MÄLARDALEN UNIVERSITY
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School of Innovation, Design, and Engineering

REDUCING LEAD TIME IN A LOW VOLUME PRODUCTION LINE

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Abstract

This report is done through cooperation with Eskilstuna Elektronikpartner AB (EEPAB) in order to find some solutions to reduce the cost and improve the production line for one of the company's products called Bestic. Bestic is a robot that helps disabled people to eat their food. The group made several visits from the company and both sides had very good cooperation with each other. This report explores possible solutions for the Bestic problem and provides some suggestions regarding the issue.

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1 Background

This project is a part of the course KPP206, Production, Maintenance and Quality Management, and is performed with cooperation with a company. The purpose of the project is to engage students with real problems in the industry and to use their knowledge to solve some of them. Groups from the class are consisted of 3 to 4 members with different backgrounds and each group is assigned to one project with a company. This group works with Eskilstuna Elektronikpartner AB (EEPAB), an electrical component manufacturer in Eskilstuna. The problem area that the group has to work on is about one of the company's products called Bestic. The group has to find some ways to reduce the final cost of production. The solutions and the suggestions are to be expressed and explained in this report.

1.1 Project specifications

The project specifications are introduced in detail in following subcategories.

1.1.1 Problem descriptions and project's objectives

EEPAB manufactures, assembles and performs testing of the robot Bestic. All steps of the assembly are almost done manually and the lead time is 10 hours. Thus, the cost of producing Bestic is very high because of not standardized processes.

The aim of the project is to find possibilities to reduce the cost by 10%. The project is conducted during week 16-22 where main focus is to suggest improvements in assembling and testing of the robot Bestic in EEPAB. The members in the group are all responsible for fulfilling the goal.

1.1.2 Project organization

Connection between the participants of the project is shown on Figure 1. It shows the group was involved mostly in the optimization of the production as a third party of the system, but suggestions toward the design or development of the Bestic also created by the group.

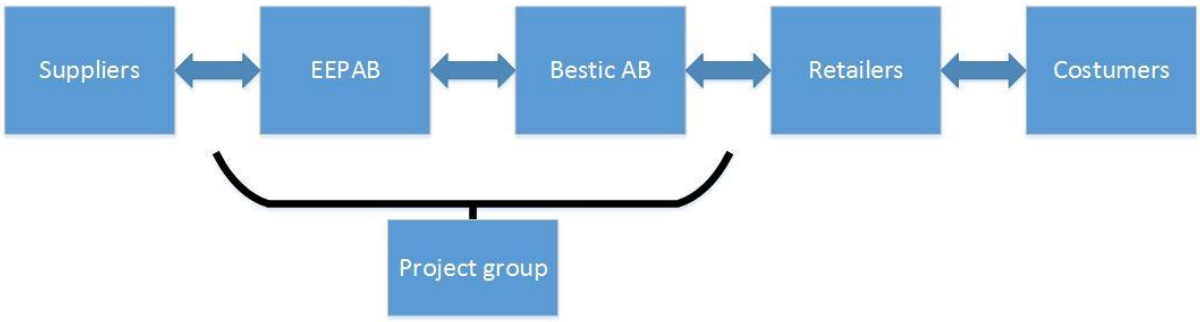

Figure 1. Supply chain in term of Bestic

The group had several visits in the plant of the EEPAB. During these meetings the product manager of Bestic AB was present too. The production was shown in detail, but unfortunately the actual production was stopped during the project. However, the group had the possibility to see some parts of the manual assembly. Regardless of the company, the group had several meetings in person and online, shared notes and ideas with online Google documents. In the beginning the focus of the project was the improvement of the production and assembly. However, during the project it changed to those parts which were actually possible to examine during this period, such as long partly standardized testing methods, the prototype nature of

Bestic is not optimized for the production, etc. The tasks during the project were equally divided among the group members.

1.1.3 Time plan and deliverables

Project plan includes time plan and deliverables. Different milestones and deliverables are presented in Table 1.

