FLAME

FURNITURE AND LANGUAGE
INNOVATIVE INTEGRATED LEARNING
FOR SECTOR ATTRACTIVENESS
AND MOBILITY ENHANCEMENT

Module 6

Management and quality control

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FOR SECTOR ATTRACTIVENESS
AND MOBILITY ENHANCEMENT

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Module 6

Management and quality control

AIM OF THE MODULE

The aim of this Unit is to explain and analyse the basic aspects of management and quality control in furniture and wood-making companies. This unit describes the main assumptions of the organisation of production, entrepreneurship systems, as well as systems used in industry management. The main content of each subunit is described at the beginning.

LEARNING OUTCOMES

Knowledge
planning with quality control
production management with quality control

Skills
cost calculation
project development
product development
purchasing

LEARNING PLAN

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ESCO PROFILES

8172 – Wood processing plant operators
1321s - Industrial production managers
1324s - Supply Chain manager (Supply, distribution and related managers)

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Unit 6.1

Basics of production organisation

EDUCATIONAL APPROACH

Course book	Additional readings	External links	Exercises and games

ASSESSMENT	DURATION	ECVET
Quiz (at the end of the module)	**1** HOUR	**0.04** Credits / 0.16 total of the module

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Linear production type 5
Net production type 6
Determinants of good company organisation 6

Unit 6.1 Basics of production organisation

This unit discusses what types of production organisation are in furniture and wood-making companies. The materials are divided into three groups:

Non-linear production line
Linear production line
Net production organisation

Each organisation type is used depending mainly on the company size. Table 1 shows the most commonly used production types.

Table 1. Used production types

No	Type of organisation	Size of company	Number of employees
1.	Non-linear production	Micro and small	1-49
2.	Linear	Medium (sometimes large)	50-249
3.	Net production	Large	More than 250

Non-linear production type

Non-linear production (1) - the direction of the production elements on the stand is random. Each production stand is able to cooperate with the other stands and the direction of the technological operation may be random.

There are various conditions for non-linear production on production stands, with randomly assigned **operations (6)**. These operations are not regulated with repeated and cycled time schedules, so it is also mostly random. As a result, we can see that as they are on a non-repeated cycled schedule, the production stands are connected with each other at infrequent stages.

In non-linear production, one worker is usually responsible for making the entire product.

Linear production type

Linear production (2) is one of the forms to organise product. It is one of the most effective production methods. Linear production is the form in which the tasks are done continuously or materials are processed in a continuous and progressive way. This production ensures effectiveness thanks to the:

- Location of production stands according to the technological process run,
- Allotment of time for a single operation on one production stand or a parallel group of production stands,
- Distribution of the treated object from one stand to the other without a break (if possible),
- Equal or multiplied duration of operations on each stand that is a part of linear production system.

Linear production is created with the production stands located along a conveyor to transport and treat elements or to assemble the entire product. This production model is based on widely understood automatics and robotics, as well as on a limitation of individual work to mainly controlling the tools. Linear organisation is organised based on limiting breaks and maximizing the resources used.

In linear production, one worker is usually responsible for making the part of the product on the stand that is assigned to this worker.

Net production

Net production type (3) is described also as group technology (GT). This production type combines the advantages of non-linear and linear production.

Net production is divided into:
- **Technological nets (4)**,
- **Object nets (5).**

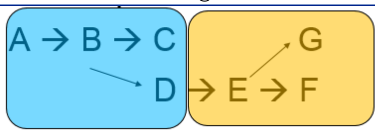
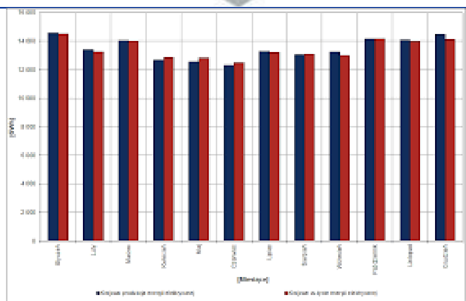
Group technology (GT) relies on production stands grouped to treat similar families of elements. The advantage of this system is the reduction in the time for the preparation-finishing processes, enriching the content of work and improving autonomy within the group of employees.

