

# Staff cost reduction in the company through re-engineering of production layout

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Abstract  <p>Logistics – be it in production, transportation, warehousing or communication – is an essential part of today's business life. This makes the organization of logistical processes in companies a crucial issue on the one hand and a profitability booster on the other.</p> <p>The study focused on certain operations of a service company with aim to improve them and achieve cost reduction through those improvements.</p> <p>The aim was achieved by using observation and analyzing the process, searching for weaknesses and room for improvements and re-organization based on the theoretical framework of the thesis. This was followed by proposals for the steps needed to be taken in order to meet the aim.</p> <p>The study included costless implementation events in which the proposed changes were applied to the process. The study also included estimations of possible cost savings that could improve the balance sheet of the company.</p> <p>In addition, the conclusions of the study were in line with previous research findings stating that targeted corrections and improvements in the logistical processes could bring significantly bigger outputs for a company. This opened avenues for future studies that could focus on the creation of a framework for internal logistical processes in a service company or on the development of a quality management system that would include the mentioned framework.</p>		
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Miscellaneous		

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## **Acronyms**

JIT – Just in Time

TQM – Total Quality Management

ISO – International Standards Organization

ERP – Enterprise Resource Planning

BOM – Bill of Material

# 1. Introduction

## 1.1 Subject of the study

<Name of the company> is a Finnish cleaning company founded in <year> and operating all over Finland in a different kinds of premises including hotels, resorts, offices, cruise vessels. It employs over 1000 workers. Company's headquarter is located in <city>, Finland.

Company has many premises in a province of <province>. One of them is in a municipality of <city>. It is <client name>. Company provide there cleaning services in various premises including <premise 1>, <premise 2>, <premise 3>, <premise 4>and <premise 5>. First three categories cover most of company's activity in the area.

Check-out cleaning in these type of locations include cleaning itself and bed linen changing. Bags with certain content of linen are prepared on previous day and include certain items depending on location where they will be used.

The preparation process of those bags which can be described as assembling is an object of current study as well as staff costs related to that process is subject.

## 1.2 Motivation

The idea of the writing thesis on this topic appeared during working in a company and observing those everyday processes. Knowledge received in previous years of studying allowed to assume that some small changes can optimize process and improve its efficiency. Some measurements were made and then workers were asked to change some things and new measurements were made as well. And those rough results were already impressive. Because they have shown how such a tiny corrections and optimizations can bring significant changes in a big scale and raise a profitability of a premise for a company. So beyond this certain problem this study is able to demonstrate how valuable could be logistic improvements in a company and what results they could bring. So, probably not exact result but the idea can be transferred to another company's premises and beyond.

### 1.3 Targets & research questions

Main problem which need to be solved is inefficient usage of workforce, what leads to excess labor costs. The solution to be suggested in this study should include recommendations for modifying the layout of production process which involving that workforce. The questions to be answered in order to reach objectives of study are:

The main questions are as follows:

- *What are the problems of current layout, how does workforce utilized?*
- *What difference can new layout brings and how it will affect on issues above?*

Based on research findings this following question will be discussed

- *How the changes can be implemented, in what time, what inputs required and outputs expected?*

### 1.4 Research approach

This study include both qualitative and quantitative methods used in cooperation and on different stages of study. Whole process can be described as a case study involving measurements and observations followed by analysis of current problems. Further solution will focus on resolving found problems with a calculation of possible expected results shown in a potential savings on labor costs of the company.

Closer look on research methods will be taken in 'theoretical concepts' chapter.

### 1.5 Limitations of the study

The study will focus on certain process which take place on real premise and involves certain resources. It will not take into consideration other company's activities in this premise or similar activities but in other premises. This study also will not take into account any material management issues. As it was mentioned above, thesis results in a form of recommendations could be possibly transferred to other activities and premises as well as idea of improvements in general. But it will require modifications according to specific details of new premises and activities which are not part of this study.

## 2. Theoretical Concepts

In this chapter different theoretical concepts related to the study will be observed. List of those concepts includes following: Bill of materials, Modularity, operations management and its part quality management, lean philosophy and its practical example – JIT production, production layout, its goals, available layouts and their pros and cons.

### 2.1 Operations Management

Operations management is concerned with creating the products and services upon which we all depend. And creating products and services is the very reason for any organization's existence, whether that organization be large or small, manufacturing or service, for profit or not for profit. Thankfully, most companies have now come to understand the importance of operations. One survey of chief executive officers showed 43 per cent of them citing operations as the most important area of employee know-how. Also there is evidence that organizations are spending increasing amounts of money on improving their operations. Operations management is the largest segment of the market. This is probably because organizations have realized that effective operations management gives the potential to improve revenues and, at the same time, enables goods and services to be produced more efficiently. It is this combination of higher revenues and lower costs which is understandably important to any organization. (Slack, Chambers, Johnston, 2001, vii)

Operations management is about the way organizations produce goods and services. Everything you wear, eat, sit on, use, read or knockabout on the sports field comes to you courtesy of the operations managers who organized its production. Every book you borrow from the library, every treatment you receive at the hospital, every service you expect in the shops and every lecture you attend at university – all have been produced. While the people who supervised their 'production' may not always be called operation managers, that is what they really are. (Slack, Chambers, Johnston, 2001, 3)

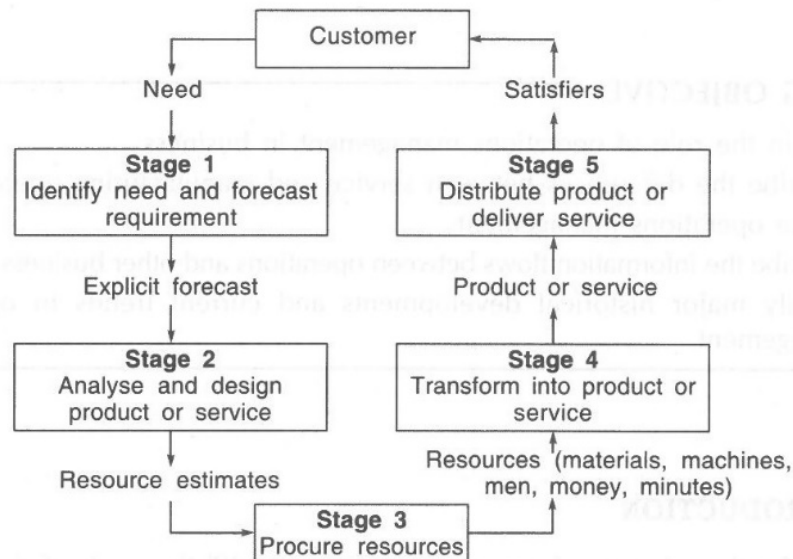


Figure 2. From Customer to Customer – Closed loop

Adapted from Khanna, 2015, 4.

Production and operations management deals with the Stages 2, 3 and 4 of Figure 2 which presents the creation of product. Operations management designs and operates productive systems. Since its ambit extends to large variety of functions, forming a comprehensive definition is difficult. Operations management is the planning, scheduling and controlling of the activities that transform inputs by way of raw materials, capital, machinery, labor, information and time into outputs in the form of products and services of higher value than the inputs. It may also be viewed as a value addition process. For instance, a metal sheet is formed into different shapes and then assembled with thousands of components to form an aircraft. The value of the aircraft is much more than the total sum of the raw inputs which go into its manufacture. The transformation may be physical as in the case of the aircraft; locational – transporting goods to a warehouse; physiological – healthcare; psychological – entertainment and education; and so on. Some definitions of operations management are:

A field of study that focuses on the planning, scheduling, use and control of a manufacturing or service organization, through the study of design engineering, industrial engineering, management information systems, quality management, production management, accounting and other functions as they affect the operation

**APICS Dictionary, 1995**

...is concerned with the efficient conversion of an organization's resources into the goods and services that it has been set up to provide

**Barnett, 1996**

...is concerned with creating, operating and controlling a transformation system which takes inputs of a variety of resources and produces outputs of goods and services which are needed by the customer

**Naylor, 1996**

...is concerned with all activities involved in making a product or providing a service: it is responsible for the transformation of various kinds of inputs to useful outputs

**Waters, 1991**

...is the management of systems or processes that create goods and/or provide services

**Stevenson, 1993**

Most of the definitions emphasize the transformational aspects of operations management. Operations management has interfaces with the rest of the managerial functions and cannot be viewed in isolation. (Khanna, 2015, 6-7)

Proper operations management can benefit the organization in several ways. Due to the effective and efficient processes, the costs of producing the products, as well as services, will reduce. The good quality and service, maintained by proper management, will increase the customer satisfaction, which will increase the revenue. Also the amount of capital invested/working capital/capital employed that is needed to produce the right amount of right quality products or services, can reduce via effective operations capacity, as well as by creating new, innovative ways to use their physical resources. It will also give a good, solid base of operations skills and knowledge, which might enhance the future innovations. (Slack, 2004, 7)

## 2.2 Quality management

The Oxford Dictionary describes quality as the standard of something as measured against other things of a similar kind; the degree of excellence of something.

Hoyle (2007, 10) gives following definition of quality: The degree to which a set of inherent characteristics fulfils a need or expectation that is stated, general implied or obligatory.

