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Michael BAUMGARTNER

DESIGNING OF PRODUCTION SYSTEMS

Abstract

Industrial Engineering methodologies improve production workplace and eliminate waste in a work setting. Important work has to be done at the beginning during designing of production system. While lean methods may be most often used in manufacturing and production, the methodology can improve workflow and customer satisfaction in all workplaces. This article will give you the answer on the question „What have to be used into consideration to design of production systems to create effective model“

1. METHODS AND TOOLS OF INDUSTRIAL ENGINEERING BEING USED IN PRODUCTION SYSTEMS DESIGNING

1. TOC – Theory of constraints - why? TOC is a combination of philosophy, ideas, principles and tools developed by Dr. E. M. Goldratt aiming towards maximization of any system performance by identification, management and elimination of limiting factor (limitations), which prevents reaching maximal system performance (Fig. no. 1); TOC – Theory of limitations – it is Philosophy which emphasizes capability to solve problems and communicate them with the use of so called "good sense" (well known as "Common Sense").

Optimal possibility in terms of system preparation and function capability of planning, that might manage real copying and timely responding to certain reality, is TOC method usage as well as its steps and procedures.

Obviously, the old saying is valid here as well: the road to successful realization leads through keeping specified rules verified by many projects.

Then, the whole systems works in these five steps:

1. Identification of constraint /overloaded machines, machines, which have problems with instantaneous availability; machines with unbalanced usage of the planned working time of the machine etc. /.
2. Decision making how to use full capacity of constraint- buffer at the maximum – and continuous work supply, work schedule for constraint.
3. Submission of all to the point 2 – all workplaces from the material input work according to the constraint timetable.
4. Constraint removal – the best workers are appointed for the constraint, quality control is before the constraint, TPM in the constraint, switching of some tasks to other machines/necessity to lighten the constraint/, time shortening for re-definition of the constraint, capacity increase of the constraint.
5. Return to the point 1.

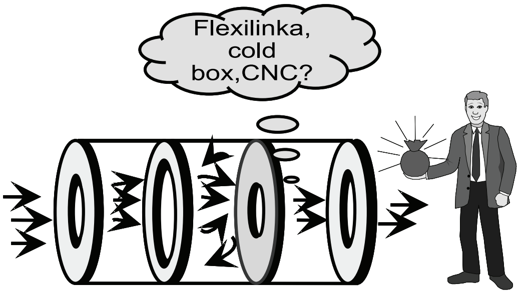

Fig. no. 1: Constraint (bottleneck), which influences reaching higher performances

2. ABC Analysis – usage in terms of production planning for products division with the aim to determine product groups according to:

- Greatest priority – group A – the most distinct benefit for the firm (by production volume, turnover, coverage contribution, orders frequency, and product life cycle, production continuity, i.e. by campaign or impulse). In terms of planning, the main and decisive indicators are amounts being ordered, regularity of orders, frequency of orders as well as rejection rate indicators for the given product, accomplishment of required performances, availability provided = OEE/Overall Equipment Effectiveness

- Products with lower priority – group B – with less volume and less important production for the firm in terms of profits

- Negligible production in the view of profitability and production volume for the firm – group C.

3. Project management – at present, where there is a real need of fast production commissioning of new products into serial production in relatively short time, it is obvious and inevitable to use methods and procedures which are used within the project management.

I will state only some areas, where it is “impossible” to fulfil requirements and targets specified for the given task, project, without project management.

It is nothing unusual if automobile factory comes with a new requirement for production of new cylinder head and at the same time it is interested whether the whole process is going to be managed for the product – cylinder head, which is its substitution and the commissioning plan for production will be 3-4 years later.

With the current customer portfolio it is natural that in the same period of time there is production being prepared, commissioned regarding a new product for two, three customers at the same time. That requires good coordination of individual steps and all departments participating in the projects realization. Obviously, without project management, the possibility to “manage” projects in these cases is almost unreal.

Should the production factory be bringing financial benefit to its owners and thus showing its capability of further perspective into the future, it needs not only good basis of customers and safe production volumes but also it needs to “search“ for possibilities on continuous basis regarding possibility to lower production expenses, possibility how to have slimmer process, possibilities how to produce faster. That is another space for projects focused on revealing and realization of these “possibilities”.

Those are main areas, where project management is being used in the company Nemak Slovakia.

4. Calculation, monitoring and usage of machine device efficiency – OEE (Overall Equipment Effectiveness) - utilization for machine device monitoring, its possibilities in comparison with actual usage. Detecting of losses, which are a part of production process with the aim to name these losses and search for possibilities of their decrease or elimination from the production process.

Important point is correct measuring of the cycle time and its usage in calculation of capacities, searching for possibilities of optimizations and targets determination of optimizations as well as limit-nominal possibilities of machine devices.

2. WHAT IS NECESSARY TO DO BEFORE PRODUCTION SYSTEMS DESIGNING ITSELF?

- Project plan creation with regard to limitations of individual resources.
- Discussing and verifying the project logics directly with people (resources), which are involved in the project – inputs and outputs from respective activities, interconnection of individual activities, responsibility for individual activities, resources, and activities duration,
- Time schedule creation of the project with expected values of activities duration, which have been determined in cooperation with engineers from the project.
- Elimination of the main problem causes with resources availability yet in the phase of the project planning.
- Crucial chain identification.
- Project term protection by correctly determined time buffer of the project, which eliminates variability of activities duration on crucial chain. Time, which is traditionally added to each activity "just in case", is not added to activities, but part of it is added as time protection of the whole project.
- Terms protection of activities start on crucial chain by correctly determined connection buffers.
- Terms protection of activities start on crucial chain, which perform crucial (overloaded, inaccessible) sources with the help of buffers before crucial sources ("alarm clock" – previous source always gives signal in agreed advance to another source on crucial chain, when it ends its activity and when another source is supposed to be prepared).
- Provision that people may work on the project without disconnections/breaks, in order to fulfil their task as quickly as possible – main crucial sources, which have e.g. red flag on the desk that signalizes their priority.
- Management of suppliers whose outputs enter into crucial chain in order to finish their activity as soon as possible.
- Connection buffers monitoring and protection of crucial chain.
- Project buffer monitoring and protection of crucial chain.

3. HOW TO DESIGN PRODUCTION SYSTEM CORRECTLY?

- Analysis of material flows and recalculation of transport performances.
- Production disposition processing (deployment of production means).
- Analysis of existing means (transport devices, auxiliary means, warehouses, buffers, material handling devices).
- Variants processing regarding systems of transport, manipulation/material handling and warehousing:
    - Topology of transport system – deployment of transport devices, loading and unloading places, transport roads.
    - Static dimensioning of material flow elements (amounts of transport means, parameters – speed, bearing capacity, times for loading and unloading, etc.).
    - Solution of transport system connection with workplaces – methods of pallets and tools relocation.
    - Transport management system processing, material handling and warehousing.
- Simulation – dynamic dimensioning of material flow components and optimization of transport, material handling and warehouse system (analysis of constraints, system blocking, size of buffers, loading of transport and warehouse devices, management rules).

4. PRODUCTION DISPOSITION CREATING – LAYOUT OPTIMIZATION

1. Material flows analysis as well as relations between workplaces
2. Ideal arrangement creation (Fig. no. 2,3,4), in which workplaces, enter and exit places and other limitations are not taken in regard
3. Variants creation (Fig. no. 5,6) – Lay out optimalisation
4. Variants evaluation, selection and elaboration of detailed arrangement (Fig.no.8), not only production in consideration (Fig. no.7)

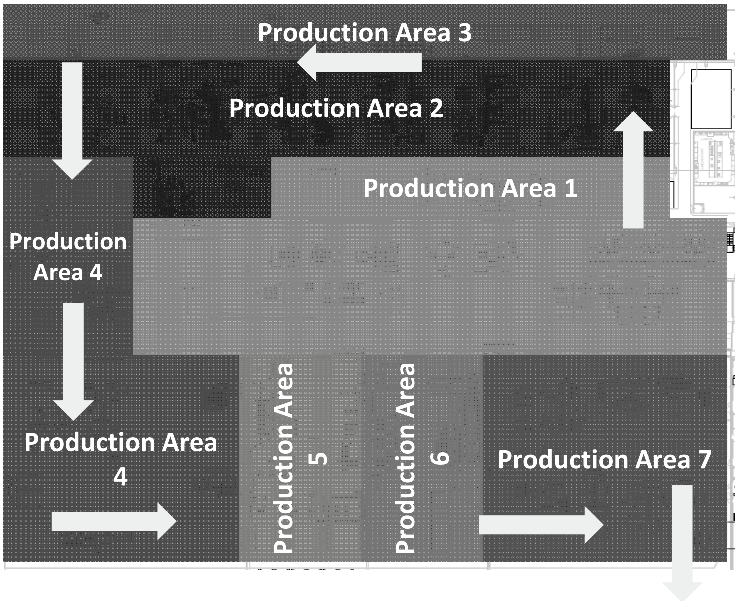

Fig. no. 2: Creation of ideal arrangement (Layout of production system. Example from Nemak Slovakia)

Fig. no. 3: Example of Lay Out composition for production factory : BBS company in Germany

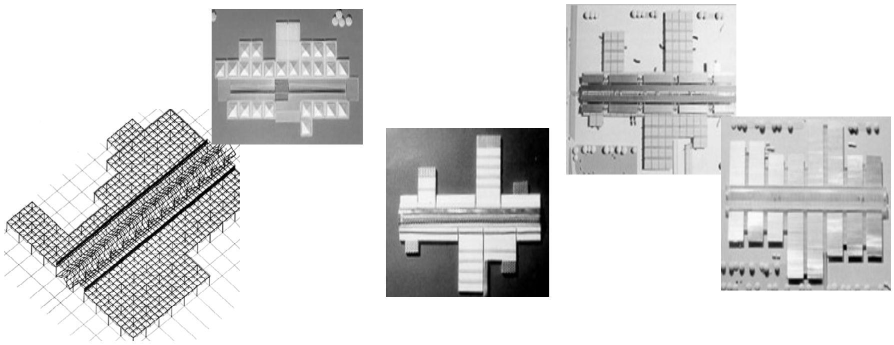

Fig. no. 4: Example of modular system - Future Growth and modularity under control

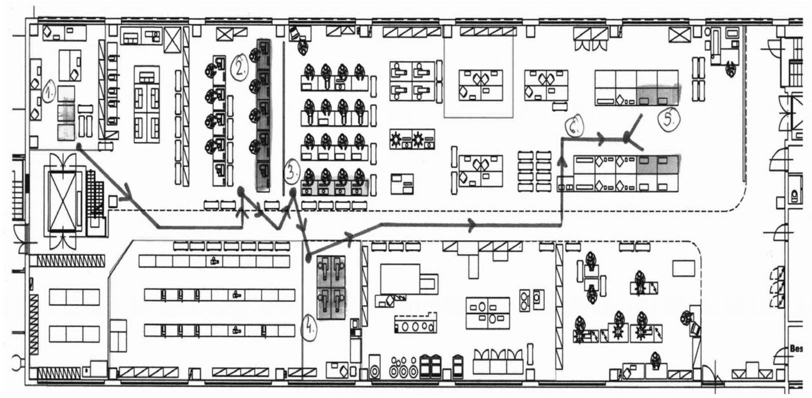

Fig. no. 5: Creation of ideal arrangement (Example for Layout of production system) – status before

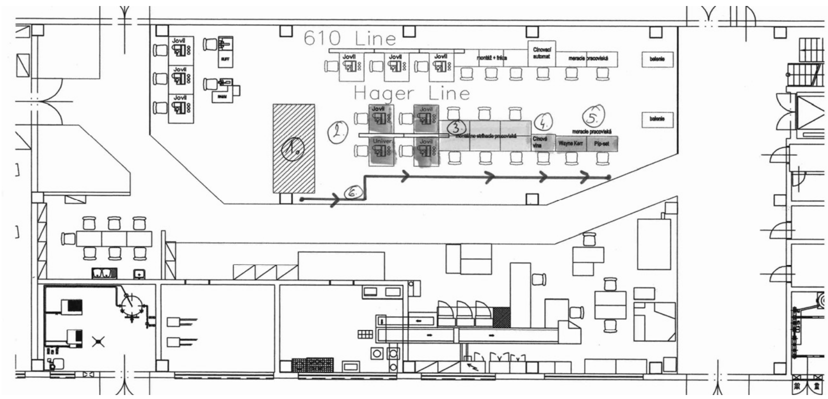

Fig. no. 6: Creation of ideal arrangement (Example for Layout of production system) – status after

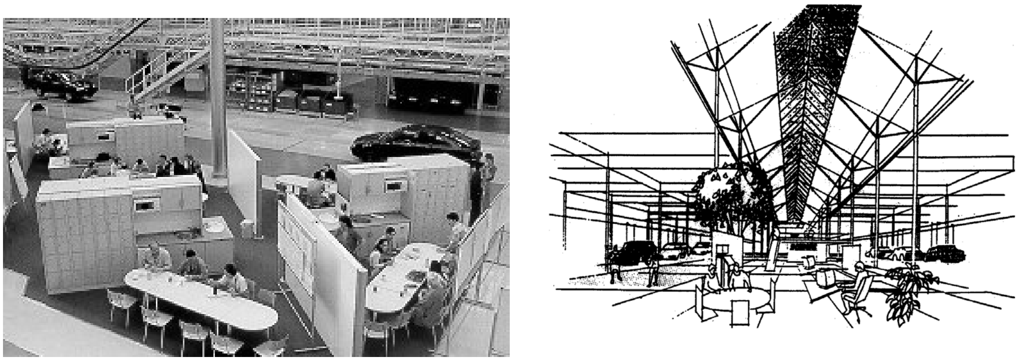

Fig. no. 7: Detailed arrangement – proactive production offices example

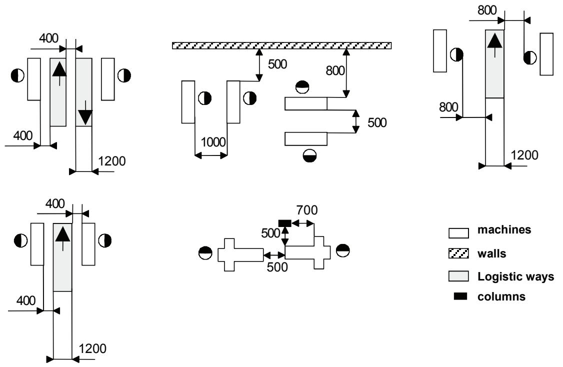

Fig. no. 8: Lay Out optimalisation by detailed analysis

5. CREATION OF VARIANTS – BASIC PRINCIPLES

- We will take regard to limitation – e.g. demands for areas, engineering networks, cleanliness and dustiness of the environment, vibrations, etc.
- We come out from basic concepts of production arrangement:
  - Substantial
  - Technological
  - Cellular

- Modular principle, spine arrangement model
- Keeping principles for machines deployment – their mutual distance from each other, distance from fixed structures, access to machine devices, operation and maintenance of the machine
- Minimization of supplies/inventory and continuous times
- Provision of safety and hygienic work requirements
- Minimization of transport performances, transport expenses
- Minimization of areas

- Direct material flow – this “classical” requirement needs to be taken with a grain of salt, because direct material flow may sometimes mean that there are transport devices unloaded and then they must come back on the long track empty. In such case, material flow is more convenient e.g. in the shape of the letter U or N
- Connection to external logistic chain – especially with assembly of more complicated products (automobiles), suppliers are usually directly integrated in assembly lines

6. CONCLUSION

Optimal layouts are the foundation of a predictable, productive and cost-efficient factory. This becomes immediately evident when comparing the movement diagrams of a modern, flow-oriented green-field operation with that of a plant that was subject to ‘organic growth’. Typically, only the old-style plant deserves the term ‘spaghetti diagram’ to describe its material movement. Reduced complexity assures better efficiency, better transparency and, due to fewer and shorter movements with fewer intersections, a higher degree of safety for the workforce involved.

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Project management, Nemak,

Michael BAUMGARTNER

PROJECT MANAGEMENT AS APPLIED AT NEMAK SLOVAKIA SPOL. S R.O. (LTD.)

Abstract

One of the options how to move constantly forward with own skills, abilities and knowledge is to use the experience of project management. Especially with regards to the application of a systematic approach and procedures that support efforts to manage projects with timeliness (specified milestones), costs and project objectives. The author´s goal is to point out that correctly chosen project management procedure has a significant impact on achieving the objectives, the resources needed for the project and the success of the project as well. Great attention in this paper is paid to project management in the company Nemak Slovakia spol. s r.o. and success criteria of project management as well.

1. INTRODUCTION

In this day and age there is probably not a single company that is unfamiliar with the terms *project* and *project management.*

A task is defined as a project when it exceed the normal level of difficulty and complexity compared to the normal tasks, or requires a longer period of time to solve it.

It is argued here that if fast and simple solutions to the problem at hand were available, it would not be necessary to give it so much attention, and apply methods and techniques of project management on it. At the same time it is mostly the unique task that is new to the organization, i.e. the organization still does not have perfect experience with solution or execution of the task.

However, often projects are not entirely new. Their specificity and uniqueness may lie in different conditions or output parameters, compared to tasks that have been implemented or addressed in the past. In brief, the project is a variety of activities aimed to achieve the same objective, within the budget and timetable.

The project is characterized by:

1. Extensive size: the project is a set of many activities and items
2. Diversity: project requires unification of efforts of people from different professional backgrounds
3. Interfaces: contains many interrelated ties of elements
4. Limited resources: project has limited time, material, human and financial resources to ensure quality of its output

The objective can be the introduction of new technology, new product development, process modification or successful completion of other activities with limited duration.

These projects are often being a part of the strategic enterprise management.

Project Management is the process of managing and coordinating human, material and financial resources over the life of the project by using modern management techniques, aimed at achieving predetermined objectives in the scope, cost, time, quality and satisfaction of the project participants. Established objective must be achieved by respecting the defined strategy and the use of specific procedures, tools and techniques for planning and process management of individual projects.

2. PROJECT MANAGEMENT IN NEMAK SLOVAKIA SPOL. S R.O.

For project management we use five different managerial activities:

- Definition – the definition of project goals.
- Planning – scheduling the activities, time frame, the necessary human resources and budget.
- Management – application of management style of control or creating the multilayer teams.
- Tracking (Monitoring) – controlling the status and progress of project work in order to identify deviations from plan in short time so that we can quickly proceed to their correction.
  In this context, we utilize the possibility of using "red card", which visually informs about critical status of the project or individual planned activities.
- Termination – verifying that the finished job corresponds with definitions of what should have been done.

A standard approach to the use of project management:

- Introduction of new products, machines, technology in the production process,
- Implementation and improvement of Lean Manufacturing methodologies,
- Planning and management of preparation and subsequent maintenance work during the summer shutdown of the whole plant
- Project management for cost optimization

Project management is a daily and routine job of senior and middle management. In the first case, the introduction of new products, we proceed in accordance with standards (NPDS – Nemak Product Development System) taken from our parent organization based in Mexico. The process consists of a number of interconnected Milestones in a logical sequence (Fig. 1) from feasibility stage through testing of tools up to the staff training.

Deliverable	Description	Responsible	Due Date	Status
M-1.10	Zákaznícky RFQ	CGM		●
M-1.20	Interný RFQ			
M-1.30	Štúdia uskutočniteľnosti	Senior Engineer		●
M-1.40	Výrobný Integrálny Plan	Senior Engineer		●
M-1.50	Agregátny Kapacitný Plan	Nemak Europe		
M-1.60	Hlavný plán (Master Plan)	Senior Engineer		●
M-1.70	Ciele projektu & Celková analýza nákladov	Senior Engineer		●
M-1.100	Ponuka	SAM/CGM		●
M-1.999	Zistené ponaučenia			

Fig. 1 NPDS – Nemak Product Development System

Project management role in our case is obvious – In shortest possible time to identify and solve the problems that might arise in the process of pricing, training, testing or actual serial production of a particular product.

The procedure is summarized in the following milestones (Fig.2):

M – 1.10 – Customer and request for a quotation (RFQ):

Milestone – 0: This process begins by accepting a formal request for a quotation from a customer. This can arrive through e-mail or by means of other communication channels.

File Name	Description
1_RfQ	Customer RfQ
2_Feasibility	Feasibility Study
3_Planning	1st Planning
4_Calculation	Calculation Development Cost
5_Business Plan	Business plan Calculation of Part price
6_Offer	Offer to
7_Technical Presentation	NEMAK presentations
8_Customer Order	LOI, Order

Fig. 2 - Milestones

M – 1.20 – Internal RFQ:

This document provides relevant information about the product from content in customer´s RFQ. This document will start a feasibility study analysis, production process flow diagram and equipment requirements. After release and acceptance of such product by the product engineer, the specialists for planning, production and projects are being defined into a team.

Preliminary strategy of the plant determination:

Central Planning Department issues preliminary strategies and rules for determining the plant where the product will be produced based on the price quotation. It must be defined if this product is 100% manufactured in the xxx company or is necessary to choose another combination of external suppliers.

M – 1.30 – Feasibility Study analysis

Product Engineer shall review the product to decide whether the xxx company has required performance capacity for its production. He must consider the processes of the xxx company and its experience to meet the product specifications required by customer. He must be also informed if any of these specifications are not fulfilled and reasons must be stated as well.

M – 1.40 – Manufacturing Integral Plan (Production Integration Plan)**:**

Conceptual management and advanced production management will accept the results of Feasibility Study analysis. They will prepare a production process flow diagram. The output of this component is the lists of required equipment and its specifications as well as the work required for continuous operation of the program. Conceptual and advanced production management will prepare together a preliminary layout of the production area based on the production process flow diagram. Conceptual and advanced production management will develop together a production integration plan. It must include at least the following items: production process flow diagram, deployment of technology in plant (layout), requirements for work and services as well as an estimate of the production costs. In addition to the above stated points, there must be defined assumptions, risks and basis covered in this analysis.

M – 1.50 – Aggregate Capacity Plan (ACP equipment facilities)

Planning Department will obtain lists of equipment form conceptual and advanced production management. They will use this input to compare the installed capacity of the xxx company with required capacities. This result will decide about current equipment, which can be used to manufacture the product and the needs for investment into new equipment to be designed or purchased. Based on list of equipment requirements, the Planning Department will decide on the preliminary number, which will be necessary to invest.

M – 1.60 – Main/General Plan (Master Plan – Fig. 3):

This Master Plan is prepared by the Project Manager of the whole program. It must include the following items as minimum: key dates of the program, time horizons of the tooling requirements to achieve these program goals. In this folder there are the main risks of the program highlighted in the critical path.

Scenarios and models of the price quotation:

The data requirements are implemented into forms the "Model of the xxx company price quotation." Some of these data are: full production volumes, the percentage of acceptable scrap (rejection rate), customer´s data on investment, price of aluminum, etc. Several simulations will takes place to evaluate the economic feasibility of several scenarios based on the estimated return on capital and current market conditions.

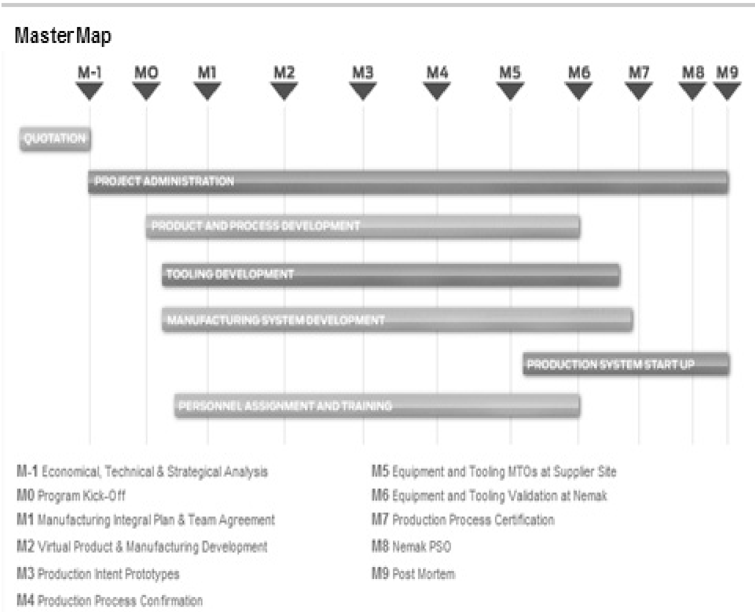


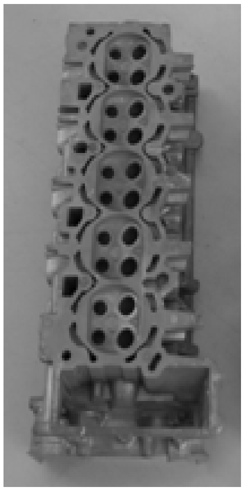
Fig. 3 – NPDS Master Map

M – 1.70 – Project Goals & Total cost analysis:

For this purpose, project management cooperates with Planning Department on introduction of the required information. They take into consideration the results of Feasibility Study analysis, Manufacturing Integration Plan and Master Plan, models and scenarios of the price quotation. The management team defines and evaluates the goals versus production costs, investments, quality, productivity and the introduction of total costs (Fig. 4).

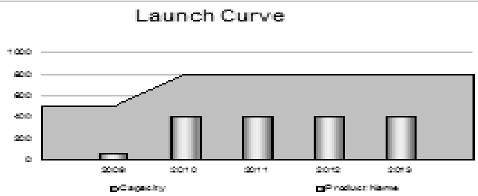
Program Name

- ➢customer engine plant — Audi Hungaria
- ➢SOP — Oct '07
- ➢requirements — 8.000 parts per year
- ➢displacement — 5,2l
- ➢volume production plant
- ➢casting process
- ➢heat treatment — T6 water (solutionizing 5h@520°C / quenching 80°C@water / 5min500-200°C@air / aging 2,5h@180°C)
- ➢alloy — AlSi10Mg(Cu)
- ➢finishing — CNC pre-machining
- ➢cleanliness requirements — sand and shots max.100mg / machining chips max. 2 pieces
- ➢leak testing — 100% water jacket, oil gallery, pressure-less oil room
- ➢measuring — 100% SPC control combustion chamber depth



project	product	process	timing/volume	customer	tooling	investment	budget	quality	partshipment	Total status	comments
	H	H	H	H	●	●	●	△	●	△	

SCORECARD		Objectives	
Q	Internal (at SOP+6m)		[%]
	External (at SOP+6m)		[%]
€	Investment paid by project		[M EUR]
	Launching		[M EUR]
	Manufacturing costs per part (at SOP)		[M EUR]
	IRR		[%]
P	Cycle time		[pcs/hc-mould]
	Uptime		[%]
	Operator (plant manning)		[heads]
T	Key Dates		[%]



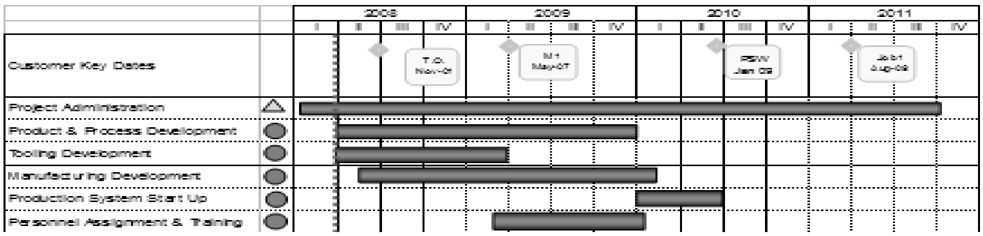


Fig.4 - NPDS Project Highlights

M – 1.100 – Price quotation:

An offer is presented to the customer on the basis of previous analyzes and defined business strategy. In addition to this proposal is necessary to consider several key data, such as: volumes, type of process, unit weight, the price of metal, dross loss value, type of endings or measurements, heat treatment requirements, wrapping material and considering the costs for returning of palettes/packaging boxes, investment requirements for tools and equipment, etc.

Basis for one as well as the other method is to control the sequence of the above management techniques using project management tools. Those are for instance Gantt´s diagram and CPM (Critical Path Method). Microsoft Project software is an excellent assistant for both tools (in terms of availability, use, visual outcomes).

Gantt´s diagram (Fig. 5) - is a graphical method for planning work. The graph shows when must be which task fulfilled compared with the current status of each. This method allows the manager to monitor what was already done in the process of completing the project and assess whether the activity is ahead, behind or being on time.

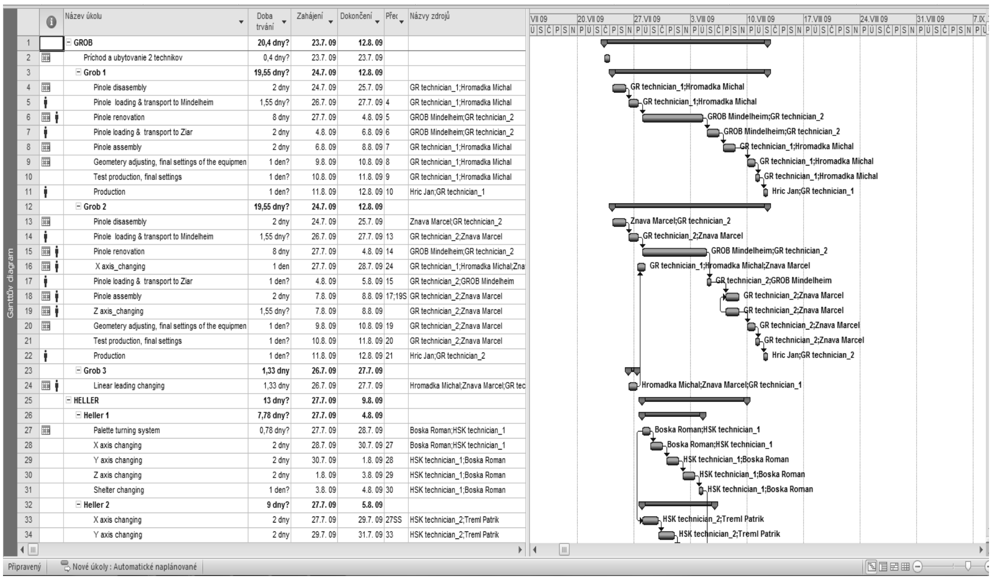


Fig. 5 - Gantt´s diagram for carrying out maintenance activities

CPM - The critical path is the shortest possible duration of the project, therefore the time period needed to meet all tasks in the project. Delay of a task on the critical path is directly reflected in delays in the project as a whole.

Implementation of Six Sigma methodology serves as a good example, and the company Nemak Ltd. selected it as one of the key methods for process improvement and competitive advantage acquirement (Fig. 6).

