the of the month a report of machine statuses should be prepared by the program. It should present the active time percentage. The finished machine module is presented below in the Figure 19.

Pavadinimas	Procesas	Būsena	Minutės kaina klientui	Minutės kaina darbuotojui	Gedimo data	Veikimo laikas	Užimtas iki
CNC tekimas	Tekinimas CNC ceche Viktoras Didelis	Veikiantis	€	€		40 h / sav.	2027-04-14
Pjovimas Pegas CNC	Pjovimas Pegas CNC	Veikiantis	€	€		40 h / sav.	2020-04-13
Tekinimo automatas Nr 2	Tekinimas Automatas "2"	Veikiantis	€	€		120 h / sav.	2020-04-30

Fig. 19. Machine status and information module (in Lithuanian)

3.11. New Process Flowchart of Order Management

To check new process order management processes and compare it with the old software (Fig. 9) flowchart is needed. The flowchart of the new process is presented below in Figure 20.



Fig. 20. Flowchart of order management using new method

In the Table 22 of new order management process flowchart only four processes need action and time. Adding order to the system takes more time, due to a more complex interface of the program, while other processes having shorter durations compared to the older method.

Another upgrade that can be added after implementation of the program is working remotely. With no distances needed to be travelled, and no physical drawings needed it is possible to perform administration duties online. This can be applied when hiring new employees, that prefer possibility of working remotely. Covid-19 virus has shown importance for a workplace to have an ability of working from home. Businesses without option of working remotely had to be closed or worked with risks and restrictions, while organizations with ability to work remotely had an ability to perform main tasks online.

Table 22. Table of new order management process flowchart

Location: JSC Kagneta		Summary							
Activity: Order Management		Event		Present					
Purpose: Time calculation for project		Preparation		▼	0				
Date: 2020.04.19		Operation		●	6				
Name:	Lukas Kandrotas	Transportation		→	0				
Remarks:		Delay		⬮	1				
Analysis of current order management process. Evaluation of time needed to add it to the system.		Inspection		■	0				
		Storage		▲	0				
		Time (s)		450					
		Distance (m)		0					
Event Description	Symbol					Time (s)	Distance (m)	Comments	
New purchase order	▼	●	→	⬮	■	▲	-	-	
Add the order to the order module	▼	●	→	⬮	■	▲	150	-	
Calculate the need of a material	▼	●	→	⬮	■	▲	180	-	
Add material need for the order	▼	●	→	⬮	■	▲	60	-	
Prioritize order processes in a planning module	▼	●	→	⬮	■	▲	60	-	Drag the processes according to the demand
Wait for completion of the order	▼	●	→	⬮	■	▲	-	-	Time calculations not needed
Order completion	▼	●	→	⬮	■	▲	-	-	

As it can be seen only five processes are needed to complete order management process compared to ten that are needed in the old method. Manual planning, printing of drawings, bringing drawings and adding data from leadpaper are all eliminated and automated. According to the table, it should save approximately nine minutes and fifteen seconds for each order. With current 7.8 orders per day on average, 72 minutes can be saved every day. Comparison of both processes are presented below in the Table 23.

Table 23. Comparison between the order management methods

	Old Method	New Method
Operations	9	6
Transportations	1	0
Delays	1	1
Time, s	1005	450
Distance, m	75	0

4. Implementation of the Order Management Software to the Company

After the creation of the software is finished, it should be implemented into the culture of the company. Software implementation is not an easy task to complete, however it can help company to achieve its results in long-term. Correct and detailed implementation plan can help and benefit for the most efficient results possible. It is important to provide all the necessary information for all employees. The implementation process should be easier compared to the other production planning programs, because during the creation process it was designed to be as user friendly as possible. There are variety of different factors when implementing the new system to be analysed. There are five stages of project management:

- characteristics of a project;
- project planning and organizing;
- project execution;
- project monitoring, reporting and controlling;
- project closeout. [18]

The first stage - characteristics of a project is presented in the chapter four, so it will not be presented in this chapter. Four phases of project implementation to an organization will be analysed in the further sections.