Hoyle also states, that not only the product or service has to meet certain requirements, but all techniques, methods, principles have to follow a direction: getting as close to the stated requirements as possible. He lists characteristics of quality of products and services, that customer might require. Product quality characteristics might be for example: availability, consumption, functionality, reliability, size,

strength, toxicity, transportability, weight. Service characteristics could be accuracy, credibility, effectiveness, flexibility, responsiveness, reliability, security. When these values are quantified with numbers, they become product or service requirements. Quantifying is important, because quality is subjective: one might be satisfied with meeting the needs by a certain degree and say, the product or service is of good/high quality, while other individual might consider the very same product or service of poor/low quality. (Hoyle, 2007, 15-20)

Other important issue is that a service, product or process can be of good quality one day, and be of poor quality the next. Quality does not only mean that the products and services provided have to have good quality, but the whole organization behind the concept, including people and the environment has to be of good quality. (Goetsch and Davis, 2013, 4)

So, based on statements above it can be concluded that quality management is a non-stop process in organization which aims to keep and improve product or service as well as environment where it is produced in order to meet and overmeet customer's expectations.

### 2.3 Total Quality Management

Total Quality Management (TQM) is an approach to the management of quality throughout the entire organization. It is a way of managing to improve efficiency, flexibility and competitiveness of a business as a whole.' TQM is often defined as a philosophy and a set of guiding principles that represent the foundations of a continuously improving organization. It is an application of quantitative methods and human resources to improve all the processes within an organization and exceed customer needs now and in the future. The principles of TQM are as follows:

1. Committed and involved management.
2. Focus on customers-both internal and external.
3. Effective involvement and utilization of entire work force.
4. Continuous improvement of business and production processes.
5. Treating suppliers as partners.

## 6. Fact-based decisions.

*Committed and involved management:* It is imperative that the top management is committed to the cause of total quality management. If the top management lacks commitment towards quality, the organization will merely pay lip service to quality. The top management must develop a clear vision and set long-term goals. Quality goals should be included in the business plan and an annual quality improvement programme should be established. Managers must take part in quality improvement programs. They should be visibly and actively engaged in the quality effort and should participate in training the employees on quality management. The top management should also ensure their attendance at award and recognition ceremonies related to quality as this can act as an inspiration and motivate the employees.

*Focus on customers:* Since quality is aimed at satisfying customer needs, it is important to focus on the customer and his stated or implied needs. Traditionally, companies have focused on product-out. They have considered the product as the mission of the firm. Companies make what they feel is a good product; and employees tend to believe that they have only to follow production manuals and procedures with little regard to the customer or his complaints. However, TQM focuses on market-in. It shifts the emphasis to feedback from the market. The job is well done only when the customer is fully satisfied. Every employee has a customer whom he must satisfy. The concept of customer is not restricted to external customers who may be the end-users of the product. Internally, each step in a process serves all subsequent processes and the philosophy is that all those who use the 'product or output' of any employee are his customers. He, in turn, may be a customer of other employees. For instance, a machine operator is the 'customer' as far as the maintenance crew is concerned. If they do not maintain the machine properly, the operator may fail to use it satisfactorily thus adversely affecting output. The employees thus have external as well as internal customers and it is imperative that each employee satisfy both his external and internal customers. For achieving total quality management, all employees irrespective of their level or functions must aim at customer satisfaction. Quality is everyone's business. The quality of in-process items is just as important as the quality of the finished product and the final product is bound to be of high quality if the quality of in-process items is maintained.

*Effective involvement and utilization of the entire work force:* TQM is an organization's wide challenge. All employees must be trained in TQM, statistical process control and other appropriate quality improvement skills. Since the output of each employee is used by someone else downstream of him in the process, it is important that the employees understand their customer's needs irrespective of whether the customer is internal or external. Employees should be motivated to accomplish desired goals and should be empowered to make necessary changes to effect improvements in the processes. Employees should come not only to do their jobs but also to think about how to improve their jobs.

*Continuous improvement of the business and production processes:* The organization must strive to continually improve its business and production processes. Generally, organizations are organized on a functional basis with vertical chains of responsibility and authority within the function. However, processes cut horizontally across functions. For example, the order filling process may be initiated by a sales executive from the marketing department. The order may then have to be vetted by the finance department to determine the credit worthiness of the customer. The production department would have to check if the items ordered are in stock or they may have to be produced. The order has to be assembled and dispatched to the customer by shipping and logistics. An invoice will have to be raised by the finance and the account for the particular order will be closed after the final payment is received by them. The order filling process can be improved only if all concerned departments cooperate, exchange information, and work concertedly. Unfortunately, in most functional organizations no one is responsible for the entire process. The adoption of a work team approach consisting of members from the concerned department can go a long way to achieve improvement. The process of improvement should not be a one-time measure but a continuous process. The Kaizen approach of "do it better, make it better, improve it even if it isn't broken, because if we don't, we can't compete with those who do" should be followed as against the Western philosophy which advocates "if it ain't broke, don't fix it."

*Treating suppliers as partners:* Traditionally, an adversarial relationship has existed between suppliers and customers with a feeling of mistrust that each one is being short changed by the other. Sometimes organizations encourage purchases from a

large number of suppliers in order to promote competition amongst them and to bring down prices. However, most quality problems originate from variations both in the process and in the materials. The focus should shift to quality and life-cycle costs rather than price. Organizations should nurture fewer suppliers and have long-term partnering relationships with them. This will ensure quality, lesser variations and a better understanding between the organization and its suppliers. (Khanna, 2015, 82-84)

## 2.4 Quality systems. ISO 9000 quality system

Improving quality is not something that happens simply by getting everyone in an organization to 'think quality'. Very often people are prevented from making improvements by the organization's systems and procedures. Indeed, there is a belief that direct operators can only correct, at the moment, 15 per cent of quality problems; the other 85 percent are management's responsibility because they are due to 'the system' or the lack of one.

A quality system is defined as:

*the organizational structure, responsibilities, procedures, processes and resources (or implementing quality management).<sup>1</sup>*

According to Professor Barrie Dale of the University of Manchester Institute of Science and Technology:

*The quality system should define and cover all facets of an organization's operation, from identifying and meeting the needs and requirements of customers, design, planning, purchasing, manufacturing, packaging, storage, delivery and service, together with all relevant activities carried out within these functions. It deals with organization, responsibilities, procedures and processes. Put simply, a quality system is good management practice. (Hall, R., 1992, 142.)*

The documentation which is used in a quality system can be defined at three levels:

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<sup>1</sup> International Standards organization, ISO 8402, 1986

Level 1 *Company quality manual*. This is the fundamental document and provides a concise summary of the quality management policy and quality system along with the company objectives and its organization.

Level 2 *Procedures manual*. Describes the system functions, structure and responsibilities in each department.

Level 3 *Work instructions, specifications and detailed methods (or performing work activities)*.

There can also be a database (level 4) which contains all other reference documents (forms, standards, drawings, reference information, etc.).

The ISO 9000 series is a set of worldwide standards that establishes requirements for companies' quality management systems. ISO 9000 is being used worldwide to provide a framework for quality assurance. Most countries have their own quality system standards which are equivalent (usually identical) to the ISO 9000 series. By 2000, ISO 9000 had been adopted by more than a quarter of a million organizations in 143 countries.

ISO 9000 registration requires a third-party assessment of a company's quality standards and procedures and regular audits are made to ensure that the systems do not deteriorate.

The ISO series provides detailed recommendations for setting up quality systems:

**ISO 9000** Deals with ... 'quality management and quality assurance standards and guidelines for selection and use'.

**ISO 9001** Deals with ... 'quality systems model for quality assurance in design/ development, production, installation and servicing'.

**ISO 9002** Deals with ... 'quality systems model for quality assurance in production and installation'.

**ISO 9003** Deals with ... 'quality systems model for quality assurance in final inspection and test'.

**ISO 9004** Deals with ... 'quality management and quality system elements: guidelines'.

The purpose of ISO 9000 is to provide an assurance to the purchasers of products or services that they have been produced in such a way that they meet their requirements. The best way to do this, it is argued, is to define the procedures, standards and characteristics of the management control system which governs the operation. Such a system will then help to ensure that quality is 'built into' the operation's transformation processes. This is why ISO 9000 is seen as providing benefits both to the organizations adopting it (because it gives them detailed guidance on how to design their control procedures) and especially to customers (who have the assurance of knowing that the products and services they purchase are produced by an operation working to a defined standard). The following are just some of the advantages associated with ISO 9000:

- Many operations do find that it provides a useful discipline to stick to 'sensible' procedures.
- Many operations have benefited in terms of error reduction, reduced customer complaints and reduced costs of quality.
- The ISO 9000 audit (when an organization is inspected to see if it warrants the award of the ISO, or local country, accreditation) is generally accepted and takes the place of other audits such as customer audits.
- Adopting ISO 9000 procedures can identify existing procedures which are not necessary and can be eliminated.
- Gaining the certificate demonstrates to actual and potential customers that the company takes quality seriously; it therefore has a marketing benefit. (Slack, Chambers, 2001, 687-688)

The Figure 1 shows the meaning of process-based quality management system, illustrating the necessary steps of continuous improvement, and how and which stage is inevitable to cooperate with customers.