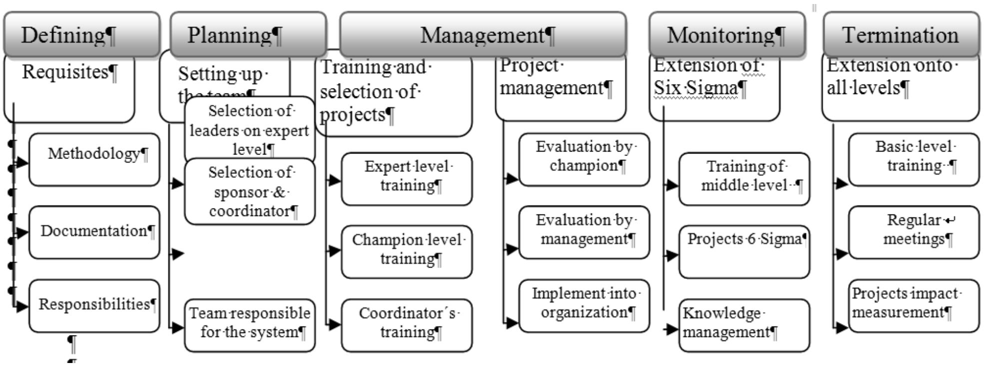


Fig. 6 - Project Management of Six Sigma implementation

Crucial element in management process is to define the objective, project purpose, identify the staff team and define their responsibilities and powers. Everyone on the team must be familiar with the issue. The last point we assured by layered training from the management to masters in production. Training courses met the requirements regarding the difficulty of performance or problem solving or approaches that will be required from teams. All the projects as well as implementation of the methodology are conducted according to the plan drawn up by management. We have implemented the methodology into internal quality system. Methodology itself is based on the DMAIC cycle, which includes elements of project management. Continuous progress of projects in the company is monitored (supervised and evaluated) by management, which organizes regular meetings. On these meetings the team leaders inform management about the results, meeting the time schedules, the financial plan or the obstacles that arose during the project management.

3. CRITERIA FOR SUCCESSFUL PROJECT MANAGEMENT IN NEMAK SLOVAKIA LTD.

Upon project completion, the Top management evaluates its success (after detailed performance information relating to the project).

Basic criteria for success (Table no. 1):
Methodology

- Completion on schedule (within planned milestones)
- Utilization of the Lean Management tools or statistics (a number of tools that are in practice more or less successfully used. One of the main tools is the "common sense")
- The level of project complexity

Cost efficiency

- Estimated costs versus the real costs
- Explanation in a case of deviations from the estimated cost

The degree of improvement

- Objectives of the project fulfillment

Effectiveness

- The level of importance and influence with regard to corporate objectives
- The chosen solution versus achieved project goals
- Table no. 1: Evaluation criteria for 6 Sigma projects

		Project A	Project B
Methodology	Evaluation of the methodology used (little or badly used methodology = 1 point / correctly used methodology = 5 points)	1 - 5 points	1 - 5 points
Cost efficiency	Assessment of costs (large or small investment benefit = 1 point / low cost solution or high benefit = 5 points)	1 - 5 points	1 - 5 points
Degree of improvement	Evaluation of improvements (very small improvement = 1 point / better than target = 5 points)	1 - 5 points	1 - 5 points
Efficiency	Evaluation of the effectiveness of solutions (low efficiency = 1 point / high efficiency, sustainability = 5 points)	1 - 5 points	1 - 5 points
	Together	4 - 20 points	4 - 20 points
	Evaluation	%	%
	excellent	80 % - 100%	
	very good	60 % - 80%	
	good	40 % - 60%	
	insufficient	0 % - 40%	

The evaluation is performed by management using the system of points allocation to project A or Project B for the four criteria of success. The success is determined by rate of the maximum possible number of obtained points to the evaluation given by management. This evaluation serves not only for management as a way to distinguish the level of projects, but also for the leaders (project leader) who know on this basis which areas of their management can be improved in future.

Implementation projects of the Lean methodologies in extent of 6 Sigma, VSM, 5S, TPM should not end with just the introduction. In order to obtain their good function, they should become a part of daily work and they should be periodically evaluated. For this purpose we have introduced SCORECARDs. It is a table of indicators monitoring our moving towards our goals, and we also see a trend how/where we are moving.

In compiling the key indicators and then defining the goals for them it is necessary to answer two basic questions:

- How well do I use an instrument / tool (methodology)?
- How well the whole system works?

In our case the answers are:

- The number of successfully completed projects for the given period
- The financial benefit for the company resulting from the projects

CONCLUSION

Project management brings a system work to our business activities, it maintains a continuous implementation of activities and the last but not least it provides the possibility of flexible business response to market demands. At the moment, the flexibility is the key with which project time (Lead time) is closely linked from its definition phase to delivery to the customer. Much more frequently it is said that Slovakia needs research and development for competitiveness against low-cost countries of the East. And the use of project management in research and development is one way how to get to the goal.

Many times we promised to perform "unrealizable" things for customers, but we solved their problem. Finally, when we re-calculated our costs, we found that such a good looking business was in fact the activity of “non-profit organization".

For these and similar reasons the requirement of needed project management is really justified.

Project management utilization in designing of production systems is a very effective tool to quickly and efficiently manage the valuation process, preparation of samples, prototypes as well as a way to handle the preparation for mass production. In our case, we try to identify and solve the problems as quickly as possible, so that there is sufficient room for a complete solution without unnecessary compromises due to underestimation of the extreme urgency and seriousness sufficiently in advance.

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Simulation,3Dview, Plant Simulation

SlavomírDILSKÝ*

3D SIMULATION MODEL – POWERFUL DECISION SUPPORT TOOL FOR MANAGERS

Abstract

At present factory planners are increasingly using three dimensional view for design or redesign of old production facilities. This trend starts enforcing in computer simulation. Theme of this article is to compete time-consuming, advantages and disadvantages of using 3D simulation models compared to 2D simulation model.

1. DEVELOPMENT OF SIMULATION MODELS

Simulation models were developed together with development of computer technology. Development proceed from text files with code written in universal programming languages like C++, where simulation expert had to search for any errors line by line in source code, what required high requirements on expert knowledge and time needed to build model. Over time special languages for simulation like GPSS, GASP were developed, whichincluded construction programmed for frequently repeating elements of simulation models such as machine, buffers, etc..This step helped with creation of models but problem with finding errors stayed. Next evolutionary step was using of 2D view for easier and faster creation of models. At this stage pre-defined elements are used, which expert put on desktop in form of icons, which helps expert to understand to imagine work of system and to accelerate identification and correction of any error in system. Using of dialog boxes brought further simplification for setting variables in simulation model. In recent years three-dimensional view technology is starting to expand not only in product design, but also in design of production system.Therefore simulation software developers responded on this trend in recent years, who are trying to integrate 3D visualization to theirs solutions. This trend is supported by creating digital factory software packages, which work with same database that makes it easy to find and deploy necessary 3D data that is used to create 3D simulation models. One of such tool is Tecnomatic software package from company Siemens, which includes tool for computer simulation Plant Simulation.

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2. 2D VS. 3D SIMULATION MODEL

Before solving simulation study it is important to define type of model, which will be used in solving problem. We can create simple 2D model, which contains icons that are predetermined in simulation software. Another option is to use 2D model in which we change default icons to reflect layout of plant and to converge actual situation. Last option is to create 3D simulation model.

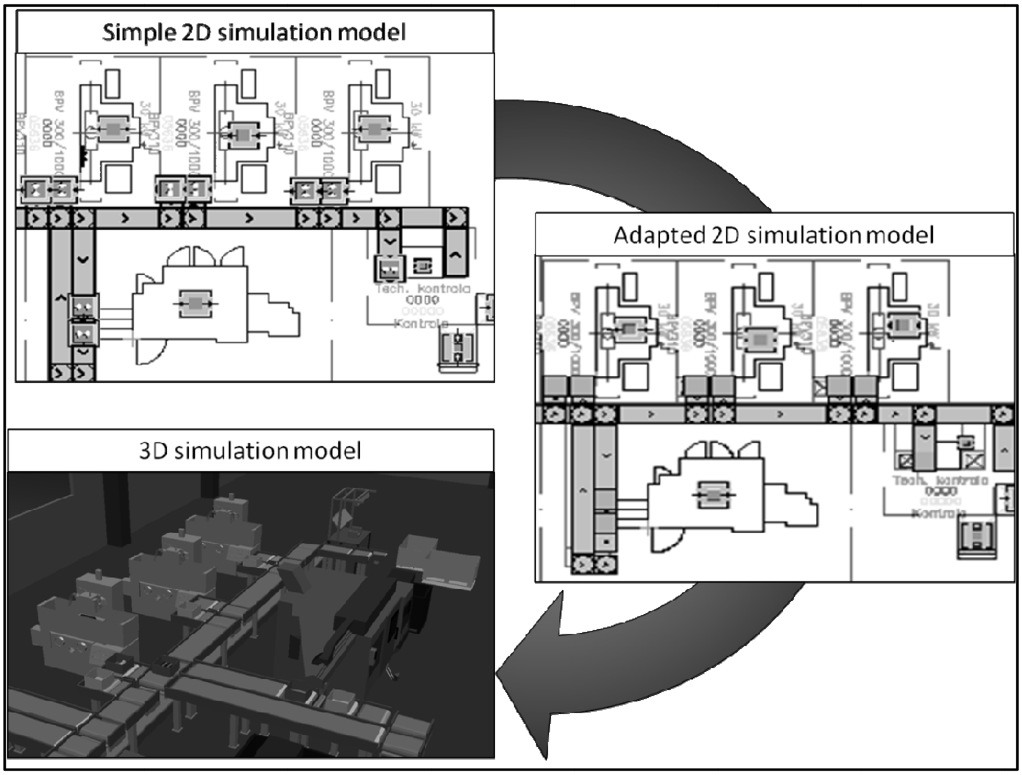

Fig.1Different types of simulation models

2.1 Time demands of creating 2D and 3D simulation models

Depending on type of model, which we want to use, labour-consumption of model creating depends. When editing default 2D view to one than better reflects real situation, changes are not so time-consuming compared to create of 3D model. When creating 3D simulation model we have to work with already created models of all elements of model like machines, buffers. However you have created model you have to determine position of various animation point manually, what significantly increases time, which is needed for completion of model. Compared to creation time stands informative capability of model, which brings ability to find errors in model and fix them faster and also facilitatesexplanation of behaviour to person who does not know principles of simulation itself. Figure 2 shows comparison of time requires to create model and time needed to detect errors, which occur in model, where reference times are times for basic simulation model, which is created using predefined icons and using simplest form of graphic presentation.

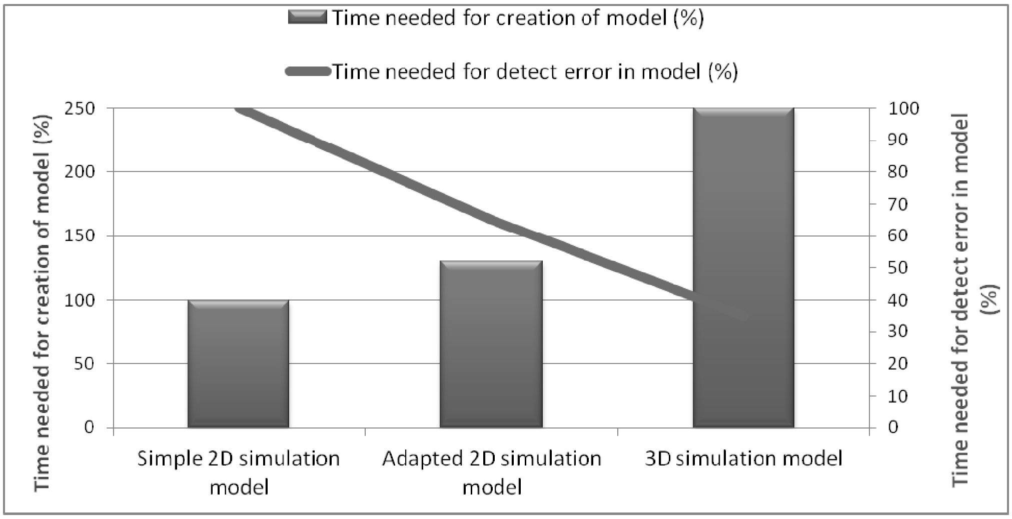

Fig.2Comparison of time required to create model and time needed to detect errors of different types of simulation models

2.2 Advantages of using 3D simulation model

Each technology, which wants to be successful and should be promoted against today used technologies, has to provide benefits. So 3D simulation models have several advantages over 2D models such as:

- Clearer model verification – verification of logical correctness of model.
- Faster detection of collision situations between moving and static elements of model.
- Better notion of project team about functioning of simulation model.
- Improve acceptance of simulation results from perspective of company management.
- Option to use 3D simulation model for creation of instructional videos of how to behave in crisis situations for staff responsible for logistics, production, etc..

2.3 Disadvantages of using 3D simulation model

As every technology has its advantages and disadvantages, so deploying of 3D simulation model has disadvantages, which must be observed. When using 3D simulation models main disadvantages are:

- Longer creation time of model.
- Longer time of simulation runs compared to 2D simulation models.
- Higher requirements for computer hardware equipment technology.

The biggest problem is time consuming of creation of 3D model itself. We can reduce this time by using pre-defined libraries of 3D objects that contain all data necessary for simulation and animation. Using these libraries, manual process of manually defining animation is not necessary. Therefore it is advantageous to use tools of digital factory, where many modules operates with single database and after filling database, process of 3D simulation model creation will become more effective.

2.4 Areas suitable for use 3D simulation models

Main advantage of 3D simulation models is display space in third dimension. This allows increasing transparency of verification of model, especially, identify errors and correct them. Therefore, its use is mainly in models where movement of material is realized at various levels such as:

- Model of logistics systems with multi-level transport of material – combination of transport by forklifts, cranes and conveyor systems.
- Models of overhead production and assembly lines.
- Models of container terminals.
- Models of loading and unloading in multi-level storages.
- Models of robotic workstations.

Basics of simulation are statistics which are collected in background of simulation runs. These statistics are collected in same way for both models. If we want to make quick testing of possible variants and it is problem at same height level, it is more convenient to use 2D simulation model. However it is great number of processes, which run simultaneously at several height levels, it is suitable to use 3D model, especially in term of transparency and verification.

Each simulation project is tool that helps managers make right decision in shorter time. And any technology, that helps to facilitate and to accelerate decision of managers, in today´s rapidly changing condition, is welcome. Therefore 3D simulation is increasingly promoted in simulation projects solved in companies.

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Nanotechnology, food

Linda DUBIEL-KOZIEŁ*

WHERE IS NANO?

Abstract

In the article abilities of the use of nanotechnology in the food production were described. The nanotechnology will change the production method, packing and storing food. Salt about the more intense taste, low-calorie sugar and fat, after which we won't put on weight - the nanotechnology is entering the food industry. Scientists are announcing a new generation of "chemistry" culinary which is supposed to be not only tasty, but also healthy.

1. TECHNOLOGY ON THE LEVEL OF THE ATOM

Nanotechnology and GMO (Genetically Modified Organisms) are subjects having both their supporters and opponents. Each of them has it arguments concerning the given issue. However new solutions are arousing intense controversies in the production both at scientists as well as consumers.

With the greater certainty it is possible to say applying the nanotechnology will influence all aspects of life and progress in the communication, the contact, the health care, the production, materials and technologies being based on a knowledge will enable.

The nanotechnology more and more often appears in cosmetologist and household detergents, even clothes being aimed at a materials and devices design about assumed properties: mechanical, chemical, biological.

Producers of the food are starting competing not only on the domestic market, the competition is going the Euromarket up. Therefore applying new technologies became so important production, packing permitting the primitive quality the longer maintenance.

The nanotechnology is dealing with producing structures having sizes within the limits of from 1 to 100 nanometres 1 nm = 10^{-9} m (1 nanometre = one billionsthsmetre). He enables nanostructure to get new properties of materials get to know already. The name of the prefix derives from Greek language nanos-midget.

The nanotechnology in the manufacture of foodstuffs is changing features, properties of the food product. It permits emulsion the also production about special properties. Drops of these emulsions on account of the small diameter won't diffuse the light and therefore are clear. They are being used nanoemulsions in the production of low-fat products i.e. chocolate, ice-cream, mayonnaise about the lowered calorific value. The reduction in assessments of fatty pellets allows for the production of low-fat products at keeping the functionality and the texture.[7]

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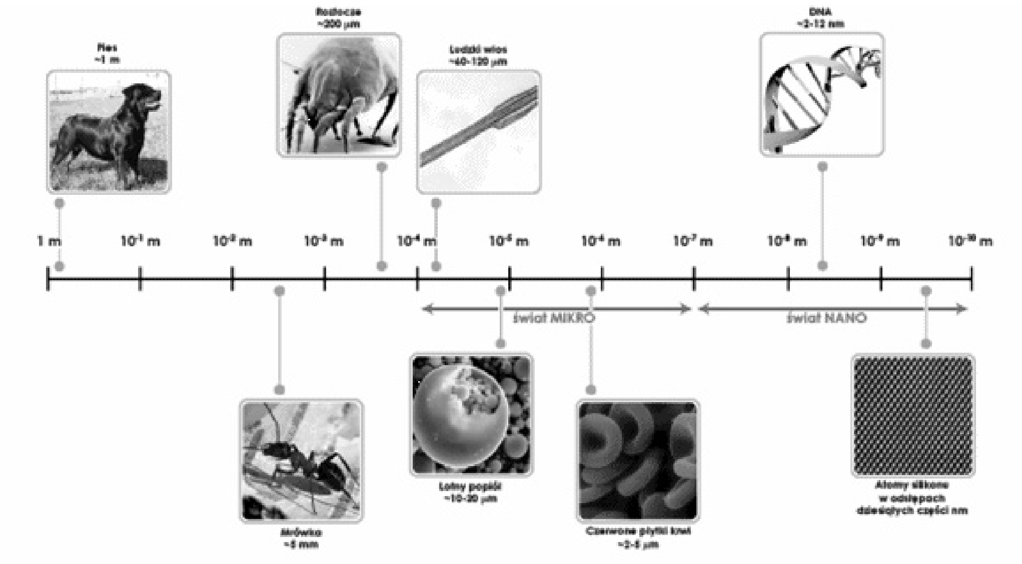

Fig 1. Word of Nano [8]

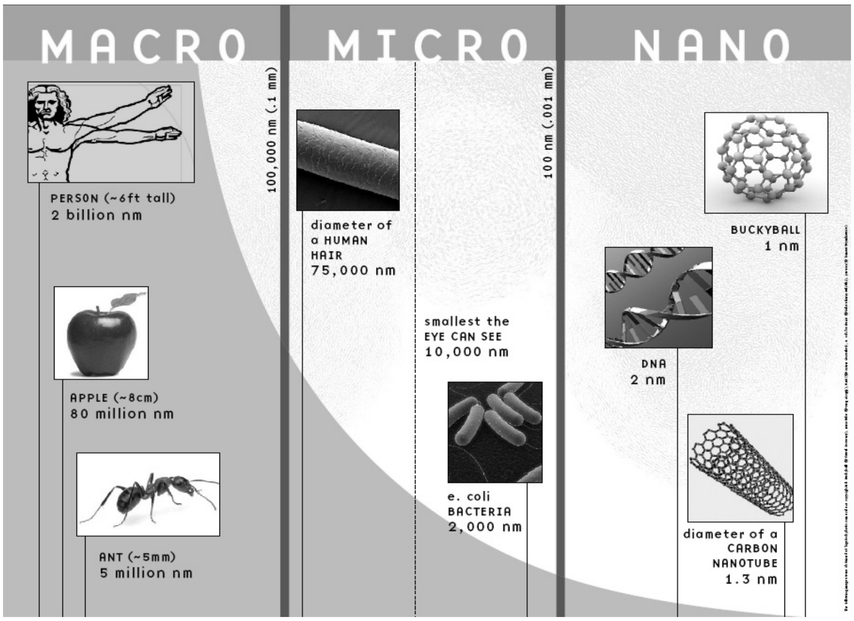

Fig. 2 Macro-Micro-Nano [9]

2. ELEMENTS AND THEIR INFLUENCE ON MICRO-ORGANISMS

In the nano-scale it is possible to get different elements about various properties, being used for different branches of industry. Silver is very much strongly antibacterial and a little bit more poorly is acting fungicidal.Copper has strongest fungicidal, but a little bit weaker action antibacterial, very well is working in cosmetologiesantifungal.Gold has a great easiness of penetrating to the inside of cells of the organism and cannon on, strongly stimulatingly and regenerating, more poorly however is out of order biocide (bactericidal).Platinum as only is supporting the process catalytic decays of cancer cells and is reviving deformed units e.g. skins.[2]

3. WHY SILVER?

Nano-silver is applied more and more often for producing packaging which can counteract the multiplication of bacteria, fungi and mould and prolong freshness of such products as: meat, bread, fruits, vegetables and a whole range of other food products. Antibacterial nano-silver is applicable in sanitary and medical devices and equipment, and even in case of everyday devices, where bacteria appear most often, e.g. computer keyboards, refrigerator interior surface. [6]

In shops we can often notice household detergents with nano-silver antibacterial properties and with the use of nanotechnology which strengthens the effect, facilitates cleaning, delays dirt settlement, makes the area scratch resistant, possesses self-cleaning properties.[4]

Clothes with nano-silver, contrary to appearances do not look like a knight's armour. Thanks to the use of the precious metal bacteria that likes sweat doesn't multiply and consequently - the comfort and hygiene of physical exercises and the practicing sport remain. Moreover, it has antimycotic and antiallergic properties.

Canadian biochemists developed the method of putting on textiles put to sleep to propagate bacteria which alert with humid dirt are starting themselves. Enzymes secreted by them are digesting pollutants and are removing unpleasant smells.[2]

However applying the bacterium has a lot of lacks. For defrosting them a special microclimate is essential as well as a possibility of generating pathogenic mutants exists.

Scientists from Institute of Textile and at the Polytechnic higher education in the Hong Kong covered with Clothing cloth with cotton superthin layer of the powdered titanium dioxide, of which particles are nanometric. The layer of such particles is 2500 times thinner than the diameter of the human hair. Exposing the sunlight for her to action is releasing the reaction with contained oxygen in air. The area incurred is destroying dirt, micro-organisms. Turning them into water and CO_2 [2]. Such a kind of materials can find application also for the production of work clothes used at the food production.

Between processes of washing using nano-silver to the production of antibacterial floors is one of new solutions improving the hygiene of the area. Ions of silver are migrating to the surface floors and are destroying micro-organisms. This process is occurring for the entire period of using the floor, irrespective of the degree of the wear and tear. [3]

The side effect of the influence of silver is an illness called the argyrosis. It is believed that at one time aristocrats which ate meals on the silverware suffered from it. Hence, probably, a proverbial “blue blood”.

The argyrosis is grey-blue colouring covers of the body into the effect of the accretion in the skin of molecules of metallic silver, as a result of long-term taking the salt silver e.g. of pills with solution of silver nitrate. [5]

4. NANOTECHNOLOGY IN THE FUTURE

Antibacterial properties of silver can negatively have an influence on a natural environment. I think that not yet a generation which fully would use the nanotechnology was brought up. Mainly it is about a food industry from which of "benefits" we are using every day and very much important for each of us an influence of the food on our health has.

Informing consumers of the applied technology is necessary. The government of Great Britain thinks that reporting about nano-particles in the list of elements on the label is necessary so that consumers are able to take the conscious decision.[1]

Pursuant to the treaty of the European Commission applying nanotechnologies will have to meet requirements of the high level of health protection public, of the safety and the consumer protection and the natural environment. Corporations which nanotechnologies want to exploit must have a trained staff and recipients appropriately on big scales. The possibility of applying the nanotechnology in the food industry depends largely on the consumer acceptance.

The nanotechnology of the future will apply methods of manipulating matter much more precisely and effective than so far. They predict, around new materials will have self-organizing, self-repairing properties oneself and conserving.[1]

Getting to know mechanisms of the transport of food elements and their intentional freeing will enable producers of the food to design gifted intelligent systems to ensure the optimum health of every citizen e.g. possibility of control of hypertension through the regulated level of freeing ions of sodium of the food.[1]

In order to benefit from nanotechnology, industrial development must be based on the possibilities of combiningtraditional manufacturing processes and technologies (top-down) with innovative processes, which are able to create, manipulate and integrate new nanometric ingredients, using existing or new platforms.

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Job shop scheduling problem, simulation, genetic algorithm, SSEM methodology

Štefan FIGA* Michal STARINSKY**

SSEM METHODOLOGY IN PRACTICE

Abstract

Presented in the paper is methodology of SSEM (Scheduling using Simulation and Evolutionary Methods), which is used to generate, evaluate and optimize the production schedule. The proposed methodology can be used to shorten the process of Job-Shop Scheduling (JSS). Practical benefits of SSEM methodology are declared in the case study, which is a practical example in order to optimize schedule.

1. SSEM METHODOLOGY

SSEM methodology was described in paper [1]. Advantages of simulation approach to solve scheduling problems are evident in the article [2]. The conceptual system architecture of the SSEM is represented in Figure 1. This methodology consists of three modules, which are necessary for generating, evaluating and optimizing production schedule. The first module is about generating schedule respectively scheduling using priority rules. The second module is designed to evaluate production schedule with support of a parametric simulation model and the third module is about implementation of evolutionary optimization methods to get better solutions.

The input date can be provided from the production database system such as Enterprise Resource Planning (ERP) systems or Manufacturing Enterprise Systems (MES). The output is the optimized scheduling according to the selected criterion value (for example minimization of makespan).

2. CASE STUDY

Practical part of the case study is solving job shop scheduling problem 10x10, in order to achieve the shortest amount of time needed for machining of all parties. Experimental production system consists of ten universal production workstations, each of which is capable of simultaneously machined just a job - never two or more jobs. Into the system shall enter 10 production jobs. Each job has to be machined on all ten workstations, but on each workstation can be machined only once. Each job has a defined technological process of production, determining the order and process times. Technological processes are different in sequence and

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length of time at workstations. For each workstation is defined preferential order of job in which they must be machined. The preferential order respectively schedule of production, technological processes and machining times for workstations were generated using the SPT dispatching rules in scheduling module.

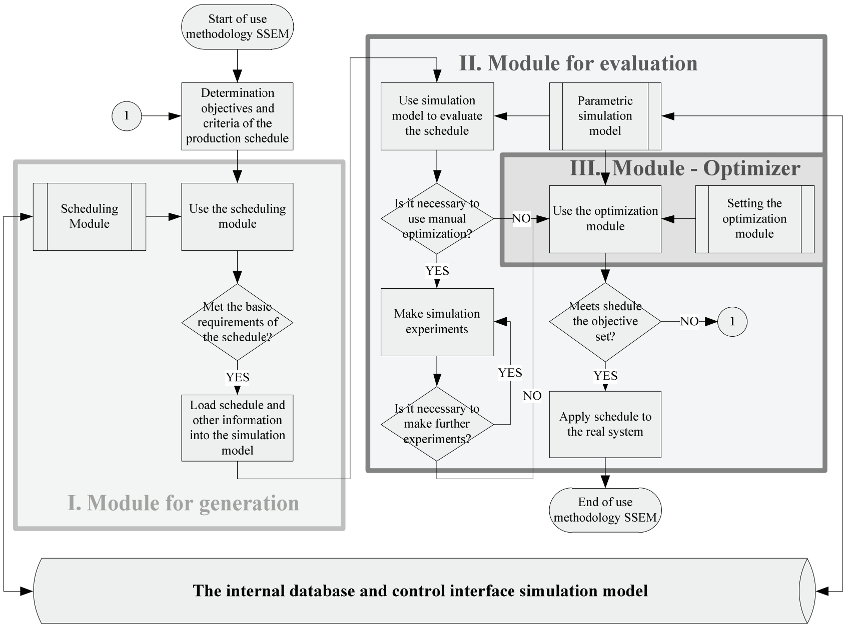

Fig. 1. The basic algorithm of SSEM methodology

The aim of this case study is to establish a basic production schedule according to priority rules SPT and then optimized using a genetic algorithm.

1.1. Base schedule

The evaluation of the basic schedule after the simulation run can find many statistics. In this paper we focus only on the workstations utilization and makespan (total processing time of all jobs).

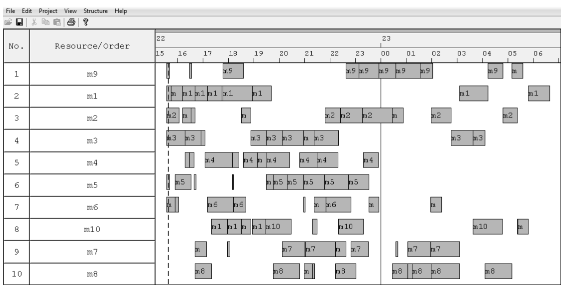

Fig.2. Gantt diagram of the base schedule

Total time required to make the schedule – all 100 operations, is 15 hours, 4 minutes and 40 seconds. As the first production job was completed j10. Behind him was completed production jobs in order J4, J5, J7, J8, J6, J2, J1, J3, and the last job was completed j9. In Figure 2 is a Gantt chart showing the process of production jobs to individual workstations.

1.2. Optimization schedule

In this chapter are assessed the results of application of genetic algorithm for optimized production schedule using SSEM methodology. The objective optimization was to minimize the makespan. Total time required to run the GA module was 3 hours and 53 minutes, during which it was generated, and evaluated total of 23 938 individuals. The best evaluated individual was created in a generation 593 with the number 23 697 and fitness value 136. The time course of fitness values is shown in the chart Fig.3.

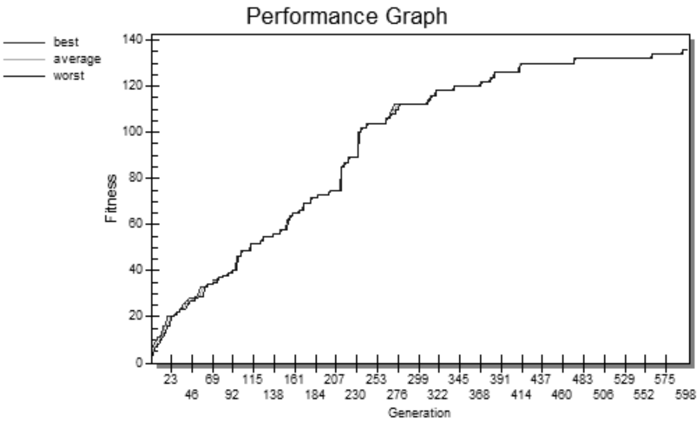

Fig.3. The time course of fitness values

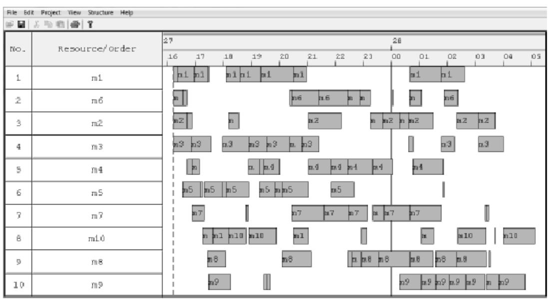

Fig.4. Gantt diagram of the optimized schedule

The simulation time of the individual needed to carry out the production schedule subject to the preferential order jobs to machines is 12 hours and 56 minutes (Figure 4). This schedule is shorter by 2 hours, 8 minutes and 40 seconds compared to the base schedule, which is improvement of 14.23%.