4.1. The Project Planning Phase

Project planning phase is the first phase in the implementation of a new software. To have fluent implementation of a system, assembling of a team is needed. In team building process it is important to take four different stages into account:

- determine what skills are needed;
- invest time in building team;
- assign people to the listed tasks and get confirmations;
- organize team meetings. [19]

When assembling a team for a project, there are six positive specifications, that can increase effectiveness of a team:

- Professional interest and willingness to participate in the activities;
- Recognition of achieved results;
- Good relationship between team members and respect for each other;
- Necessary technical service and good team management;
- High level of qualification in specific field;
- Opportunities to improve professionally. [19]

It is also important to understand and evaluate the risk of each obstacle. There are six negative specifications that can be influential when forming a team:

- Not clearly formulated goals and tasks of the project;
- No resources to complete and achieve specific tasks;
- Fighting for influence in the project and conflicts within the team;
- Indifference of the upper management regarding lower management to project realization;

- No rewards for employees;
- Changing tasks and goals of the project. [20]

To have the most efficient team possible it is important to have employees from different professional areas. For example - without quality inspection, scrap issues and quality management modules of the software will not be correctly checked, and without people from a workshop and their feedback it is impossible to improve and correctly apply the software into an organization. Possible team for implementation of the project is production manager, quality engineer, plant manager, project engineer, workshop supervisors and operators. There is a need to involve as much of personnel as possible to achieve positive results. Every employee is assigned to complete different tasks and participate in weekly meetings. It is important to get the feedback from every employee, workshop supervisors are assigned to collect information from the operators and bring the main formulated ideas to the main meeting. Three operators are assigned for the meeting, since there are more than twenty operators in the company, operators can be changed every week in order to get all the ideas. All the personnel assigned for the project is presented in Table 24 below. The tasks are also visible.

Table 24. Team formation for the implementation project

No	Employee's Occupation	Quantity of Employees Assigned	Tasks and Functions
1	Production Manager	1	Organizing weekly meetings, lead meetings, possible improvement analysis, communication with developers of the program, organize trainings
2	Quality Engineer	1	Participation in meetings giving weekly feedback, possible improvement analysis
3	Plant Manager	1	Tablets placement plan, possible improvement analysis
4	Project Engineer	1	Supervision of Implementation, preparation of the plan, possible improvement analysis,
5	Workshop Supervisor	2	Participation in meetings, giving weekly feedback, collecting information from operators, brainstorming possible improvements
6	Operator	3	Participation in meetings, giving weekly feedback, brainstorming possible improvements

As it can be seen in the table, people of six different occupations are assigned to participate in the meetings. It is important to note that communication plan is one of the most crucial factors in implementation of a new software. There are four main stages in the project communication phase. Regularity of the meetings is important and can help to build stability and consistency of employees. Meetings must be assigned according to the chosen schedule; it is best not to reschedule or change the dates or time of the meetings. It can be organized online using conference-call software or in a face to face manner. Both ways are efficient and used according to the given circumstances in the company. It is also important to note down the meeting length after every meeting. Meeting length can be checked after certain period of time and improvement of every point can be analysed. Third stage for communication plan is a draft of a progress report, where progress of the project or implementation can be checked. This document is supplementary to help and see possible improvement of the project.

In this document following points can be explained:

- completion of the work tracking;
- which tasks are in progress;
- which tasks are not started;
- what problems happened and was not expected;
- general project evaluation. [21]

It can also provide useful information regarding functions of the implementation project:

- assures that project is running smoothly, and issues if any changes is needed;
- gives an ability to see findings of the project;
- possibility of giving other people to give a draft progress report for evaluation and comments;
- gives a possibility to see problems in the project and gives ability to control solutions;
- forces to create and follow schedule of the work. [21]

It is important for a project manager to make sure that both ends of team understands the idea of each task and project itself. It is also important to understand that communication plan is a non-ending cycle and it always continues. The representation of the communication plan for the implementation plan is presented below in Figure 21.