Table 1. Different milestones and deliverables for this project.

Week	Monday	Thuesday	Wednesday	Thursday	Friday	Saturday	Sunday
15			Contac with Mikael Joki form EEPAB by Email				
16		Get the reply from Mikael Joki. Arrange a meeting with Mikael Joki and Ann-Louise		09:00-11:00 First meeting with EEPAB			21:00-22:35 Skype meeting: use Google Document to discuss the possible suggestions, the project plan, and the next meeting with EEPAB
17	14:00-16:00 Creating the logbook for the project. Write the project plan, specialize the ideas especially in mechanical design area. Send the agenda and the project plan to all of the participants	Check articles. Send Mikael and Ann-Louise the summary of first meeting and plan of second meeting	Check scientific articles related to the project's topic	13:00- 16.20 Second meeting with EEP AB, observer the assembly processes	Write the paper plan, discuss the expected results		
18		Writing down the questions that the group wants to ask in the third meeting (questions are related to supply chain, maintainace, design, production, and qaulity respectives)	Send the paper plan and questions to Mikael and Ann-Louise	13.00-16.00 Third meeting with EEPAB, ask questions and discuss about suggestions	Start writing the report by fellowing the project template		
19	Waiting for Natasha Lagumdzija´s Email for assambling Bestic			Skype meeting: go through the project template together. Use Google Document to write down the notes for each subject after discusion. Divide the tasks and assign the each small subject to each group member	Writing small subject individully		
20					Dicuss about the suggestions and improvement		
21		Assembly workshop of Bestic	Assembly workshop of Bestic		Share the observation of assembly workshop. Discuss the improvement of assembling. Full speed on writing report	Full speed on writing report	21.00-22.30 Skype meeting: discuss the impossible suggestions, go through some parts of the report together
22	21.00-22.30 Skype meeting: do the modifications of the final report, rewrite the Project Organisation part	Edit the final report together and hand in the report	Prepare the presentation	Practice the presentation	Final presentation		

1.1.4 Delamination

The study will focus on different ways to reduce the cost of production for Bestic. To do that, the group investigated various aspects of the production from relationship with the suppliers to the quality control process and so on. At the end, the group decided to narrow down its focus on some major parts and leave the rest of the value chain. One part that was left early, was the relation with the suppliers because it needed more time and accessibility to them than what was available for the group. At the other hand, since the production of Bestic was stopped temporarily due to excess inventory and wrong forecasts of the market demand, some of the time and motion studies had to be abandoned. But the companies accepted to assemble one Bestic to make it possible to examine the process for the group. So the focus was mostly on the production line, sound- and quality testing and the design of Bestic. The validity of the suggestions and their applicability depends on many factors related to various constraints of the market and work environment and most importantly to the EEPAB's culture. They are based on common theories that are in practice in many manufacturing firms around the world.

1.2 Company description

EEPAB was established in 1991. Their work is based on technical choice and overall total cost throughout the product life cycle, from the concept phase to the finished product – with a focus on production adapted design. EEPAB´s businesses are related to different areas, e.g. automotive, industrial, energy and security. This is a small sized company and their turnover was 60 million Swedish Kronor in 2012. EEPAB offers circuit boards depending on the customers' needs. The company also provides service from production to final assembly (or even send to products to end customers) to the other companies. Bestic AB is one of their clients.

Since this project, the group focuses on the product Bestic, therefor every time the group is having meeting in the EEPAB´s office with Mikael Joki, who is the CEO of EEPAB and Ann-Louise Norén who is product manager of Bestic AB. After 7 years, in 2011, the sales of robot Bestic had launched. Bestic AB´s only product is Bestic and its related accessories. Today the distributors of Bestic are in Denmark, Norway, Finland, Netherlands, England and France. Bestic AB is today based in Stockholm and is produced in Eskilstuna EEPAB.