The order of completion production jobs is follows: J5, J4, J6, J9, J7, J10, J1, J3, J8, and finally J2. Figure 5 shows of workstations utilization of the base and the optimized schedule. We can see that compared to the original schedule, the most improved utilization of work m8, which is now utilized at 51.29%. This is an improvement of 7.3%. Workstation utilization is lowest on workstation m6, where there was an improvement by only 4.75% over the original.

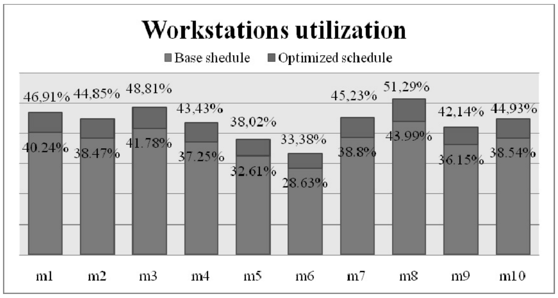

Fig.5. Workstations utilization between base and optimized schedule

3. CONCLUSION

This paper has presented SSEM methodology in practice, which is used to generate and optimize production schedule. Using this methodology, schedule includes most aspects of real production and is able to react quickly to changes. In the case study, we demonstrated the functionality of SSEM methodology and also reached the optimization of schedule using genetic algorithms. We managed to reduce the total production time by 2 hours, 8 minutes and 40 second, which is saving of 14.23%.It follows that SSEM methodology can be used as the practical tool for manager in praxis for quick identification of bottlenecks in creating of schedule to minimize production costs.

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Lenka FLANDEROVÁ*, Richard TENCER**

ROBOTICS APPLICATIONS IN MAINTENANCE AND REPAIR

Abstract

Industrial robots are used in a variety of applications in maintenance and repair of a system or facility. Applications of robots in the maintenance are mainly associated with activities with elementary caring such as lubricant exchanging, cleaning of hard-reaches places, parameters adjustment and monitoring, repair after failure, correction or review. Robots applications improve the quality and speed of corrective work; reduce equipment downtime and increase reliability of equipment or facility.

1. INTRODUCTION AND BACKGROUND

Maintenance is process that preserves or restores a desired state of a system or facility. The maintenance process includes these major activities: inspection-status checking, caring, planned maintenance and disturbance handling (where disturbances are unplanned system states). Inspection or status checking is the activity in which information about state is monitored to allow prediction or early detection of disturbances, and for state estimation for place and cause location of wear or failure. Inspection or status checking is performed by state testing and checking, machine specification measurements, technical diagnostics. Caring is the activity in which measures is destined for elongation working life of the material layers, which are reducing of wear. Caring is performed by cleaning, lubricant exchanging, complementing, adjusting and setting of the machines. Planned maintenance is the activity in which elements of the system are modified or replaced according to a pre-determined schedule, with the aim of avoiding or reducing the frequency of disturbances. Disturbance handling is the activity in which elements of the system are modified or replaced to restore the desired state, following a disturbance.

Industrial robots are used in a variety of applications in maintenance and repair. Maintenance is a task that has some important differences from tasks commonly selected for industrial robots. Applications of robots in the maintenance are gaping and mainly associated with activities with elementary caring such as lubricant exchanging, cleaning of hard-reaches places or parameters adjustment. With status checking such as inspection work, testing diagnostically parameters and consequently with activities associated with failure or intervenes in emergencies. The scope and

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frequency of these operations depends on the complexity of the machine, on the level of reliability, on impact of operational characteristics of the machine working or on machine operation and economic indicators (costs, benefits).

Mainly advantage of robotics applications is in remote control, which significantly reduces exposure to particular operators. Robots applications improve the quality and speed of corrective work; reduce equipment downtime and increase reliability of equipment or facility.

2. TECHNIQUES AND EXAMPLES OF APPLICATION

Robotics application in maintenance is used by service robot. Service robot is generally independently operated, computer controlled, automated, freely programmable, stationary, mobile device designed to partially or fully automated implementation to activities and actions which are addressed to the technical or operational equipment or systems services or maintenance. Service robot is technically equipped with the skills to ensure his mobility in the operating space, action capacity, motion planning and the power control. Robot motion in space is execute by his cybernetic system, which integrates motor subsystems (reference mobile base, coordinating base and effectors) management (processor and communication processor) and sensors (internal, external). Service robot is by these components able to practice autonomous broad-based and goal-oriented interaction in a real environment.

In the case of robots for maintenance we means the category of robots, which are able to manage with handling operations (handling, tools and parts recorded), supporting technological activities (repair and restoration work), diagnostic activities (locating, fault detection and correction) and other special activities (identification and state checking for diagnostic purpose).

1.1 Application examples

In this chapter, we have reviewed the primary application areas (inspection, planned maintenance, and disturbance handling.), in which robotics are used for maintenance and repair.

Tab. 1. Summary of robotics applications in maintenance and repair.

	Maintenance Task		
Application Area	**Inspection (check status)**	**Planned Maintenance**	**Disturbance Handling**
Nuclear Industry	Growing area, especially as new facility designs incorporate remote maintenance philosophy	Well-established field, with several decades of successful robotic applications.	Much current activity related to decontamination, decommissioning, and dismantling.
Highways	Relatively new area with few current prototypes, except as packaged with crack sealing and pothole repair systems.	Relatively new area, with quickly growing interest and a huge potential impact. Several ongoing efforts should result in a number of new robot prototypes in the next 5 years.	Of significant interest, particularly for highway integrity management. A number of successful prototype systems are gradually making way into routine use. Several new efforts underway.

Tab. 1. Summary of robotics applications in maintenance and repair. continue

	Maintenance Task		
Application Area	**Inspection (check status)**	**Planned Maintenance**	**Disturbance Handling**
Railways	Few current systems and little ongoing activity.	Most common area of railway robotics, but with little new activity.	Little current use.
Power Line Maintenanc e	Little current use.	Interest is increasing, especially for robotic techniques that work on live power lines.	Greatest area of current use, with much potential growth due to technology advances and need to remove humans from highly dangerous tasks.
Aircraft Servicing	Steadily growing area, due to recent advances in automated inspection technologies.	Steadily growing area, especially for automated stripping and painting.	Little current use.
Underwater Facilities	Steady progress over the last two decades, with continued advances.	Of increasing importance, with several new prototype systems under development.	Of increasing importance, with several new prototype systems under development.

Interest example of robotics applications in maintenance is the robot system proposed as a solution to inspect, clean and redevelop the fresh water pipes. The robot consists of 3 modules, a mobile robot for movement inside the pipe, a maintenance unit for redeveloping the pipe and a control station outside pipe, monitoring and controlling the in-pipe modules. The robot system includes the conventional inspection of the pipe system, which is carried out using a cable-tethered robot with an onboard video system. An operator remotely controls the movement of the robot systems.

The proposed robot system is designed to perform several tasks like inspect, clean and redevelop pipe. Water pipe systems are prone to damage due to aging, excessive traffic, geological changes and earthquakes. Commonly, due to high cost of pipe replacement, pipe cleaning and repairing is preferred. Consequently, the applications of robots for the maintenance of the pipeline utilities are considered as one of the most attractive solutions available.

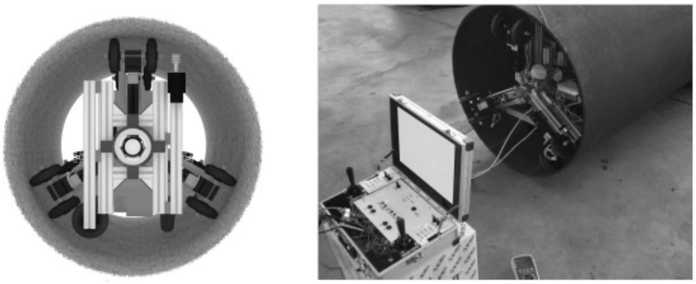

Fig.1. Robotics applications to inspect clean and redevelop the fresh water pipes

2. TRENDS IN ROBOTIC MAINTENANCE

In this chapter, we have reviewed some trends in robotic maintenance in recent years can be identified. These trends can be divided into three elementary divisions, which are computer control/monitoring system of maintenance, virtual reality or increasing sensor integration.

Computer control/ monitoring/ assistance maintenance system is important for increasing integration of computer control over subsystems and sub-tasks, form monitoring the position, for monitoring user inputs and evaluating their appropriateness and for user assistance. By base inspection robots are more capable of accurately position monitoring or sensory measuring. Robotics application in inspection will be more autonomous and more effective. By planned maintenance robotics application will assist in scheduling and reduce human involvement in maintenance tasks. Virtual reality assists in robot navigation by providing displays to enhance user situation awareness. It may be used to display robot progress through planned maintenance tasks without on-site video. It may be used to display information about maintenance or recovery tasks. Increasing sensor integration will make to perform inspections in multi-sensor fashion and develop a picture of inspected items that integrates several sensors, including energy not sensed by humans. Arrays of sensors may provide more complete information about a component and aid in assuring the effectiveness of planned maintenance. Arrays of sensors may provide more complete information about a disturbance and aid in diagnosis and remediation.

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Innovation, Lean Manufacturing, continuous improvement

Joanna FURMAN*

TOOLS OF LEAN MANUFACTURING AS A TYPE OF ORGANIZATIONAL AND PROCESS INNOVATIONS IN INDUSTRY COMPANIES

Abstract

The following paper contains possibilities of industry companies improvement based on the new innovation methods. These companies, in order to exist in market economy, should be open for changes and readjust to changeable conditions. In the paper, attention was paid to chosen tools of Lean Manufacturing (LM). LM is costumer oriented and helps to obtain permanent competitive advantage.

1. THE ROLE OF INNOVATION IN ENTERPRISE

Modern management methods and concepts are designed to provide industrial companies not only survival in a volatile environment, but also lead to long-term competitive advantage and business success in the global market [1]. Currently one of the key competitiveness is innovation. Owing to innovation there is: an improvement and modernization of manufacturing processes, an increase of productivity, efficiency and quality of work, an increase of product quality and competitiveness, an increase of efficiency, improving the organization and working methods, improving security and working conditions, etc. [2]

According to the Oslo Manual [3], innovation is an introduction of a new or significantly improved solution for the product, process, marketing or organization. Implementation of the new product is offering it on the market, while introducing a new process, new marketing methods or new organization is its application in the current functioning of the enterprise.

A product innovation launching by the company of a new product or service, or significant improvement of the offered goods or services in relation to their characteristics or destination. Process innovation is the introduction to the practice in the company of new or significantly improved methods of production or supply. A marketing innovation is the use of a new marketing method involving significant changes in the appearance of the product, its packaging, promotion, pricing or business model, resulting from the new marketing strategy. An organizational innovation is application of a new method of organization of activity, new jobs or the organization of a new organization of external relations in the company.

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According to P.F. Drucker "not innovating, that is to die" - innovation allows the existence and development of the company in the future [1]. The company combines innovative action of three essential elements: creates a new idea, implements it in practice and finances its realization In addition, it forms, absorbs and implements new products, and also prepares to a permanent adaptation to changes in the environment. Looking at an innovative company in a more tangible way, it is assumed that it is an organization which:

- conducts a wide range of research and development and purchases new products or technologies,
- devotes relatively high financial outlays to this activity,
- systematically implements new scientific and technical solutions,
- represents a large potential for new products and technologies in the volume of production and service,
- constantly introduces innovations to the market [4].

2. LEAN MANUFACTURING

Modern production systems, with innovative solutions allow to adapt quickly and easily to changing market needs, delivering high quality products and meeting customer expectations. These are modern, automated processes, supported by ICT tools and using a completely new approach to management. These include: Flexible Manufacturing System, Computer Integrated Manufacturing, reengineering, X-engineering, Just In Time system, Total Quality Management or Lean Manufacturing (LM) which is very popular especially in the automotive industry.

Regarding manufacturing systems, "lean" means to trim production in terms of material resources needed for the maintenance of inventories of finished goods and work in progress and used space of the production halls. Lean Manufacturing describes a manufacturing system, which in comparison with traditional mass production systems are characterized by faster and more accurate to satisfying customer needs, using fewer resources. The first lean manufacturing system is considered to be the Toyota Production System, in which all the elements work for the company. The Toyota Production System is focused on complete customer satisfaction, continuously searches for better methods of environmental improvement and teamwork.

Lean Manufacturing is a method of improving the operation of the company, which optimizes the creation and flow throughout the manufacturing process by constantly reducing wastes. LM is based on five principles, where the starting point is the value clearly defined by the end user. The next step is to set all the measures of value added services for a specific product along a value stream and flow values. The fourth principle of the LM system is a pull system - that is, responding to customer needs. Excellence, the last principle is the constant aspiration for improvement [5].

3. TOOLS OF LEAN MANUFACTURING

Industrial enterprises, introduce a number of innovative solutions. Innovation does not concern only offered products, where change is most felt by the user. The changes also affect the organization of production and work processes, making moves to increase the efficiency of a single work post, to increase efficiency and productivity of the process, improving it continuously. This gives businesses the opportunity to implement Lean Manufacturing tools, which include: visual control, “5S” method, Value Stream Mapping, kaizen, Total Productive Maintenance (TPM), Single Minute Exchange of Die (SMED).

The initial phase of implementation of Lean Manufacturing is to create a value stream map that identifies any action required to design, procure and manufacture the product. This tool lets tracing the path which the product flows from the customer's order and ending with the suppliers of raw materials [5]. One of the objectives of value stream mapping is to map the current situation, which shows the relationship and information governing the process. Map reveals the source of waste and develop a future state map by using appropriate tools (e.g. kaizen) in order to improve processes.

Visual control is an easy and effective tool in the supervision and conducting the manufacturing process. Visualization explains the process of comparing the results of any expectations of achievements in the production system and management systems in use. Furthermore, it is a control that allows receiving significant information (the state of manufacturing processes, the level of stocks of work in progress, the number of defects, the number of non-working machines) only by going through the premises and observation of these phenomena. This means that anyone entering the production area can almost immediately see what the status of ongoing processes is. For visual control many tools can be used, including:

- the "5S" method,
- kanban cards,
- Andon signals,
- communication passages marks,
- work instructions [6].

“5S" is an essential tool for visual control. Companies often begin implementation of the LM concept with the "5S" method, which concerns the organization of the workplace. It is believed that improperly organized, unstructured workplace is causing the increase of production cost and any wastes. Organizing the work, production hall and the entire company consists of five stages: selection, systematic, cleaning, standardizing and self-discipline. Although the "5S" is associated with cleaning, it is actually a process of profound change in corporate culture, based on visual management, standardized processes and team work. The method enables continuous improvement of production systems and is the basis for making other tools of Lean Manufacturing: kaizen, SMED and TPM [7].

Kaizen is one of the most important concepts in the Japanese management mode. It consists of small, gradual changes to already existing techniques, technology and working methods by eliminating wastes. This is achieved mainly through the involvement of workers in search of small improvements. In order to improve the activities necessary to conduct a process kaizen and a flow kaizen. The process kaizen concentrates on activities doing by workers and it refers to the single production process. The flow kaizen focuses on the flow of material and information in a process in order to understand the formation and improvement of flow values. Kaizen with a small change allows to achieve improved efficiency of operations without incurring large amounts of money in every area of business. Pillars of kaizen are: standardization, the "5S"method and removing wastes [8].

TPM is a continuous process of handling machinery and equipment within the company by all operators and maintenance personnel. With the implementation of each machine in the production process, it is always possible to perform the tasks, because there is no disruption of production. The main objective of TPM is to achieve a level of three zeros: zero accidents, zero defects, zero accidents. This goal is achieved in two areas: human and machine, by increasing the efficiency and commitment of employees, improving the current state of machinery and equipment and increasing the efficiency of the machinery [9].

Thanks to the SMED method, shortening of changeovers time is achieved. It is assumed that the system allows replacement of parts, tools, production machine in less than 10 minutes. Quick change of tools is a critical condition for the company that uses such systems such as Just In Time system, because it allows the machine to adapt quickly to new working conditions. The basic premise of the SMED method is to reduce the size of production batches in order to adapt production to changing market requirements [5].

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Delmia, Tecnomatix, assembly designing

Beáta FURMANNOVÁ*

MODERN APPROACH OF ASSEMBLY DESIGNING

Abstract

This paper describes the modern approach to assembly systems design in the digital factory. It presents the basic process of assembly workstation design using the strong tools in the assembly systems design, DELMIA and Tecnomatix. By tools of digital factory is possible change design, simulate and optimize of production composite products and prevent thereby possible by lack of and mistake.

1. INTRODUCTION

Typical feature for the 21st century is development and implementation of "intelligent solutions" in all areas of human life. Production and technologies become intelligent. Only countries, which maintain top technological development, will succeed in the future.

Competitive advantages in the global environment make possible to increase. Competitive advantages, than quality, costs, time, flexibility, productivity, innovation, are essential for every producer. Time is now the most important element, how to gain a customer.

Digital Factory (DF) represents one of the most progressive, integrated approaches to the design of new products, production processes and systems. Digital Factory entitles virtual picture of a real production. It represents the environment integrated by computer and information technologies, in which the reality is replaced by virtual computer models. Such virtual solutions enable to verify all conflict situations before real implementation and to design optimized solutions. This concept is offered by DELMIA and TECNOMATIX software.

2. DELMIA AND TECNOMATIX

DELMIA (Digital Enterprise Lean Manufacturing Interaction Application) offers the most complex totality of digital 3D solution for the production field that is in the present in the market. Technology provides complete solution that is focused on critical production process of customers. It includes production of engines, final assembly and body in white in the field automobile industry, assembly aircraft in the air industry and assembly practices in industrial department. It enables complete design and verification production process with utilization of digital model. DELMIA solution is built on an open PPR model (product – process - resource),

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by means of which it is possible continuous designing and verification of production process in the individual design phases.

DELMIA consists of three basic parts: V5, Process Engineer, Quest.

TECNOMATIX is aimed at increasing the effectiveness of workstations planning by optimization of the production facilities layout and material flows in the company. By using these tools company can achieve a sustained increase of productivity through the implementation and optimization of robotic and automation systems.

TECNOMATIX is a comprehensive portfolio of digital manufacturing solutions that deliver innovation by linking all manufacturing disciplines together with product engineering – from process layout and design, process simulation and validation, to manufacturing execution. Built upon the open product lifecycle management (PLM) foundation called Teamcenter™ manufacturing platform, Tecnomatix provides the most versatile set of manufacturing solutions on the market today.

TECNOMATIX consists of these basic modules: Process Designer, Process Simulate, Factory CAD, Factory Flow, Robcad, Plant Simulation, Jack.

3. ASSEMBLY WORKSTATION DESIGN

Assembly workstation design in the digital factory can be performed in the following steps:

1. Collection of basic information about product, processes and resources.
2. Preparation of 3D mock-up of assembly workstations components in CATIA and their insertion into the database.
3. Defining the basic structure of the project (product structure, assembly process and assignment of resources).
4. Creating a layout of the workstation.
5. Analysis of assembly workstations using various tools (ergonomic analysis, line balancing, simulation ...).

Collection of basic information is an important step in the project. It is necessary and important to collect true information about the situation in which company is located. Only high-quality input data will ensure success in the next steps. Basic data can include product components, assembly process, operations times etc.

Preparation of 3D mock-ups can be omitted if the parts of assembly workstations are in the library. If it is necessary to complete them, at first they must be modeled in the CATIA program and consequently imported into the library. Possibly change the format that is compatible with the needed library. They can be used in the library in the other created projects as far as these objects are not removed from the library.

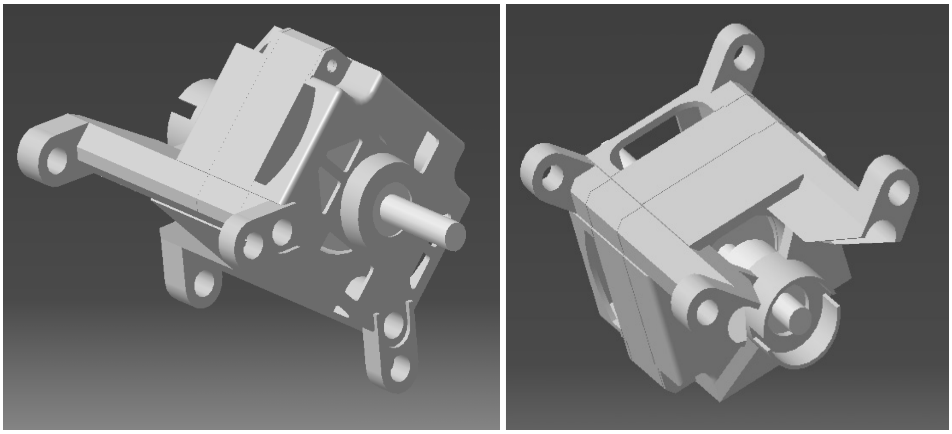

Fig.1. Example of components in CATIA

Defining the basic structure of the project in the different software is distinguished. DELMIA proceeds from the product defining through the process to the assigning resources to each operation in the assembly process. Tecnomatix begins by defining the product, creation and filling the library of resources follows and finally the structure of process is created.

The program will allow us to create schematic 3D layout of assembly workstations after giving all necessary data about products, process and resources. The system enables various modification by adding the layout plan, floor plans of equipment and storage areas for materials. The layouts examples are shown in the following figures.

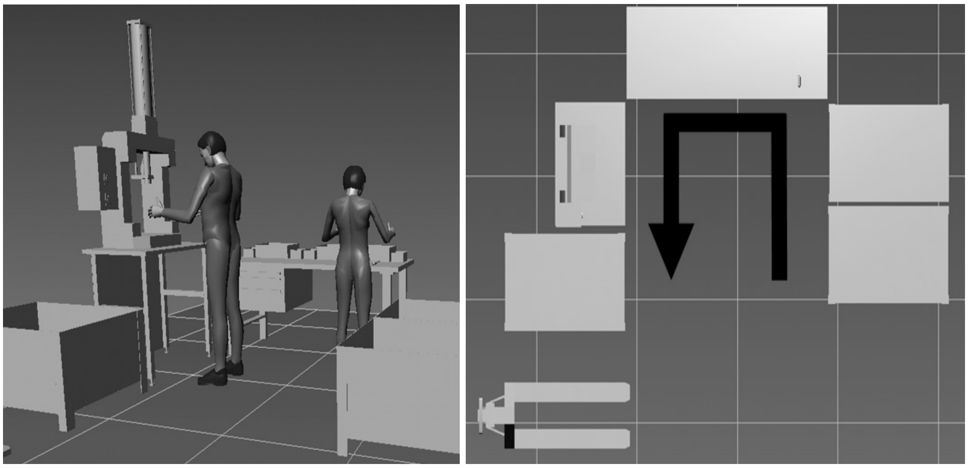

Fig.2. Layout example in DELMIA

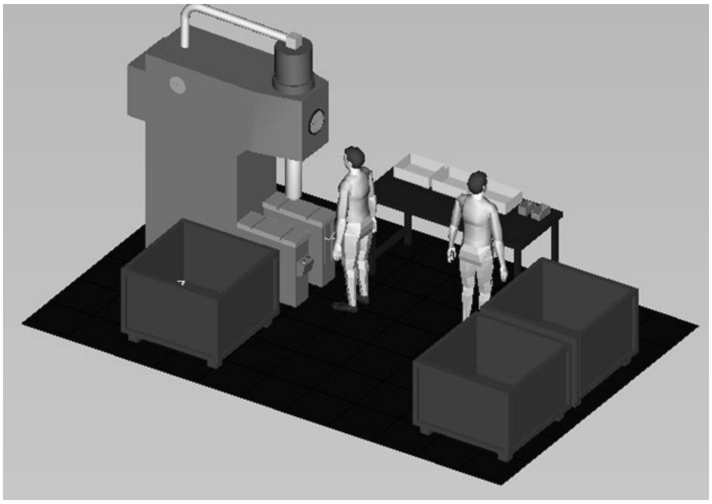

Fig.3. Layout example in TEXNOMATIX

After the creating different variants of assembly workstations the program enables us to carry out the line balancing, ergonomic analysis, creating a new organization of workstations, new assembly procedures, simulation and so on.

4. CONCLUSIONS

An assembly design represents an interesting scope which needs its further development nowadays. Using the 3D digital solution allows: to discover the bottlenecks and clashes before an assembly realization, to verify an assembly process before starting production, to create the minimal number of prototypes. The biggest advantage of Digital Factory concept applications is the cost and time saving – the most important indicators nowadays.

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Automotive, motor industry, process costs, work costs, production costs

Ewa GOLIŃSKA*

PROCESS COSTS ANALYSIS IN THE ENTERPRISE OF THE AUTOMOTIVE INDUSTRY

Abstract

The article analyses output costs in one of the automotive industry enterprises. Issues of the changeability of the market absorbency (from the standpoint of assembly costs, connected with a change of the tact time of the line and/or a change of the employee cast of individual positions in the production system) have been discussed. They demonstrate the fact that if processing costs are supposed to stay on the plateau while strain on the production line is reducing, one should this way steer the payroll so that workplace costs appropriately tail off.

1. INTRODUCTION

The main purpose of the paper is describe the cost analysis of the processing in the enterprise of the automotive industry. Different variants of the employee cast have been considered, and consequently different payrolls and the split quality level committed by employees about different qualifications. A changeable demand for cars on the market, what in consequence to lead for changes in the production system have been investigated . The author proposes solving this problem will back the work analysis of the production line with different burdening (from 100 to the 50%), what economically must be connected with changing in the payroll in the analyzed enterprise.

Taking construction of computing algorithms on as the criterion it is possible to distinguish three basic methods of determining prime costs of the production:

- method of the division calculation,
- method of the addition calculation,
- method of the cost accounting of action.

The choice of the method of the cost accounting depends from many factors, e.g.: the kind and the size of the production, the degree of the automation and the mechanization, the specificity of manufacturing processes, etc.

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Addition calculation (called also erratic) is perfect for the serial production, when on positions with the value moved close or different various products are being produced according to different technologies.

In order to determine the production costs within the serial and mass production, the adding method of calculation according to the places where the costs occur (fig. 1.) is used. The method is based on calculating separate costs for each carrier established before. Direct costs are assigned to the carrier directly basing on the source document, whereas indirect costs are added as percentage surcharge of direct costs.

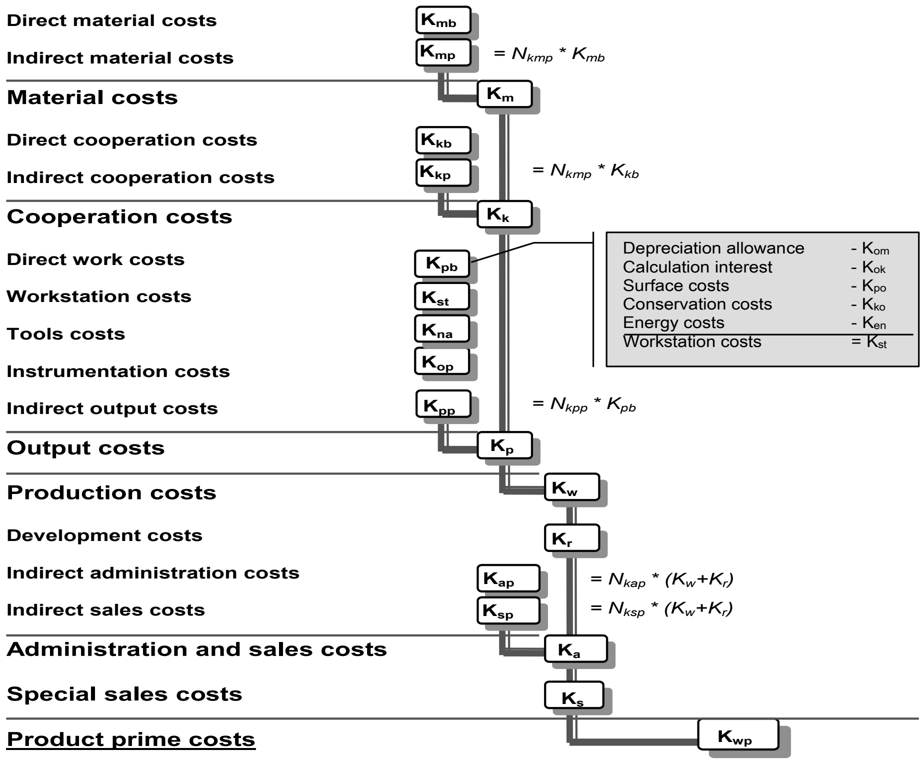

Fig. 1 The adding method of calculation according to the places where the costs occur

2. PRODUCTION COSTS IN THE ANALIZED ENTERPRISE

A system of the job evaluation and diversifying the remuneration of employees is finding application in the analyzed enterprise. According to the skill stencil, the following determiners for the employees have been given:

- Employee A – student, observer
- Employee B – worker who practises under independent worker's tutelage, is able to carry out a part of operations independently

- Employee C – independent worker
- Employee D – independent worker, carries out additional, untypical operations

Based on such an established qualifications scale a table of rates of basic pays is built (classifying the employee in the group, associated with A, B, C, D with the rate appropriately 8.5; 9.5; 10; 10.5 of cost units).

In order to adapt the working practice on the position to organizational conditions of the plant (adaptations to efficiency and quality requirements) the simulations of different courses of the work, for different skill levels and the number of employed employees have been made . On fig. 2 different model variants of the course of the process depending on the classification of the employee casting have been described.