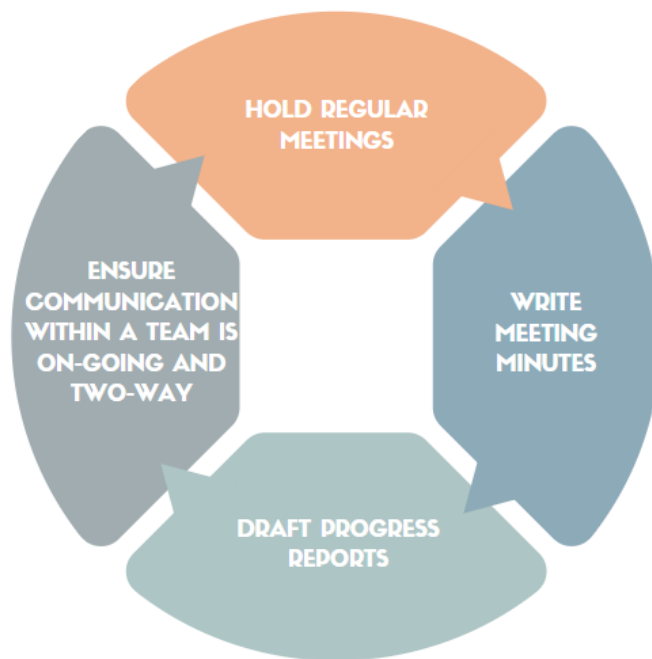


Fig. 21. Communication plan for the project

Lastly, it is important to delve into the possible risks of the project. When implementing a project there is a huge possibility that unexpected occurrences will happen, it is important that a project manager assures a least amount of possible unexpected risks. To find out all the possible risks mind mapping and brainstorming methods were used.



Fig. 22. Mind map of risks

- **Resistance of the Employees**

Even though people usually want to see improvements in the organization, many initiatives regarding changing fail and does not meet expectations. From 40 to 70 percent of the new projects fails in the one of the phases. [22] Employees are likely to feel uncertainty regarding a variety of organizational changes, such as the transition implementation process and the anticipated transition outcomes. They can also feel risks to their security and their place in the organizational environment and their future career and responsibilities. Negative reactions of the people regarding an implementation of novelties to the company can have a serious impact. It is important to explain the need of change and importance of engagement of employee, so the company is more likely to keep a competitive advantage and most importantly good know-how for every employee. Moreover, the voluntary turnover of key staff would not only cost an employer organizational expertise, talents, and abilities, but will also challenge their competitive position if those workers then join competitors. [23] Different variety of theoretical concepts were analysed regarding change in an organization and their influence on individual change. Changes in the environment are taken complete different by different people and their behaviour. There is evidence, that peculiarity of people has influence on desire to change. For example, it was found that people with higher level educational degree are more willing to change compared to ones with lower level. This can be explained by assuming that these people see possibility of improving themselves as specialist and achieve possible promotions in their professional careers advancing in the company. [24] Additionally, willingness to change was highly associated and compared with positive personality traits of the person. To conclude the resistance of the employees, it is important to mention that every employee is different and will most likely react differently regarding the changes in the company. It is important to understand every person and try to communicate with him, explain the current situation and need of changes, explain that changes are being made to create easier environment for employees and can be helpful tool to complete daily tasks in the working environment. [25]

- **Potential Mistakes and Errors in The Code of The Program**

It is a common case where errors in the code is only found out in the testing of the software. It is important to have responsive and reliable customer service. In creation process of the software weekly meetings with developers were organized, analysis of current version of the program was discussed

in the meetings, based on the feedback program was improved. Same practice can be applied in implementation process. Frequency of meetings can be adjusted according to the need, for the first two months, weekly meetings will most likely be needed, after two months of implementation, meeting every two weeks can be organized. For urgent cases and fatal bugs in the code of the software meetings must be held immediately.