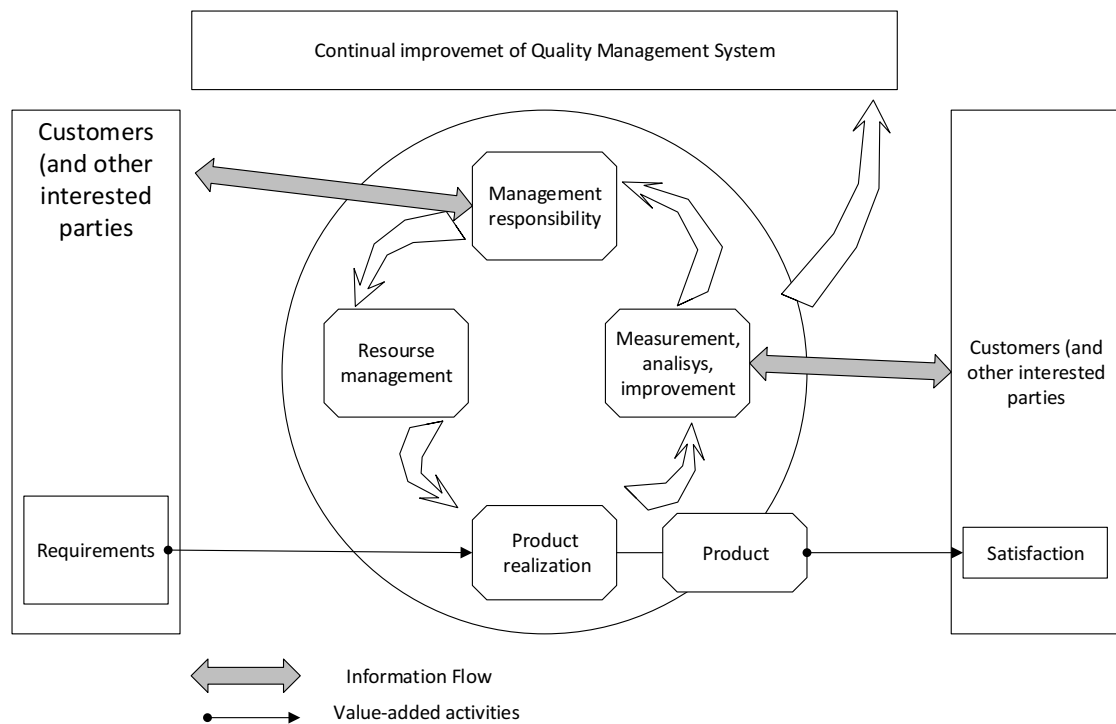


Figure 1 Model of Continual Improvement of Quality Management System

Adapted from ISO 9001-2008

## 2.5 Lean philosophy

Throughout industrial history few words have become as powerful as the word *lean*. Today almost everyone has heard this word used in some sort of context. Many of us probably have a book or two that explains this very simple word in excruciating detail. But what we may not appreciate is that this word, which at its core deals with the relentless pursuit and removal of waste, is really a powerful *business* philosophy and mindset that can mean the difference between success and failure in today's hypercompetitive world.

The reality of lean is that while most managers likely have a basic understanding of the concept, few organizations have truly achieved lean, partly because the pursuit of lean is a never-ending journey. Furthermore, lean adopters, as well as the research and writing that support the intellectual domain of lean, often focus narrowly on the internal operations of manufacturers. We conveniently ignore the hundreds of thousands of service and nonprofit organizations that just might benefit from the applica-

tion of lean principles. And the idea that lean is an end-to-end concept where everyone along a supply chain has a role to play also gets lost too frequently in the shuffle. (Trent, 2008, 3)

A logical place to begin is the definition of lean. Much like Total Quality Management, the perspective is that lean is a business philosophy rather than a set of tools and techniques. At a very high level lean is the *relentless pursuit of eliminating waste across an extended supply chain*. Over the years many observers have offered their opinion on this topic, which Table 1 summarizes. One thing that readers should notice is that most of these viewpoints at least include the subject of waste, something that will be elaborated upon shortly. (Trent, 2008, 4)

Table 1. Different perspectives of lean

Lean thinking James Womack and Daniel Jones	Lean thinking seeks to eliminate waste, specify value, line up value-creating actions in the best sequence, conduct those activities without interruption whenever someone requests them, and perform them more and more effectively.
Lean John Shook	A philosophy that seeks to shorten the time between the customer order and the shipment to the customer by eliminating waste.
Lean manufacturing www.isixsigma.com dictionary	Initiatives focused on eliminating all waste in manufacturing processes.
Lean John Kerr	Lean is essentially a business discipline that is built around obeying only the customer's demand signals and getting rid of waste everywhere in the supply chain.
Lean Lean Advisors, Inc.	Lean is simply a thought process, not a tool, used to look at your business, whether it is manufacturing, service, or any other activity where you have a supplier and a customer/receiver. The thought processes within lean are identifying waste from the customer perspective and then determining how to eliminate it.
Lean National Institute of Standards and Technology	A systematic approach to identifying and eliminating waste through continuous improvement, flowing the product at the pull of the customer in pursuit of perfection.
Lean Anonymous	Lean is a set of tools to reduce waste, where waste is defined as any nonvalue-added process for which the customer is not willing to pay.

Lean is about doing more with less: less time, inventory, space, labor, and money. Lean manufacturing is a commitment to eliminating waste, simplifying procedures, and speeding up production. Lean manufacturing, in its most basic form, is the systematic elimination of waste-overproduction, waiting, transportation, inventory, motion, overprocessing, defective units-and the implementation of the concepts of continuous flow and customer pull. (Benton, 2014, 5)

Five areas drive lean manufacturing/production:

1. Cost
2. Quality
3. Delivery
4. Safety
5. Morale

Just as mass production is recognized as the production system of the 20th century, lean production is viewed as the production system of the 21st century. It has been shown from testimonials that the establishment and mastering of a lean production system allows manufacturing organizations to achieve the following benefits:

- Waste reduction of 80 percent
- Production cost reduction of 50 percent
- Manufacturing cycle times decreased of 50 percent
- Labor reduction of 50 percent while maintaining or increasing throughput
- Inventory reduction of 80 percent while increasing customer service levels
- Capacity in current facilities increased by 50 percent
- Higher quality
- Higher profits
- Higher system flexibility in reacting to changes in requirements improved
- More strategic focus

- Improved cash flow through increasing shipping and billing frequencies

However, by continually focusing on waste reduction, there is truly no end to the benefits that can be achieved. The five elements of enabling a lean approach are:

1. Specify value
2. Identify and map the value stream
3. Efficient flows
4. Pull philosophy
5. Quality perfection

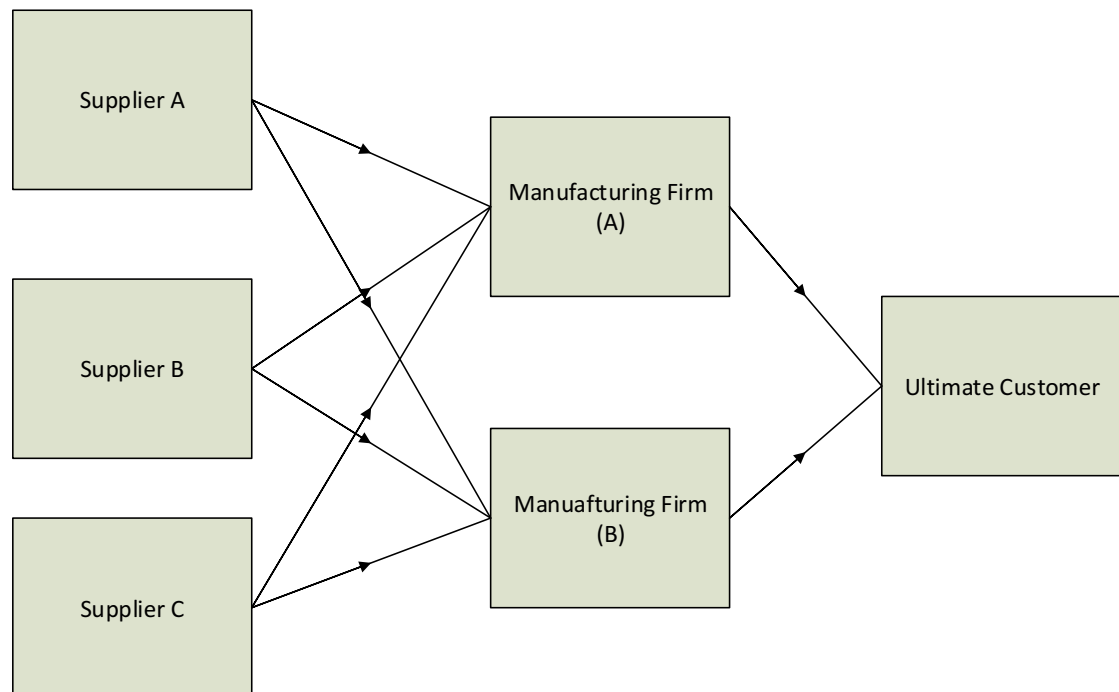


Figure 2 Typical Supply Chain Focused Manufacturing network

Many practitioners and academicians believe that the future of global manufacturing planning and control must be lean, adaptable, and integrated. However, there is no consensus on how integration is defined. Integration is sometimes described as linking the product design, the manufacturing process and manufacturing planning and control using information technology as shown in Figure 2. At the same time, many

organizations are now searching for ways to integrate all their manufacturing activities and connect them with the entire supply chain by using fully integrated enterprise resource planning (ERP) systems. (Benton, 2014, 6)

## 2.6 Just-in-time Production

Just-in-time (JIT) is an integrated set of activities designed to achieve high-volume production using minimal inventories of raw materials, work in progress, and finished goods. Parts arrive at a workstation just when they are required and move through operation quickly. It is based on the logic that nothing will be produced until it is needed. JIT works on a pull system. When an item is sold, the market pulls a replacement from the last workstation, that is, finished goods. The last workstation in turn pulls parts or subassemblies from the station upstream of it and assembles another unit. The upstream station in turn pulls from the station immediately upstream of it and so on back to the release of raw materials. Figure 3 (Adapted from Khanna, 2015,441) shows the pull system schematically. For the pull system to work smoothly, high quality, strong vendor relationship and a fairly steady demand is required. (Khanna, 2015, 441)