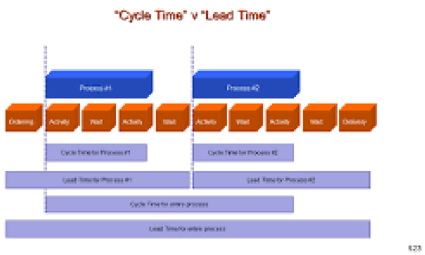
By identifying products with similar features, we can connect resources to each product family and form production nets that include the entire product creation process. This relies on the assumption that machines are grouped for defined tasks, however they are independent from each other and they do work within their specialised objective. Together with the nets, we can connect the work of the independent groups (the employees). Net production work follows the rules of self-reliance and independence.

The main factors that have to be determined during net production description are:
- **User needs (7)** - when customers order any number of elements that we have to manufacture, we usually have the exact date when the customer would like to receive their order. The user's needs define the number of elements to be created in the contractually specified time.
- **Work needed (8)** - each operation that leads to the final product takes a precise amount time. The sum of all operation times is the work needed.
- **Cadence (9)** - if we count the work needed, we usually notice that the sum of it all is too long to do the order in time. Cadence is the time for producing a final element, when we divide the whole time that we have for production based on the contract by the number of elements to produce.

Determinants of proper company organisation

When analysing the production type that is suitable for our company, we should take the main determinants of our production into account:
1. **Scope of production (10)**,
2. **Cycle duration (11)**,
3. **Time for production (12)**,
4. Cost,
5. **Risk (13),**
6. Possible product defects.

NON-LINEAR PRODUCTION TYPE		
Keyword	*Description*	*Image*
(1) Non-linear production	The type of production where the direction of production elements on the stand is random	**1. A → B → C → D…** **2. A → B → C → D…**
(6) Operation	Defined part of the production process	
LINEAR PRODUCTION TYPE		
Keyword	*Description*	*Image*
(2) Linear production	The type of production in which the tasks are done in a continuous way or materials are processed in a continuous and progressive way	**1. 2. 3. 4.** **A → B → C → D** **A → B → C…** **A → B→ C…**
NET PRODUCTION TYPE		
Keyword	*Description*	*Image*
(3) Net production	The type of production relies on production stands grouped to treat similar product component families	
(4) Technological nets	Machine groups that allow technological activities to be carried out	
(5) Object nets	Machine groups that allow for the possibility to product the product (elements)	
(7) User needs	Needed number of production units in time	

(8) Work needed	The sum of all operation times	
(9) Cadence	Time in which each work net has to do its work	
DETERMINANTS OF GOOD COMPANY ORGANISATION		
Keyword	*Description*	*Image*
(10) Scope of production	The idea for our product	
(11) Cycle duration	The time to make one product	
(12) Time for production	Production time for the number of products ordered	
(13) Risk	Possibility of unforeseen events during production	

Unit 6.2

Deming's conception

EDUCATIONAL APPROACH		
Course book, Additional readings, External links, Exercises and games		
ASSESSMENT	**DURATION**	**ECVET**
Quiz (at the end of the module)	1 HOUR	0.04 Credits / 0.16 total of the module

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Variety in Deming's conception 12
Deming's cycle 12
Deming's 14 points 13

Unit 6.2 Deming’s conception

One of the most important people in the history of quality control development in production was William Edwards Deming. All of his theories were based on the conception that the quality of the process/product will be good when stable improvements are made on it (Keizen theory). This unit will analyse the 3 main elements of Deming’s assumptions:

- Variety in Deming’s conception;
- Deming’s cycle;
- Deming’s 14 points.