- **Inability to Change Organizational Culture**

JSC “Kagneta” has never used any structural ERP software with high involvement for the employees. Starting to use a new program can be challenging. There are employees with work experience in the company of ten or more years. New ERP must fit current processes to succeed. This can be one of the biggest risks in the implementation process.

- **Bad Quality Training of the End-Users**

When implementation process starts, it is commonly being implemented with rush and with need to complete the process as soon as possible. It is important to invest time in preparation of training and training itself. Without proper training end-users will not be able to complete their daily tasks using the new program. However, it should not be a top risk of the implementation plan, because the program was developed with design that is convenient to use and user friendly.

- **Not Enough Knowledge Running Project and No Senior Support of the Management**

It is a common experience to have and keep good ERP specialist in big organizations for continuous improvement of new projects. In JSC “Kagneta”, the program will be implemented by people who perform other functions in the workplace and do not have wide experience regarding program implementation.

- **No Full-Time Employees are Designated for Implementation Process**

As it is common experience to have ERP specialist in the company for big corporations, it is also frequent to meet employee employed for specific project or to complete specific tasks. It is important to consider that production will not be stopped and daily activities that must be performed by the employees will have to be completed. To avoid possible indifference from the project team it is important to motivate people with rewards, it is also important to allow employees to stay overtimes to finish their duties.

- **Poor Knowledge of Technology**

JSC “Kagneta” does not have an IT department, thus the only deeper technology knowledge can be provided from the developers of the software. Since the program will be held in cloud storage, it should not require powerful technology and there is no need of high-end laptops, tablet, and personal desktop computers. However, with future improvement and heavier code it is possible that the program will be more demanding.

- **Does Not Work in Practise**

Not everything that is written out on the paper works in practice. Difference between practice and theory is important risk to consider. If any of the modules or part of the programs does not satisfy the needs of organization it has to be updated, recreated, or adjusted according to the need and demand.

4.2. The Project Execution Phase

First stage of project execution is setting of the tablets in the workplace. Company provides mobile phones to employees that need to communicate with clients or for other tasks that can be completed with mobile phones. However, not every employee has one. To provide ability of using the new software tablet in the workshop must be added. One of the main tasks of the ERP is to save time of the employees, it is important that there are no lines of people waiting to use tablet. Tablets should be distributed in the workshop in the manner so different operators would have fast and easy access to access the program. Representation of the workshop layout and tablet placement is presented below in the Figure 23.