1.3 Expected outcomes

EEPAB and Bestic have high expectations from the group regarding cutting the cost for producing Bestic. The expected outcome is a cost reduction by minimum 10% for producing one robot. Since the temporarily stop in production, the group will find improvements in further areas than assembly. The group expects the companies to implement at least one improvement and evaluate the potential of the others.

2 Current state of processes

The main problem for Bestic is its high cost. The group tried to find different factors that could have a role in the high production cost of Bestic. One factor was the long cycle time at the final stage of the assembly line. Since the production volume for Bestic is very low, EEPAB has decided to assign the whole final assembly to only one or two operators, but it has made the cycle time very long and the production line has lost its flexibility. At the other hand, educating a new operator to assemble Bestic takes more than one month and it is

costly. Another problem that the group noticed was in the sound quality testing stage. At this stage, one of the operators has to listen carefully to the sound that different motors in Bestic produce to see if there is any noise or not. They do this manually without using any device and therefore there is a high potential for human mistake and it also takes a long time. The group noticed that processes are not standardized. There were also other problems. Those robots that do not pass the tests, have to be sent back and be disassembled which takes time and money and is non-value added. Regarding the design, there are four motors in every robot. One of the motors, which is the smallest one, makes a lot of noise because of its small gearbox. It is also the most expensive motor in the robot and has the most defects rate among the others.

2.1 Process description

- Material handling and logistics

During the manual assembly the steps are done by two specifically trained operators, all steps are done by them. Each operator has a workstation for the assembly, and the necessary parts, materials and tools mostly available without leaving the workstation. However, the parts are not well-organized and not sorted depending on which subassembly the parts will be used in. The operator has to search for the necessary parts on the trolley what takes time. The workstations are spacious enough, but after the first few subassemblies the desk is getting crowded with tools and assembled parts.

- Production information–planning and control

Bestic is produced in predefined batches. Each batch contains 10 robots. EEPAB keeps a stock of parts for Bestic, because their suppliers' lead time is quite long, in the case of some parts from the order until the reception it can take 16 weeks. Due to the long lead time of these specific parts they need to receive the order from the Bestic AB several weeks earlier than the products have to be delivered. The forecasting is done by Bestic AB. Due to the incorrect forecasting there are several finished products on stock of both companies, the reason is that Bestic AB got too optimistic feedbacks from their retailers.

2.2 Products

Bestic is an eating assistive device with a robotic arm and a spoon attached on it. The robot makes it possible for people who have difficulties to move their arms or hands to eat by themselves. The weight of Bestic is only 2 kg and the height about 30 cm, which makes it easy to move and place Bestic at a table when having dinner, see Figure 2.
Bestic contains over 200 components, some of them are already pre-assembled. However, in the process for assembly all components should be put together and be ready for the final test (bestic.se).

Figure 2. The size of Bestic. Bestic is placed next to other objects and the size can be estimated. (Source: http://www.bestic.se/en/home)

2.3 Manning and Capacity

EEPAB has 43 employees in the company. There are two-shift schedule in production process. The equipment and machines used in the production of Bestic have high reliability. EEPAB uses very advanced machines with high quality and reliability. However, the reliability of the whole operation can be questioned. The final step of the assembling of Bestic is performed manually by one or maximum two operators. This step includes preparing the motors and other parts and assembling them together. The whole process is long and complicated. If one or both operators are not present at work for any reason, the production rate will stop or will slow down. Other operators at EEPAB are currently not able to make the whole assembly of Bestic. Processes are not standardized. It is not clear what the best possible way is to perform every step. There is a high probability for making mistakes due to complexity of the assembly. So in general, it can be said that the equipment is reliable but the whole operation in total is not.

There are some hidden problems regarding ability of delivery for Bestic. The main problem is the long production lead time because of the final assembling step. For example if the forecasts are lower than the real market demand, it is difficult for EEPAB to adapt itself quickly to any extra demand. On the other hand, if the forecasts are higher, EEPAB will produce extra products that are considered as overproduction, one of the seven deadly wastes.