Variety in Deming’s conception

Variety (14) in production is an inherent element of every production process. In industrial environment there are two types of variety:

1. Random variety, which is due to random causes. These causes are usually stable elements of the observed process. A vast number exist and they are the reason for the variety. These causes may be unidentified. Each from these factors may have relatively small meaning and minimal influence on the observed random variety.
2. Special variety, which is the effect of special causes, named also determinable causes. Special cause is the factor that can be identified as the one that is the reason for changes in quality properties or in process level (for example: change of material properties, tools used, machines, etc.).

From Deming’s point of view, variety is a sickness that threatens production. He underlined that with greater variety in deliveries, prices, and production practises, more waste is produced.

Deming’s cycle

Deming’s cycle (15) (also described as **P-D-C-A (16)** cycle Plan-Do-Check-Act or **P-D-S-A (17)** cycle Plan-Do-Study-Act or Deming’s circle). It is the framework that shows the basic rule of constant improvement to the process production. Deming’s cycle exists in 2 versions: the original version and the popular version.

The popular version of Deming’s cycle was not good enough from Deming’s point of view. As such, towards the end of his life he decided to come back to thinking about the original version of his cycle. This version was based on the conception of Design of Experiments (DOE). The original version consists of 4 steps:

1. Plan: Each change should be planned in advance.
2. Do: Changes should be made after previous implementation on a small scale, in controlled conditions.
3. Study: The results of experiments should be thoroughly analysed.
4. Act: Carry out the proper activities to implement standard of the process.

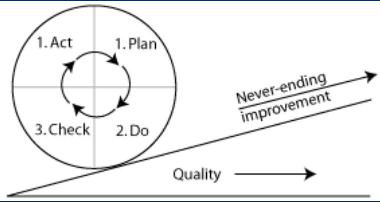
The most popular version of Deming’s cycle is P-D-C-A. This version is used by people working on quality management and ISO standards. The cycle in this version has 4 main steps:

1. Plan: Plan the better method of action.
2. Do: Carry out the plan for testing.
3. Check: Examine if the new method of action really provides better results.
4. Act: If new method provides better results, take it as the standard.

Deming’s 14 points

Deming's 14 points (18) apply to any type and size of business. Service companies need to control quality just as much as manufacturing companies. The philosophy applies equally to large multinational corporations, different divisions or departments within a company, as well as one-man operations. The 14 points are as follows:

1. Create a constant purpose toward improvement. Create constancy of purpose toward improvement of product and service, with the aim of becoming competitive, staying in business, and providing jobs.
2. Adopt the new philosophy. We are in a new economic age. Western management must wake up to the challenge, learn their responsibilities, and take on leadership for change.
3. Stop depending on inspections. Eliminate the need for inspection on a mass scale by building quality into the product in the first place.
4. Use a single supplier for any one item. End the practice of awarding business on the basis of the price tag. Instead, minimise total cost. Move toward a single supplier for any one item, built on a long-term relationship of loyalty and trust.
5. Improve constantly and forever. Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.
6. Use on-the-job training.
7. Implement leadership. The aim of supervision should be to help people and machines and gadgets do a better job. The supervision of management is in need of overhaul, as well as the supervision of production workers.
8. Eliminate fear. Drive out fear, so that everyone may work effectively for the company.
9. Break down barriers between departments. People in research, design, sales, and production must work as a team, to foresee problems of production and in use that may be encountered with the product or service.
10. Get rid of unclear slogans. Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the workforce.
11. Eliminate management by objectives. Eliminate work standards (quotas) on the factory floor. Replace leadership. Eliminate management by objective. Eliminate management by numbers, numerical goals.
12. Remove barriers to pride of workmanship. Remove barriers that rob the hourly worker of their right to feel pride in their workmanship. The responsibility of supervisors must be changed from sheer numbers to quality. Remove barriers that rob people in management and in engineering of their right to feel pride in their workmanship. This means, inter alia, the abolishment of the annual or merit rating and of management by objective.
13. Implement education and self-improvement. Institute a vigorous education and self-improvement programme.
14. Make "transformation" everyone's job. Put everybody in the company to work to accomplish transformation. Transformation is everybody's job.