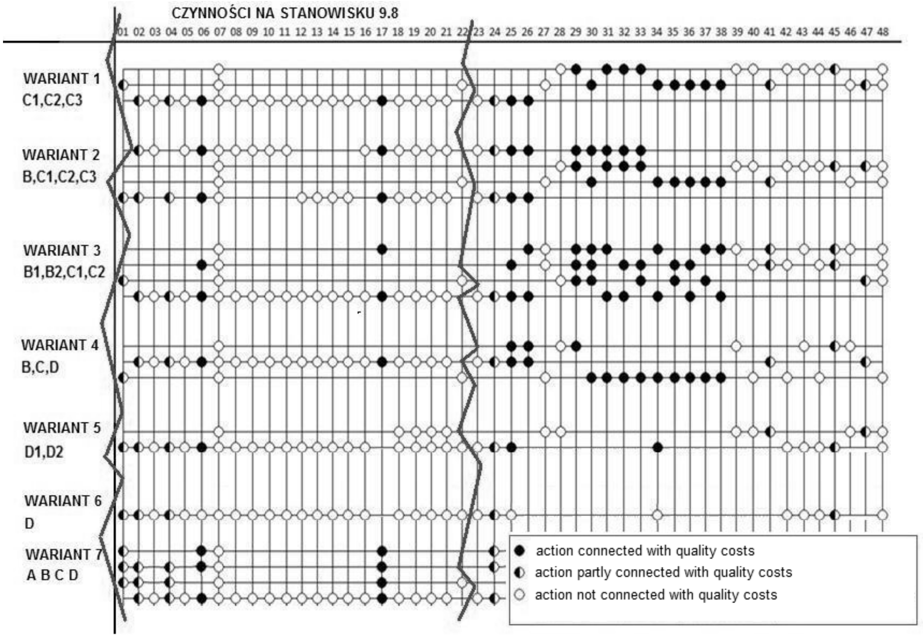

Fig. 2 Analized variants of a production process

For setting the costs of the assembly determining the K_{pb} direct labour is essential (indirect costs will be determined as the interest-bearing mark-up of direct costs).

$$K_{pb}/h\ (C) = 10\ [\text{ c.u.}] \tag{1}$$

At the full load of the production line equal 100% what in the conversion is explicit with producing 60 cars per hour

$$K_{pb}=0{,}17\ [\text{c.u./itm}] \tag{2}$$

Appropriately for the analysed burdens equal of the production line one by one the 90%, the 80%, the 70%, the 60% and the 50% and at the rate will amount to C Kpb pay grades 0.19; 0.21; 0.24; 0.28 and 0.33 [c.u. / itm].
Conducting analogous analysis for all sorts groups of classifying employees results in achieving results collected in table 1.

Tbl. 1. Direct labour at different rates of the pay grade and at changeable burdening the production line

RATE	PAY GRADE	BURDENING THE PRODUCTION LINE					
		100%	90%	80 %	70%	60%	50%
8,5	**A**	0,14	0,16	0,18	0,20	0,25	0,28
9,5	**B**	0,16	0,18	0,20	0,23	0,27	0,31
10	**C**	**0,17**	**0,19**	**0,21**	**0,24**	**0,28**	**0,33**
10,5	**D**	0,18	0,20	0,22	0,25	0,29	0,35

A calculation of costs of the direct labour is a further step of analysis for each of seven chosen variants of the employee cast on the 9.8 position. Results have been presented in table 2.

Tbl. 2 Direct labour at different rates of the pay grade and at changeable burdening the production line for analysed variants of the employee cast on the 9.8 position.

	100%	**90%**	**80%**	**70%**	**60%**	**50%**
3C	0,51	0,57	0,63	0,72	0,84	0,99
3C+B	0,67	0,75	0,83	0,95	1,11	1,3
B+C+D	0,51	0,57	0,63	0,72	0,84	0,99
2XD	0,36	0,4	0,44	0,5	0,58	0,7
D	0,18	0,2	0,22	0,25	0,29	0,35
A+B+C+D	0,65	0,73	0,81	0,92	1,09	1,27

Next workplace costs Kst have been determined. Workplace costs consist of fixed costs (depreciation allowances, calculating, costs of rooms and the conservation) and variable costs - costs of energy. (3)

$$K_{st} = K_{oa}+K_{ok}+K_{po}+K_{ko}+K_{en} \qquad (3)$$

- K_{oa}=1.000.000j.k./10 lat = 100.000 c.u../year
- K_{ok}=1/2*1.000.000c.u.*0,08 = 40.000 c.u../year
- K_{po}=20m^2*300c.u.=6.000 c.u../year
- K_{ko}=8.000 c.u../year
- Ken=10kW*1/2*1c.u.=5 c.u./h.

So K_{stst}=154.000 c.u../year = 28.000/37.500 =**5,5 c.u./h**
K_{stzm}=**5 c.u./h** [100% burdening the production line]

Performing analogous calculations for the different value of burdening the production line a variable cost values of workplace one by one have been received : 4,5; 4; 3,5; 3; 2,5 c.u. for the smaller burdening.
Knowing the cost value of the direct work, workplace costs and labours cost indirect (a mark-up of the 20% has been taken) for different values of burdening the line it is possible to appoint values of the process costs - Kp. (4)

$$K_p=K_{bp+}K_{st+}K_{pp\ (for\ N=20\%)} \quad (4)$$

Process cost values have been described in table 5. Minimum value of Kp = 1.297 have been received at the full exploitation of the power of the production line, this value disadvantageously grows with performance loss of the line.

Tbl. 3 Process costs for changeable burdening the production line

	100%	**90%**	**80%**	**70%**	**60%**	**50%**
K_{ST}	0,175	0,185	0,198	0,214	0,236	0,267
K_{PB}	0,51	0,57	0,63	0,72	0,84	0,99
K_{PP}	0,612	0,684	0,756	0,864	1,008	1,288
K_P	**1,297**	**1,439**	**1,584**	**1,798**	**2,184**	**2,545**

3. SUMMARY

Contemporary literature sources in the general way issues are presenting cost analysis including costs of ensuring the quality in a production process. Every problem of the occurrence of errors in the production requires the individual examination which the author undertook.
Because of changing needs of the market and likings of the customer manufacturing companies are contending with the problem of the cost increase workplace, of which the participation is very significant in costs of the processing, and consequently in prime costs of the product. These costs disadvantageously grow along with lowering straining the production line. If producers want to keep process costs on the similar level like in case of the full load of line, it are forced to control quantitative and quality employing employees directly production (what is explicit with the guidance with payroll).
From a point of view of the work efficient to the reduced value of the tact of the line it is possible to reduce the employment or to adapt qualifications of employed employees to requirements. In order can do it one should analyze times of works carried out on individual positions.

Simulating the quantitative and quality employee casting at the different load factor of the production line in the program Arena is a next stage of the work. Determining costs and lead times for individual variants it is possible based on the Pareto optimization for given production conditions solution what is an aim of further deliberations.

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Virtual factory, knowledge

Jozef HNÁT*

VIRTUAL FACTORY FRAMEWORK

Abstract

This article describes the concept and objectives of the Virtual Factory Framework (VFF) project. VFF project is funded by the European Union through the 7th Framework Programme. Company CEIT,a.s. (spin-off of University of Žilina) is a member of the project team and actively participates on the solution of this project. Also some members of the Department of Industrial Engineering are involved into the project.

1. INTRODUCTION

One of the current problems of industrial engineering is the integration of product, process, resources (data and tools) and synchronization of their life cycle. Major IT players offer the comprehensive PLM solutions supporting most of the business processes. However, these solutions do not offer all the functions and often are characterized by insufficient interconnection and cooperation. The Virtual Factory Framework (VFF) project is trying to find the answer to this problem.

2. VFF – VIRTUAL FACTORY FRAMEWORK

The Virtual Factory consists of an integrated simulation environment that considers the factory as a whole and provides an advanced planning, decision support and validation capability. The VFF implements the framework for an object oriented collaborative virtualised environment, representing a variety of factory activities meant to facilitate the sharing of factory resources, manufacturing information and knowledge. VFF promotes major time and cost savings while improving collaborative design, management, (re)configuration and evaluation of new or existing facilities. This requires the capability to simulate dynamic complex behaviour over the entire life cycle of the factory that is considered as a complex and long living product [1].

The VFF architecture (see figure 1) is based on four Pillars: (I) Reference Model, (II) Virtual Factory Manager, (III) Decoupled Functional Modules and (IV) Integration of Knowledge. The key characteristics of the pillars are openness, scalability and easiness to plugin the decoupled software tools, thus reducing the investment costs compared to “all-in-

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one" software suites. Moreover, the VFF aims at promoting major time and operating cost savings, while increasing the performance in the design, management, evaluation and reconfiguration of new or existing factories [4].

All the functionality needed for factory planning are provided by various independent VF Modules (Pillar III) which work on a consistent Reference Model of the factory (Pillar I) thanks to VF Manager (Pillar II), which plays an important integration role by linking all the modules together.

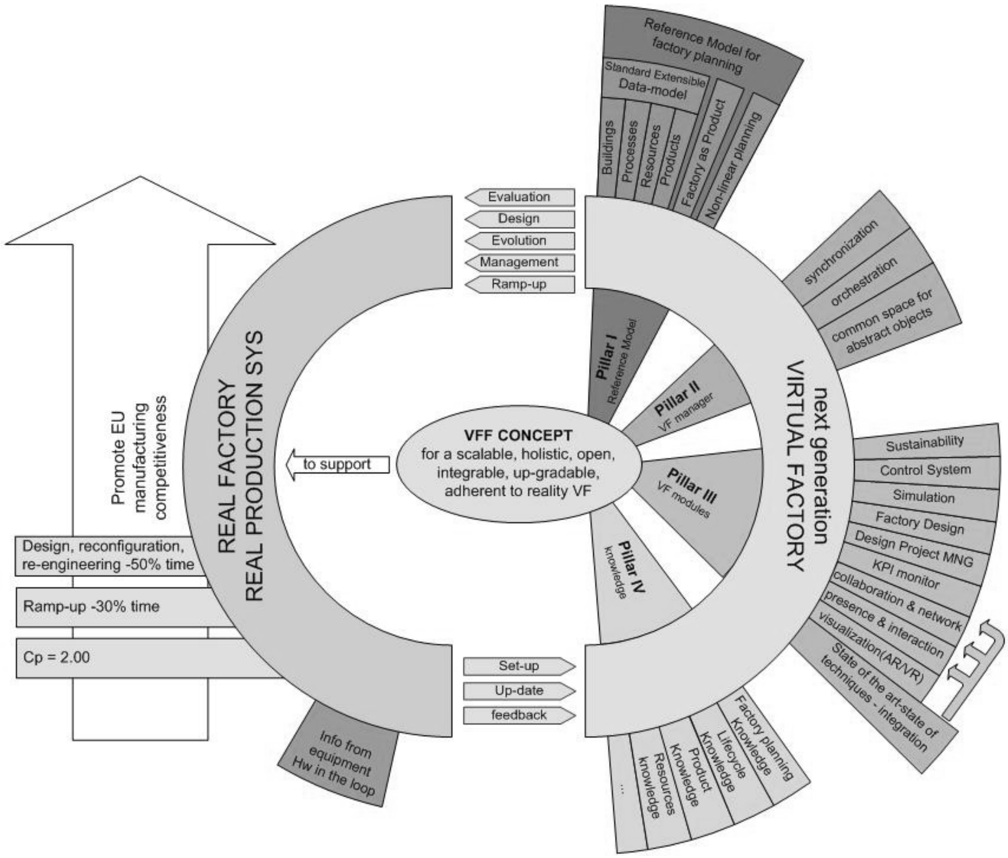

Fig.1. VFF concept scheme [5]

Reference Model – Pillar I - the objective of a reference model is to support planners and interdisciplinary teams in different phases of the planning activities. The VFF Reference Model for Factory and Process Planning (RMFPP) implements this concept and approaches all phases and activities required as standard and mandatory for the purpose of factory and process planning. Furthermore, the VFF Reference Model provides possible planning entities for the virtual factory data model in the VFF project.

Virtual Factory Manager (VFM) – Pillar II - is the core of the VFF and handles the common space of abstract objects representing the factory as defined by the common data model (Pillar I). The VFM orchestrates the decoupled functional modules and provides a controlled access to the different virtual factory instances.

VF modules – Pillar III - are the software tools that implement the various methods and services to support the activities related to factory design, performance evaluation, management, production monitoring, etc. The VF modules can be located on a remote workstation or on the server where the VFM resides. Considering the scope of the VFF approach, the VF modules can be grouped into categories. For each category, different solutions can be adopted according to the specific needs and the availability of commercial applications. The integration of VF modules endowed with different functionalities and level of detail but insisting on the same factory representation will offer the possibility to reach a *wide range of users*.

Knowledge – Pillar IV - integration of Knowledge at different layers as engine for the modules aiming at giving reality to the envisioned Learning Factory. The primary objective is to use contextual knowledge to model a wider range of complex systems and support greater comprehension of the modelled phenomenon. Moreover, the integration of knowledge throughout the VF has the potential to deliver fundamental advisory capabilities as a companion to factories development in all its scales and complexity dimension.

2.1. Real Factory

The collaboration of the four pillars leads to the realization of the Virtual Factory concepts. The Virtual Factory itself, deployed according to the VFF concept, will be permanently synchronised with the Real Factory to achieve time and cost savings in the design, ramp-up, management, evaluation and reconfiguration of the real production itself. The Real Factory, interacting in terms of feedbacks and of data needed to set-up and up-date the simulation system, closes the loop. Communication between Real and Virtual Factory (see Figure 2) is realized through the Factory Image, which represents a picture of the company at that time. This image is created from data that are collected from the real production using connectors (hardware devices).

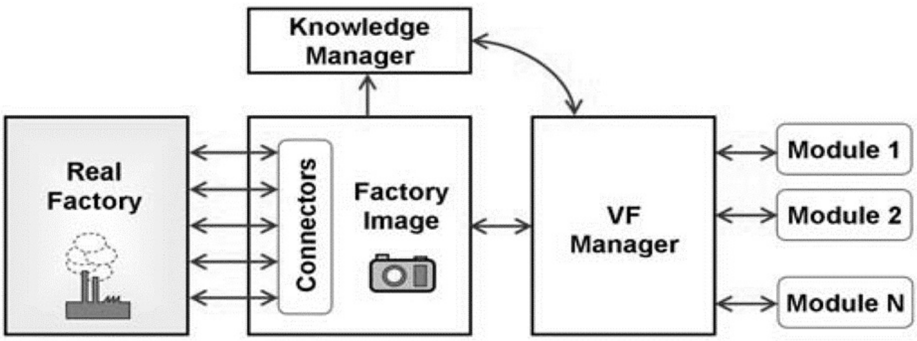

Fig.2. Communication between Real and Virtual Factory [3]

2.2 Validation

Since the final goal of the Virtual Factory is to improve the performance of the Real Factory, it is necessary to verify the impact of the VFF approach. This need asks for the cooperation of industrial companies to define demonstration scenarios that aim at testing and validating the framework. Within the VFF project four demonstration scenarios have been designed by pairing different factory planning processes and industrial sectors represented by the project partners:

- Factory Design and Optimisation in the machining sector - Compa S.A. and Ficep SpA.
- Factory Ramp-up and Monitoring phases in the automotive and aerospace sectors - Volkswagen Autoeuropa and Alenia Aeronautica SpA
- Factory Reconfiguration and Logistics in the automotive and white-goods sectors - Audi Hungaria Motor Kft. and Frigoglass S.A.I.C.
- "Next Factory" scenario aims at demonstrating the applicability of the VFF on the entire factory lifecycle. This integrated scenario focuses on the woodworking and automotive sectors - Homag AG and Comau Powertrain SpA.

3. CONCLUSION

In this article it has been presented the basic structure and goals of the Virtual Factory Framework project. There are 30 partners from 11 European countries working on this project. The project is currently in the process of solution and its completion is scheduled for February 2013th.

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The production system, range, automation, transportation

Radovan HRIVNÁK*

THE SUMMARY OF THE PROPOSAL AUTOMATION IN THE PRODUCTION SYSTEM

Abstract

The contribution is focused in the automated production system. The paper presents the elements that need to be addressed in its proposal. At the beginning of this paper is concerned with the facts that one needs to know that we can design an automated system and also the benefits of such a system.

1. INTRODUCTION

The main reason for addressing this issue in my paper is that the elements of automation is an important part of the design process of an automated manufacturing system. Only the use of such elements in mass production can guarantee fast and efficient production, which is necessary to be able to meet rapidly growing demands of customers. It is necessary in this process, the emphasis not only on the machines themselves, but also the possibility of transport, handling and storage products in the manufacturing process.

2. ELEMENTS IN THE PRODUCTION PROCESS AUTOMATION

The main elements of automation, which is necessary when designing a system to deal with are:

- machine,
- tools,
- operaction´s manipulation,
- inter - operaction´s manipulation,
- storage.

An important part of this process is, of course, man, because without the human factor is not possible to carry out certain acts which are necessary in the production takes place is therefore evident that the human factor is and will always an important part or production, but also non-productive process in modern operations.

Another important part of the production design is that of producing what it is (mass production). The piece does not manufacture automation of the process to such importance as

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in mass production where the production of many products. Each element relates to the automation of the implementation of funds and therefore should be considered when and where to implement automation.

2.1. Machine, tool – automation capabilities

For the selection of production equipment according to [1] is necessary to have different default input data, for example:

- Product range and production volume,
- Determination methods and structures technological processing, handling and management,
- Technological and organizational structure of production, which is specified mainly seriality, degree of automation and flexibility.

Currently, companies that manufacture machinery and equipment manufacturing, offering their products a complete technological units. Figure 1 is an example of a modern production CNC machine GTX 300 [2]. The actual manufacturing facility in addition to containing most of the input-output space (handling tools and the workpiece) and the control panel to control the machine. The number of production machines is a stack of tools from which selects the machine tool according to the technological process.

Fig. 1. CNC machine GTX 300

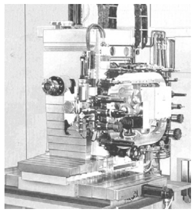

Fig. 2. Tray with toolbars [1]

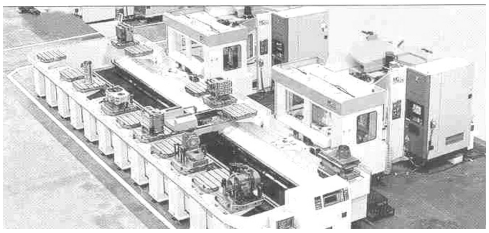

Fig. 3. Flexible manufacturing system [1]

2.2 Operation´s and inter - operation´s manipulation - automation capabilities

Another important area that needs to be addressed in designing an automated system is operational area and a buffer handling. Without these two important components is not possible to design an automated system. The operating handle back in the technology involves the manipulation of work (work piece - palette tool) - figures 4, 5.

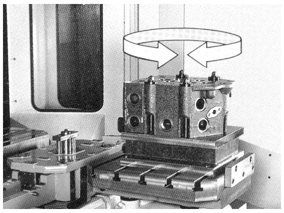
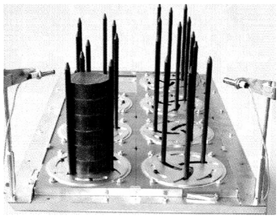

Fig. 4. Operation´s manipulation – technology and system range [1]

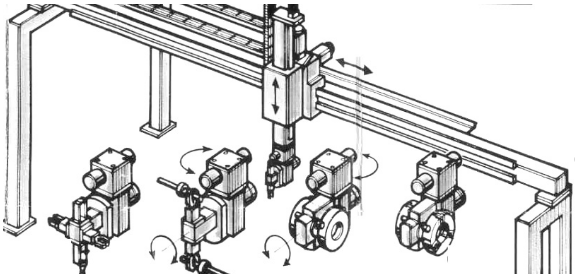

Fig. 5. Operation´s manipulation – Portal manipulator [1]

Inter - operation´s manipulation Fig. 6, 7 includes manipulation between operations (such as conveyors, forklifts, cranes, suspended track, ...). The type of manipulation depends on the nature of production and the type and size of provender.

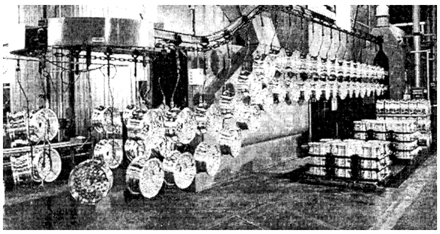
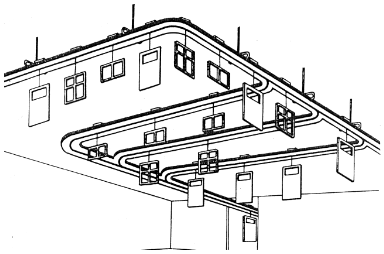

Fig. 6. Inter - operation´s manipulation – Overhead conveyor track and hanging [1]

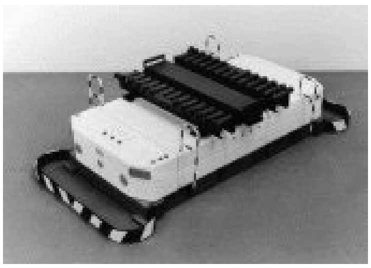


Fig. 7. Inter - operation´s manipulation – induction cart [3], track cart [3]

2.3 Storage - automation capabilities

After the manufacturing process must be finished products shipped. While these products migrate to the customer, are usually stored in the warehouse. Also available is possible to use the automation features - such as racks - fig. 8.

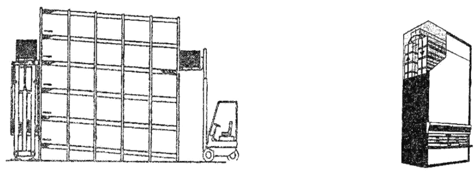

Fig. 8. Gravity racks and rack Paternoster [1]

3. CONCLUSION

The present contribution shows the possibility of automation. Briefly describes the automation capabilities - implementation. In my opinion it is necessary to deal with automation because only high quality product and quickly escorted to the customer for the company can bring the desired effect in the form of profits. Automation is evolving and will evolve in the future and the need to deal with it.

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Standard revenue, cost, controlling, budget

MałgorzataJUCHA*, JózefMATUSZEK**

MODEL OF THE MANAGEMENT OF THE BUDGETING AND CONTROLLING PROCESS IN THE ORGANIZATIONAL ENTITIES OF ACADEMIC INSTITUTIONS

Abstract

In this article, the tendencies of the development of financing and functioning of academic institutions on the present-day educational market are presented. The required changes are characterized in the way finances are managed with a particular consideration of public academic institutions. Proposals are provided in relation to the determination of standard revenues of the organizational entities of academic institutions, analysis methods of the costs of the functioning of these entities and the budgeting of their operation. Prospects are presented of the development of the controlling of the realization of the budgets of the organizational entities of academic institutions.

1. INTRODUCTION

The national higher education system is entering a new stage of its functioning. A growing competition between academic institutions, progressing changes in the rules of financing of academic institutions, the numbers of students recruited which are to decrease in the coming future, increasing investment demands, growing numbers of unemployed graduates, increasing demands on the part of the economy concerning the quality of teaching and related to the skills possessed by graduates: all of these force changes in the management of academic institutions. Running of academic institutions, regardless of the social functions they perform, is becoming increasingly more similar to managing of an enterprise. The financing systems of academic institutions are changing: their community functions, in line with the tendency which is occurring at present, is being taken over by grants and other financing sources obtained.

2. PURPOSE AND SCOPE OF THE STUDY

The basis for decision making in management processes is formed by the knowledge of standard revenues, the real functioning costs, the ability to determine the budgets of individual organizational units, pursuing an adequate staff policy as well as the accuracy

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of the forecasting of future events in the manner of the university financing, on the labor market, the development of the competition.

The purpose of the present study is:

- to develop the data required to determine the management model at a university; this model will guarantee the achievement of the objective and the realization of the university's strategy with specific conditions being met;
- to develop a budgeting model which determines the distribution of funds and the way in which these are disbursed;
- to develop a control method of the realization of financial values and its cohesion with strategic objectives.

3.STANDARD REVENUES OF THE ORGANIZATIONAL ENTITIES OF AN ACADEMIC INSTITUTION

3.1. Notion of standard revenues of organizational entities

The algorithms of the allocation of funds, which are at the disposal of an. Standard revenues are understood to be revenues related to didactics, subsidies from the government budget, fees paid by students, receipts from research work and other services to production and service enterprises, local government institutions etc. This is also funds obtained by organizational entities e.g. from cooperation with the economy, through an execution of scientific and research projects by them etc.

3.2. Algorithm of the determination of standard revenues

The model proposed to cover the needs of decision making at an academic institution permits a determination of the real costs of the functioning of anorganizational entity (1).

$$Fj = Fk_j + Fs_j = Fk_j + \sum_K ((F_{SBKj} + F_{SCKj}) * \frac{IG_{Kj}}{IG_K}) \qquad (1)$$

where:

F_{SBkj} –funds allocated to "j" unit from government budget for students attending classes organized by it and who study on "kth" field of studies,

F_{SCkj} –funds allocated to "j" unit from fees paid by those students who attend the classes organized by it and who study on "kth" field of studies,

KS – field of studies,

IG_{kjp} – number of hours related to given classes taking into consideration cost consumption index "p" of classes run by "jth" organizational entityon "kth" field of studies,

IGk –number of hours of classes on the field conducted by an academic institution on "kth" field of studies, whereas:

Fj – funds allocated to "j" entity, for j = 1, …J,

Fkj – funds allocated to "j" entity for the staff of this entity, Fsj – funds allocated to "j" entity for those students who attend the classesconducted by it.

4. CALCULATION OF TEACHING COSTS

4.1. Modeling of teaching costs

An academic institution, while preparing to open a new field of studies, before it takes a decision, needs to collect information concerning the following:

- any additional costs to be borne by an academic institution,
- the values to be reached by the costs during the first year,
- what costs will burden the budget of the academic institution in the years to come.

4.2.Estimation of teaching costs

The components of personnel costs related to conducting didactic classes on a field of studies are comprised of data concerning the following:

- number of didactic hours,
- types of didactic classes,
- the hourly rates of those persons who conduct didactic classes.

The component of the cost of conducting a subject includes the personal cost, which can be calculated on the basis of (2):

$$Ko = \left[(Lh_w \cdot Gr_w \cdot A_w) + (Lh_c \cdot Gr_c \cdot A_c) + \left(Lh_p \cdot Gr_p \cdot A_p\right) + (Lh_l \cdot Gr_l \cdot A_l)\right] \cdot N, \quad (2)$$

where:

Ko–the personal cost of the subject,
Lh_w–the number of lecture hours for the subject,
Lh_c–the number of class hours for the subject,
Lh_l–the number of laboratory hours for the subject,
Lh_p–the number of project hours for the subject,
Gr_w–the number of lecture groups,
Gr_c–the number of class groups,
Gr_l–the number of laboratory groups,
Gr_p–the number of project groups,
$A_w, A_c, A_l, A_p,$ – an hourly rate for the teacher who conducts: lectures, classes, laboratories, projects,
N–the value which increases the costs of remuneration (benefits to employees 30%), a constant of 1.3.

The personal costs obtained from Dependence (2) is a component of the cost of conducting a subject (3):

$$Kpp = Ko + (Ko \cdot C), \quad (3)$$

where:

Kpp–the cost of conducting a subject,
Ko –personal cost (gross remuneration + margins),
C –proportion of personal costs to total costs 2/8 (costs of maintaining rooms, laboratories: energy, materials, external services, depreciation, equipment).

The cost of conducting a field of studies is the sum of the costs of the realization of the subjects which are foreseen to be conducted in the teaching standards, which are obtained from the following dependence:

$$Kpk = (Kpp_1 + Kpp_2 + Kpp_3 + \cdots + Kpp_i), \quad (4)$$

where:

Kpk–the cost of conducting of a field of studies,
Kpp_i–the cost of conducting of i^{th} subject.

5.BUDGETING OF ORGANIZATIONAL ENTITIES OF AN ACADEMIC INSTITUTION

The real revenue of the organizational entities of an academic institution forms the basis for the determination of standard revenues of these entities. The basis for the budgeting of these entities is formed by the determination of the real costs of their functioning, conducting an analysis of these costs, a formulation of actions aimed at their reduction and further the determination of their budgets – Fig. 1, 2. The field marked on UAR may have for example three values, where:U –standard revenue,V – budget assigned,R – real costs borne.

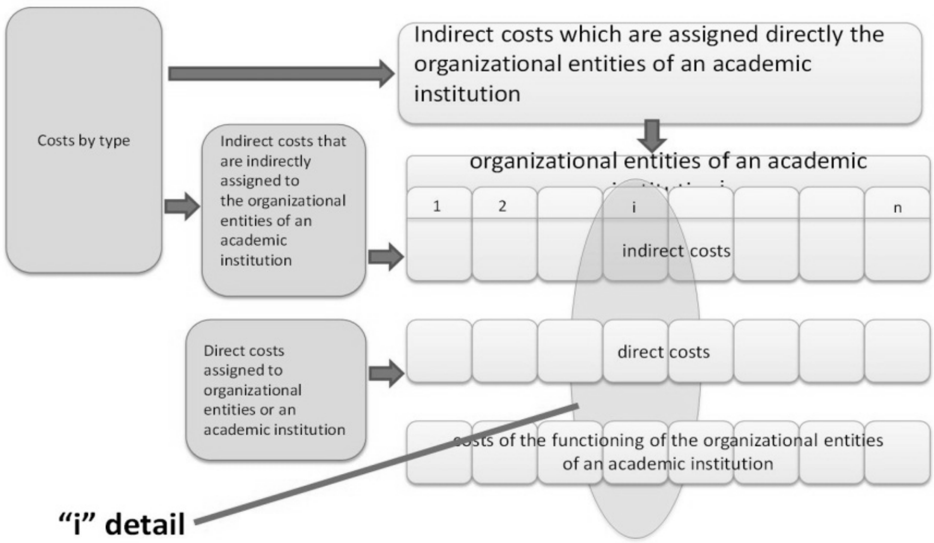

Fig.1.Accounting sheet of an academic institution

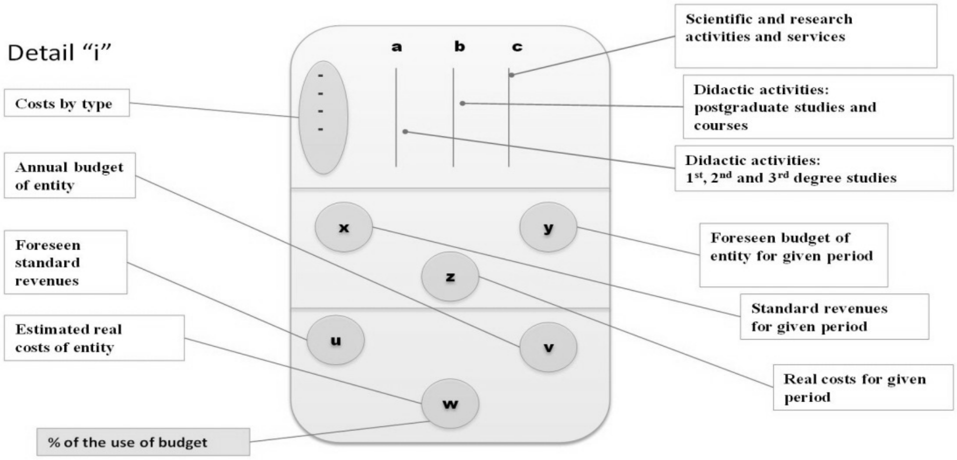

Fig.2."i" detail from the accounting sheet of an academic institution, those parameters that determine the financial conditions of an organizational entity of an academic institution (places of the generation of costs).*Source:Author's own studies*

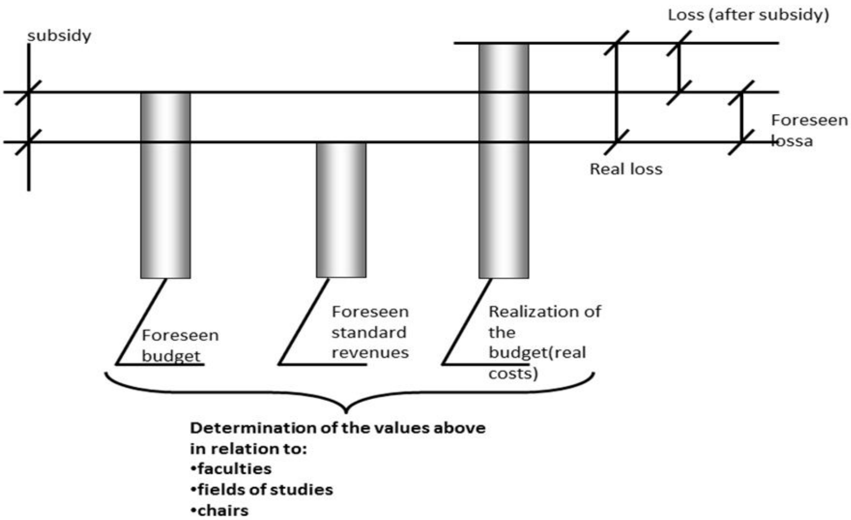

Fig. 3.Principle of budgeting of organizational entities of faculty.
Source: Author's own studies

6. SUMMARY AND CONCLUSIONS

The model proposed of the management of an academic institution through the determination of costs and budgeting makes the following possible:

- an analysis of the costs of the subject conducted, of the field of studies, the organizational entity, the faculty, the academic institution,

- provision of data for the management of an academic institution concerning estimation of costs on the basis of the variables possessed, and also with the level of the university's budget being specified,
- an estimation of the impact of the creation of new fields of studies on the costs of conducting of the existing fields of studies.