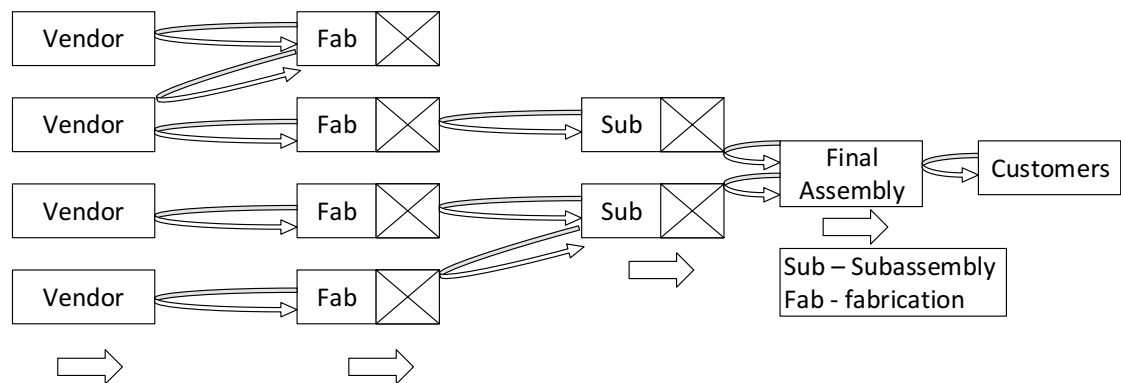


Figure 3 Schematic diagram showing the Pull System

JIT was originally developed by taking a hint from the way that U.S. supermarkets do product replenishment. JIT in the Toyota Production System gives the Japanese auto industry an edge in the market and is adopted by many companies in the manufacturing industry.

"JIT (Just-in-Time)" is said to be a model system of the manufacturing industry that was formulated by Mr. Taiichi Ohno as the Toyota Production System. Behind the

creation of JIT was the issue of whether the Japanese auto industry could survive after the war. Facing the presence of the U.S. auto industry that produced twice as much as the Japanese auto industry did, the Japanese government actually discussed whether or not auto manufacturers were really needed in Japan. (Imaoka, 2012)

JIT can be viewed either as Big JIT or Little JIT. Big JIT is also referred to as lean production and aims at eliminating waste from all aspects of the company's production activities - human relations, vendor relations, technology and the management of materials and inventories. Little JIT takes a narrow view of providing goods and service resources where and whenever needed. (Khanna, 2015, 441)

### Philosophy

The Toyota production system or JIT was developed to improve quality and productivity and is based on two philosophies that are central to the Japanese culture – elimination of waste and respect for human beings. The JIT system eliminates waste, exposes problems and bottlenecks and achieves streamlined production. It requires employee participation, industrial engineering basics, total quality control and a system of continuing improvement. JIT works best in a stable environment and where the demand is fairly steady. It advocates small factories as opposed to large integrated units and works in small lot sizes, ideally of one unit each. Though it can be applied to any form of production, it is best suited for repetitive production. (ibid., 441)

### Elimination of waste

Waste as defined by Fujio Cho, Toyota's president, is 'anything other than the minimum amount of equipment, materials, parts and workers (working time) which are absolutely essential for production.' (Khanna, 2015, 442)

Waste has been categorized into seven types by Ohno;

1. Waste from overproduction
2. Waste of time (waiting)
3. Transportation waste
4. Inventory waste
5. Processing waste

6. Waste of motion
7. Waste from product defects

In continuation, Khanna (2015, 442) states the seven elements to eliminate waste:

1. Focused factories
2. Group technology
3. Quality at the source
4. JIT production
5. Uniform plant loading
6. Kanban production control system
7. Minimized set up times

*Focused factories:* The Japanese build small, specialized plants, often producing just one item. They do not build large, vertically integrated plants. They find it difficult to manage large operations and the bureaucratic systems associated with large plants. It is not in conformity with their management style. Toyota has 12 small plants located in and around Toyota City. These small plants designed for a single purpose can be constructed and operated more economically. In Japan most plants have between 30 and 1000 workers.

*Group technology:* Jobs or products which pass through similar operations are identified and grouped into families. Machines and equipment required to carry out these operations are grouped together to form a group or a cell and are laid out together in an area reserved for the group. The group consists of a team of workers who work solely in the group. The workers share a common product output target and are responsible for achieving it. The group develops multi-skills and workers work in close cooperation with each other to achieve their target. The groups are independent of each other and have the autonomy to pace their work according to their perceived requirements.

The jobs are completed in the cell and do not have to move from department to department. This eliminates movement between departments, reduces waiting time between operations as queues do not build up, reduces inventory and reduces the

number of workers required. The workers are multi-skilled and can handle the machines and equipment in the cell. They enjoy greater job security due to their multi-skills. Group Technology facilitates making batches and lots of single unit size.

*Quality at the source:* Quality at the source implies getting it right, the first time. JIT does away with inspection. The worker is responsible for quality. If something goes wrong, the worker stops the line immediately and a light indicates the station, where trouble has occurred. The problem is attended to and the line resumed only after the fault is rectified. When Toyota started the system, there were frequent interruptions, but with the passage of time as more and more problems got ironed out, the line rarely stopped. The worker is his own inspector and is responsible for quality. Since production is being done in very small lots, the worker can concentrate on the quality of what he produces. Toyota also introduced Jidoka. This involved designing machines which had an inbuilt capacity to detect any faults in the product and to respond suitably when such faults were detected. The attempt was to make machines mistake proof so that workers do not have to baby sit the machines. When the line is stopped due to some problem the workers are empowered to do their own maintenance and housekeeping till the line restarts.

Employees are involved in quality management. Quality circles and continuous process improvement are practiced. JIT advocates total quality management. Since the work-in-progress is low, it is easy to get feedback on errors. A proper analysis of all defects must be carried out and causes determined.

*Just-in-time production:* JIT produces what is needed and when it is needed. Any extra production is viewed as waste. JIT can be applied effectively to repetitive manufacturing. It does not require high volumes and can be applied to any segment of business which is repetitive in nature. The ideal lot size is one. Even when workstations are dispersed geographically, the movement is minimized and the quantities moved are kept small – generally not more than one tenth of a day's production. Vendors ship several times a day to keep lot sizes small and inventories low. The aim is to drive all inventory queues to zero. This reduces the investment in inventory and decreases lead time. Having minimal inventory also helps to identify problems which otherwise remain hidden in excess inventory and stock. JIT's minimal inventory levels

are in sharp contrast to traditional thinking of keeping inventory and safety stocks just in case things go wrong.

*Uniform plant loading:* Fluctuations in demand cause fluctuations in production plans. The changes in the end product demand have a ripple effect on the upstream processes. JIT works efficiently when the production rate is uniform. Toyota achieves this by freezing monthly demand and producing a mix of products to ensure that any fluctuations can be met. When the production rate is uniform, it is easier to implement JIT.

*Kanban production control system:* Toyota introduced the Kanban system of production control. *Kanban* in Japanese means instruction card. Kanbans are only used to signal. Or authorize movement of parts from an upstream workstation to a downstream workstation or to act as release for production order to an upstream workstation. In paperless organizations, Kanbans may be replaced by crates or bins in which parts are transported from one workstation to another. In some cases, squares are marked on the ground where stores are to be placed. An empty square signals that parts are required at that particular workstation and are moved from the preceding upstream station. Lights, placards hung on posts or on storage bins, colored golf balls or any other convenient method of signaling can be adopted.

*Minimized set up times:* JIT advocates small lot sizes and mixed production on the line. It is important to reduce the set up times so that delays do not take place because of set up. In the late 1970s, a team of operators at Toyota were able to change an 800 ton press in 10 minutes compared with six hours for American companies. Set up activities were divided into external activities and internal activities. External activities are those set up activities that can be performed while the machine is running while internal set up activities are those that can be carried out only when the machine is stopped. The use of duplicate tool holders also helps to save set up times. (Khanna, 2015, 442-446)

*Kaizen* is an important part of Toyota work culture. Kaizen means continuous improvement in the personal life, home life, social life and work life. When Kaizen is applied to the work place it means continuous improvement for workers and managers.

Kaizen involves everyone in the organization to make improvements without large capital investments. The basics for JIT improvements are the five Ss. These are given in Table 2.

Table 2 The 5 S concept

Adopted from Khanna, 2015, 447

Name (Japanese)	Interpretation	Description
<i>Seiri</i>	Organization	Separate out all the things that are not necessary and eliminate them or tidy them away
<i>Seiton</i>	Neatness	Arrange the essential things in order so that they can be quickly and easily accessed and put away
<i>Seiso</i>	Cleaning	Keep machines and working environment clean
<i>Seiketsu</i>	Standardization	Make cleaning and checking a routine practice; maintain a pleasant environment
<i>Shitsuke</i>	Discipline	Standardize the previous four steps and constantly improve them

The five Ss are about doing the basics. They provide a foundation on which to build other quality activities. With a tidy, disciplined environment, you can see many of the things which need further attention. Companies that live in chaos, no matter how fashionable it is these days, spend a lot of time in unproductive activities. Implementing the five Ss requires full cooperation of all involved. (Khanna, 2015, 446)

## 2.7 Production Layout

Selecting process structures for the various processes housed in a facility is a strategic decision, but must be followed by a more tactical decision-creating a layout. A *layout* is the physical arrangement of operations (or departments) created from the various processes and puts them in tangible form. For organizational purposes, processes tend to be clustered together into operations or departments. An *operation* is a group of human and capital resources performing all or part of one or more processes. For example, an operation could be several customer service representatives in a customer reception area; a group of machines and workers producing cell

phones; or a marketing department. Regardless of how processes are grouped together organizationally, many of them cut across departmental boundaries. The flows across departmental lines could be informational, services, or products. Process structures that create more flows across departmental lines, as with job or batch processes, are the most challenging layout problems. (Krajewski, Ritzman, Malhotra, 2013, 117)

What is usually expected to accomplish with an appropriate production layout design? To answer this question following points should be considered:

*Product cost.* Reducing the product cost is often mentioned as a goal for new layout. However, unless present operation is chaotic, it will almost impossible to reduce the product cost significantly only by designing a new layout.