EEPAB has quite low production volume for Bestic. In the first year of production, they produced 60 Bestic. In 2013, they forecasted that the market demand would be around 300 but the real customer demand was lower and they had to store some of the finished products. However, Bestic AB has predicted that demand will be much more in the coming years.

2.4 Time Study

Due to the stop in production, the group was not able to perform time studies and find bottlenecks in assembly regarding longest lead time. Instead of that, one Bestic was assembled with the group. One bottleneck was identified by the companies, which was the assembly of the elbow joint. During the assembly, the group found more formerly unknown bottlenecks: the engine assembly, unstandardized components, sound testing, and not proper tools during the manual assembly.

The identified losses are the following:

- Raw material loss: in Bestic, there are four motors, which are the strategic items of Bestic. First, motors have high profit impact for the whole product. Second, motors are essential parts, which are also expensive items. In this case, 3-4% of the big motors are the defective products that come directly from suppliers. Meanwhile, the smaller motors are having much higher percentage of defects, this is 30%. EEPAB pays half of the price for ones that they send back to suppliers.

- Tool loss: from the assembling workshop, one can see that the operator uses a brush one time, and then the operator throws it away. For the common understanding, the brush is not one time consumption item. Instead it can be used more times for saving tools.

- Loss in manual labor: except the value adding activity, assembly, there are losses in man hours. From the observation of assembly workshop, there are some activities which are semi production activities, e.g. the worker has to do the preparation of the work before the assembly, fetch material and tools during the assembly, inspection, reassembly and cleaning. The waste activities are sorting components, searching for materials and tools.

2.5 Fishbone diagram for high cost

A fishbone diagram, also called Ishikawa, is a tool of quality and useful for identifying possible causes for a problem. This project aims to reduce the cost of production, therefore the problem is high cost. The group decided to draw a Fishbone diagram to find causes of the high cost. This was made after watching the assembly. The result is shown in Figure 3.