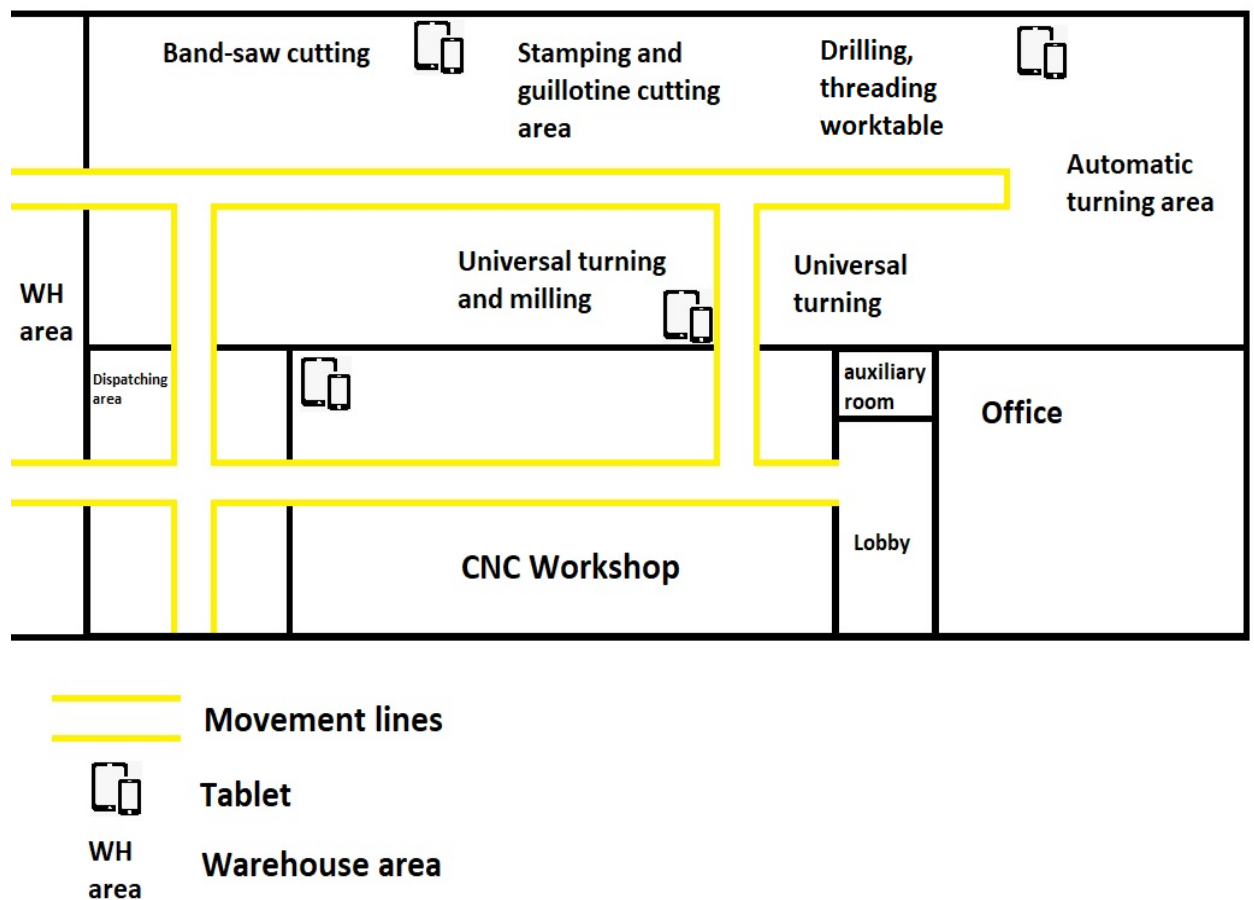


Fig. 23. Functional layout of the property facilities and placement of the tablets

Bandsaw cutting, stamping and guillotine cutting operators can use one tablet, that can be reached within few meters. Drilling and threading operators can share tablet with automatic turning machine operator. There is one tablet assigned for universal milling and turning machine operators. Lastly, CNC workshop is assigned with one tablet. Every tablet is assigned with a printer if drawing of the product or part is needed. Usually, operator can complete from one to around ten orders per day depending on difficulty of the orders. Average of orders that an operator performs per day according to the old order management software is 3.3. Approximate time to use tablet to pick up one order is predicted to be around 60 seconds. With 42 employees in the workshop per shift, sum of 2.3 hours is expected to be used using tablets. With 4 tablets, every tablet is expected to be used 35 minutes – it is unlikely that lines waiting will be formed. Additionally, users can use their own mobile phones or use other point if the tablet is busy.

Another important stage of the execution phase is tasks. It is important to understand responsibilities of each member of the team and understand how tasks must be performed. Correct distribution of tasks and timely planned schedule can improve implementation process duration time. It is also important to assign tasks to people that have experience or knowledge of specific assignments. The list of all the tasks are presented below:

- **Training processes**

With efficient and correct training processes implementation process can be performed in shorter amount of time and the results achieved can be improved. To complete the training phase faster three stages of trainings can be used:

- common trainings;
- focus groups trainings;
- individual trainings.

Common instructions and trainings for operators and administrators of the software goals is to introduce individuals to the working principle of the program and basic functions that can be performed. It is important to have common trainings to show and explain general view and bases of the program. Focus groups trainings importance is to teach individuals their daily tasks. Operators will be shown how to use virtual environment module of the program, quality engineers will be introduced to the scrap module of the program, administrators will be shown how to use order module, etc. Not everyone can learn new things in the workplace on the same pace, it is likely that organizing weekly meetings and individual trainings will be needed. Individual trainings can be arranged formally or informally. It is a responsibility of project's manager to teach every employee to do their part in the project.