Directions of further research:

- an extension of the model to include issues of the comparison of data foreseen with the realization,
- determination of the costs of the specific operations in an academic institution,
- implementation of a system to support decision making in the management of an academic institution.

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DESIGN OF ASSEMBLY WORKSTATIONS

Abstract

This article describes the design of an assembly workstation based on ergonomic principles in the company producing white goods. The process of designing is described as the first. In the following chapters single steps are described in detail. Proposal was confirmed by ergonomic analysis like RULA or OWAS in Delmia Human and Tecnomatix Jack.

1. INTRODUCTION

Assembly is a collection of activities aimed at creating a functional unit (machine, equipment, etc.) by means of joining various components. Usually it is the last stage of production, followed by functional testing and running in. It has decisive impact not only on quality and reliability of products, but also on productivity and efficiency of the whole assembly and production system. Assembly of difficult products is still manual work even in automotive or mechanical industry. Therefore it is necessary to ensure suitable working conditions during designing assembly workstations.

Designing is complex, challenging and creative work, which requires highly qualified team work divided according to the level of designing. Each object, as well as level of designing, requires different approach and it is also necessary to respect the universally applicable principles.

2. PROPOSAL OF DESIGNING PROCESS

Digital factory tools are the most appropriate tools for speeding up designing and finding possible collisions before launching the production. Therefore, using these tools is very useful if they are available. The procedure of designing must be systematic and should pass through various developmental stages from conceptual to detailed solution. (Fig. 1)

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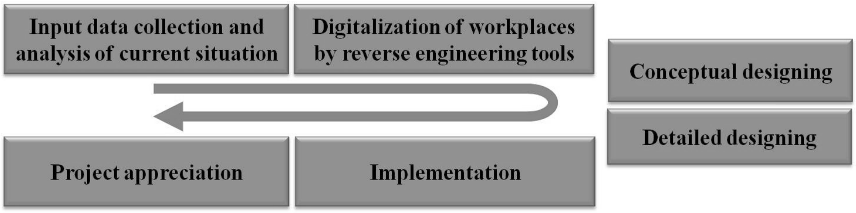

Fig.1. Designing of assembly workstations

We will describe this procedure in following parts on the example from a company producing white goods. Each part of procedure has its own start and finish and procedure suggests their sequentiality.

2.1 Input data collection and analysis of current situation

If we want design properly and implement corrective actions, it is necessary to obtain high-quality input data. From these data we make some basic analyses like:

- product analysis,
- process analysis,
- resource analysis,
- material manipulation analysis.

The aim of these analyses is to obtain basic information about workplace and potential reserves that must be considered in future proposal.

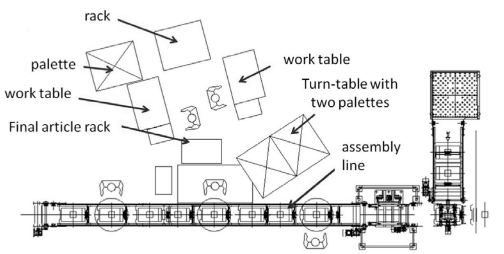

Fig.2. Current layout

2.2 Digitalization of workplaces by reverse engineering tools

Reverse engineering is an area, in which we make tree-dimensional models from all components of workplace and prepare current layout. These 3D models are used in creating new layout variants and there are no problems with quick and effective changes.
Digitalization consists of following steps:

- scanning plan creation,
- laser scanning,
- processing of scanned data in an appropriate software,
- digitalization in an appropriate software.

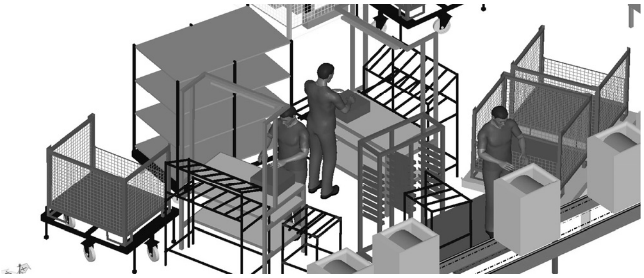

Fig.3 3D model of selected workplaces

2.3 Conceptual designing

In the stage of conceptual designing there were identified some problems that must be removed, before the start of detailed designing. Just to mention some:

- worktable anchoring – safeguard against unwanted worktable movement,
- high-adjustable worktables – at tables work operators of different height,
- arrangement of the components in the workplace – based on ergonomic principles,
- change of quantities of components transported to the workplace.

2.4 Detailed designing

There were three solutions designed to improve the current situation in the workspace on the basis of third stage. Particular proposals differ in the amount of changes, complexity of solution and economic demands.

First solution

Layout of workstations stays unchanged. Solution consists of four proposals depicted in conceptual designing.

Second solution

Solution also consists of four proposals mentioned in conceptual designing, but workspace layout and material flows are significantly different: tables are placed opposite to each other, stands are narrower and free space is used for gravity conveyor through which the preassembled parts are shipped from workspace to assembly line.

Third solution

This solution, similarly to the first two solutions, consists of four proposals mentioned in conceptual designing, the layout is changed as follows: tables are placed side by side, between them the simple gravity conveyor used for shipping preassembled parts to assembly line is placed.

After evaluating all three solutions and comparing the advantages and disadvantages, the third variant was chosen as the best. Solution was created using the principles of ergonomics and design was verified in ergonomic software Delmia Human and Tecnomatix Jack in order to ensure suitable working conditions. (Fig. 4)

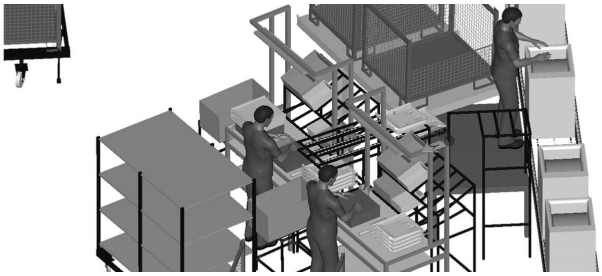

Fig.4 Third solution

2.5 Implementation and project appreciation

After selecting the final solution, the project of implementation is elaborated. All activities are described. There is also a need to set the necessary funds and dates of beginning and ending every activity. After implementation of all activities the re-designed system is tested and small deficiencies and abnormalities that show up during the system start-up are adjusted. After a period of time there follows the project appreciation, which consists of complex appreciation of deadlines and costs, success of introduction, benefits of the project, or possible fails.

3. CONCLUSION

At present there is emphasis on well-designed production and assembly systems. As a result of globalization there is a need for the systems to be more and more complex. The issue of designing assembly systems shifted from conventional design methods into 3D designing. Digital factory tools and virtual and augmented reality are increasingly used for designing. Thank to these tools we can save significant part of fiscal resources and shorten the time of introduction of new products on the global market.

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Quality, microenterprises, medium enterprises

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PROVISION FOR THE QUALITY IN MICROENTERPRISES, SMALL AND MEDIUM ENTERPRISES

Abstract

Current global economy is characterized by its discontinuity, hyper competition, non-transparent changes, too. Ability of enterprises to survive and grow in such an environment is conditioned by implementation of strategic tools. The quality of products is part of such strategy. Our contribution is aimed to the quality management in microenterprises, small and medium enterprises with specific emphasis on microenterprises.

1. PROVISION FOR THE QUALITY IN MICROENTERPRISES, SMALL AND MEDIUM ENTERPRISES

We can see quantitative differences among micro enterprises, small and medium enterprises in the following table 1.

Tab. 1. Qualitative features of enterprises

	Micro	**Small and medium enterprises**	**Large enterprises**
Targets	- market-oriented - intuitive - improvised	- market-oriented - intuitive - ad hoc strategies	- dominant - systematic - strategic
Management	- authoritative - direct	- personal consultations - small teams of experts	- big teams - line and staff structure
Planning	- minimal	- short-term	- long-term

We briefly focus on the gradual development of microenterprises in Slovak economy in the first part.

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1.1. Basic features in the development of enterprises in Slovak state economy from 1990 to 2010

The development in Slovak business environment for the last twenty years went through the certain periods with its objective and subjective reasons. In a certain simplified way we are able to talk about three periods in the development of Slovak enterprises from the beginning of 90 ties of 20-th century(this also concerns microenterprises):

- period called the crisis of liquidity
- period called the crisis of efficiency
- period called the crisis strategy and management

The task of change management is confirmed here. Its task is to react to the changes and the result of such reaction should be innovation, even innovation of management. [3]

In the second part we focused on quality management with its specific qualities in microenterprises small and medium enterprises.

1.2. Quality management in microenterprises, small and medium enterprises

If a microenterprise tends to become successful in both economic and business way it should meet the requirements of its customers and other involved parties. Microenterprise has specific qualities which also relate to the quality management when compared to larger enterprises.

Many small enterprises even microenterprises are not able to imagine what is important for the performance of the system quality management when deciding on quality management. They have no knowledge, no information about the specific system approach for the quality management. They lack of information about personal and administrative problems in this field, about the need and amount of sources necessary for assuring and working of the system quality management.

The following table confirms the importance of quality of the products. It shows the direction towards the customer. [1]

Tab. 2. Direction towards the customer and its influence on chosen economic indicators [4]

Economic indicators	Enterprise directed towards the customer	Conservative enterprise
Profitability of proper capital	17%	11%
Profitability of sales	9,2%	5%
Growth of market share	6%	2%
Reduction of costs	10-15	2-3%
Growth at stock market	16,9%	10,9%

1.3. Quality management in microenterprises, small and medium enterprises based on 8 principles of quality management

Eight principles of the quality management are recognized as the common basis for the quality management in both theoretical and practical way. ISO principles 9000 are also formed on 8 quality management principles. Eight quality management principles:

1. principle Direction towards the customer
2. principle Management
3. principle Staff involvement

4. principle Processing approach
5. principle System approach towards the management
6. principle Permanent improvement
7. principle Deciding based on facts
8. principle Mutually profitable supplier's approach [2]

1.4. Description of 8 principles - Implementation in microenterprise

Implementation of the quality management in microenterprise according to 8 principles is a relatively simple way for making functional and effective quality management in microenterprise.

Tab. 3. Implementation of the eight principles of quality management in microenterprise - For example Principle - Permanent Improvement

General quality management principles	Quality management in microenterprise
Permanent improvement The fact that processes with quantitative indicators (time, costs, sources...) are measurable contributes to the quality management. We can analyse, improve eventually change them on the basis of results' analysis. The enterprise should monitor, measure processes and with regard to their results it should accept measures for improvement of the processes or enhance the quality management system by implementation of improvement projects. The main tasks for permanent improvement in this field: - Systematic development of environment towards the creative activity of empolyees. - The results from research made by management should be decisions on improvement and not only decisions on remedial measures. - Identification of opportunities for improvement (by auditors, judges and key management) particularly carried out due to self-examination processes. - Release of necessary sources for permanent improvement and performance appraisal. Implementation of generally valid methodology for processes.	**Principle - permanent improvement** Enterprise should collect information and keep a good track of the number of mistakes, claims and complaints about the products. Information should be analyzed and revised in microenterprise. On the basis of this analyze it should set remedial and preventive measures, opportunities for improvement of processes and activities. It is not necessary to make individual program for permanent improvement in microenterprise. For microenterprises and small enterprises, it is recommended to use Kaizen method, in priority, PDCA cycle, 7 simple statistics tools or quality circles for improvement in microenterprises. Stimuli for improvement in microenterprise are for example: interaction of 3C (Changes – Competition - Customers), analysis of claims, benchmarking, internal and external audits, customer's satisfaction measurement. The owner and managers are directly motivated for improvement of all processes and activities in microenterprise. Improvement plays an important part every day in owner's, management's as well as empolyees' work. **Recommendation**

	The system of improvement is gradually carried out in microenterprise (e.g. Kaizen method, PDCA cycle, Quality circles and etc.) **Recommendation** The management of microenterprise is based on the direct management of the owner or manager if we compare it with other types of enterprises. Due to this fact it is recommended to use team work for improvement of processes and activities to larger degree. Enterprises' employees are source of permanent improvement. It is necessary to use the potential in most cases.

2. SUMMARY

It is impossible to manage the enterprise in the 21-st century with the same methods as it was managed in the 20-th century. Enterprise has to adapt to changes if it wants to remain competitive at the market. Quality of management and quality of products belongs to strategic tools of competitive strength. The quality is the relation between the customer and producer. The quality management system with full support of corporate's management, with support of the owner or manager will be successful in practical field. This is key fact for this field. The quality management should work functionally and should be permanently improving.

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Knowledge management systems, education

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ENTERPRISE KNOWLEDGE MANAGEMENT SYSTEMS

Abstract

The article deals with the introduction of systems for knowledge management. Enterprise knowledge management requires a formal knowledge management in order to facilitate access to them and to ensure their usability repeatable. There are many widely used model systems for knowledge management. Because each organization has a specific and diverse needs, area of knowledge management systems are developed in areas with a lot of creative innovators, continually coming up with new solutions for the processing and sharing of knowledge. The following section describes some of the most popular solutions for managing and sharing knowledge.

INTRODUCTION

Nowadays, companies face ever-increasing competitive environment. To be able to maintain such a market, they have often come to reduce their costs. In many cases this is done mainly through reductions in staff. However, if organizations fail to capture the knowledge of its employees, reduction in employment may lead to loss of important information. Similarly, high staff turnover in today's crowded job market may make the organization lose access to large amounts of critical information. International expansion, and geographic barriers may also affect knowledge sharing and prevent easy access to them. These and many other cases, forcing organizations to seek better methods for managing and sharing knowledge. Many organizations, large and small included, are trying to respond to these challenges by introducing a variety of systems for knowledge management Many organizations have even put the care of knowledge management as one of its priorities. Some companies create specialized departments that are responsible for creating the appropriate infrastructure and an enabling environment for knowledge sharing.

2. KNOWLEDGE MANAGEMENT

Enterprise knowledge management requires a formal knowledge management in order to facilitate access to them and to ensure their repeatableusability.

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There are several definitions of knowledge management. Definition according to OECD (2003)based on a wide range of areas in which knowledge management can be applied.

Knowledge management covers any intentional and systematic process or practicein obtaining, recording, sharing, creating and using productive knowledge, wherever located, to support learning and performance in organizations.

Definition by Cross reflects the social changes of recent decades that placehigh standards of learning and value creation.

Knowledge management is a discipline of creating a thriving work and learning environment that supports continuous production, gathering anduse of personal and organizational knowledge to create new businessvalue.

Looking at knowledge as a source of revenue and competitiveness reflects the definition according to KTI, Inc.

Knowledge management is a strategy that transforms intellectual capital of organizations - both recorded information, as well as talent and knowledge workers - the higherproductivity, new value and increased competitiveness.

3. KNOVLEDGE MANAGEMENT SYSTEMS

Most current systems for knowledge management is designed especially for managers, executives, specialists, operators and suppliers to business partners and customers. These end users can join the knowledge-based system via the intranet, internet or extranet, which is directly connected to the corporate knowledge portal serves to provide individual access to corporate data, specialized reports, enables collaboration on group projects, categorized search, monitor and record the end user based on their profile and on - line activities.

3.1 Documents sharing

One of the most common types of knowledge management is a system that allows multiple people in an organization to share documents via the corporate network. There are many software solutions that enable easy access to shared documents

In connection with these solutions, however, several fundamental questions arise. First, the different organizations have different people authorized to access and familiarize themselves with various documents. It is therefore necessary to create an environment that allows the selection of access to various documents on the basis of pre-defined authorizations. This point is especially critical for large companies with many employees at a lower level of management. However, it is important to find a suitable because employees with limited access may feel discriminated against the others and may feel that their ideas and insights are important for society, or even that they are not welcome.

Another problem that can arise when sharing documents,is managing co-operation, respectively. simultaneous work on different documents If multiple people try to work on the same document at the same time, there can easily be some misunderstandings, especially if several people try to simultaneously edit a document.

Another problem with the sharing of documents is a way to properly secure their organization. Because it may happen that the organization becomes chaotic due to the layout of directories, subdirectories, overlapping documents, respectively. existence of several versions of the same document. Therefore there has to be a responsible person that will take care of documents organization.

3.2 Community knowledge database

There is a reason why Wikipedia, despite its many errors become one of the most visited Internet sites, as the primary source of knowledge about virtually anything. The fact that virtually anyone in the world can become a contributor and editor of this page gives an unprecedented potential.

Of course a situation where people in the organization find the time to enroll their knowledge in a central knowledge base can be difficult indeed. From the beginning, may deem that the knowledge base is unnecessary for the company and the individual does not bring any benefit. But the time when the knowledge base will be widened to include more knowledge of the amount collected from employees, are its benefits for individuals and the organization evident.

Such knowledge database can be useful for example in job training of new employees who are not familiar with business processes. It can also provide considerable support for employees whose work involves complex procedures which may be difficult to remember. In this sense, we can thus functioning corporate knowledge base based on Wikipedia regarded as a flexible tool for digitizing in-house procedures and manuals.

4. KNOWLEDGE MANAGEMENT SYSTEMS AND EDUCATION

Unlike traditional MIS systems, KMS systems supporting nearly continuous staff training.. For the learning process is more important to show how the knowledge can be obtained from aninformation to ensure the most correct understanding.

Therefore, many organizations in an effort to strengthen educational activities based in their system called KMS. online learning centers that include a variety of audio and video training courses and various webinars and the like. Some training programs even work on the basis of interactivity, where there is a real-time communications staff and supervisor through a special application of KMS. Employees then can more quickly acquire the knowledge gained thus realized through interactive discussions.

4.1 System Troubleshooting

This process refers to the collection of data using scientific methods, the use of systems analysis for assessment of root causes of the problem and finding an optimal solution that takes into account various factors and aspects of a solution does not become isolated.

4.2 Testing

Testing of this perspective is complementary teaching methods. It is primarily aimed at addressing the current problem but also an opportunity to broaden the scope of education and is an effective tool for creating new knowledge for the future. Testing also plays an important role in the development of the organization itself.

4.3 Learning from past experience

Tools, data warehouses can provide support in dealing with similar issues, based on historical data collected.

4.4 Exchange of knowledge

This step is usually the most critical in many organizations. It requires a positive approach by all departments and all employees in order to ensure effective dissemination of knowledge. This step is the finalization of the KMS and in most cases is carried out by or intranet. Internet. In addition, KMS systems in this case can provide a kind of additional feature to share documents. All these tools are used to secure the transfer of information, knowledge, documents or toward employees in as much as possible.

CONCLUSION

Sharing knowledge can be seen as doubling them, thus achieving a synergistic effect. It is also important to note that in the process of sharing is a free and voluntary act for which the individual decides himself and which should be somehow motivated. On the question of motivation to sharing is very difficult because the expected change in approach towards people from individualistic to collaborative. Collaboration is a progressive form of cooperation that allows largely eliminate the problems associated with the transfer of knowledge, while ensuring efficient generation of new knowledge. It offers many possibilities for a more open and extensive cooperation in the use of ICT and virtual research environment especially in terms of geographically distributed research.

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Expert, system, data, maintenance

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IDENTIFICATION OF REQUIREMENTS FOR DATA BASE AND FORM OF DATA COLLECTION FOR BUILDING AN EXPERT MAINTENANCE SYSTEM

Abstract

The article deals with a brief explanation of the concept of expert system and its possible application in the field of maintenance. The main direction of deployment of expert systems in maintenance,according to author, is particularly the area of planning and scheduling of preventive maintenance and its subsection - a condition based maintenance (CBM) and also fault diagnosis of machinery and equipment itself. For a clear and effective decision making process about preventive maintenance scheduling, the manager (an expert system) has to have actual data about the condition of equipment and also other necessary data, which are mentioned in this article. An important factor in this case is to make sure we have provided the manager with up to date data, therefore it is really necessary to deal with data collection itself.

INTRODUCTION

All organizations that hold asets such as machinery, information technology, distribution and power generators and many others, have a common problem: how to ensure their functionality as long as possible, while ensuring the economic benefits and without reducing the reliability and safety ?

The answer is, of course, appropriate and adequate maintenance. The problems associated with maintenance can reduce systematic and active approach to asset management organization. A necessary condition in this case is correct and timely information about the property. Based on these predictions can be made the development of their state and act according to these forecasts, to prevent the occurrence of unwanted conditions in the future.
Properly integrated with asset maintenance systems can affect all parts of the organization, increasing the availability of machinery and equipment, reducing maintenance costs, increasing profits and strengthening the company's reputation with its customers.

The integration of reliable information with efficient tools to support decision making in the management of assets may be costs for maintenance, repair and recovery significantly limited.

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In the past, information was available on the state property at the current time and their subsequent evaluation for the purpose of taking action a major problem. The answer to this problem lies in the inclusion of effective decision-making analysis of this information to better managed predictive maintenance. Even if the manager has the necessary database information could lead to a situation where for whatever reason will not be able to take the necessary, critical decisions that will lead to more efficient maintenance.

The delay, respectively.to delay the decision may occur mainly because of potential need for professional and expert knowledge to evaluate the collected data. Based on this analysis, then the manager can take appropriate decision. But what if the worker does not have the necessary knowledge? It is in such cases, the decision-making process can be effectively entered by an expert system that belongs to the DSS system

1. SELECTION OF AREAS FOR APPLICATION OF EXPERT SYSTEM

Maintenance in general is too large and complex area and so expert systemscan not solve problems across the entire spectrum of maintenance, but it is necessary to define the selected area in which the expert system is applied. The other solution, therefore we will deal with preventive maintenance according to maintenance of the status and capabilities of expert system applications in it.

1.1 Condition based maintenance

This kind of maintenance is an integral part of the concept of preventive maintenance.
Many machines and devices are not clearly visible to the decrease in the parts and equipment so it is difficult to use a model of planned repairs.

CBM- to monitor the current status of plant and equipment is one of the possible solutions to avoid potential mistakes and failures of machines and equipment. CBM is defined as preventive maintenance performed on the basis of performance and / or monitoring the parameters of subsequent reactions. Condition monitoring can be accomplished using several techniques. The purpose of monitoring the current state of machine is gathering data that are used for early detection of potential failure of the machine and allowing scheduled maintenance procedures at the right time in order to avoid such failures.

CBM is used essentially to the two following purposes:First Determine whether the problem occurs on monitoring the components, how serious is this problem and how long will it take until there is complete failure of a component (how long you can work without the component of maintenance).
Second Detection and identification of specific components that are subject of degradation, and then diagnose the problem.

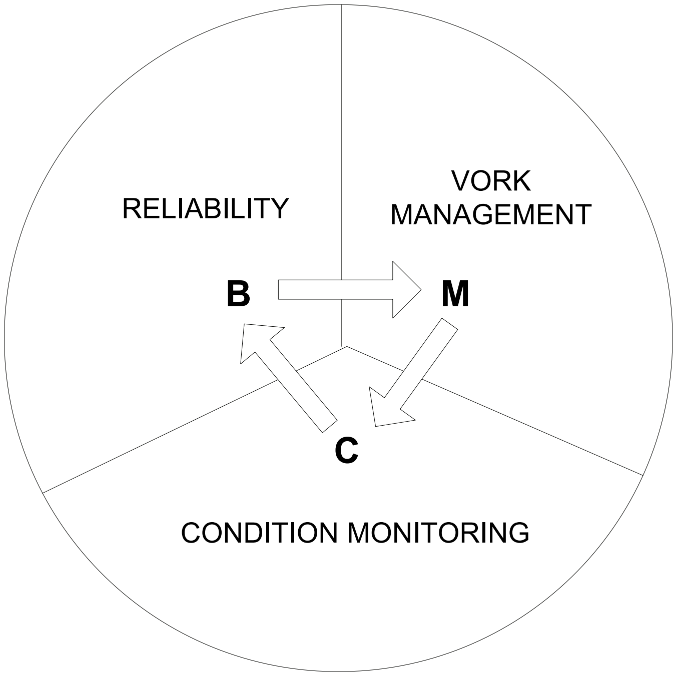

Fig. 1 - A balanced approach to asset management - CBM
(Source: http://www.matrikon.com/condition-based-maintenance/condition-based-assessment.aspx)

2. APPLICATION OF THE ES UNDER THE CONCEPT OF PREVENTIVE MAINTENANCE

Early recognition of beginning faults the most efficient way to reduce the likelihood that equipment will fail. However, a major obstacle to recognizing the critical symptoms that may indicate the emergence of disorder is the inability to provide enough specialists from industry practice with the necessary knowledge of the preventive maintenance of specific machinery and equipment and analysis of signals that could indicate the failure of the component. One possible solution, how to overcome this obstacle is to use decision support systems - Expert system.

Expert system in this case can fulfill two purposes. Based on the collected data, which are listed in the following chapter is to offer solutions for maintenance management support, namely setting a timetable for maintenance and assigning the necessary staff, tools and aids, but can also be created by an application that directly serve as a support of preventive intervention namely as a diagnostic tool and detailed instructions as the maintenance action carried out as efficiently and correctly, of course.

Managerial application of expert system should also be time for scheduling preventive maintenance, the possibility of a short delay necessarily predictive performance for a long time if you meet the required daily production plan. ES will therefore compare the time needed to fulfill the production plan with the time remaining until a pre-critical state of the monitored parameters and the time needed to implement the performance of preventive maintenance, this fact must not be conditional upon the endpoints of a particular machine, below the critical value. If the expert system based on a comparison of the times decides that it is possible to postpone preventive intervention, the manager will make an evidention of fact and ESautomatically assigned to that machine and its maintenance a top priority. At the same time the ES to continue to monitor the background and compares different times and in the case reached a decision, it is necessary to carry out maintenance of the machine, immediately notify.

2.1 Requirements for data base

This chapter addresses the requirements for data to be collected for further use in expert system maintenance - part of CBM.

The first and also the logical requirement is to define the necessary data for machinery and equipment, which the organization has.

The proposed data structure is as follows:

- Code Equipment
- Description of equipment
- Serial Number
- Location of facilities

These data are used to uniquely identify a machine and avoid any misunderstandings in the further processing of the collected data.

Other data that are to work with expert systems is inherently important and directly related to plant and equipment are data on the status of these funds, respectively. data on the status of critical components of these devices. Here it is very difficult to define the type and extent of specific data, as each organization uses different types of machinery and equipment. But the important thing is to clearly identify a group of critical components and critical data that is on each machine should be collected. It can be for example the following endpoints:

- Input / output pressure
- Operating Temperature
- Oil pressure
- Oil temperature
- The engine speed
- wear of bearings
- Levels of liquids and emulsions
- Tightness of components
- Vibration components
- Functionality el. fuse
- Checking the grounding of the machine
- and others.

Ensuring the availability of these data is very important because a substantial part of the input data on which occurs within an expert system for the derivation of the hypotheses. This data is necessary to ensure extensive archive and history of the measured data for the effective functioning of the system for decision support. Collection of this data will be given to the next chapter.

The data we obtained in the previous step, but by themselves have almost no explanatory power. Therefore, these data should be compared with reference data or so. signals required by normal values. It is therefore necessary to establish a base reference valuesof monitored signals. Within this base, it is necessary to define the desired signal value, the minimum and the critical value at which point there must be an immediate maintenance action. As part of ensuring the effectiveness of maintenance is not desirable to wait for the monitored variable to the critical value, therefore, as a base reference values observed signals must be set as well. limit the diagnostic signals that represent the value at which the effective maintenance intervention and there is no equipment damage due to the achievement of critical values of the signal. This limit state is notional, what we can allow the endpoint. It is not always possible to plan maintenance activities right after the cross of optimal signal value simply because of job scheduling and availability of machines.

The next step is to create a base of maintenance personnel with regard to qualifications because not every worker is able by virtue of their skills to intervene in any maintenance activities. Expert system for our solutions may therefore reflect this aspect. The design of appropriate measures can be compared because the requirements for interference with the database staff, which will also count with the paid holiday of the employees, thus facilitating the scheduling of staff to the intervention.

Finally, it is also important to create a database of tools, work equipment, spare parts and diagnostic equipment needed to be in the framework of preventive intervention eaten. Indeed, some interventions can be delayed because of the momentary unavailability of necessary materials tools and spare parts. In this case, the expert system makes recommendations based on the values of the measured parameter (do not reach the critical value) and information about the availability of appropriated funds. If an endpoint reference, while exceeding the recommended value, but has not reached a critical value, while the organization does not currently have the necessary means to carry out maintenance, the system can make a recommendation to continue operating with reduced work performance or on the possible outsourcing of maintenance, respectively. to stop operations if an endpoint close to the critical value

CONCLUSION

Expert systems come to the group. DSS systems (from Decision Support Systems) and in helping to solve problems in industrial practice have their irreplaceable place. Maintenance is an area in which expert systems can be largely used either to support the scheduling of maintenance or when diagnosing machine problems alone and facilities, but also in providing support in solving problems assigned to the diagnosis.