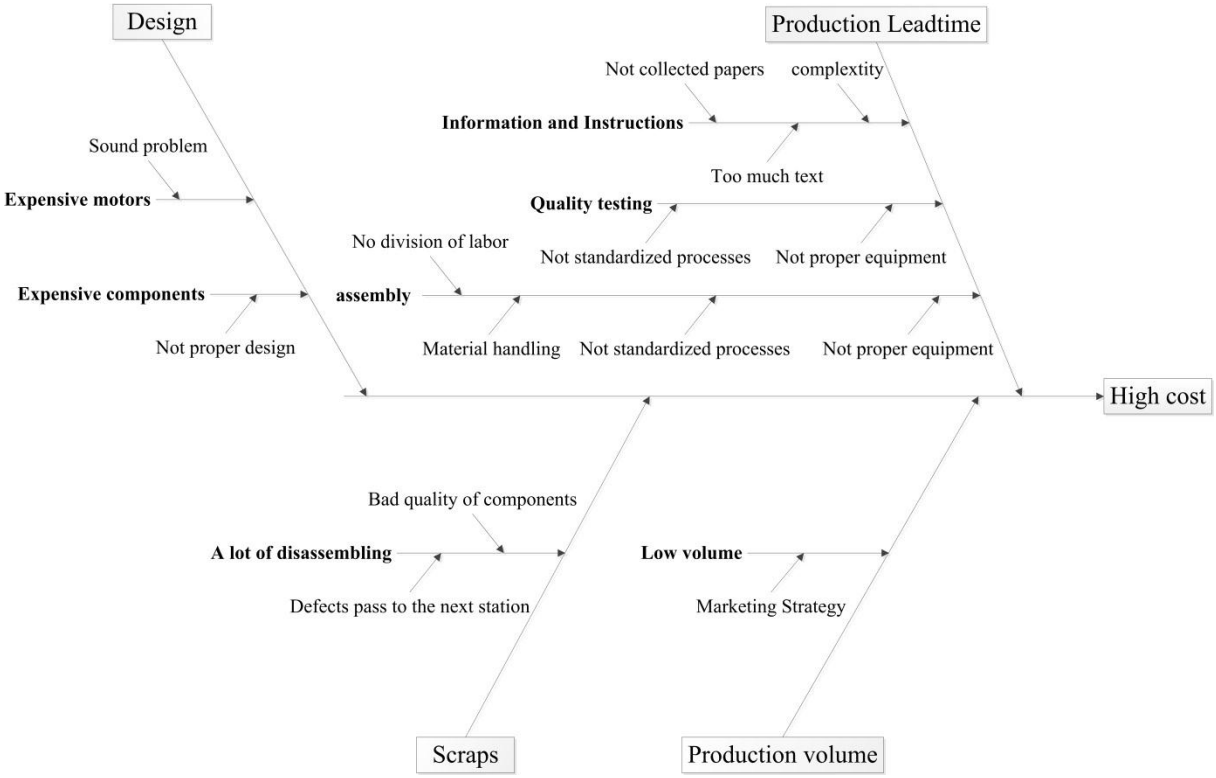

Figure 3. Fishbone diagram. The diagram shows causes of high cost in different categories that occurs when producing Bestic.

After setting up a Fishbone diagram the group started to analyze it. One cause was seen over and over again and the cause is that Bestic is not designed to be assembled smoothly. Here Jidoka can be useful, that in every stage building in quality.

3 Suggested improvements

The group's suggestions are organized into different groups depending on the field of their appliance and the following Fishbone diagram can be used in all of them.

Use Fishbone diagram to find causes of a problem

The group suggests Bestic that together with EEPAB create their own Fishbone diagram, where they consider problem regarding assembly as well as other activities in the process. The group recommends to use paper even though templates can be found on computer based program to not hinder the creativity. An implementation plan for Fishbone diagram and root cause analysis contains 5 steps:
Step 1. Identify the problem and start drawing the fishbone.
Step 2. Define cause categories.
Step 3. Identify possible causes.
Step 4. Analyze the diagram and find root causes.
Step 5. Plan for improvements.

Resources needed: Team members, paper and pen + know-how for making a Fishbone diagram.

Step 1. Identify the problem and start drawing the fishbone.
Identify the problem you want to solve. Set up the fishbone which is the horizontal arrow in the middle, see for example Figure 3, and write down the problem where the arrow points at.

Step 2. Define cause categories.
Come up with categories for causes and draw arrows towards the horizontal line.
Examples of categories:

-materials	-price	-supplier
-machine	-equipment	-volume
-process	-environment	-skills

Step 3. Identify possible causes.
It is time to identify causes why the problem occurs where we focus on each category. To help explain this, see Figure 3. One category says "Production Lead time" and we ask questions in terms of why. "Why do we have high cost in the category that concern production lead time?" The group found assembly as one cause, wrote it and drew a horizontal lines with an arrow. The why-question repeats, now "Why do we have long lead time in the assembly?" and one answer is given.

Note: You can always try to find more than one answer and go further on each level, just by draw another arrow.

Continue the why-questions in each category and subcategory.

Step 4. Analyze the diagram and find root causes.
When the Fishbone diagram is filled the team can analyze the result and try to find causes that appear more than one time. Those are called root causes and 80% of the effects come from 20% of the causes. Therefore, it is a good idea to start to eliminate the root causes. Use a pen to mark them.

Step 5. Plan for improvements.
When the root causes are known, plan how to eliminate the causes and identify improvements. Implement those and do not forget to follow up the outcome. If necessary, come up with new improvements to eliminate the causes.