- **Leading of Meetings**

It is another responsibility of the project manager. To achieve optimal results, it is important to have structured meetings. As it was shown in communication plan of the project it is important to write meeting minutes, draft progress reports and ensure communication between different departments and individuals. Without a leader and a moderator, meetings have high possibility of being inefficient. A good leader of the meeting must be ready, prepared, organized, confident and focused. It is important to conclude every meeting and come up to a summary.

- **Possible Improvement Analysis**

It has to be performed in a smaller team of a project engineer, a production manager, a plant manager and a quality engineer. Before giving new tasks to the developers of the software for updates it is important to clearly formulate the tasks. The process sequence of improvement will be discussed in the next section. After the tasks are formulated production manager can hold a meeting with the software developers.

- **Table Placement**

To achieve optimal results and save time it is important to place tablets for operators to use virtual environment with. It is important that every operator can reach a tablet and perform given functions

within few meters. Placing a tablet too far from employee will lead to a waste of time for supplementary operations.

- **Feedback from the Operators**

Employees and workshop supervisors have to give weekly feedback regarding their experience using the program. It is important to give positive and negative feedback on the existing functions of the software as well as brainstorming to improve and update program.

After the program is ready to be launched to the workshop, it is important to prepare appropriate and measured implementation plan. Moving all open purchase orders from old software to the new, unchecked and unreliable software can lead to a loss of data and chaos in planning and management. In the project execution phase, it is crucial to complete every task and process step by step. To test-out the new order management module it is advised to test it with small quantity of new orders and parallelly run the same orders on old and reliable program if anything fails. In JSC “Kagneta” case, five orders and approximately two weeks of completion times can be tested. The shorter lifespan of production is, the faster feedback can be collected. It is also important to choose orders with different operations and processes to test out all the functions of the program and to test out as many error possibilities as possible. If all five orders run smoothly without mistakes, it is advised to add other new orders to the program and raise the quantity of the orders managed. After three or four stages without error, all the orders can be transferred to the new program. Since it is not possible to add half complete orders to the software, old purchase orders have to be finished using MS Excel method. To fully switch from old to new program can take from four to six months depending on the mistakes in the code and software.

4.3. The Project Monitoring and Control Phase

After implementation of the process, it is important to maintain, monitor and control it. For a program to be successful it is important to understand the importance of continuous improvement. Another important aspect is to listen to the employees from workshop and administration, respect and discuss possible development steps. After using the program for a specific amount of time, in this case – for one week, data from the employees had to be collected. Collection of the data can be performed in various ways, questionnaires, face to face discussions, communication with managers of the employees. Not all suggestions will be worth implementing, however lean practice suggests examining and analysing all ideas. After suggestions are analysed, formulation of the new tasks for developers must be performed and communicated. After the creation of updates is complete, implementation can be performed. This process can be repeated every week to achieve the most optimal results. To satisfy these both needs it is possible to use the project improvement sequence presented below in the Figure 24. To monitor and measure efficiency of the program it is important to measure different metrics before and after implementation process. The best metrics to check efficiency of the program are:

- late purchase orders;
- late material arrival;
- employee satisfaction;
- customer satisfaction.