<table>
<tr><th colspan="3">VARIETY IN DEMING'S CONCEPTION</th></tr>
<tr><td>Keyword</td><td>Description</td><td>Image</td></tr>
<tr><td>(14) Variety</td><td>Diversity of products that may or may not be possible to control.</td><td></td></tr>
<tr><th colspan="3">DEMING'S CYCLE</th></tr>
<tr><td>Keyword</td><td>Description</td><td>Image</td></tr>
<tr><td>(15) Deming's cycle</td><td>A framework that shows the basic rules for constant improvement in the production process</td><td>
</td></tr>
<tr><td>(16) P-D-C-A</td><td>Original version of Deming's cycle</td><td>
</td></tr>
<tr><td>(17) P-D-S-A</td><td>Popular version of Deming's cycle</td><td>
</td></tr>
<tr><th colspan="3">DEMING'S 14 POINTS</th></tr>
<tr><td>Keyword</td><td>Description</td><td>Image</td></tr>
<tr><td>(18) Deming's 14 points</td><td>Core concept on implementing total quality management (TQM)</td><td></td></tr>
</table>

Unit 6.3

Basics of quality control

EDUCATIONAL APPROACH				CONTENT
Course book	Additional readings	External links	Exercises and games	

ASSESSMENT	DURATION	ECVET
Quiz (at the end of the module)	1 HOUR	0.04 Credits / 0.16 total of the module

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Shewhart's control chart and variety 14

FMEA 15

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Unit 6.3 Basics of quality control

One of the basic tools for product quality control (as well as variety in processes) is Shewhart's Control Chart. Control Charts are the basic instruments for quality control. By using them we know if the processes are stable to provide predictable results.

Shewhart's control chart and variety

The main elements that should be shown on this card are:

- goal to reach,
- upper specification limit,
- lower specification limit,
- upper control limit,
- lower control limit.

Control Limits (19) are always described by the production manager and selected stakeholders. Control limits are the boards that inform that the process has to be improved, so that all of the products will have proper quality for our customers. In fact, Control Limits are types of warning limits - they give us information that the process is becoming unstable, but that the product is still good for our customer.

The bases for **Specification Limit (20)** are the contractual requirements. These Limits describe the minimal and maximal values of our product. Exceeding the Specification Limits informs us that the product does not have the suitable quality for the customer and that it probably can be sold.

The main reasons for process instability are the variety of materials, tools and machines. Since Shewhart's time there has been a great improvement of technological processes. More innovative numerically controlled machines have been produced which allow for the machine and tool parameters to be controlled. Moreover they have active measurements, which automatically correct processes. Material producers make materials that have stable parameters by implementing quality management systems. Tool producers, thanks to implementing better materials, machines, and technologies, are able to produce tools with perfect treatment parameters.

These factors combined have led to a reduction in the underlying reasons for process instability, which for years has been interpreted as the effect of the tools used or changing material properties These "books" process runs, which can be found in **ISO 8258 (21)**, in many processes do not exist anymore. Process operators have major problems in the observed variety of interpretation. If the existing variety is interpreted incorrectly, there can be two types of mistakes:

Mistake A – this occurs if the corrections to the process are implemented, under statistically stable conditions. This will cause the process to be under-regulated. Consequently, inconsistent products will be made and the process will need to be regulated again.

Mistake B – this occurs if corrections to the process are not implemented, under statistically unstable conditions. This will cause the production of inconsistent products.

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FMEA

There are a wide variety of traditional and modern hardware options, the application of which depends mainly on the availability on the market, the costs, and the quality (function and safety) of the furniture. They are mainly used in large furniture pieces that are assembled in the destination. They are classified into:

Fixation hardware

If uncontrolled variety is detected, the reasons must be analysed. One of the most popular methods for it is **FMEA (Failure Mode and Effect Analysis) (22)** that is also known as:
-FMECA (Failure Mode and Criticality Analysis),
-AMDEC (Analys des Modes de Defaillace et Leurs Effets).