To estimate total labor hours, there can be constructed spreadsheet and be used to justify or reject a change in a layout. Before-an-after spreadsheets can be used to compare the labor hours for old and new layouts. (Cedarleaf 1994, 141.)

*Product expansion.* Increasing the output capacity of the manufacturing area may be the most common goal for a new layout. (ibid., 142.)

*Travel distance.* Reducing the material travel distance between stations is another goal that is often set for a new layout. It even may be proposed that large section of facility be moved, at enormous cost, merely to achieve the close proximity of two departments. (ibid., 143.)

*Flow.* Reducing the flow time should be dominant goal when you are designing a new layout. Improving the flow of manufacturing system can affect the operation of the entire facility. Before start mechanics of designing the new layout, it is recommended to concentrate on improving the flow time of the manufacturing system. Many times, it can be shortened by simple method improvements, such as changing to smaller batch sizes or kitting the parts for each assembly operation. Unless significant changes in the flow time are made, the new layout by itself will not do it. (ibid., 143.)

*Supervision.* This is seldom mentioned as a goal of new layout, but in many ways, supervising an area can be easy or hard, depending upon how it is laid out. These items make it difficult for a supervisor to control an area efficiently:

- The area is fragmented in many subdivisions
- The area is very long and narrow
- The area is distant from supervisor desk
- The area has many rooms containing operations that cannot be easily observed from the outside
- The material flow is difficult to follow, and operations must be trained to expedite some units and not others.

The supervisor himself may not notice that these difficulties exist. So supervisor must be advised of potential problems while layout is under design. (ibid., 144.)

Research with many companies reveals that many advantages are possible when firms pay close attention to physical layouts. It is not exaggerating to say that improvements to a physical layout can lead to some positive outcomes, including reduced production cycle times, reduced work-in-process inventory, and reduced floor space requirements. Other outcomes include less material handling, less complex scheduling and control systems, improved product quality, enhanced operating flexibility, and lower total costs. Perhaps most importantly, certain physical layouts create a stronger ownership among employees for the success of a product from start to finish. (Trent, 2008, 83)

Layouts are generally defined by the pattern of work flow. The three basic formats are process layout, product layout and fixed position layout. Hybrid layout or group technology or cellular technology layout is a combination of process and product layouts. (Trent, 2008, 212)

Process layout: It is also called functional layout. In this type of layout all machines and equipment which perform the same function are grouped together. For example, all lathes may be placed in a machine shop, all welding plant may be grouped together in welding shop, and painting equipment may be available in a painting shop and so on. The Job is routed to various shops as required. The set up is ideal for batch production. In service facilities, hospitals provide a good example of process based or functional layout. The wards and departments provide specific medical care, like the surgical ward looks after the surgery cases, and the obstetrics ward provides care to maternity and neonatal cases and so on. (Trent, 2008, 212)

Process layouts aim at minimizing the costs of interdepartment movement. The cost of movement is the number of loads multiplied by the distance between departments and the cost of moving one load. The loads are standardized. They can be in terms of a single unit, a bin load or a pallet load of material or a crate of materials that is normally moved from one location to another. For example, in an automobile factory, a single car may constitute a load. In a manufacturing unit making carburetor subassemblies, a crateful of carburetors may constitute a load. (Trent, 2008, 213)

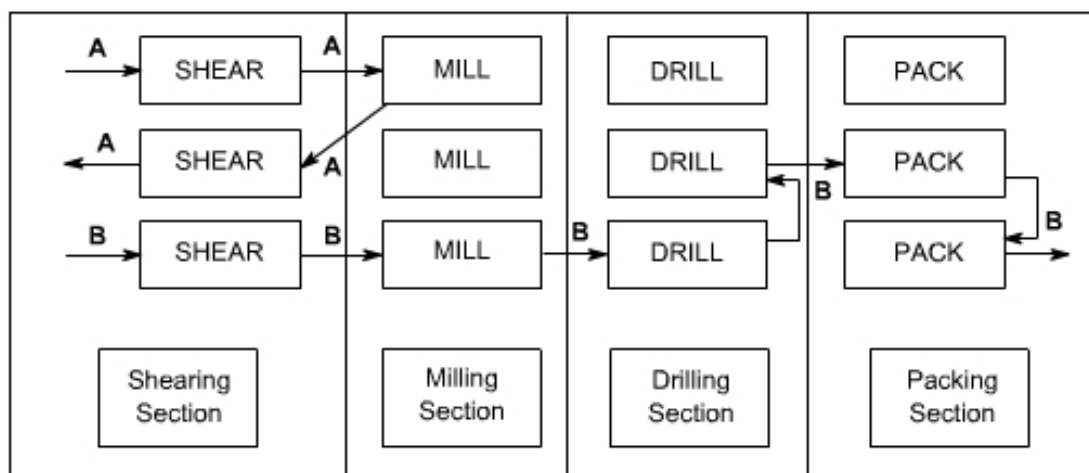


Figure 4 An example of process layout for two products

**Product layout:** It is also referred to as the flow line layout. In this layout, equipment and work processes are arranged in the progressive steps in which the product is made. The work flow in effect follows a straight line. Automobile production on an assembly line, chemical plant, cement factory, and a steel plant are all examples of such layouts. The layout is particularly suited for flow and continuous production process structures. (Trent, 2008, 212)

In a product layout workers and machines are arranged in a line according to the sequence of operations required for assembling or making a product. If a particular process is to be repeated, the machines required are duplicated along the line to avoid back tracking. The layout is determined by the sequence of operations that need to be performed. Precedence lays down what operations must precede others, what can be done concurrently and what must wait. The precedence requirements form an important input in product layout. The layout effectively follows a line and an assembly line is a typical product layout. The assembly line is used for producing

high volumes of standardized goods. The job is broken down into its smallest indivisible portions called work elements. A work element can be performed by one worker or at one workstation and cannot be split any further. But more than one work element can be performed by a worker as the job passes through his workstation. An assembly line in its simplest form consists of a moving conveyer with workstations located along it. A workstation is any area along the assembly line which requires at least one worker or one machine. The jobs move on the conveyer. The conveyer stops for a fixed duration referred to as the cycle time, during which all workstations perform the work elements on the job piece before them. When the fixed duration is over, the conveyer moves again transferring each job to the next workstation and so on. The job is finally completed at the last workstation. Since the process is a continuous one, a finished product rolls off the line at the end of every cycle. The layout attempts to group work elements and assign them to workstations in such a manner that the time taken at each workstation to complete the work elements is the same. This will ensure smooth flow of work, and neither the job nor the worker will have to wait. While grouping the work elements, precedence relationships and any other restrictions will have to be kept in mind. The process of equalizing the work content at each workstation is called line balancing. (Trent, 2008, 219)

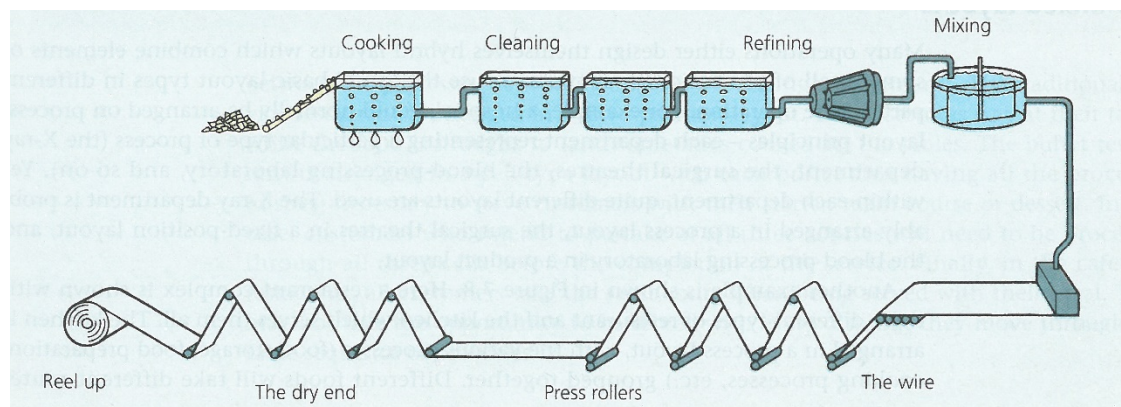


Figure 5 An example of line (product) layout: paper-making process

(Source: Slack, 2001, 193)

**Fixed position layout:** In a fixed position layout, the product stays fixed at a particular location because of its bulk and size, and worker teams and equipment move to the work site to work on it. Examples of such layouts are ship building yards, bridge con-

struction sites and so on. The layout is suited for project and high tech job shop production processes. In this kind of layout the product may be visualized as the hub of a wheel with materials and equipment arranged concentrically around it in the order of use and movement. Equipment that is used frequently is positioned closer to the product. Materials are arranged according to their technological priority. (Trent, 2008, 212). Schematic example of fixed position layout is presented in Figure below.