When creating an expert system for maintenance is necessary to pay attention to the necessary data to decision-making process will enter. It is all about the data itself, which will be collected and evaluated, but should also focus on the data collection form, because the maintenance is always necessary to work with current data. But for effective decision making is necessary to have also a historical database for the identification of similarities and relations reveals the possibility of recurring problems.

The introduction of the concept of real-time expert system may be in response to previous requests. Though it represents a comprehensive solution that incorporates decision support system coupled with real-time subsystem, which collects data for the current needs of an expert system and also the data stored for further use in the future.

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Martin MAJDAN*, Vladimíra BIŇASOVÁ**

PLANNING AND CONTROL OF ASSEMBLY SYSTEMS

Abstract

The paper deals with continuous assembly planning - beginning with formulation of the objective and progressing all the way to operation of the system - is the declared goal to achieve. For example, adding some more information (synthesis) or checking the quality of the process by analyzing the data (for example estimated costs and production times). On the other hand, the continuity should exist not only within the planning. The aim is to make it possible for the data created in the planning process to be used for system to avoid the break between 'virtual' planning and reality.

1. ASSEMBLY PROCESS

'Digital Mock-up', the use of simulations for joining parts in the virtual world of a computer, is going to be established in the industry. Computer-based assembly planning is becoming more and more important within the field of product development. But assembly planning covers much more than simulation. The main task is to develop an assembly process and the assembly systems that is able to generate the product. Besides assembly planning there are of course product design and production planning and some more departments of an enterprise involved in the process of product development. In the following the focus is set on the assembly planning in its relationship to the product design.

1.1. The Deficit of Computer-Aided-Production-Engineering (CAPE) – Tools

Some aspects of assembly planning are available in commercial software packages that support the processing of individual task packages (for example layout planning), but there is still a deficit of computer aided tools for process planning (fig. 1).

Additional, the performance capabilities of the individual tools in their specialized areas are usually limied by the lack of integration. One result of this is the high degree of complexity involved in the repeated conversion of data during transfer from one system to the another. This often results in loss of the time advantage gained from the use of these tools. A further shortcoming lies in the fact that data created in the planning process cannot be re-used for the "realization/op-eration" stage of planning. This is mainly due to the fact that different data

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formats and structures are used for the planning and control processes. This makes it difficult, for instance, to adopt production sequences or robot programs that were created offline.

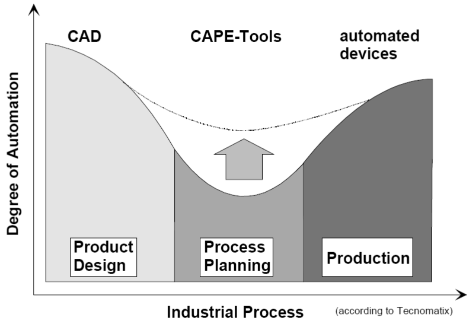

Fig. 1. Deficit of computer aided tools for process planning

1.2 Efficient Planning

Plan, optimize and validate your manufacturing processes before it starts production. With the advanced planning, simulation, and collaboration tools provided by Tecnomatix 9, it can achieve greater efficiency by synchronizing your product and process development stages.

Be more productive by quickly re-using your existing manufacturing data and process knowledge. Source of product, process data and Gantt, Pert chart in Process Designer in a more intuitive and powerful user interface (fig. 2).

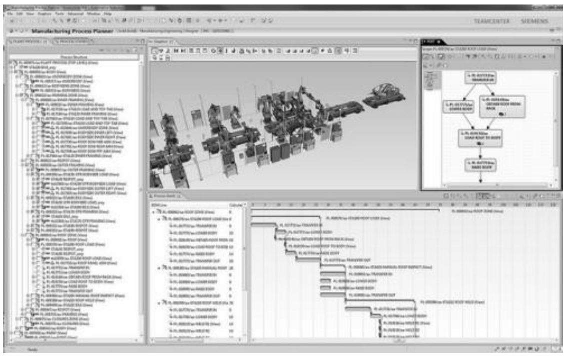

Fig. 2. Gantt, Pert chart for process planning and tree operations, production resources and products

1.3 Steps of Assembly Planning

The steps of assembly planning is based on the principle that the assembly planning should start as soon as possible. Therefore the results of the product design have been analyzed and the corresponding tasks of the assembly planner have been matched to them.

We have identified five important kinds of data the assembly planner needs to do his/her work. Besides the general information about the product that is given by the project management the following design information is important for the assembly planner: product structure, first geometry of a single part, first subassembly and complete design of the product.

For these five blocks we have created five ‘layers’. Each layer contains the tasks of the assembly planning that can already be started with the specific information. For example, the tasks of the second layer can start as soon as the product structure is available. These layers are non-consecutive phases, they are just characterized by the needed input and can all last till the very end of the planning (fig. 3).

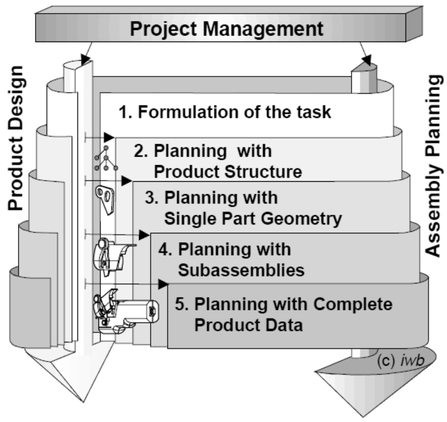

Fig. 3. Steps of Assembly Planning

Assembly Planning and Validation is a solution comprised of four key capabilities, including: A synchronized process-driven design environment that facilitates communication between manufacturing and design. This environment allows your company to fully understand the impact of product changes on the assembly process.

Product assembly issues arise during the process design can be communicated back to product engineering for review and adjustment of the product.

Commonality and re-use capabilities facilitate the utilization of standard processes and resources as well as maximize re-use from previous production programs. These capabilities significantly reduce future capital investment and shorten assembly planning activities and its related costs. Comprehensive set of assembly validation tools enable smooth production setups and flexible line tuning, which leads to reduced system try-out costs.

Make smarter manufacturing decisions during the planning phase, that is when 80 percent of manufacturing costs are established. Assembly Planning and Validation enables you to start this optimization in tandem with lean manufacturing initiatives on shop floor.

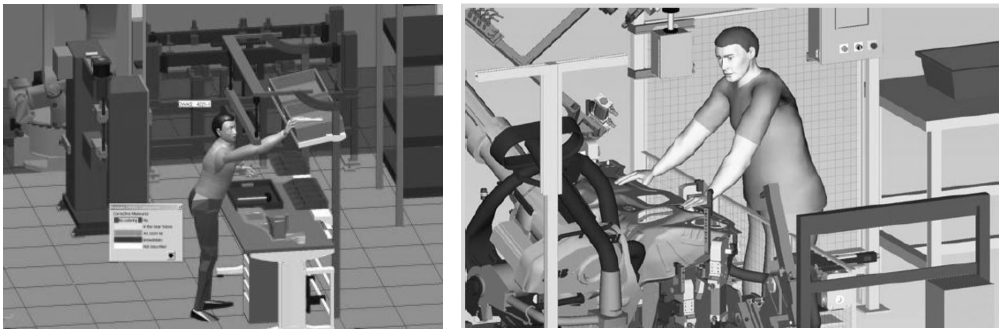

Fig. 4. Illustration of PLM software Technomatix 9

Situation-driven planning is becoming increasingly important to production facilities in these fast-moving times of change, particularly in terms of resource and energy efficiency. Existing technical and organizational course of action in terms of resources (both human and technical) need to be selected for the specific case at hand, and changes (to workshops, products, processes and equipment) need to be managed.

Project managers are responsible for assigning subcontracts, coordinating services and combining them in a single project.

This article was prepared by within the project VEGA no. 1/0701/12 named as Research on the use of low-cost automation and artificial intelligence in the process of recording stereoscopic

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Virtual reality, projecting and simulation assembly, assembly systems,

Martin MAJDAN*, Branislav MIČIETA**

VIRTUAL REALITY AS A SUPPORT TOOL IN ASSEMBLY

Abstract

The paper focuses on the possibilities of support to facilitate virtual reality - VR in order to increase the efficiency of assembly systems and workstations in their design and simulated assembly process. Subsequently, it points to the actual reasons for VR applications and its benefits in the assembly.

1. VIRTUAL REALITY

The basis of virtual reality - VR procedures are known from computer graphics. It's all about creating solid models and scenes, handling, movement in three dimensions and real time imaging by means of VR, which is in development (Fig.1).

VR enables one to visually convey complex and extensive data, manipulate and integrate with them by using a computer. Also, VR is currently the most advanced interface for the integration of man - machine. Using VR technology can move in n-dimensional world.

Standard methods are widespread in applications of virtual reality by using special hardware equipment (peripherals), which provides video, audio and tactile interaction.

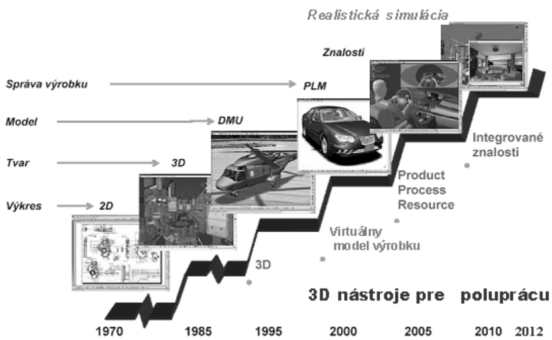

Fig. 1. First Development of VR funds (Mičieta, 2005)

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1.1. The application of VR in the assembly

The growing importance of VR is supported by the activities of major world producers in this area. Based on the information about implemented projects and studies based VR on the Volkswagen Group can be seen by growing number of VR applications in various fields.

On (Fig. 2) is shown the percentage distribution of activities related to the type of VR applications and objectives. It follows that now is the main area of deployment of VR design and construction. Activities leading to the assembly consist of about 10%.

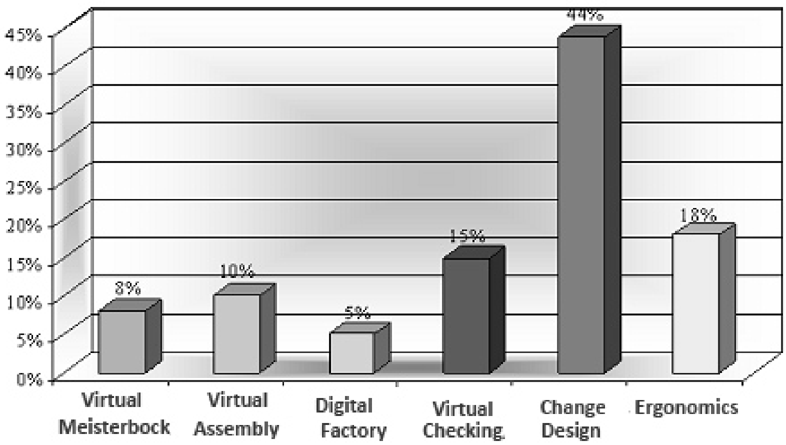

Fig.2. Applications and objectives of the studies conducted in the group Volkswagen

1.2 Virtual reality in the design of assembly

One of the main tasks in the design process is to convey the essence of design and rework it into a state of a standard method, put the recipe in their own way, to which he would be able to turn in all situations.

It should also be aware that depending on the circumstances, the process design can be changed in a very wide margin. The main problem in the design process is that the designer must be based on current information; predict some future state, which arise only if they are forecast correctly. The designer is forced to examine the events in reverse order from effects to causes (Mičieta, 2004).

As shown in (fig. 2), VR is also on the application installation. VR can be used both in the design of assembly workstations, as well as in the actual planning process of a particular product assembly and installation in the simulation. The fig. 3 shows a possible integration of the very concept of VR assembly simulation environment in CAD / CAM system. On Fig. 4 is a view of the overall system simulation based on VR installation and on fig. 5 is a representation of the simulation of assembly compared to the virtual assembly environment with the real environment.

The reasons for the application of VR in the assembly are listed as follows (Kuhlen, 2005):
Product Development

- replacement of physical prototypes by virtual,
- simulates the various stages of development in a virtual environment,
- enhances and accelerates the product development process,

Important aspect: **assembly planning and disassembly**

- assembly sequence planning,
- training, education

Thus, VR can be used in three ways:

1. in the design of assembly workstations,
2. at planning the installation procedure of a particular product,
3. in the simulation assembly.

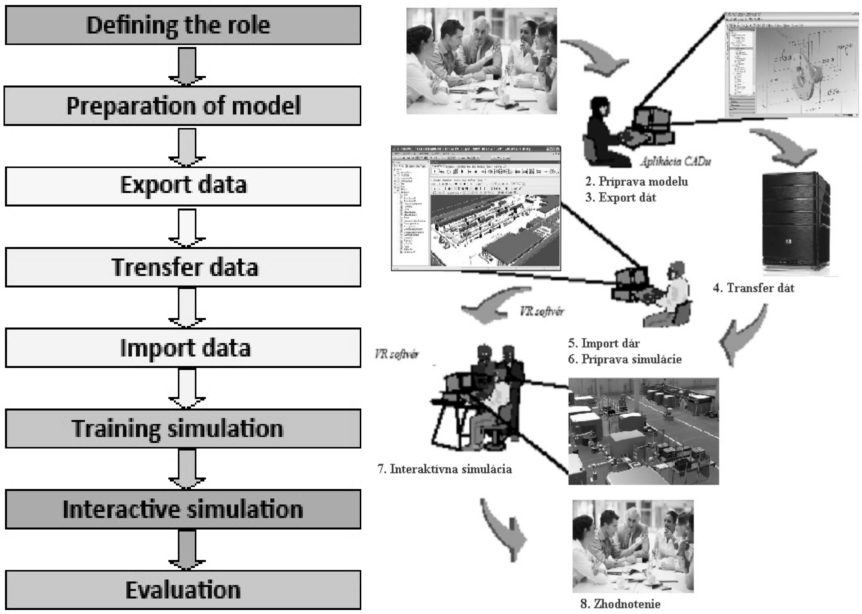

Fig. 3. The process of integration of simulation-based fitting of the VR environment, CAD/CAM

1.3 Simulation assembly on based VR

The simulation assembly based on VR installation usually encounter two types of problems:

1. **Modeling problems**
   - **a)** physically correct behavior of components in real time,
   - **b)** compensate for modeling inaccuracies.

2. **Problems in interaction**
   - **a)** representation based on an interactive installation in terms of relevant information,
   - **b)** multimodal, especially haptic feedback.

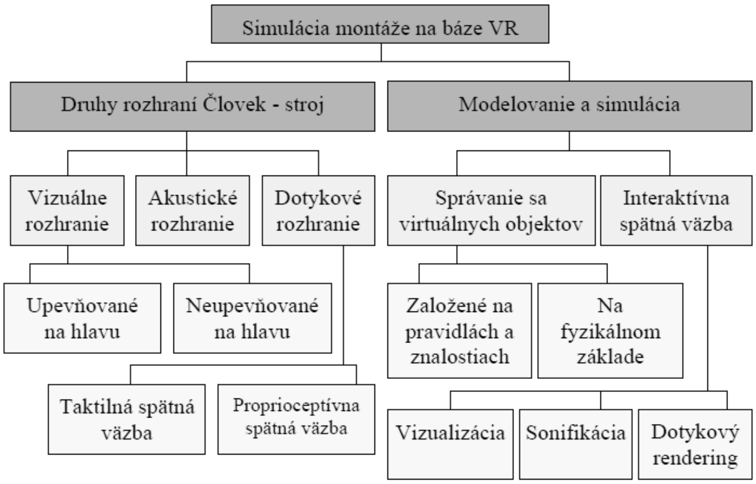

Fig 4. The overall assembly system simulation based on VR

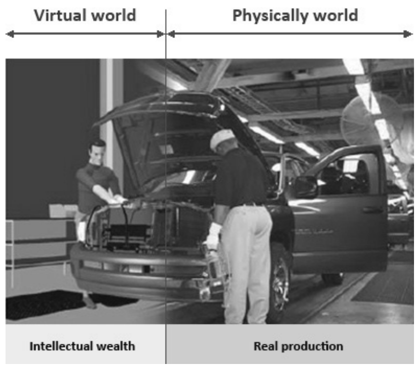

Fig 5. Simulate the assembly process of comparison between the real and virtual assembly (Mičieta, 2004)

This article was prepared by within the project VEGA no. 1/0701/12 named as Research on the use of low-cost automation and artificial intelligence in the process of recording stereoscopic

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Project management processes, PMBOK, projects quality information

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QUALITY INFORMATION IS KEY TO THE SUCCESS OF THE PROJECT MANAGEMENT IN INDUSTRIE

Abstract

Each project is a unique. The method of control depends on many aspects, for example the size and nature of the project, human factors, organizational culture, experience and skills as a manager and other project team members, technology, but also the quality of inputs including, but not least, include quality information. The importance of the organization should be given to dispose of an optimum amount of information in the required quality and especially to share this information. Quality information is key to the success of the project management, but also in many other areas.

INTRODUCTION

Globalization and internationalization of markets has increased competitive pressures on organizations. This fact has led them to engage in projects that are critical to their performance. If organizations want to be successful they have to realize projects on time, within budget and project must meet the requirements for the management of project risks. Much time and many resources are dedicated to the selection and development of projects, but most important is that projects are properly implemented in organizations to achieve their objectives. For effective projects management organizations are using project management information systems, which are viewed as support for project management. Within project management is necessary to emphasize on quality of input information as well as their ongoing monitoring, coordination, editing throughout the project life cycle. Quality management is performed through the project life cycle with particular reference to quality planning, quality assurance, quality control and independent verification of quality.

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1. PROJECT MANAGEMENT PROCESSES

The project is a group of processes, which are developing at the time of their existence and are situated at various stages. Process groups in the project management are the process activities in the project from initiation through planning, execution/coordination, monitoring and control to the completion of the project (according to Svozilová, Swalbe).

To make the project successful, the project team has to:

- select appropriate procedures within a group of project management processes,
- use a defined approach to adapt the product specifications and plans to meet requirements for product,
- meet the demands and needs of all involved sides,
- keep balance between competing opportunities in demand, time, cost, quality, resources and risks to produce quality products.

Methodology PMBOK documents information necessary for initiating, planning, implementation, monitoring, management and completion of a project. Also identifies the processes of project management, which were recognized as "good practice" in most projects. These procedures are used globally, mostly in industry. "Good practice" means that compliance has been demonstrated that the use of these project management processes will increase the chances of success in larger scale of projects.

In respect of project management, we can define five project management process groups:

- Initial procedural group - the main purpose is to create a basic definition of the project and obtain authorization for its implementation,
- Procedural planning group,
- Executive/procedural coordination group,
- Process monitoring and control group,
- Procedural final group (by Svozilová).

Methodology for mapping the 42 PMBOK project management processes into five project groups and the nine project management knowledge areas of project management. Each of the required process of project management is provided in a process group in which most activity takes place. These activities are the main processes of knowledge areas.

2. QUALITY ASSESSMENT PROJECT

Project Quality Management processes include all activities of the organization that determine quality policy, objectives and responsibilities, so that after their implementation, the project will meet all the guaranteed needs of the customer. Quality management is done through policies, procedures and processes of quality planning, quality control processes, continuous improvement activities as appropriate (according to PMI Global Standard).

The role of quality management project is to ensure that the project will satisfy the needs for which it was created and its solution was initiated. The project team therefore has to build good relationships with key participants, particularly with major customers of the project and clarify what is quality especially for him, just as he decides whether the quality of the project is acceptable for him or not. Many projects end in failure mainly because the project team focuses its attention only on the written specifications of the main developed products and forgets about other needs and expectations that participants placed on the project. It follows that it is equally important to place emphasis on quality in the same way as the scope of the project, time and costs necessary for its implementation (as Svozilová, Swalbe).

Parts of the quality of project management are the three most important processes (according to PMI Global Standard, Swozilová, Swalbe):

- The quality planning process represents the determination of quality standards applicable to the project and determines how to reach their fulfillment. A key part of quality planning is to incorporate quality standards into the project design.
- The process of assurance / quality assurance - describes the use of planned and systematic actions dealing with the quality to ensure the use of all the processes needed to meet its requirements.
- Process undergone quality control - monitors specific results discovered in the project, if they are in accordance with relevant quality standards and determine a way how to eliminate causes of unsatisfactory results and identify opportunities for overall quality improvement.

PMBOK methodology is a tool to help organizations manage their projects, identify projects processes and different knowledge areas. PMBOK methodology does not guarantee success and quality of projects, but helps to achieve the desired goal. When managing projects according to the recommendations described in the PMBOK methodology is essential that organizations put a high emphasis on information that are used in all phases of projects. Collecting, sharing, archiving, and work with quality information leads to success and to ensure of their competitive advantage.

3. PROJECT MANAGEMENT SYSTEMS

Systems for project management (Project Management Information System - PMIS) "provide to managers important information about the cost, project time, project performance parameters and links between these parameters" listed in Raymond and Bergeron by Cleand and King. The nature and role of the PMIS project management is characterized as support for the achievement of project objectives and implementation strategy of the project. PMIS support project managers in the tasks of planning, organizing, controlling, reporting and decision making at the same time. Scientific studies have shown that there are several important factors that support the use of PMIS:

- Whether the project manager uses PMIS strongly depends on the quality of information generated in the PMIS,
- Project managers more desire to use the information system if it provides an adequate level of details with respect to their needs,
- It is important that the generated information will be simple, easily understood and can be easily shared among project team members,
- PMIS must allow continuous monitoring of project progress.

Caniës and Bakens in their study were dealing with PMIS relationship between information quality and its impact on the quality of decision making. Project and excessive load with information is affecting the quality of the information in PMIS, while satisfaction with the use of PMIS with the quality of information affects decision-making process.

It follows that the organization can only handle so many projects simultaneously, how many available resources capacity it have. Procedures and processes can be useful for the project only if they are standardized and project staff knows what to do and how work should be done. Too much or too routine information may become a burden to project staff, too big administrative burden can shift attention from the real tasks of project management to process activities and too little routine creates a feeling of insecurity.

CONCLUSION

The area of information quality in project management is not well specified and not clearly associated with the project of quality. For organizations, it is important to dispose with an optimum amount of information in the required quality and especially to share this information. Projects database maintenance can help organizations to prevent of any error status by any situation solving, respectively if such a situation occurs it may facilitate its solution based on previous experience from other projects that are recorded, not only in terms of time, but also in terms of cost and quality. The use of PMIS helps to the effective decision making and project management, helps to efficient redistribution of resources. For an organization it is important to think about how to capture, share, and not to lose and apply the right information at the right time and right place. Quality information is key to the success not only in project management, but also in many other areas.

This contribution is a component presenting the results of research VEGA 1/1203/12 Quality Management in project management in industrial enterprises, which is solved by Institute of Industrial Engineering, Management and Quality MTF STU.

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Assembly concepts, ergonomic design, adaptability

Branislav MIČIETA*, Vladimíra BIŇASOVÁ**

RANGES OF APPLICATION OF MANUAL, HYBRID AND AUTOMATIC ASSEMBLY CONCEPTS

Abstract

The paper deals with possible variables and constraints, that must be taken into account when designing a manufacturing facility such as an assembly line, which often depends on common practices and experience of the manufacturing engineer. New product introduction typically involves the design of new manufacturing facilities such as machining and assembly lines. Time to market is therefore not only affected by the pace of product development but also the pace to design the manufacturing facilities.

1. ASSEMBLY LINE DESIGN

Efficient assembly line design is a problem of considerable industrial importance. Unfortunately, like many other design processes, it can be time-consuming and repetitive. In addition to this, assembly line design is often complex owing to the number of multiple components involved: line efficiency, cost, reliability and space for example. The main objective is to integrate the design with operations issues, thereby mini-mising is it costs. Since it is impossible to replace a designer`s intelligence, experience and creativity, it is important to provide him with a set of assistance tools in order to meet the conflicting objectives involved.

Producing multiple products in a single line yields at least two major problems that have to be solved: getting the right input to the right place at the right time, and determining the best production run to match supply with demand.

1.1. Manual, hybrid and automatic assembly

The continuous change is required to keep pace with changes in demand, new product introductions, process changes, improved tooling and technology, new legislation, etc. For assembly processes, similar manufacturing forms exist, which are distinguished by their sequential nature. The assembly process constitutes the final phase of production in almost all sectors. The proportion of time taken by the assembly process amounts to between 25 and 40% of product creation.

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The assembly and parts manufacturing processes are separated based on a division of labor across the supply industry. While in machinery construction, the combination of parts manufacture and assembly still predominates (although admittedly this trend is decreasing), in automobile construction, division of labor is so far advanced that the customer- supplier chain has developed into pre-assembly/final assembly. Since assembly processes are becoming ever more automated (especially in the automobile industry), robots, and their steel mountings within the building, predominate.

The assembly process is one of the last production processes to be successfully automated by the industrial engineer. However, as much of the factory cost of a product is incurred during assembly, it is this area where great productivity improvements can be made. The design of the assembly system should be undertaken with due consideration of the design of the manufacturing system and of the design of the product. The design of the assembly system, manufacturing system and product should be considered integrally.

These three components, when combined, should create a product having the lowest factory cost at the desired level of quality. The design of a product and it's associated production system is an iterative process, whereby product design features dictate the design of the production system and the capabilities of the production system determine the product design. The extent to which these actions can be carried out is only limited by the commitment of a manufacturer to a particular production system and product design. Structure of the assembly is shown in figure 1.

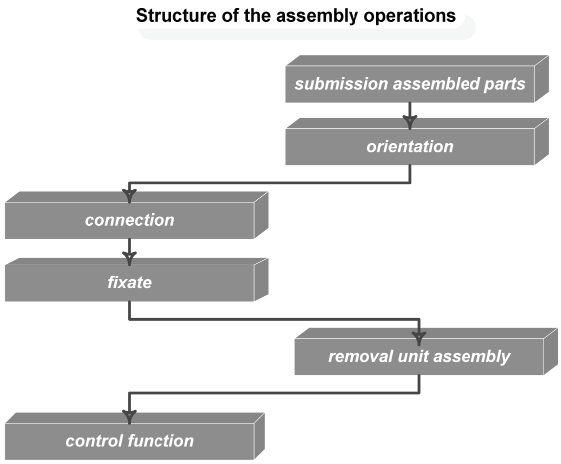

Fig. 1. Structure of the assembly operation

It is possible to differentiate here between *stationary* (assembly object/unit is stationary) and *mobile* assembly (assembly object moves).

Construction site and group assembly (individual location) count as stationary assembly. They have a high degree of mobility, as here it is predominantly a matter of the movement of workstations.

Bank and flow forms of production line assembly, including clocked, are categorized as mobile assembly. Here the mobility is limited, since the object movement is fixed spatially by technical equipment.

The development of manual assembly workstations for automatic assembly includes hybrid assembly (automated and manual assembly). Figure 2 demonstrates the *ranges of application of the assembly concepts* that are used for the assembly of components and/or products.

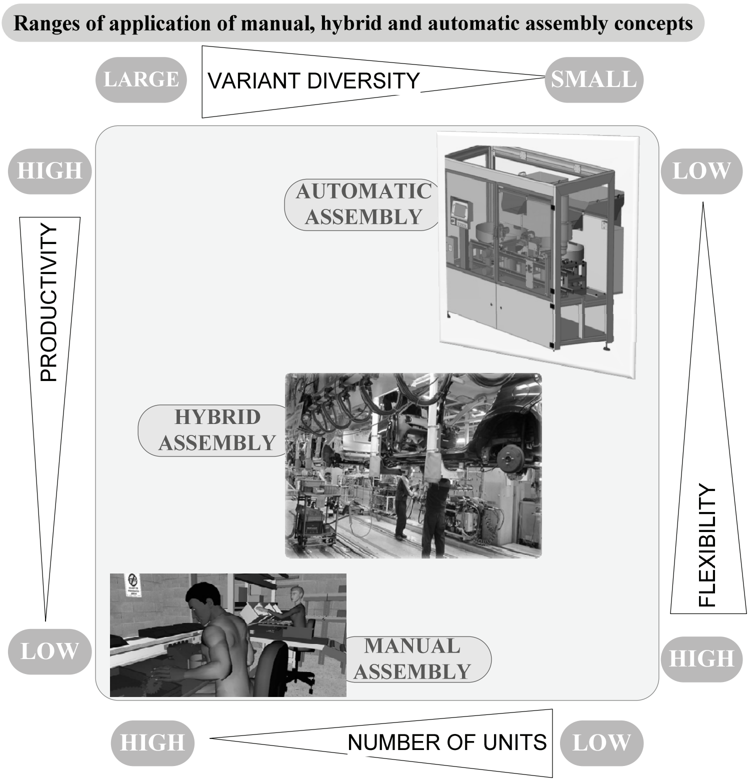

Fig. 2. Ranges of application of manual, hybrid and automatic assembly concepts

1.2. Ergonomic design of assembly workstations

Ergonomics is employed to fulfill the two goals of health and productivity. It is relevant in the design of such things as easy-to-use interfaces to machines and equipment. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability. Ergonomics is commonly thought of in terms of products. But it can be equally useful in the design of services or processes. It is used in design in many complex ways.

The prerequisite for assembly workstation design is compliance with the ergo- nomic design principles of the individual (manual) workstation. They are linked by transport, handling and storage facilities according to organizational (production form), ergonomic, technical and spatial principles. The height of the workstation area must be seitable for workers of differing body heigts. Ergonomic design of assembly workstations - examples in figures 3 and 4.

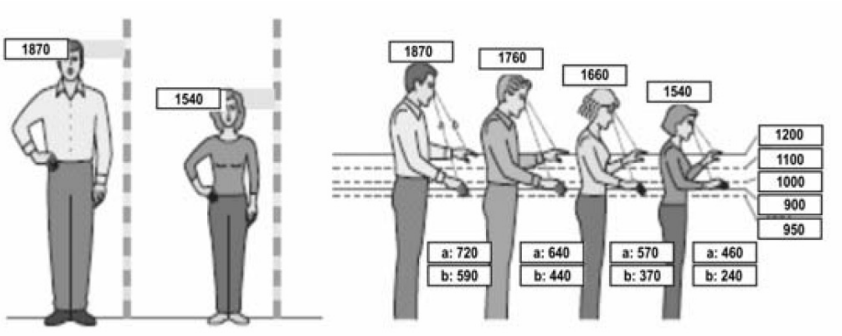

Fig. 3. Body size and workstation floor space

Avoid working positions above heart height, as this reduces the blood circulation. This results in the performance of your workers dropping off rapidly. Introduce seated/standing or standing/walking concepts in order to enable a change of load on the body.