The method is interesting for producers, for a few reasons – the low cost for example. However, the most important aspect is the variety of phases in which it can be used:
-Product conception,
-Before implementation until production,
-During implementation until production on the industry scale,
-Production,
-Exploitation.

The table shows how to perform the analyses:

Failure	Potencial reason	Potencial result	Solution	W	P	R	WxPxR	Activites for failure observing	W	P	R	WxPxR
Cracks	Blunt tool	Higher material usage	Purchasing more tools	10	3	1	30	Control of workers responsible for orders	10	2	1	20
	Errors in transport	Product return guarantee	Better packaging control					Control of workers responsible for packing				

Current Term	Corrected Term
False Transport	Errors in transport
Higher Using of materials	Higher material usage
Guaranty product back	Product return guarantee
Buying of more tools	Purchasing more tools
Beeter packing control	Better packaging control

The most important aspect of the analyses is the number analysis. The letters **W (23)**, **P (24)** & **R (25)** describe the: percentage of failures, frequency of failures, and the meaning of failure for customers. Multiplied together, the value gives the meaning of each failure (the higher the value, the worse the failure). The numbers used in analyses are described on the following slides.

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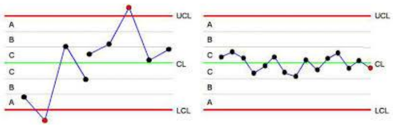
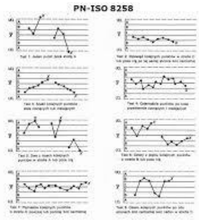
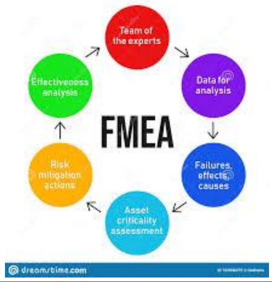
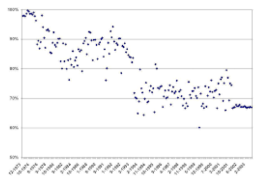
SHEWHART'S CONTROL CHART AND VARIETY		
Keyword	*Description*	*Image*
(19) Control Limits	The boards that inform that the process must be improved so that all of the products will have the suitable quality for our customer	
(20) Specification Limit	These limits describe the minimum and maximum values of our product properties	$CPL = \frac{\bar{X} - LSL}{3 * \bar{S}/c_4}$
(21) ISO 8258	ISO 8258: SHEWHART'S CONTROL CHARTS, Revision: 1st Edition, December 15, 1991; Published on: April 15, 1993; Status: Superseded By: ISO 7870-2	
FMEA		
Keyword	*Description*	*Image*
(22) FMEA	Failure Mode and Effect Analysis	
(23) W	Percentage of failures	
(24) P	Frequency of failures	
(25) R	Meaning of failure for customers	

Unit 6.4

Quality control methods

EDUCATIONAL APPROACH			
Course book	Additional readings	External links	Exercises and games

ASSESSMENT	DURATION	ECVET
Quiz (at the end of the module)	1 HOUR	0.04 Credits / 0.16 total of the module

CONTENT

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Six Sigma 18
5S 19

Unit 6.4 Quality control methods

Lean management (26) is an approach to managing an organisation that supports the concept of continuous improvement; a long-term approach to work that systematically seeks to achieve small, incremental changes in processes in order to improve efficiency and quality.

Lean management focuses on:
a. Defining value from the end customer's standpoint.
b. Eliminating all waste in the business processes.
c. Continuously improving all work processes, purposes, and people.

This Unit describes the main methods used in Lean management, including:
1. Poka-Yoke;
2. Six Sigma;
3. 5S.

Poka-Yoke

The term **Poka-Yoke (27)** (poh-kah yoh-keh) was coined in Japan during the 1960s by Shigeo Shingo, an industrial engineer at Toyota. Shingo also created and formalised Zero Quality Control – a combination of Poka-Yoke techniques to correct possible defects and source inspections to prevent defects.