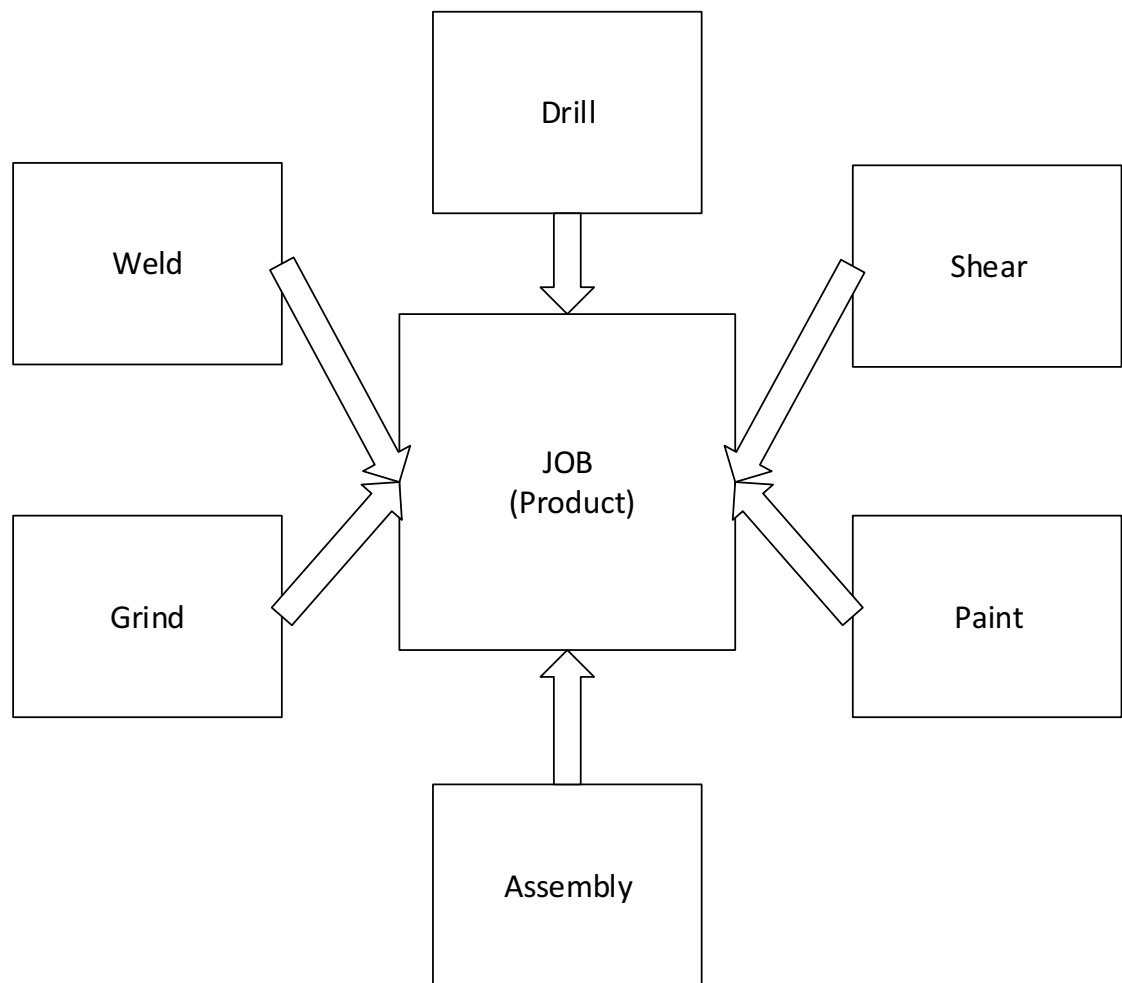


Figure 6 Scheme of possible fixed position layout

***Hybrid layout:*** It is also referred to as cellular layout or group technology layout. In this type of layout dissimilar machines are grouped together into a work center which manufactures a family of products having similar processing requirements though not necessarily in the same order. The layout is similar to a process layout in as much as the machines perform different processes and is similar to the product layout as the machines are grouped to perform processes required by a limited set of products or a family of products. (Trent, 2008, 213)

## 2.8 Bill of Material

An inclusive definition of a final product includes a list of the items, ingredients, or materials needed to assemble, mix, or produce the end product. This list is called a bill of material (BOM). The BOM can take several forms and be used in a number of ways. It is created as part of design process and is used by manufacturing engineers to determine which items should be purchased and which items should be manufactured. Production planning use the BOM in conjunction with the MPS to determine the items for which purchasing requisitions and production orders must be released. The BOM is also used by accounting for project costing.

The BOM is thus a basic required input for many production planning and control activities, and its accuracy is crucial, in computerized system, the BOM data are contained in BOM files, a data base organized by the BOM processor that also produces the BOM in various formats required by the organization. The way in which BOM files are organized and presented is called the structure of the bill of material. The simplest format is two-level BOM as depicted in Figure. It consists of a list of all components needed to make the end item, including for each component (1) a unique part number, (2) a short verbal description, (3) the quantity needed for each single end item, and (4) part's unit or measure. As an example, Figure 1 represent that an auxiliary power unit and a turbine housing is needed to make J750 engine assembly.

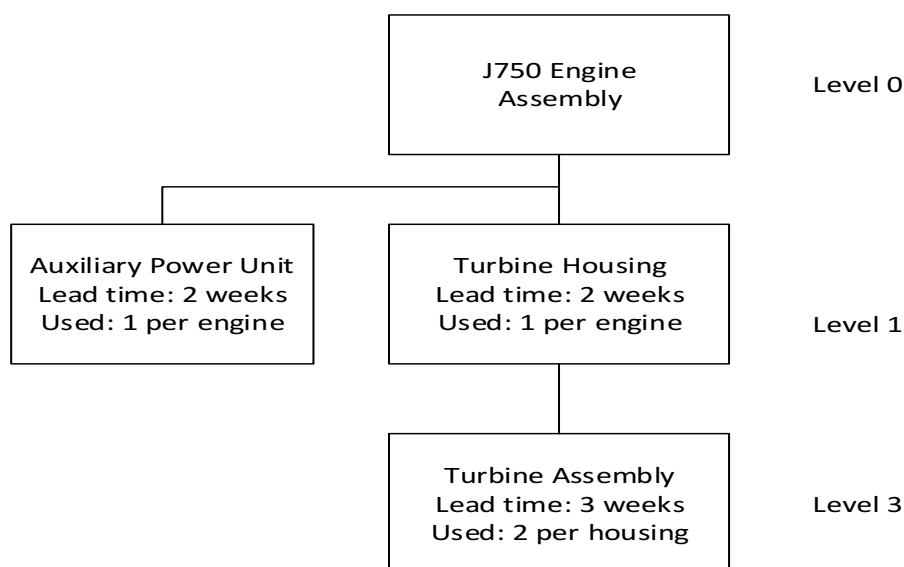


Figure 7. J750 Engine product structure

Adapted from Benton, 2014, 83.

The manufacturing and purchasing lead times required to produce the turbine housing and the turbine assembly components are indicated in Figure 7. Note that two weeks are required to fabricate the turbine housings and that all of the turbine housings must be delivered to the engine-assembly plant before the week in which they are to be used. It takes three weeks to produce one lot of turbine assemblies, and all of assemblies that are needed for production of turbine housings for a specific week must be delivered to the subassembly department stockroom for the turbine housing before the usage week. (Benton, W 2014, 82-83)

In real bill of material amount of materials needed for certain product could be counted in hundreds, thousands and more and that makes a task of ideal production process very difficult and challenging.

## 2.9 Modularity

In order to satisfy wide array of customers, companies sometimes provide a variety of model options for product. Variety can be expensive if each model has many unique parts or required different processing or costly production changeovers. An efficient way to provide product variety at low cost is to use modularity. This is done by dividing the product into generic parts or modules and then determining which variations of each module would be desirable from a marketing and manufacturing viewpoint. Thus, the product can be customized for the customer at little additional material cost.

Modular design can be advantageous in two other ways. First, if alternative versions of a module are packaged exactly the same way and connected to the rest of the product the same way, other components of the product do not have to be specially designed for each version of the module, and the assembly processes for different modules of the product can be identical. If two alternative versions of the same module have naturally different shapes and sizes, they can be encased in the same housing to make them interchangeable in the assembly process. For example, computer manufacturers use a variety of hard drives and central processor units. Even though their working elements are different, they are housed in a same-shaped housings with the same connecting mechanism to make assembly identical for all versions.

This approach is especially helpful in automated or robotic operations; the robot does not need to adjust to different shapes or be reprogrammed; as long as correct component is there, the processing is the same for alternative modules. A second benefit of modularity is that combining several functions into single module simplifies testing, especially if the modules are enclosed in identical housings. (Martinich, J. 1997, 225-226)

## 2.10 Research methods

The reason for carrying out a research is to provide knowledge. A research is therefore a procedure during which data is collected and analyzed in order to provide an answer for a particular research question. Requirements for research should be based on empirical data and previous researches, should be objective, valid, reliable and making generalizations possible. (Dahlberg & McCaig, 2010, 14)

According to Denscombe (2003, 231) there are two main research methods to be carried out: qualitative and quantitative research. He also claims, that researches usually cannot be stated being only one or the other one. In his opinion good research should be done by using both methods and the assumptions made with the use of the two methods usually overlap.