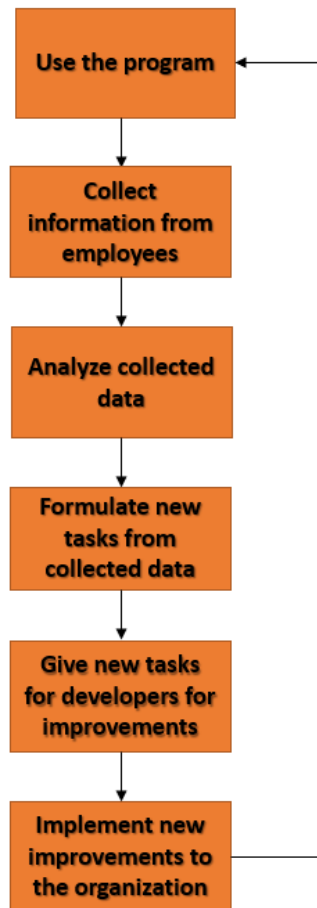


Fig. 24. Project improvement sequence

One of the most important categories that were measured in the old software was late purchase orders. Late purchase orders can cause problems with clients, manufacturer can be responsible for the ready production time financially. According to the purchase order requisitions, it is also possible that incoterms of the order can be changed if lead-time is violated by manufacturer. For example, EXW incoterm can be changed to DAP if production is not ready according to the given date. Every week report of unacknowledged and late purchase orders is generated. After implementation process of the new software is finished, quantity of late purchase orders can be checked and compared to old data. It is expected that metrics should be improved, because of more visibility, better planning tools and possible adjustments to the lead-time of products can be added. The questionnaire that was performed in the first chapter can be repeated after implementation of the new software is completed. With high involvement of all employees of the company it is expected that satisfaction of order management and communication between administration and operators will improve. Lastly, customer and client satisfaction can be checked. At the end of every year JSC “Kagneta” sends short questionnaire for their clients to find out their performance. The test is designed to find out how satisfied are clients with quality of the production, communication of the management, compliance with deadlines, etc. There are also categories that could be added to the evaluation phase, but there were no possibilities to collect certain data with old software.

4.4. The Project Closeout Phase

The last phase of the project implementation is the project closeout phase. During this stage, a project manager and a plant manager can confirm that project is completed and meets all the requirements. It is important to review the implementation plan, check if all the necessary tasks have been completed. During the closeout stage it is important to check:

- all the work documents have been relied on;
- review legal documents with the developers and check if everything has been confirmed and completed as stated;
- check if any code of inspection was applied by the authorities;
- review all the supplementary documents, files from the developers and check their completion status;
- hand over the future implementation process to the workshop supervisors and production manager.

Risk assessment is another concern to be analysed before handing over the project. In the section above, all the possible risks have been mentioned. It is important to measure every risk and evaluate potential outcomes. In the risk assessment matrix ratio between probability and impact can be seen. It is important to evaluate each possible risk and prepare an action plan for every such case. The matrix is presented in the Figure 25.

Probability	High	Medium	High	High
	Average	Low	Medium	High
	Low	Insignificant	Low	Medium
		Low	Average	High
		Severity of impact / consequences		

Fig. 25. Risk Assessment Matrix [26]

The biggest risks in JSC “Kagneta” for the project with highest impact are employee resistance to changes and possible failure to redesign the business. It is hard to predict probability of this case, but the impact of these occurrences would most likely ruin the implementation process and the program would not be finished. To avoid these problems common trainings must be splendidly prepared and explanation of need of changes must be pointed out.

Conclusions

1. After questionnaires given to the employees, assumption that communication between departments and order management procedures in the company proved to be correct. The result showing employee satisfaction regarding order management processes in the organization is 2.46/5 which is below average.
2. Current method of order management lacks functionality such as virtual environment for employees or customization. None of the tested programs (Microsoft Projects, Asprova, MRPeasy, NetSuite Software) provided required functionality and a set of tools that the company needs. According to these settings, a decision to develop new software was adopted.
3. According to the given requirements, developers created new ERP system for JSC “Kagneta”. Collecting information from control meetings and formulating new tasks for developers will allow possibilities of continuous improvement of the software.
4. Removement of printings of drawings and lead-papers, bringing physical papers to the manufacturing operators or workshop supervisors, and collecting lead-papers eliminated physical movement of the manager, which he needed to complete the order. These improvements in the workflow of order management can provide abilities to work remotely. It can be useful to attract new employees or to have an ability to work during quarantine conditions.
5. Automation of the order management software helped to decrease quantity of operations, from 10 to 5 comparing to the old method. Decreased quantity of processes, gives an ability to save time needed to manage functions of the order. Previous method required approximately 16 minutes and 45 seconds to complete one order, now is 7 minutes and 30 seconds by the new ERP. It can save time of administrative tasks needed to complete the order by 9 minutes and 15 seconds.
6. Implementation plan helped to identify possible risks of the project, to assign tasks for each member of the group, and to prepare a communication plan for the project. Transition process from the current to the new program is expected to take from 4 to 6 months, by adding gradually increasing number of orders to system every 2 weeks.