Suggestions regarding assembly

- Dividing the process to smaller tasks
  The final step for assembling Bestic is comprised of different tasks that can be assigned to different operators. These tasks include preparing motors, soldering the wires, assembling the gears and etc. The operator has to do all these tasks individually based on printed instructions. The group's suggestion is to divide the assembly to smaller and simpler tasks and then assign each task to a different person. Doing this, it will be easier for operators to learn how to assemble their own part. They can also produce each part faster due to the effect of the learning curve. When all the steps are performed by only one

operator, it is difficult for her to remember every step and she also has to jump from one task to a completely different task all the time. This needs changing the tools and fetching required materials which wastes so much time. There is also a lot of unnecessary material handling since she cannot have all the parts for Bestic on her small desk. The production lead time is long and there is a high potential for mistakes during assembly. A lot of time is wasted on reading and understanding the instruction for each step and this cycle is repeated for each Bestic. It is almost impossible for one to completely master how to assemble one Bestic. By giving different tasks like preparing motors or assembling the gear parts to different operators, the learning process will be much shorter. They do not need to memorize a lot of complex steps and after a while, they will master their job and will do it much faster. The learning curve effect will help a lot. Also there will be less risk for making mistakes since they are doing simpler tasks and can focus only on one thing. If one or two operators are sick or they quit their job, other operators can replace them since they are not doing complex tasks. There will be less material handling because each operator can fetch enough material for one week's demand and have them near himself. They do not need to jump to different tasks all the time or change their tools so they can save some time here too.

- Using proper tools
  Another suggestion from the group is to use proper tools during assembling. At one step, the operator has to place a circlip between two washers and in another case she has to use a pair of water pump pliers to fix two different parts together. Figure x is an example of water pump pliers.

Figure 4. Water pump pliers.
(Source: hyperclaw.com/)

These processes are difficult to do and take time and power. They are also dangerous since it is possible that some small parts like circlips can jump into the eye because of the heavy force from the pliers and not being fixed to any fixture. The group suggests that using a hand press machine can make the process faster and safer. Figure 5 is an example of hand press machine. There is also a need for using safety glasses in some steps.

Figure 5. Hand press machine.
(Source: hiwtc.com/)

- Avoid unnecessary changing of tools
  Another suggestion is for soldering the wires of electrical motors, see Figure 6. The soldering is done by putting some oil on one wire and then performing soldering for that wire. When one wire is finished, the operator goes for the next wire. There are usually four wires for each motor. Soldering the wires one by one can take some unnecessary time since the operator has to change the tools very often. Instead, she can put oil on all the wires and then start soldering all of them one after another. This way there will be less changing tools and less wasted time.

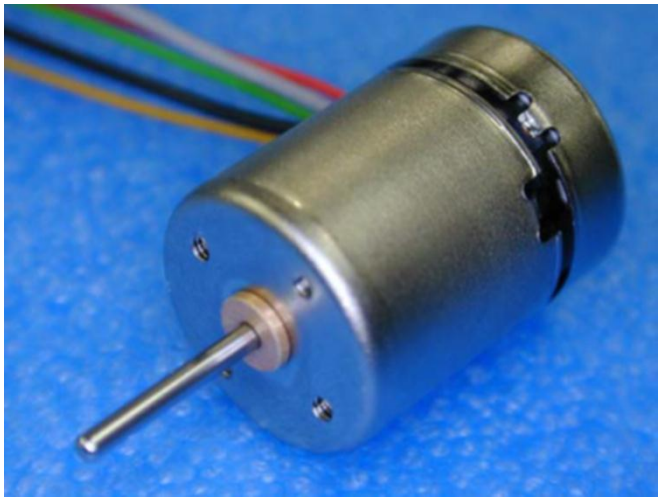

Figure 6. Electrical motor.
(Source comes from Anne-Louise Norén.)

In another case, she has to insulate the wires with plastic parts. This is done by putting open-wire insulators on the wires and then exposing them to a warm

flow of air produced by a heat gun. This process is done for each wire one by one but it can also be done for all the wires together which will take less time.

- Using bigger ferrit rings
  The other thing is that when they assemble the motors, they twist their wires around a ferrit ring. Sometimes those rings are small and it is difficult and time consuming to twist those wires around them. It will be a good idea to use larger rings.