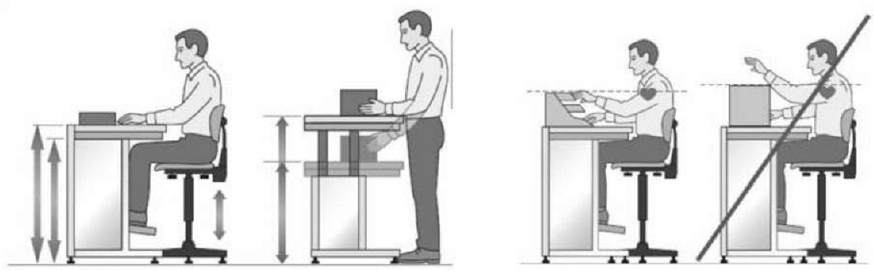

Fig. 4. Heart height and working position

Workstation-related design solutions are based on the individual manual workstations, flexible single-station machines and inflexible special purpose machines.

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Branislav MIČIETA*, Vladimíra BIŇASOVÁ**

THE INTEGRATION OF LEAN MANAGEMENT WITH ECO-INNOVATION

Abstract

The article deals with possible approaches to the management of manufacturing organizations in terms of the debt crisis. The authors emphasize the need for enable lean management with eco-innovation. The integration of a sustainable development introduce reducing environmental impacts, achieving more effective use of natural resources and production costs.

1. ECO-INNOVATION BOOSTS ECONOMIC GROWTH WHILST PROTECTING THE ENVIRONMENT

Innovation is "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations" (OECD 2005). Such a definition is neutral in the sense that it does not determine the content or the direction of change (Rennings 2000).

The term environmental innovation, or shortly 'eco-innovation', relates to innovations aiming at a decreased negative influence of innovations on the natural environment. There is no generally accepted definition of eco-innovation. Various definitions have been proposed in the literature since the mid-1990s. As for any other innovation, eco-innovations have several types and can result in a new or significantly improved product (good or service), process, a new marketing or organizational methods. Eco-innovation should be seen as an integral part of innovation efforts across all production and service sectors.

The debt crisis has many negative impacts on the organization. It's mainly decrees in production and services, reduce the volume of foreign funds to finance organizations activities, decline of long-term investments and also often occur unpaid debts. Practical experience suggests that in order to reduce costs often leads to demands of suppliers to reduce prices of purchased goods and services. This is in many cases liquidating, especially for small and medium-sized organizations. It leads to spiral formation, when efforts to maintain some organization often causes problems even the ruin of other organizations. Many organizations have used the crisis to reorganize its operation with a lean management, reduction of unproductive costs and use of energy saving and environmental solutions.

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Many organizations, especially manufacturing, integrate lean management of eco-innovation. It turned out that that integration creates conditions for sustainable development. They reduced environmental impacts. This is more efficient use of natural resources which often markedly reduce production costs. Manufacturing organization based on that approach are trying to use (if permitted by the conditions of production) so-called pull production control systems.

1.1. Eco-innovation against crisis

At present, it is appropriate to use the full potential of eco-innovation, environmental protection, to promote competitiveness, growth and job creation. It is necessary to ensure that the EU maintain a sustainable competitive to other parts of the world. Eco-innovations are key technologies (Cleantech) to the environment. Cleantech is also economical and ecological solutions to enhance productivity, efficiency, saving energy costs and thus the environment. Currently, the Cleantech referred to as a separate industry. Although many Cleantech organizations essentially manufactured, but help improve the business types of organizations.

Cleantech is not only business with renewable energies. It is also about water purification, more efficient transport, production of organic products, improving materials, but also on the design and architecture. Cleantech is a logical response to trends such as lack of resources, urbanization and climate change. Cleantech organization grew during the crisis. The principles of environmentally oriented business for profit are shown in figure 1.

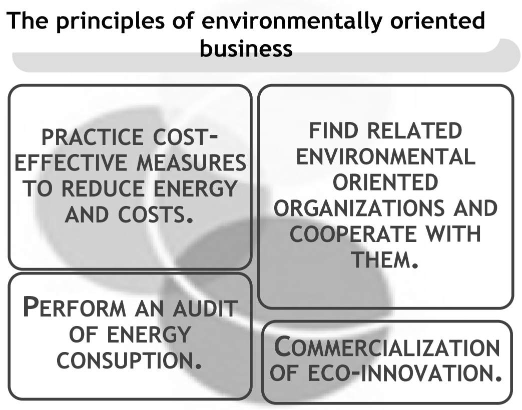

Fig. 1. The principles of environmentally oriented business

Cleantech solutions are suitable for all industries. It is important to take this trip not only management of the organization, but all employees of the organization. Product and process innovations

A product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics (OECD 2005a). Product eco-innovations include any novel and significantly improved product or service produced in a way that its overall impact on environment is minimised. Products can include various goods with a different number of components (e.g. from a household appliance to a house) and various types of services such as new public mobility schemes (e.g. car sharing) and environmental services (e.g. waste management, environmental consulting).

Increasingly, the distinction between the goods and services is becoming blurred, indeed it can be argued that people need services (utility, value), rather than goods themselves. However, from an eco-innovation perspective, it is important to underline that a service society can be as, or even more resource demanding than our present 'commodity' based society since all services require resources.

At the same time, by focusing upon services, it is possible to achieve a dematerialisation of the economy, in as much as society favours technologies which enable the fulfilment of needs (through services provided) without necessarily the current consumption of 'things', hence minimising resource use.

1.2. Strategies lean management organization

Within the lean management of organization application of the following lean strategies (figure 2) is needed. They represent models of solutions for the most important tasks of the organization - production at market costs, in the quality demanded by customers and in competitively advantageous time.

Fig. 2. Lean management: 6 basic strategies

Managers of organizations, in addition to daily operational decisions, must deal with the analysis of global risks. They need to have information about these risks, to which the organization is exposed. It is therefore appropriate, if they recognize and appropriately apply some basic principles.

The principle of a global system approach, which derives from the fact that the whole world is closely connected and relations exists. The success of the organization should be based on knowledge of global political, economic, ecological, scientific, technological and social developments.

The principle of interdisciplinary means sharing knowledge and methods of several disciplines. The greatest effects are achieved by the work of interdisciplinary teams to solve problems or application of knowledge of a field in another field entirely.

The principle of awareness of working with risk, while risk comes from uncertainty about the factors affecting the success of organizations. Each decision is associated with risk. Risk can be reduced by developing multiple variants and by systematic study of the information, because identified risk is not as large as unknown one.

The principle of dealing with time knowledge, which is based on the fact that in modern market society is time more important than money. Drastically shorting of the time to research, development, construction, manufacturing and marketing is therefore obvious part of a successful organization.

The principle of variation is that the strategy of the organization must always be prepared in several variants, based on knowledge of all the trends, which could happen with high probability.

The principle of permanence means that it is necessary to monitor whether processes in the organization are carried out according to plans and schedules.

The principle of creative approach assumes that an enterprise which does not bring anything new to the market could not be successful.

Routine and repetition of the old imitation of something, already used by others does not have place in lean management strategy. Only organizations that bring new products, new technologies, new ways of meeting market needs, new ways of reducing costs etc. can be successful. During the crisis, it is necessary to deal with more innovation, invest in people and prepare for opportunities in the future.

The crisis is an opportunity for those who have something to offer, for example knowledge, skills, innovative thoughts and honest work done. Integration of lean manufacturing with eco-innovation, aiming at significant and demonstrative progress, leads to a requirement for a new way of managing the production, which should use the principles of pull systems.

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Tecnomatix, FactoryCAD, FactoryFLOW, Plant Simulation

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CONNECTION OF FACTORYCAD&FACTORYFLOW& PLANT SIMULATION

Abstract

Siemens provides own concept of digital factory solutions called Tecnomatix, which links programs from designing production systems, ergonomics and simulation for improving the efficiency and verification of changes in the company. The paper discusses about connecting of three modules of Tecnomatix FactoryCAD, FactoryFLOW and Plant Simulation.

1. TECNOMATIX

Tecnomatixis a system ofPLM(Product LifecycleManagement)forproductionandprovides control overthe production ofproducts.It isbuilton opentechnologyandprovidescomprehensive information onproductiondecisions, andanalysisresults throughstrongproductivity toolsandmore intuitive user interface.

Itplans, optimizesandverifiesprocessesbefore startingproduction. Withadvanced toolsforplanning, simulation andcooperationispossible to achievegreater efficiencyandproductivityby synchronizingproductdevelopment stagesandprocesses. Fordesign and optimization ofproduction plantscontainsmodulesTecnomatixFactoryCAD, FactoryFLOWandPlantSimulation.With using of3Ddesignin the designingof production systems itisalreadypossible to finderrorsinplanning process in virtual sceneandnotafter introductionintoreal conditions.

1.1. FactoryCAD

TecnomatixFactoryCADis applicationforlayoutdesignand provides allnecessary toolsto createdetailedmodelof intelligentmanufacture.FactoryCADworkswith parametricmodels thatareusedinplantresources – fromfloors, conveyors, cranes, handling equipmentup to theoperators. Many of thetypicalprocessesforschedulingare proneto error,becausein the current2D scenedesignershaveproblems with understandingimpactsof devices locationin the production hall. Thesemisunderstandingscanbecostlyin terms ofmultiplerepeating sameprocess.With theapplicationFactoryCAD designer givesoverview onnecessarydesignand installation process.

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Designers can save up to 75% of time needed for their job byusing FactoryCADcompared to layout creation in AutoCAD. Main advantages of creating layouts in FactoryCAD are:

- using of parametric models,
- time saving creation of models,
- more organized drawings,
- reduced file size.

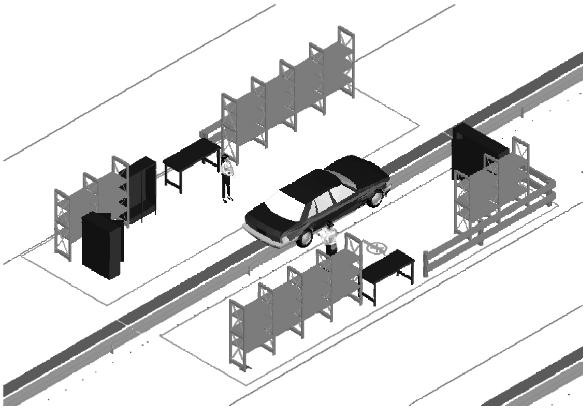

Fig.1. Example ofthe production system inFactoryCAD

1.2. FactoryFLOW

TecnomatixFactoryFLOWis graphicalsystemformaterial handling, whichallowsindustrial engineers tooptimizelayoutbased ondistance, frequencyandcost. This is achieved byanalyzing information,routes, materialstorageclaims, specification of equipmentformaterial handlingandinformationaboutcomponentscompared to thefactory layout. UsingapplicationFactoryFLOWwe get betterchoices andcreatemore effectivelayout of factory layoutwith shorterdistancesfor movingparts, size of batchesandbuffer levels. It also achieves better communication. All thisleads togreater efficiencyandproductivity of manufacturing.

FactoryFLOWincludesthese mainfunctionsandanalysis:

- calculationof material flows,
- suitablestorage locationsandstorage areas,
- planningandlayoutoptimization,
- optimizing routesof vehicles
- analyzingfeasibility offootpathways,
- analysisusageof vehicles.

TecnomatixFactoryFLOWis based on productionlayoutdrawing, whichisprocessedinFactoryCAD. Another sourceof informationforanalysis is tree structurethat containsinformation about productand itsparts, information about activitiesand information about transport and handling facilities.

Mainadvantages of usingFactoryFLOW are:

- reducing thetotallength of material flow,
- removenot addedvalueformaterial handling,
- reducing level ofWIP(work in process),
- evaluation of requests formaterial handling,
- -identification of requirements forstorage space.

1.3. Plant Simulation

The simulationmodule ofTecnomatixPlantSimulationenablesthe simulationandoptimization ofplanning atalllevels of enterprisefrom enterprise as unit, down to individuallinesandmachines, usinghierarchicalmodeling. Usage of programisuniversalandacceleratesmodelingwith using variety ofmodulessuch as:moduleforsupplyandlogistics, assembly line,simulation ofsupply chainsandclient chains. The advantage ofPlantSimulationisusage ofmoreautomaticoptimizationoptionsusing genetic algorithms. The program offerswide range of results visualizationinform ofseveral types ofgraphs,butalsoin form of detailedreports thatcan beeasilytransformed intooutput, which customerrequires. Of course there ispossibility to create modelin2Dor3Dviewand then automaticallycreate modelin missingdisplay.Plant Simulationis toolfordiscrete eventsimulation, whichhelps to createdigitalmodelsof logisticsystems (e.g..manufacturing), in order toexaminecharacteristics of systemandoptimizeitsperformance. These digitalmodelsallow experimentationandscenario"what if" without disruptingexisting productionsystemsor, when used inplanning process, longbeforeactualinstallationof production systems. Extensive analysis tools, such as analysis of barriers, statistics and graphs allow to evaluate different manufacturing scenarios. The results provide information necessary to do fast and reliable and smarter decisions in earlier stages of planning.

2. CONNECTION OF MODEULES

Tecnomatixmodulescan be connected, butwith certain restrictions. Nevertheless, transfer of informationfrom themodulesandFactoryCAD, FactoryFLOWinPlantSimulationmodulehas itsadvantages. The biggest advantageistime neededfor enteringinputinto thePlantSimulationnecessaryforimplementationother analyzesandfor simulation.

Linking procedure is following:

1. **Create layout** – draw layout using FactoryCAD.
2. **Fill necessary inputs –** fill data about material flow using FactoryFLOW – used material handling equipment, their available time, speed, price, route
3. **Accessing functions Simulation Exchange** - the functionismade availablewhenthemodulesFactoryCAD and PlantSimulation areinstalled onone computertogether or they use one server and database.
4. **Layout parameters –** settingsof time unitsanddistancescales. Enter drawingforroadsandstructures in FactoryCAD.
5. **Simulation data route editor** –loadingdatafromFactoryFLOW: used material handling equipment, theiravailabletime, speed, price, route, ...
6. **Export Simulation data –** it is export of layout created in FactoryCAD and data from FactoryFLOW in SDX file format

7. **Run Factory Simulation –**switch module in Plant Simulation.
8. **ImportdataviaSDXFile**-loadingdatainto thePlantSimulation.
9. **LoaddrawingfromFactoryCAD and data form FactoryFLOW**- it is loading of layoutdesigned inmoduleFactoryCADandmaterial handling systemcreated in FactoryFLOW with namesof transport equipmentautomaticallyassociatinginformationabouttheirroutes, speeds, timesandrestrictions.
10. **Addinglogic**- it is supplement of rules,conditions- e.g.Atintersections(right of way), theloadingandunloading…

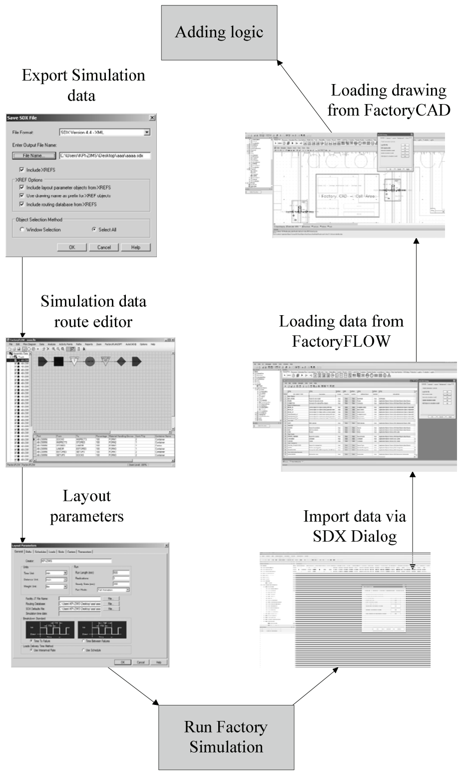

Fig.2. Connection of modules

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Augmented reality, visual management

Gabriela MIRANDOVÁ*, Ivan GABAJ **, Patrik GRZNÁR***

USE OF AUGMENTED REALITY IN VISUAL MANAGEMENT

Abstract

Visual management is an important tool of lean manufacturing. It provides effective information exchange and sharing. Currently, there are some basic visualization resources. As innovation for providing information in the visual management can be augmented reality. Options and examples of its applications with examples are described in the following sections of this paper.

1. VISUAL MANAGEMENT

Visual management allows to all team members and more sophisticated and objectively seen reality and to share common concerns and values. To see some information is not enough. It is necessary to be perceived and understood, especially by anyone, regardless of specialty or cultural and social background. One of the main principles of visual management is to make information available to as many workers. Under visual communications we understand the exchange of information through visual means between sender and recipient. Visualized information must correspond to the needs of workers.

Visual management primarily used the following resources:

- information sheets, team sheets, kaizen signs improvement, quality and the board,
- electronic display boards for power production and other production parameters,
- signaling equipment - lights, kanban boards and other means of signaling.
- graphic markings on the floor, the wall - a variety of places, the boundaries of teams, and the roads,
- visual aids to facilitate the work - image processes, multimedia presentations, TPM pictorial instructions,
- distinguish color tools, parts, pallets and so on.

Visual management is a standard tool for improving communication, information, support and troubleshooting for development of teamwork. Typical representatives of a visual management are different types of information or team boards.

Visualization is used mainly in the following cases:

- note the abnormalities - defects in the machines, high inventory, poor quality,
- simplifying processes - kanban boards, floor space for pallets, teams border,

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- avoiding mistakes - Andon, Jidoka.
- better communication - team board, board improvement,
- management by objectives.

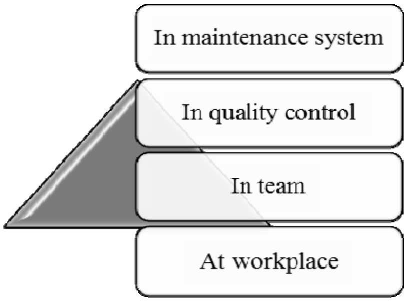

Fig.1. Levels of visual management

2. AUGMENTED REALITY AT LEVELS OF VISUAL MANAGEMENT

Augmented Reality is a tool which we can provide an effective exchange and sharing of important information. Using augmented reality in a visual management is primarily a support tool, not a replacement of known visualization means such as information boards and signaling equipment. It is important to establish what we want to visualize, how we want to visualize and to what level of visual management. The basis of augmented reality is the ability to combine elements of real and virtual worlds into a single view. It is a technology supported by the human visual perception. The view is realized through HMD (head mounted display), ie placing the device on your head or the user sees the environment through the monitor and camera.

Equipment for augmented reality has three basic parts:

- head mounted display,
- software for AR,
- laptop.

HMD used in Augmented Reality allows users to view system generated graphics and text. This technology is similar to that used in virtual reality.

2.1. Use of augmented reality at level of workplace

The use of augmented reality at workplace has the following options for visualization:

- production equipment,
- workplace territory,
- manufacturing process,
- organizing the tools and support tools in the workplace,
- safety in the workplace,
- a graphical markings on the floor, the wall – places for pallets, the boundaries of teams, roads and so on,
- visual aids to facilitate the work – image processes, multimedia presentations, animated instructions.

Organizing the tools at workplace

Creating a workspace, which would from all sites meet the demands and needs of man, is a challenging process that requires in addition to technical skills and knowledge of ergonomics. The main consideration in assessing and developing new work is a man with his physical and mental ability. With the right draft work premises is therefore carefully evaluate the factors affecting the production workspace, use the findings from their analyzes of secondary factors that may or may not influence the workspace.

Fig.2. Workplace visualization

Production and assembly process - visualization of working procedures

Augmented reality is able to bring for operator new work conditions in order to have the opportunity to get to know with them, without the risk to health. Subjective information from our work is not yet able to provide any virtual human model. Therefore, the application of augmented reality has a unique meaning not only for humans but also to have worked for the company in terms of better production in less time and with greater efficiency. Great importance is the use of augmented reality directly in assembly operations. The traditional approach is to use manuals and descriptions of individual tasks. Using augmented reality in assembly operations reduces, respectively eliminates the need for additional written assembly procedures. Operator in its field of vision sees not only the actual physical parts assembled, but also the structure in virtual form, which is displayed by the mounting procedure. In this way the real environment is completed by virtual elements which simulate the assembly operation. The use of augmented reality in assembly increases efficiency of person, reduces the time needed to fulfill the assembly tasks, reduce errors and reduce the cognitive load. Machinery and production equipment cannot replace a man with his flexibility and fine motor completely. Therefore, workers should be supported by technical facilities during the performance of assigned tasks Augmented Reality support of workers at work, can even improve their efficiency

2.2. Use of augmented reality in maintenance

The basic concept of the maintenance support system by augmented reality is following. Worker is equipped with a laptop computer located at his waist. The computer is connected through a wireless network from a central computer where he downloads maintenance information. The staff is also equipped with a HMD device and video camera, which captures the surrounding environment, located on the worker's helmet. Such a system worker navigates to the point of implementation and maintenance through augmented reality, he displayed a variety of information in the performance of maintenance operations. The problem occurs when the operator maintenance gets a new job, meet with an unusual element to the technical device or need to repair something that has never been repaired. Then he must look into work manuals and study them. Such a process maintenance work is extremely a lengthy, what manufacturing companies costs a lot of money. This is caused by the inaction of devices. Worker can help in this case, using augmented reality applications. The wireless connection between computers allows maintenance personnel to download the necessary manuals, pictures of the repaired equipment and workflow. Imaging device then allows them to study these manuals in real time directly to and during the work itself.

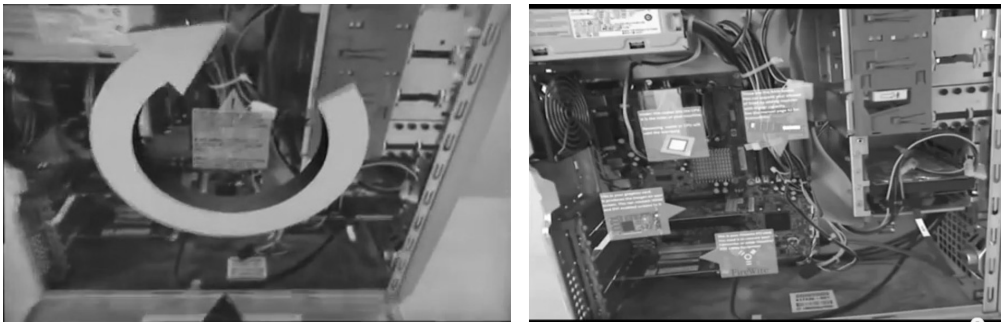

Fig.3. Example of use Unifeye Design for computer maintenance

Workplace, that uses visual management is organized, managed, organized and all processes are clearly described in it. It creates the preconditions for the gradual reduction of waste, workplace autonomy and its gradual slimming. Visual workplace using effective resources to display information sharing and visual elements for process control.

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Stock,rationalization

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RATIONALIZATIONOF ITEMS IN STOCK

Abstract

The article deals withthe rationalization ofthe locationof itemsinrealcompany, using modern technology. At the beginningwe didan analysis ofcurrent situationandevaluate currentdeployment. The core of thearticleis a sequenceof steps, whichweproceededto changethe locationof itemsinstock.Atthe end of thearticlesummarizesthe benefitsandadvantagesare achievedbyintegratingthe newlayoutandits subsequent useinthe workplace.

1. ANALYSIS OF PRESENT SITUATION

In designingandoptimizing thelayoutof the system isfirstanalyzedthe currentsituationiscreatedwhere2Dor3Dmodelcontainingmaterial, personnel andinformation flows. Subsequently, the model is modifiedsoas to minimize espace, optimizedmaterials, personnel andinformation flows, balancecapacity, performanceandminimizedtransportationetc.(Harris, 2003).

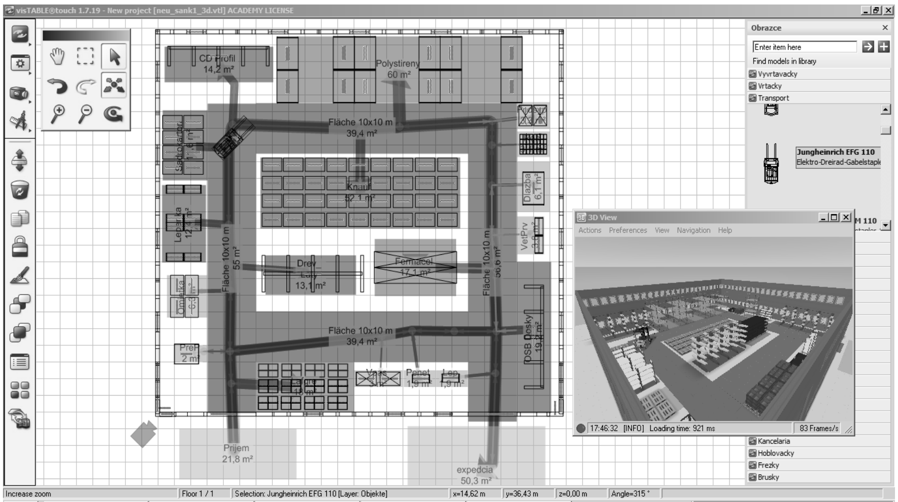

Fig.1.Material flow

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Currently, thewarehouseistheproduction ofonly a fewmeters, whichisofgreat benefitnot onlytoday, butalsoexcellent prospectsfor the future. Dimensions ofthe hallis35 metersx50 metersx6 meters. Itemsstoredin the warehouseare locateddown the hall, as shown in thelayout.

As we can see from the picture (Fig. 1) material flow tends to create the letter U, which means that the material comes into the store one a gateway based on the second gate. Whole hall is divided by concrete pillars, which are located in the center and divide it into left and right side. On the left of the hall is the revenue area, as well as most of the stored material. On the right are hard materials and also a long bar items. Of course we must not forget the dispatching area.

2. ABC ANALYSIS

The ABC analysis were analyzed by individual store items in a warehouse for a period of one week.In this step, we stored items divided into different groups A, B, C. Items are sorted according to momentum stocks. We follow the Parettrules20:80. ABC analysis we divided the items in the ratio 10:35:45. This means that in group A are 10 items, 35 items of group B and group C 45 items.

3. SUMMARIZING THE PRESENT SITUATION

Forcomparableparameterwaschosenamong other things,mainlytransportcapacity (Fig. 2). Itcan be characterizedas a multiple ofthe intensity oftransportanddistance, so transportationisaworkmadefora specified timeunit. Transportcapacity is worth 21580,23.

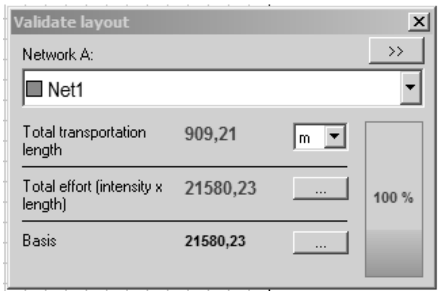

Fig.2.Transport capacity

4. RATIONALIZATION OF ITEMS

The process of rationalization of stock items prepared in advance based on ABC analysis. To work consisted of moving individual storage locations, such as items with the highest quantity transported, so all the items A, were transferred to the input-output storage locations. When you move your items and we pay attention to items of type B, which were placed under item A. At the end of C items have been moved away from input-output space in a warehouse.

For ease of layout warehouse storage space, single colored with colors as shown in Fig. 3, identical chart used in ABC analysis.

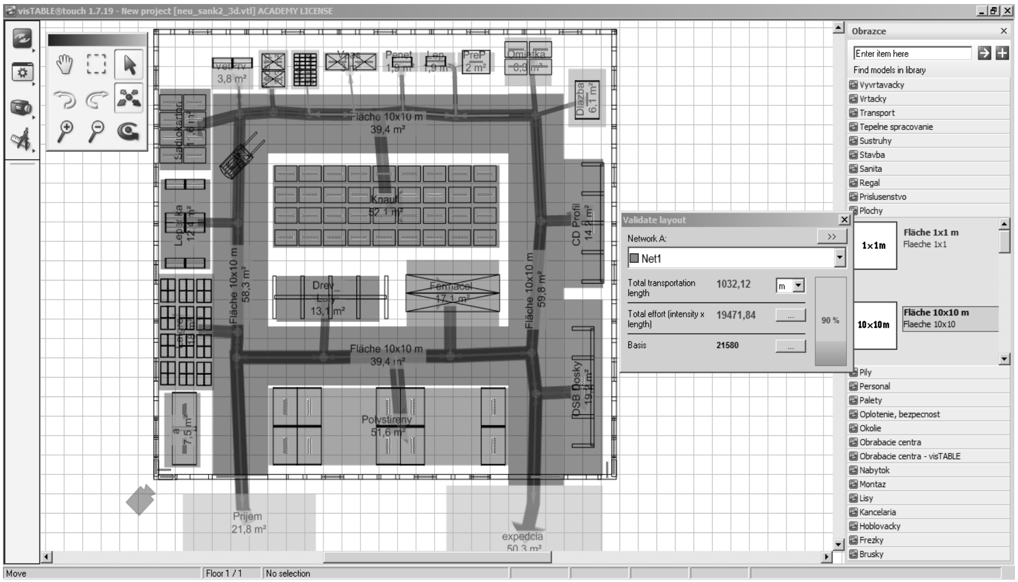

Fig.3 Rationalization of items

The result was the rationalization of inventory items for a complete layout of the storage sites and storage units. Arrangement has remained unchanged for the structural elements and places for receiving and shipping goods, as well as system operator warehouse locations.

5. SUMMARIZING THE RATIONALIZATION OF ITEMS

The result ofthe arrangementfor storage unitsthat achievethe overalltraffic performanceinthestorage space19471.84. Comparedwithbaseline, thetransportcapacity was21580.23achievetotalsavings of2108.39. This savingrepresents10% of thetransport performanceof the initial stateasshown inFig. 4.

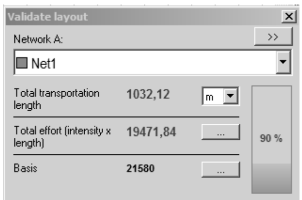

Fig.4 Transport capacity

The rationalization of the layout arrangement of stock items are also prepared proposals for methods of storage of items. These proposals, as well as the resulting configuration were performed using the 3D visualization of storage (Fig. 5).

Fig.53D visualization of storage

This paper was made about research work support: VEGA no. 1/0583/12.