However there are main differences as well between those two methods. The target of quantitative method is to translate the received information into numbers, so that they can be processed with statistical procedures (usually with the use of computer and software). On the other hand, qualitative method turns received information, research results into form of words. It has to be noted, that the source of information might not be different regarding the two methods, only the transformation of the information: into words or numbers. When talking about quantitative data, it is easy to see, since they are the result of statistical programs, they are most easy to analyze, compare with each other, however the use of qualitative data is most suitable to descriptions. Since quantitative data is dealing with numbers, the scale of those researches tends to involve a lot of samples that can be easily handled with software and computer. The nature of qualitative data however only allows a smaller, limited sample size. It is important to see, that however most people might think that be-

cause of the bigger sample size, quantitative data might be more reliable, than qualitative, that cannot be stated so simply. Research focus in the case of quantitative method usually is narrow, focusing on specific issues and specific factors. On the other hand qualitative method tends to have a wider focus, and tries to see things in their context, how things are connected to each other. It is easy to anticipate, that quantitative research is designed well before the research actually takes place, and qualitative research tends to shape during the research process itself. Another difference is, that quantitative data (and dealing with numbers) tends to be more impersonal, and the researcher might not be involved “emotionally” in the research, that allows him or her to be more objective (only of course, if the research method’s validity and reliability has been tested and proved), on the other hand, qualitative research involves the researcher on greater interest/engagement. (Denscombe, 2003, 232-235)

The main methods for collecting qualitative data are:

- Individual interviews
- Focus groups
- Observations
- Action Research

In this study Observation method will be used to describe a current situation and layout particularities related to a case.

As a quantitative method, measurements will be used. Data gathered then will be used in calculations and analysis in order to answer research questions.

### **3. The study**

In this chapter the analysis of current situation with the process in focus will be presented through description of the observations and explanation in terms of theoretical concepts from previous chapter. Later developments and improvement steps will be presented in order to utilize problems of current situation. Chapter ends with an introduction of implementation events.

### 3.1 Current situation analysis

Description of current state of the bags preparation process is a result of observation made during the winter season 2017-2018. Observation is presented in a form of summary touching the issues bothering the process and affecting on it.

Depending on a location where linen bags are going to be utilized next day, they can be categorized into 4 categories. Those categories also will refer to certain content of the bags. Content and categories are presented in a Table 3.

Table 3 Content (BOM) of the linen bags according to categories by destination

#	Category	Content (BOM)
1	<Bag type 1>	<ul style="list-style-type: none"> <li>• 4 shower towels</li> <li>• 4 facial towels</li> <li>• 4 pillowcases</li> <li>• 4 duvet covers</li> <li>• 2 small sheets (185 cm wide)</li> <li>• 1 big sheet (260 cm wide)</li> <li>• Matt towel</li> </ul>
2	<Bag type 2>	<ul style="list-style-type: none"> <li>• 4 shower towels</li> <li>• 4 facial towels</li> <li>• 4 pillowcases</li> <li>• 4 duvet covers</li> <li>• 2 small sheets (185 cm wide)</li> <li>• 1 big sheet (260 cm wide)</li> <li>• Matt towel</li> </ul>
3	<Bag type 3>	<ul style="list-style-type: none"> <li>• 4 facial towels</li> <li>• 4 pillowcases</li> <li>• 4 duvet covers</li> <li>• 4 small sheets (185 cm wide)</li> </ul>
4	<Bag type 4>	<ul style="list-style-type: none"> <li>• 4 shower towels</li> <li>• 4 facial towels</li> <li>• 4 pillowcases</li> <li>• 4 duvet covers</li> <li>• 4 small sheets (185 cm wide)</li> <li>• Matt towel</li> </ul>

Bags are assembled in a top-bottom order as it listed in a table with an exemption for <Bag type 3>, which is prepared for two Igloos, so requires a different order presented in following Table 4.

Table 4 Assembling order for &lt;Bag type 3&gt;

Top layer	2 small sheets (185 cm wide))
7 <sup>th</sup> layer	2 duvet covers
6 <sup>th</sup> layer	2 pillowcases
5 <sup>th</sup> layer	2 facial towels
4 <sup>th</sup> layer	2 small sheets (185 cm wide))
3 <sup>rd</sup> layer	2 duvet covers
2 <sup>nd</sup> layer	2 pillowcases
Bottom layer	2 facial towels

Company utilizes a concept of modularity in a following way. Small sheets (185 cm) are used in every bag as well as pillowcases and facial towels and they absolutely the same so can be replaced if needed. The same principle is applied to Big sheets (260 cm) in <Bag type 1> and <Bag type 2> and shower towels, matts and so on. All in all there are 7 different items plus bag itself that are stored.

Materials are stored in a metal wheel cages, which could have 4 different content and different color of cover referring to a content. Those types of cage are presented in the table

Table 5 Content of the storing cages

#	Cover color	Content
1	Grey	Shower towels Facial towels
2	Purple	Matts
3	Dark blue	Duvet covers Pillowcases Big sheets
4	Light blue	Duvet covers Pillow cases Small sheets

Depending on a bag type in assembling there are from 2 to 4 cages are required.

Average Daily need in ready bags is as following: <Bag type 1> – 35, <Bag type 2> – 45, <Bag type 4> – 10, <Bag type 3> – 25.

Bags are usually prepared by group of workers, 3 to 5 persons. Everyone of them take an empty bag and then fills it with the certain items in required order. Because storage space is limited they collide each other, slow down to let other person go or take an item. Utilized layout can be described as fixed position layout where different subprocesses of collecting are done by the same person, but few bags are prepared simultaneously.

From time to time it happens that other workers are also busy with another duties, so they are in the same limited storage space, affecting on a mobility of “bag” workers.

Preparation process usually starts occasionally when one of workers decides that all the other duties are taken and the only thing left for him/her is linen bags or by some other reason. That inception in most cases has no any preface as turning and opening appropriate cages, clearance of assembling spot or coordination with co-workers. So as a result, there is often a situation when in a middle of the process cage becomes empty and workers has to take a full one, which could be in a corner of a storage among few other cages. It takes time to reach it since free space is usually occupied by semi-ready bags till that moment and to reach it from the top is not safe way.

5 Measurements were made to count how long time is required to prepare 10 bags of each type with a workforce of 4 and 5 workers. Result of measurements is given in Table 6.

Table 6 Measurements results in a current situation

Type of bag	4 workers		5 workers	
	Results, s	Average, s	Results, s	Average, s
<Bag type 1>	398	415,2	374	400,4
	402		454	
	436		395	
	418		388	
	422		391	
<Bag type 2>	387	415,6	381	403,8
	447		387	
	435		442	
	401		413	
	408		396	
<Bag type 3>	334	346,2	312	321,4
	342		325	
	354		324	
	362		349	
	339		297	
<Bag type 4>	395	406	364	360,6
	387		366	
	415		387	
	406		352	
	427		334	

Based on observations above the following issues can be mentioned as main problems of current situation:

- Other processes are done in the same time what affect on bag preparation both by distracting and creating physical obstacles
- There is no certain trigger when process has to start as well as no step-by-step instruction for a process
- Because of limited storage space “bag” workers could not work without repeating stops and slowings down

### 3.2 Development ideas

In order to develop the situation and achieve better utilization of workforce, the process of assembling of bags has to organized in accordance with Just-in-Time production principles in particular and lean philosophy in general. So, discovered problem

should be utilized through theory concept of JIT and a framework for constant improvement and control has to be set up in order to make process qualified.

The most convenient way to utilize a JIT principles seems to be to apply 5S concept to a process and classify the discovered problems in terms that concept.

As it was mentioned in 'Theoretical concept' chapter 5S refers to 5 Japanese words translated as Organization, Neatness, Cleaning, Standardization and Discipline.

The description of *first S – Organization (Seiri)* – tells us to separate out all the things that are not necessary and eliminate them or tidy them away. (Khanna, 2015, 446)

This statement is strongly related to one of the most essential thing in Lean philosophy as well as JIT production – elimination of waste. Workers who do others things in the same time and in same as it was mention limited space storage, bring this waste of time to the bags assembling process by distracting bag workers and being physical obstacles on a way from time to time. They also waste a lot of time when they have to reach new certain cage instead of empty one or just because appropriate cage were not prepared in a first place.