- Study the possibility of replacing the ferrit rings
  These components of the assembly should be replaced with another solution if it is possible e.g. with filters on the main PCB or add additional filter PCB.

- Apply 5s (sorting)
  There are a lot of unnecessary tools on the table and sometimes the operator has to look for a tool to find it. The group suggests that all the unnecessary tools should be taken away and only those parts that will be used should remain.

- Same screws e.g. on the bottom of Bestic
  On the bottom of Bestic, four screws are used but they have two different lengths. A tip is to use as less variants as possible which for instance will leads to faster assembly, less variants to buy will be more cost efficient and decrease number of possible ways of putting components on wrong place.

- Connect motor to device for running it
  One motor has to be connected to run for moving the rotary in a certain position. This step takes long time and if the device could be ready and the motor is just to plug in it would be so much easier. The rotary has to be moved because of how the arm is produced. It there was a standard for how to place it, then the step of connecting it to a device even can be eliminated.

- Plastic arm difficult to hold and assembly
  When putting in the wires in the arm made of plastic, the arm is difficult to hold still because of the shape. One idea is to put something soft under it or some kind of fixture.

- Suggestion for material carrier
  From the observation of assembly, the group can see that the worker needs to fetch the raw materials and tools during the assembly. On the assembly table, there are always a lots of small/medium sized black containers. The table looks unorganized, as well as it makes the assembly process less smooth. The group comes up an idea, which is to introduce a material carrier into the assembly process.

For example, Multi Order Picking Container Trolley (Welco.co.uk), see Figure 7. It has five container, the capacity of Trolley is 300 kg total. The worker can upload all the materials into Trolley before the final assembly. The first used components can be loaded on the first container and so on.

Figure 7. Multi Order Picking Container Trolley.
(Source: Welco.co.uk)

- More standard components
  Some of the components of Bestic are not standard. That requires the specific suppliers and components may cost more. For the next generation of Bestic, the group suggests the company to use more standard components, which can speed up manufacturing and reduces the maintenance costs, as the same units can be purchased and used all around the world.

Suggestions regarding design

- Working with manufacturing engineers from the design phase
  There are some suggestions regarding the design phase from the group. When they are designing the Bestic, it would be a good idea to invite manufacturing engineers to work closely with design engineers from the concept phase to give useful manufacturing inputs. They can have discussions about different manufacturing constraints and design Bestic in such a way that is easier to manufacture.

Suggestions regarding quality

- Shorter the trimming time
  The trimming (defining the default parameters for the motors' positions) is included into the manual assembly. This process takes different amount of time for each Bestic, depending on the angle of the motors' axle and the position of the potentiometer. Mostly the time of trimming takes around 20

minutes in average. The trimming process could be automatized by built-in or external sensors. The external sensors could be built into a specific trimming box, and Bestic could make a predefined chain of movement until it reaches the sensors. In end of each move, when Bestic reach the specific sensor it can set the value in its memory, and then it can continue the trimming process.

Other possibility to improve and replace the built-in sensors with upgraded but more costly equipment, what make Bestic able to define its own position without manual intervention or without external sensors.

- Using a proper device to test the sound
  One of the problems in the final quality testing stage is that there is no appropriate device to measure the sound level of motors. The motors should not be noisy and their sound quality is measured manually, by an operator who listens to them one by one. This is a long and time consuming process that can be avoided by finding a proper device that measures the sound and noise level. Standardization of the process is an important issue here.

- There are some quality problems mostly with one of the motors
  This motor is a different type and design, a third company assembles a gearbox and the engine together and the EEPAB receive this assembled motor. In the past these parts were faulty in high ratio, after several meetings the quality has improved, but the requirements toward this part are still not defined. The properties of this motor could be measured accurately and exact values could be defined.