Poka-Yokes ensure that the right conditions exist before a process step is executed, and thus prevent defects from occurring in the first place. Where this is not possible, Poka-Yokes perform a function of detecting and eliminating defects in the process as early as possible.

It can also be used to fine tune improvements and process designs from six-sigma Define – Measure – Analyse – Improve – Control (DMAIC) projects. Applying simple Poka-Yoke ideas and methods in product and process design can eliminate both human and mechanical errors.

Six Sigma

Six Sigma (28) actually has its roots in a 19th Century mathematical theory, but found its way into today's mainstream business world through the efforts of an engineer at Motorola in the 1980s. Now heralded as one of the foremost methodological practices for improving customer satisfaction and improving business processes, Six Sigma has been refined and perfected over the years into what we see today.

Experts credit Shewhart with first developing the idea that any part of process that deviates three sigma from the mean requires improvement. One sigma is one standard deviation.

The Six Sigma methodology calls for bringing operations to a "six sigma" level, which essentially means 3.4 defects for every one million opportunities. The goal is to use continuous process improvement and to refine processes until they produce stable and predictable results. The development in Six Sigma implementation is based on the number of DPMO as follows:
-3σ means 66810 DPMO (the stage reached by companies in 20s of 20th century);
-4σ means 6210 DPMO;
-6σ means 3.4 DPMO (the aim of Six Sigma method)

Six Sigma is a data-driven methodology that provides tools and techniques to define and evaluate each step of a process. It provides methods to improve efficiencies in a business structure, improve the quality of the process and increase the bottom-line profit.

5S

5S (29) is defined as a methodology that results in a workplace that is clean, uncluttered, safe, and well organised to help reduce waste and optimise productivity. It is designed to help build a quality work environment, both physically and mentally. The 5S philosophy applies in any work area suited for visual control and lean production. The 5S condition of a work area is critical to employees and is the basis of customers' first impressions.

The 5S quality tool is derived from five Japanese terms beginning with the letter "S" used to create a workplace suited for visual control and lean production. The pillars of 5S are simple to learn and important to implement:

Seiri: To separate needed tools, parts, and instructions from unneeded materials and to remove the unneeded ones.
Seiton: To neatly arrange and identify parts and tools for ease of use.
Seiso: To conduct a clean-up campaign.
Seiketsu: To conduct seiri, seiton, and seiso daily to maintain a workplace in perfect condition.
Shitsuke: To form the habit of always following the first four S's.

Benefits to be derived from implementing a lean 5S program include:
-Improved safety;
-Higher equipment availability;
-Lower defect rates;
-Reduced costs;
-Increased production agility and flexibility;
-Improved employee morale;
-Better asset utilisation;
-Enhanced enterprise image to customers, suppliers, employees, and management.

<table>
<tr><th colspan="3">POKA-YOKE</th></tr>
<tr><td>Keyword</td><td>Description</td><td>Image</td></tr>
<tr><td>(26) Lean management</td><td>An approach to managing an organisation that supports the concept of continuous improvement, a long-term approach to work.</td><td>
</td></tr>
<tr><td>(27) Poka-Yoke</td><td>Any mechanism in any process that helps an equipment operator to avoid mistakes.</td><td>
</td></tr>
<tr><th colspan="3">SIX SIGMA</th></tr>
<tr><td>Keyword</td><td>Description</td><td>Image</td></tr>
<tr><td>(28) Six Sigma</td><td>Data-driven approach and methodology for eliminating defects.</td><td>
</td></tr>
<tr><th colspan="3">5S</th></tr>
<tr><td>Keyword</td><td>Description</td><td>Image</td></tr>
<tr><td>(29) 5S</td><td>This method involves assessing everything present in a space, removing what is unnecessary, organising things logically, performing housekeeping tasks.</td><td>
</td></tr>
</table>

References

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