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Appendices

Appendix 1. Permission of JSC Kagneta

Appendix 2. Representation of the order window (in Lithuanian)

Appendix 3. Created window of the part of the order (in Lithuanian)

Appendix 4. Main information required for order KAG.20.14.19 in virtual environment (in Lithuanian)

Appendix A: Permission

Lukas Kandrotas
39506010846 Savanorių pr. 241, Kaunas
+37063816585

Ričardui Kleizai
UAB „KAGNETA“ vadovui,
generaliniam direktoriui

**PRAŠYMAS DĖL INFORMACIJOS
PANAUDOJIMO**

2020 m. Gegužės 15d.



Šį prašymą jums pateikia Lukas Kandrotas, norėdamas gauti leidimą, naudoti jūsų įmonėje UAB „KAGNETA“ gaunamus informacijos šaltinius bei kitus šaltinius.

Direktorius
Ričardas Kleiza










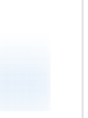





.....
(Parašas, vardas, pavardė)



Appendix 2. Representation of the order window (in Lithuanian)

Užsakymai

Užsakymo nr.	Užsakovas	Gaminys	Medžiagos	Sukūrė	Būsena	Užsakymas išvežtas	Sąskaita išrašyta	Komentaras
⋮ KAG.20.14.19		Detalė 1684405 	●	 2020-04-03	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	
⋮ KAG.20.14.16		Detalė 0654680 	●	 2020-04-03	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	
⋮ KAG.20.14.17		Detalė 0654580 	●	 2020-04-03	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	
⋮ KAG.20.14.11		LK-80GE30-30(45+45) 	●	 2020-04-01	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	
⋮ KAG.20.14.12		LK-95GE40-30 	●	 2020-04-01	Nepradėtas	<input type="checkbox"/>	<input type="checkbox"/>	

Appendix 3. Created window of the part of the order (in Lithuanian)

⋮
KAG.20.14.11
●●●

LK-80GE30-30(45+45)
●
📄
📅
📁
📁
+
⋮

2020-04-01
Vykdomas
↑ JKELTI DOKUMENTUS

Dokumentai

LK-80GE30-30(45+45).pdf
✕

Užsakymo dalis #1 Vykdoma

Procesai

Pavadinimas	Kiekis, vnt.	Komentaras	Numatoma pradžia	Numatoma trukmė sekundėmis / vnt.	Visa numatoma trukmė	Būsena
Pjovimas Pegas CNC	500/500	📄				Užbaigtas
Tekinimas CNC ceche Viktoras Didelis	500/500					Užbaigtas
Tekinimas CNC ceche Viktoras Didelis	500/500					Užbaigtas
Pakavimas	500/500					Vykdomas

Medžiaga Atvyko

D85 AISI355

Kiekis: 18m

Savikaina:

Pristatys: Kagneta

Tiekejas:

Vieta: Nenurodyta

Pagaminti iki	2020-04-17	Gaminio pardavimo kaina	€
Gaminių kiekis, vnt	500		

Appendix 4. Main information required for order KAG.20.14.19 in virtual environment (in Lithuanian)

1684405

Medžiaga	Atvyko	Gaminių kiekis, vnt	Pagaminti iki
355 kalibruotas D30 strypas		500	2020-04-22
Kiekis: 27 metrai			
Prieinama: -			
Vieta: -			

 PJOVIMAS PEGAS NC  **TEKINIMAS CNC CECHE VIKTORAS MAŽAS**  CNC FREZAVIMASHAAS

Pagamintas kiekis, vnt.

0/500 

Proceso būseną

Vykdomas

UŽBAIGTI PROCESĄ