  Suggested testing techniques:
  - Sound testing, focused on the frequency of the noises
  - Electrical testing, if the electronics is faulty, during the running of the motor, abnormal or noisy signals appear
  - Mechanical testing, if the gearbox or the motor's mechanical parts have failures it can be measured by tracking the unusual changes in the round per minute and in the torque

  The application of all three testing methods together would drastically reduce the risk of motor failure and the faulty can be measured in an accurate and standardized way.

- Avoid letting a defect to pass to the next station
  Another point from the group is that the sound quality of the motors should be measured before they are assembled. All Bestic that do not pass the quality test are sent back to the production line to be disassembled. This is waste of time, money and material and can be avoided by not letting a defect to pass to the next stage.

Suggestion for forecasting

- Better forecasting techniques
  This is the second year of selling Bestic, it is in the introduce stage in the forecast timeline. New products are critical to the success of a company but inherently difficult to forecast. From the meeting, the group learns that the forecasting of Bestic is based on the figures that retailers provide. Sometime, the retailers are too optimistic about the Bestic selling. That is the reason the production line of Bestic has been suspended to end of August.

  The group's suggestion is in the introduction stage of Bestic's life cycle, the company can use the manual forecasting to do the customer/market research since there is just one and half years' data available for Bestic. Bestic AB can focus on having direct surveys and interviews on customers, wholesalers, and relations by gathering feedback from respondents to make a manual forecasting report.

- Performing qualitative forecasting methods
  There is another suggestion for forecasting also suggested. According to Chase et al. (2005), Delphi method is a group of experts that responds to questionnaire. Bestic AB can formulate a questionnaire that regarding the forecasting is submitted to the group. Thus, there is a learning process for the group as it receives new information and there is no influence of group pressure or dominating individuals. The company tries to reduce the level of forecast demand uncertainty by providing more freedom to the participants.

Suggestion regarding supplier strategy

- Establish a better relationship with suppliers
  Increase communication channels that could include creating sustained co-operative risk-sharing interactions and building a partnership or alliance with suppliers. Use the supplier-monitoring system to increase profitability, product quality and supplier performance.

4 Time Saving Estimation

Most of the suggestions do not need high investment. These recommendations could be applied with minor changes or only reorganization. The income effect of the project mostly comes from the time savings during the processes. The suggestions toward the reorganization of processing could reduce the actual length of time in some steps. For example in the motors, assembling the ferrit rings are not necessary and they are replaceable, it is possible to save 5-10 minutes on each motor which means, since each Bestic contains 4 motors, 20-40 minutes per robot. What makes up to 200-400 minutes per batch, which means 3-6 hours of labor work savings. The reorganization of the processes and make them more parallel, shorten the lead time of the assembly and lower the risks which are connected to the specific assembly

steps. Actual costs were not accessed during the project so only estimated calculations are possible.

5 Conclusions

Regarding the aim of the project, the group estimates that by implementing our suggestions EEPAB can reduce the lead time. Because of the limitations of information and the suspended of the production line, the group could not do a proper time and cost calculation. However, an estimation of manual assembly has been done.

The product manager of the Bestic should divide the final assembly stage to different parts. One operator can be responsible for assembling the motors, others for other parts. The manager can calculate the demand for one week and then the operator assembles as many motors as needed for that week. The whole process can take less than one day and after that the operator can do his own usual task. The assembled motors are stored for a short time and then they are sent to the final assembling stage. The same thing should be implemented for other parts like circuit boards and gears. When all the parts are ready, putting them together takes a short time and the production lead time will be reduced significantly. In all suggestions, both companies can use Fishbone diagram to help them find the root causes of problems and to analyze possible solutions. In the suggestion part, the group introduced a guideline for using this tool.

After exploring their production line, the group realized Bestic is not designed to be assembled smoothly. Bestic is a high-quality product and the group recommends the companies to be inspired of Jidoka, used in the Toyota Production System. Jidoka means building in quality and ensures right quality is at every stage. This will also lead to a more standardized process.

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