To eliminate this waste of time it is proposed:

- a) to organize work in a way that other processes held in this location are done before the bags preparation process or after it is finished;
- b) do not distract bag workers and let them assemble bags fast and qualitatively;
- c) to prepare appropriate cage (-s) depending on type of bags need to be assembled

*The second S is Neatness (Seiton)* state to arrange the essential things in order so that they can be quickly and easily accessed. To utilize this, layout of the process should be in focus. The weakness of current fixed position layout is that workers spend a lot of time to bring necessary components to the bag. It can be re-engineered in a following way:

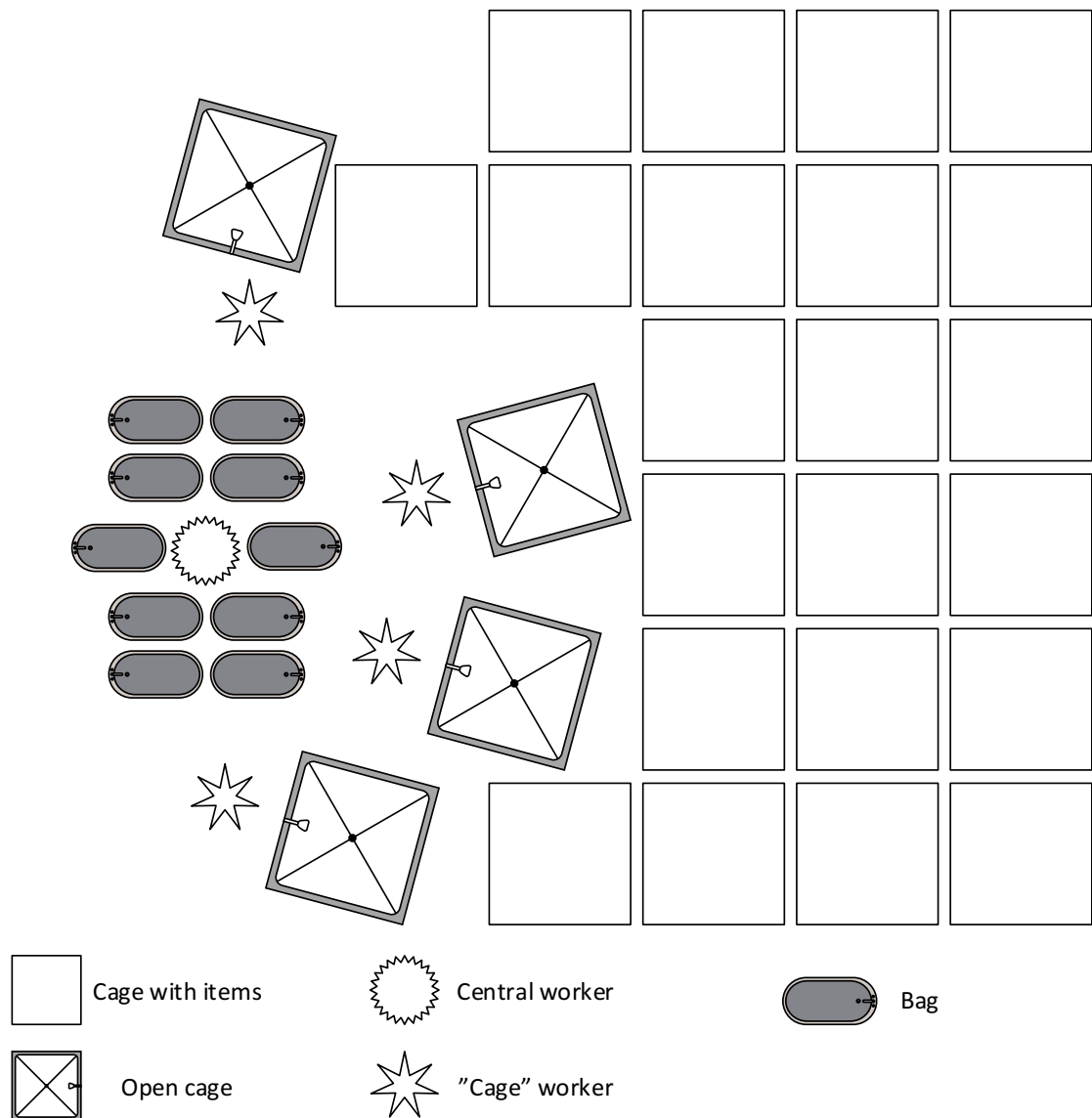


Figure 8 Scheme of re-engineered layout

4 workers stay next to cages with items, while needed amount of empty bags is located on a floor surrounded by workers. Every workers has a pile of items next to him/her and ready to give items in a smaller piles according to content of a bag. Fifth worker stays in a middle of the area, among the empty bags in a distance of 1-1.7 meters from other workers. Workers next cages start to put the items into bags announcing what they do, i.e. "4 duvets....4 duvets....4 duvets", and if bag is a bit far from him/her then workers pass this pile of 4 duvets to a person in a center. When first layer is done in every bag, what is announced by central worker, another worker who stays next to items supposed to be on next layer starts to put in the bags (pass to central worker) small piles announcing i.e. "2 small sheets...2 small sheets... 2 small sheets". So all the time workers stay in the same position and do not move, so

do not create collisions. All in all, this is movement from assembling few bags simultaneously by fixed position layout to hybrid layout in a combination of fixed position and functional parts, where in a role of functions are different items (towels, duvets, envelopes, etc.) Workers at cages represent functions, while product stays fixed in a center. In this case product can be presented as “10 bags” which requires the amount of items 10 times greater than one bag. Schematic location of re-engineered layout is in Figure 8 above.

*Third S is Cleaning (Seiso).* It very clear that assembling area needs to be clean before the process and only process related items and materials should be there to avoid any kind of unneeded interaction between focused workers and not related things.

*Fourth S is Standardization (Seiketsu).* To make the process qualified and smooth few steps could be taken such as printed instruction of the process, reminding workers about the order and necessary preparation steps, initial trainings for new coming workers to present them issues of quality in a company’s processes, putting a certain worker as a person responsible for the process quality or even a group of workers who would be responsible for the process on a permanent basis what will make them qualified and fast specialists doing the work fast and reliable.

*The fifth S refers to Discipline (Shitsuke)* and teaches to standardize four previous steps and constantly improve them. This actually brings study back to quality system concept with continual improvement as essential part of it. To achieve this company could organize repeated training, premise supervisor (assistant of supervisor) could make scheduled (or random) checks on a process and work with customers satisfaction and complaints.

### 3.3 Implementation

Implementation actions as it was mentioned in introduction chapter are quite simple and do not require significant resources or time.

Basically, supervisor is supposed to organize training for the workers in a prepared location where following issues should be enlighten:

- importance of certain order in company's processes to avoid obstacles and bothering;
- preparation and setting up the working venue;
- particularities of assembling process (layout)

Since bags assembling is always done after company's main activity – cleaning – supervisor (assistant) should be able to find time to do checks, which a key to a quality of a process and a part of constant improvement.

#### **4. Research results**

Some improvements from the previous chapter were applied to the process in order to estimate possible outputs and take a look on rough result of re-engineered layout to get approximate number in terms of company's budget savings.

So, tests were made to count time spent for assembling 10 bags, but with certain preparation procedures and with new layout. Results are given in a Table 7

Table 7 Measurement results with re-engineered layout

Type of bag	4 workers		5 workers	
	Result, s	Average, s	Result, s	Average, s
<Bag type 1>	178	181,6	162	162,6
	193		173	
	165		165	
	170		154	
	202		159	
<Bag type 2>	179	173,6	158	167,2
	158		162	
	194		165	
	169		181	
	168		170	
<Bag type 3>	112	124,8	142	125,2
	125		117	
	129		106	
	118		132	
	140		129	
<Bag type 4>	200	179,2	166	167,8
	191		152	
	162		147	
	175		184	
	168		190	

Then difference between average results was counted for every category and multiplied with average daily assembled amount of bags mentioned in previous chapter. Difference is presented in Table 8.

Table 8 Difference in time (seconds) spent for assembling daily

Type of bag	4 workers	5 workers
<Bag type 1>	817,6	832,3
<Bag type 2>	1089	1064,7
<Bag type 3>	221,4	196,2
<Bag type 4>	567	482

Then this difference was multiplied with 150 days in a season and divided by 3600 to present result in hours (Table 9).

Table 9 Difference in time (hours) during the season

Type of bag	4 workers	5 workers
<Bag type 1>	34,07	34,68
<Bag type 2>	45,38	44,36
<Bag type 3>	9,23	8,18
<Bag type 4>	23,63	20,08

Since the salary of worker is 11,78 € per hour, the result above was multiplied with the salary and amount of workers. Total difference in costs presented in Table 10.

Table 10. Total difference in staff costs related to the process

Type of bag	4 workers	5 workers
<Bag type 1>	1 605,22 €	2 042,60 €
<Bag type 2>	2 138,07 €	2 612,95 €
<Bag type 3>	434,68 €	481,51 €
<Bag type 4>	1 113,21 €	1 182,91 €
<b>Total</b>	<b>5 291,18 €</b>	<b>6 319,97 €</b>

These calculations have shown a rough result of about 6000 € savings, what can be achieved through re-engineered layout and implementation of principles of lean production and quality management as a part of operation management. Proper and more detailed implementation could definitely achieve even better results. Furthermore, continual improvement of quality could keep that result and even improve it.

## 6. Conclusions

Nowadays, both service and product markets are on a high competitive level, what makes every year harder and harder to get new clients and increase profit through increasing the revenue. In this situation cost reduction becomes very important part of management, opening new perspectives for managers.

Logistics in wide meaning presents in almost every company. It does not matter service or production, cleaning or aircraft assembly, some aspects of logistics always matter. And that makes logistics improvements so crucial and effective when they are made in a correct way by skilled professionals.

This study goal is not only to solve certain problem and improve exact process, what was suggested, but moreover to show how small and (what is very important) *cost-less* improvements can bring significant savings (profit) of 3-4 monthly salaries of employees or even more if indirect costs are taken into account.

Study has put certain research questions and answered them through sequential gathering of data, following analysis and suggestions for improvement of revealed problems and weaknesses.

## **7. Discussion**

As it was mentioned in a Chapter “Motivation”, idea of the research came during seasonal work in a company. It came because knowledge got during three years of studying Logistics Engineering is not just some abstract information. It has very applied nature. And it opens big perspective for logistics specialists, since logistics may be not main company’s operation but vital part of businesses at present time.

Once a person got a knowledge of lean philosophy, JIT production and other theoretical concepts (which actually have many practical realization all over the world), it is not possible not to think how to organize processes smart and convenient. It is human nature to aim for perfection. And logistics is pretty much about it – In right Time, in right Place, in right Condition.

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