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Strategic management, policy deployment, lean management

RadoslavPALACKA[*], MiroslavRAKYTA[**]

DESIGN THE NEW BUSINESS STRATEGY UTILIZING LEAN MANUFACTURING MODEL

Abstract

Lean thinkers have many tools available today. With so many good tools available, we should have made much greater progress in creating lean enterprises. Many organizations with elaborate policy deployment mechanisms in place never seem to actually deploy policy. They bog down selecting the right things to do and never get the right things done. In the pages ahead, will be illustrated the method as it switches from traditional planning methods to rigorous strategy deployment. We must tailor the planning and execution system to fit the business. I will explain how you can get the right things done by applying the method consistently.

1. LEAN CONCEPT IN OUR STRATEGY

Strategic management is a field that deals with the major intended and emergent initiatives taken by general managers on behalf of owners, involving utilization of resources, to enhance the performance of firms in their external environments. Strategy deployment ensures that "lean" is aimed at the heart of enterprise. Lean thinking begins by defining value – what is important to the customer. Sometimes we forget that the elegant lean tools – VSM, standardized work, pull systems, and so on – are mean to this end, and not end in themselves. It all depends on the need.

Your organization will get a clear strategy that optimizes the value of the business. You will:

- create the team and define the process of strategy deployment,
- grasp the actual situation according the model (Fig. 1),
- develop the management process comprising the micro, annual and macro Plan-Do-Check-Adjust cycles (Fig. 2),
- model the impact of each decision and risk on the organization's financials,
- Catchball – the process of gaining alignment.

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Create the team and define the process of strategy deployment.

Conventional planning is all analysis. But the essence of strategy is not analysis – it is the synthesis of analysis and intuition. Intuition helps us answer questions like:

- What is the mood in the plant?
- What did the look on the supplier s face mean?
- How are we viewed in the market relative to our competitors?

In this step is important to build strong multifunctional team with Finance team engagement.

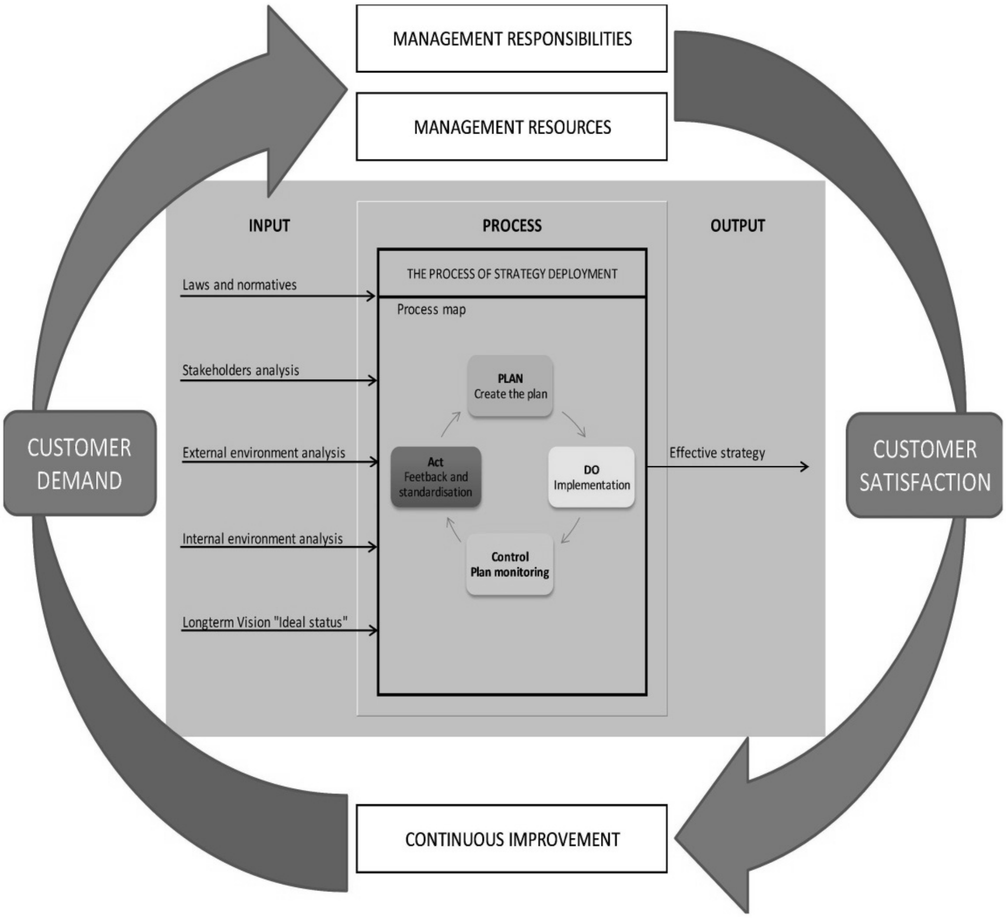

Fig. 1Model of strategy deployment

Understand the actual situation

Understand the actual situation mean check all internal and external factors influenced our strategy business results. These factors are illustrated as inputs in our model of strategy deployment.The most relativeinput to lean production is an internal analysis. In this phase we define our business fundamentals and answer on basic question “where we are”. The areas of assessment are strategy, structure and drivers. Tab. 1 showed us the content of these areas.

Tab.1 Model of internal analysis by using lean principles

Strategy	Focus on customer satisfaction
	Leadership and strategy planning
Structure	Organization structure
	Relation with customers
	Information flow
Drivers	Culture of improving
	Production management
	New equipment and maintenance management
	Engineering

The micro, annual and macro Plan-Do-Check-Adjust cycles

PDCAis an expression of the scientific method to which our society owes its prosperity. It is also the foundation of strategy deployment. Grasp the situation means grasping the where, what, and why of abnormality by scanning to spot and abnormality, and to understand the root cause of the abnormality. The strategy deployment is divide into 3 PDCA cycles for a purpose to share our strategy from top management to production consistently.

Each cycle has particular steps important for deploying effective strategy. In a case of Macro PDCA the greatest emphasis is placed on phase Plan. Annual PDCA has phase Do as the most important. The smallest PDCA depends on our ability to implement strategy and control the activities defined by managers. The cycle is closed by phase of Control, which keep running our activities.

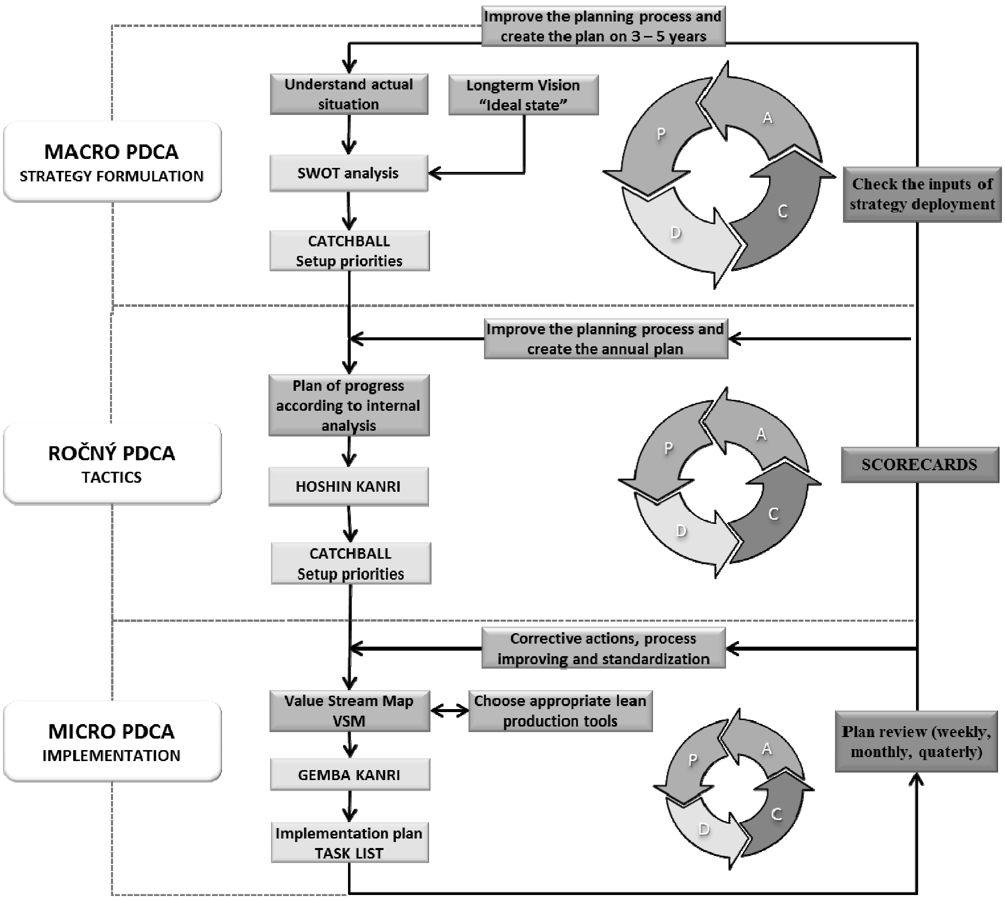

Fig. 2 PDCA method for strategy deployment

Model the impact of each decision and risk on the organization's financials.

When implementing strategy deployment, engage the Finance team early on. The Finance team grasp the benefits of lean thinking, they are among its strongest advocates. Strategy need Finance to cut through the fog of standard cost accounting and translate lean gains into real number. For example, if through lean activities we stabilize our processes and equipment, we will be able to reduce inventory and order-to-cash cycle time. We also free up cash and capacity. Standard cost accounting is not the best scorecard. EBIT and other standard profit measures can be misleading. For example, we know that lean thinking is about reducing waste, and that excess inventory is the mother of all waste. But reducing inventory will negative effect EBIT.

Catchball

Catchball is the concept, through which the vision of senior management would be translated into concrete activities throughout the enterprise.Catchball entailed frank, reality-based discussion between and within management levels. The leader normally defined the required result, the team members the mean.

2. CONCLUSIONS

Companies that have achieved operational excellence through the deployment of a Lean strategy share three key characteristics:

- Dedication to basics such as streamlining processes, creating a well orderedwork environment, and ongoing continuous improvement programs (Kaizen).
- Lean processes have been rationalized and streamlined; Lean techniques havebeen memorialized and a ‘single version of the truth’ is ubiquitous via a technologyinfrastructure that supports manufacturing, the enterprise, and the supplierbase.
- Lean principles are reflected in the corporate strategy, on the senior leadershipteam, as well as throughout manufacturing and the company.

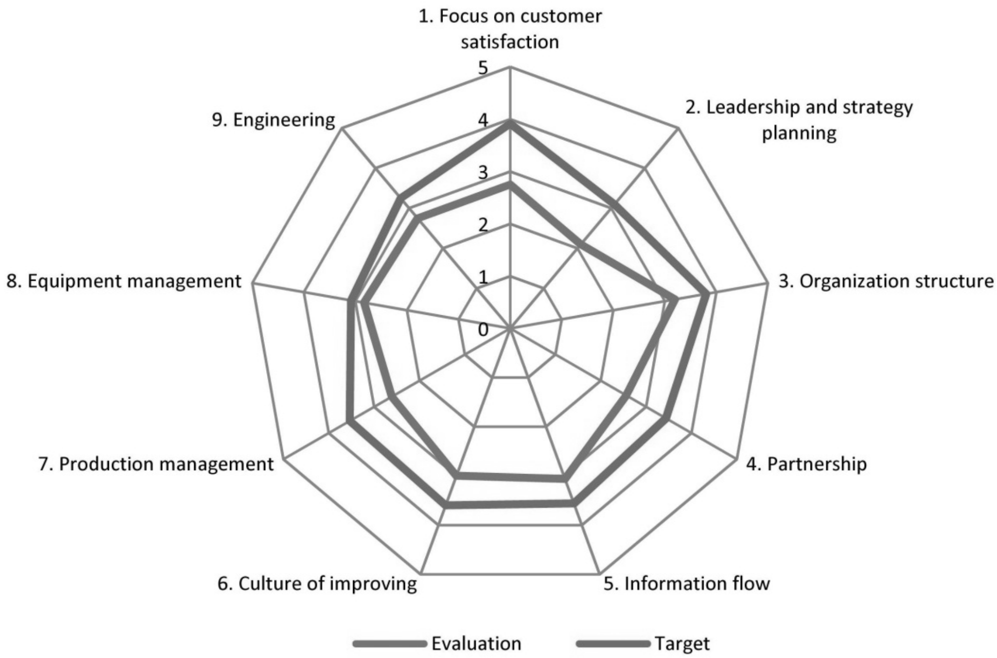

Fig. 2 Target diagram for our strategy

Five Essentials of an Effective Strategy:

- An effective strategy is deeply understood and shared by the organization.
- An effective strategy allows flexibility so that the direction of the organization can be adapted to changing circumstances.
- Effective strategy results from the varied input of a diverse group of thinkers.

- An effective strategy follows a thorough and deep analysis of both the external environment and the internal capabilities of the organization.
- An effective strategy identifies areas of Competitive Advantage

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Metamodel, correlation, parameter, regression

Silvia PALAJOVÁ* , Milan GREGOR**

APPROXIMATION CONTROL OF MANUFACTURING PROCESSES BASED ON METAMODELLING

Abstract

This paper deals with topic of simulation metamodel making process as one of possible ways how to increase effectiveness of simulation optimization. It focuses on particular steps of metamodel creation explained on specific example of a simple simulation model.

1. INTRODUCTION

Currently, it is axiomatic to solve complex problems of production systems by an appropriate computer simulation model which allows quick testing of various variants of solutions and it minimizes the risk of wrong decisions. Simulation runs of complex models can last for hours but simplicity for understanding and explanation of representations of reality is often required. Therefore there are often constructed models of simulation model which are used for studying of a computer simulations' behavior. They are called simulation metamodels.

Metamodels are used to study the behavior of computer simulations. They explain the fundamental nature of the system's input-output relationships through simple mathematical functions – regression models – that enable to forecast output *Y* for given input, if you like more inputs *X*. The acceptance of metamodels in simulation can greatly reduce the computational load of optimization process, because computational costs associated with the use of metamodels are much lower than the standard approach for evaluation of all runs with the simulation model.

2. METAMODELLING MAKING PROCESS

The metamodel creation (fig. 1) begins with a simulation model when several simulation runs for different values of input parameters are executed. Resulting output data and the statistical model, in the form of regression, are these results are then derived. In the next step, collected data are replaced by function curve, which describes a metamodel and is a reliable approximation of the original output data.

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2.1 Computer simulation

The simulation model describes the production system with three machines which tool blank in sequence. The total productivity of the system is affected by the second machine's failures that occur at specific intervals $X_1 = \{x_{11}, x_{12}, ..., x_{17}\} = \{15,20,25,30,40,50,60\}$ and repair time is defined by data set $X_2 = \{x_{21}, x_{22}, ..., x_{26}\} = \{5,8,10,12,15,20\}$. By combining of all levels of factors X_1 and X_2 were 42 simulation runs carried out and the observed response was average time of production (Y).

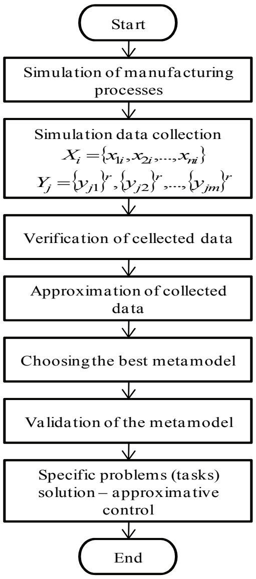

Fig.1. Metamodel making process

2.2 Correlation analysis

In order to continue in metamodel making process, it is first necessary to determine whether the observed outputs depend on defined inputs. Condition of mutual independence of the vectors of independent variables X_1 and X_2 must be executed. This is done using correlation analysis and monitoring the value of the Pearson correlation coefficient:

$$r = \frac{\overline{xy} - \overline{x}\,\overline{y}}{s_x s_y} = \frac{cov\,xy}{s_x s_y}; \quad r \in \langle -1,1 \rangle \tag{1}$$

Results (tab. 1) show that X_1 a X_2 are independent, dependence exists among values of vectors X_1 and Y, X_2 and Y. Since the p-value –second number in the table - is less than 0.05, there is a statistically significant relationship between the variables at the 95% confidence level. In respect of X_1 a X_2, there is not p-value less than 0.05.

Tab. 1 Pearson correlation coefficients for studied variables

	X1	X2	Y
X1		0	-0,7007
		1	0
X2	0		0,6667
	1		0
Y	-0,7007	0,6667	
	0	0	

2.3 Data approximation

If the values of inputs *x* and their related responces *y* are known, regression function can be estimated:

$$y'_j = f\left(x_{1j}, x_{2j}, ..., x_{kj}; b_0, b_1, ..., b_p\right) \tag{2}$$

Coefficients $b_0, b_1, ..., b_p$ are estimates of unknown parameters $\beta_0, \beta_1, ..., \beta_p$. To study the impact of two independent variables to output, the multiple linear (linear in the parameters) regression model with two regressors was used:

$$y = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} \tag{3}$$

So estimation of this function is:

$$y' = b_0 + b_1 x_{1i} + b_2 x_{2i} \tag{4}$$

The unknown parameters are determined by the method of least squares. The condition of this method is that the sum of squares of random error (residual deviations) of dependent variable has to be minimum:

$$F\left(b_0, b_1, b_2\right) = \left\|e\right\|^2 = \sum_{j=1}^{n} e^2 = \sum_{j=1}^{n} \left(y - y'\right)^2 = min \tag{5}$$

With the use of partial derivation of this function, a general expression of parameters b_0, b_1, b_2 can be obtained. Then they could be used for whatever values of y, x_{1i}, x_{2i}:

$$\underline{\underline{b_0}} = \frac{\sum_{i=1}^{n} y - b_2 \sum_{i=1}^{n} x_{2i} - b_1 \sum_{i=1}^{n} x_{1i}}{n}$$

$$\underline{\underline{b_1}} = \frac{\left(\sum_{i=1}^{n} x_{1i} \sum_{i=1}^{n} y - n \sum_{i=1}^{n} y.x_{1i}\right) - b_2 \left(\sum_{i=1}^{n} x_{1i} \sum_{i=1}^{n} x_{2i} - n \sum_{i=1}^{n} x_{1i} x_{2i}\right)}{\left(\sum_{i=1}^{n} x_{1i}\right)^2 - n \sum_{i=1}^{n} x_{1i}^2}$$

$$\underline{\underline{b_2}} = \frac{\left(\sum_{i=1}^{n} x_{1i} \sum_{i=1}^{n} y - n \sum_{i=1}^{n} x_{1i} y\right)\left(\sum_{i=1}^{n} x_{1i} \sum_{i=1}^{n} x_{2i} - n \sum_{i=1}^{n} x_{1i} x_{2i}\right) - \left(\sum_{i=1}^{n} x_{2i} \sum_{i=1}^{n} y - n \sum_{i=1}^{n} x_{2i} y\right)\left(\left(\sum_{i=1}^{n} x_{1i}\right)^2 - n \sum_{i=1}^{n} x_{1i}^2\right)}{\left(\sum_{i=1}^{n} x_{1i} \sum_{i=1}^{n} x_{2i} - n \sum_{i=1}^{n} x_{1i} x_{2i}\right)^2 - \left(\left(\sum_{i=1}^{n} x_{2i}\right)^2 - n \sum_{i=1}^{n} x_{2i}^2\right)\left(\left(\sum_{i=1}^{n} x_{1i}\right)^2 - n \sum_{i=1}^{n} x_{1i}^2\right)} \quad (6)$$

The calculated values of parameters are $b_2 = 18{,}4199$, $b_1 = -6{,}1735$, $b_0 = 316{,}3765$ and the metamodel is

$$y' = 316{,}3765 - 6{,}1735 x_1 + 18{,}4199 x_2 + \varepsilon \quad (7)$$

3. CONCLUSION

Simulation metamodelling is an appropriate tool for managing and optimization of complex manufacturing systems. Mathematical models are usually used for systems' experimentation. They represent system in terms of logical and quantitative relationships that can be manipulated and changed in order to find out how the model responds, so as the real system would respond.

We call it approximative production management. It is management based on substituting of empirical data with an appropriate type of theoretical function that adequately describes the original data obtained from the system, respectively from the simulation. By the expression of relationships with mathematical functions, reactions (responses) to changes in levels of input factors can be found. This saves the time needed for simulation runs and opens space for people who do not have deep knowledge of the simulation, whereas they pursue only those parameters that need right now.

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Improvement, workshop, learning methods

Pavlína Pivodová*, Jiří Kudrna**

THE MANAGE OF CHANGES AND IMPROVEMENT THROUGH OF SOFT SKILLS

Abstract

The paper deals with the importance of improving the application and improvement approaches. It examines the importance and scope of the methods used by companies with the research. It focuses purposefully on improving the use of alternative methods, which are called collectively as soft skills. The paper is also a record of improvement workshops with practice.

1. INTRODUCTION

Each company which is focused on the production of products or services is trying to create a customer-acceptable quality at reasonable costs. The issue of costs due to growing competition cube, constantly trying to get at the lowest possible limit. Input costs for raw materials, costs of machinery are in most cases comparable. Other costs such as labor, energy consumption may affect the company as improvements strategy. Hidden reserves in well-performing firms may, however, difficult to find.

One possible way to find hidden reserves is through process improvement. Approaches to improve several processes, some of them are not very well known, but their application has significant potential. This area is analyzed in the next post.

2. THE CURRENT STATE OF TACKLING

The reasons for improvement may be more illuminated as fact, when up to 99.9% in manufacturing activities is a waste. Continuous production time contract which is referenced from accepting the order to delivery takes an incredibly long time and if to compare with the actual time when the contract work and there to add value. It is in the order of minutes or hours. Most companies in its processes experience similar forms of waste, which is negatively reflected in the cost of delayed orders and ultimately to customer satisfaction.

In particular, wastes time, but he can not stop, slow down or save for stocks. Time just can reasonably be used for meaningful activity.

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1.1 Educational methods

The existence of different types of waste is very common in business reality. The importance of the improvement is obvious, but how? Firms and workers are trained, receive a lot of information, but because in order to assess their need to use them. Only use information obtained and their application considered climbing the knowledge that only lead to growth and prosperity of the company. To eliminate all forms of waste occurs through the application of essential knowledge. A similar formulation has also expressed by prof. Zelený. Knowledge is not information. Knowledge is not just gathering information. Knowledge is the action. Resources, money, machines and information, all is not applicable without knowledge is useless. Knowledge must be applied and used. Useless, and knowledge remain unused information if they are not transferred to the offense. It having too much information is bad, not having enough knowledge is worse. [1]

To activities eliminate that do not add value should change in thinking and view of the process. By the change is meant measurable, quantifiable difference of performance parameters of the process. New values should show improvement.

For the information change in the knowledge that will be applied to the principles of improvement through staff training programs is needed. Their apply through educational methods.

These methods include games, training (face-to-face, distance), workshops, teambuilding, etc. Currently, there is increasing awareness of management games and their development in the business environment as well as on campus. The use of management games gives us the opportunity to use another - advanced tools for training in industrial engineering. The uses of games serve to increase knowledge through practical demonstrations and the possibility of practicing a certain situation. The field of game oriented education is broad. There are board games and using, a computer and or forms, physical models or Lego bricks. They could be played from home, in schools, in groups or alone too.

The following figure shows an example of the workshop in the Pilsen univerzity, which was played in the managerial game developed at TU Chemnitz which use LEGO blocks.

Fig.1. Workshop

1.2 Research

Every company adapts to the particular conditions of their system improvement. Using different approaches and methods of industrial engineering, helping to improve processes in manufacturing companies are shown in Fig.2., Which shows the quantitative research conducted at the University of Tomas Bata in Zlin, Department of Industrial Engineering and Information Systems within the project GACR 402/09/1739 . The research was conducted at several companies. Presents the results of the evaluated set of 138 structured questionnaires, qualitative research (KC) and the subset of 80 production organizations (PCN) found using cluster analysis and compare the general results of quantitative research (C). [2]

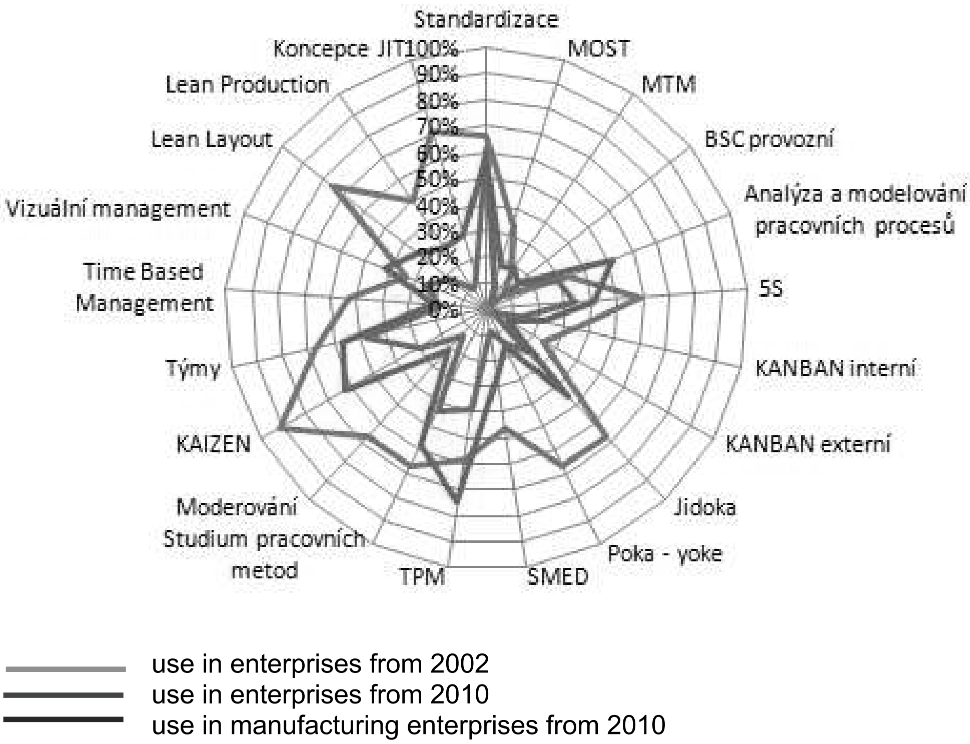

Fig.2. Welding Application of selected methods of IE in the SMEs [2]

The qualitative research interviews were structured to apply the methods of industrial engineering at the elementary level in the range do not use; we plan to use, use in part or in full. Results were compared from the previous research in 2002 focused on the production company. Great weight is placed mainly on the methods devoted to maintenance and, secondly, Kaizen, it is also essential for several important Czech and Slovak companies. Names improvement approaches are always tailored to the needs of businesses so that they are attractive to employees, and caught the attention they should take it as their own. All these approaches are based on the gradual improvement which always uses the principle of Kaizen.

The following overview:

- Z.U.Z.K.A. - Management ideas IDC
- S.M.E.R. - Management ideas Leona Slowakia
- Pro - management ideas Rautenbach Slowakia
- Louis - management ideas SHP Harmanec
- Zita - management ideas BÖGE Slovakia
- FLASH - ELBA Kremnica
- SUN - Steag Elektronic System Nove Mesto nad Vahom
- Bonatrans system improvement - management ideas Bonatrans [3]

These methods are based on improving the administration of the suggestion directly to workers involved in production. The aim is that individual workers and the process itself participated in improvement. In many situations it is not possible due to the knowledge that the company offers to employees and the powers that do not. The improvement in the workers involved in industrial engineering related industries. This approach does not promote creativity and effort employees make suggestions for improvement.

Not all companies are identical. The companies engaged in chemical production were carried out as part of doctoral studies qualitative research through case studies, which were based on participation and projects. The survey also obtained information regarding the participation of workers in improvement. Access to improving the way through workshops in that society will be described in following section.

1.3 Case study

The company engaged in chemical production professes philosophy, which is an effort at all levels involved in the improvement. Method of involvement depends on the position operator, worker in the process. It is based on continuous recording process status in real time, which is visualized by means of reporting on the status of the process. Here ideas already formed in the case of operational failures, which the workers can move ahead while it is possible suggestions for improvement. Also, if there is a recurrence of activities not entailing excessive value and activity among workers included suggestions for improvement.

The actual improvements are being made on the basis of improvement workshops. There are participates members of production and supervisors who lead it. Record from rationalization workshops is shown in Fig. 3 where the company uses improvement methods using a modified four steps.

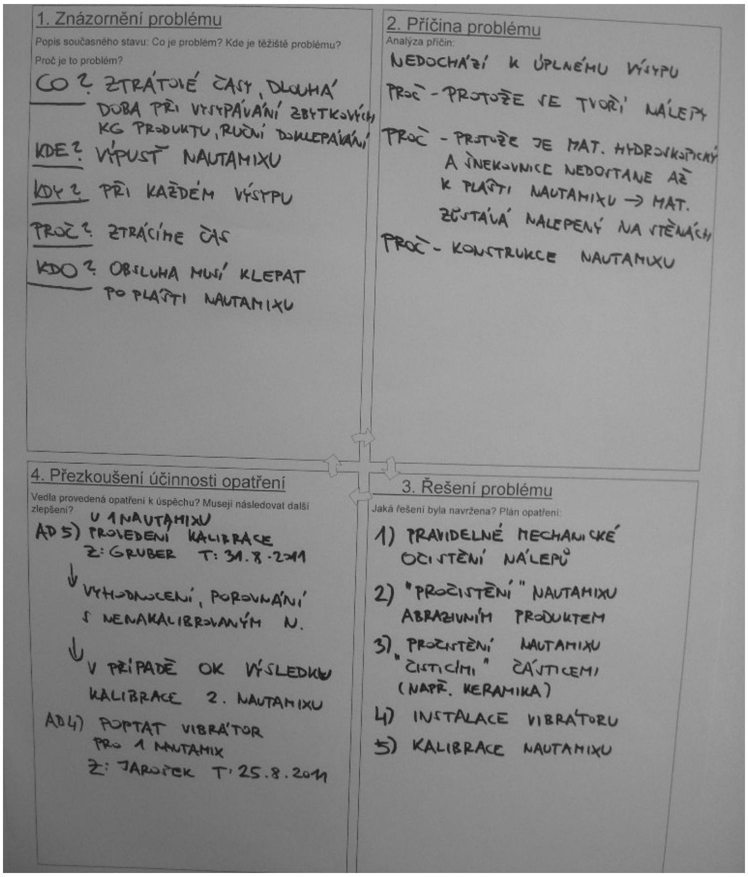

Fig.3. Record 4 steps of rationalization workshops

Introduction precedes of the record, where is recorded the name of the problem, participants and dates. It is not given due to the confidential information.

3. CONCLUSION

The paper deals with the issue of the importance of improvement in manufacturing companies. The importance of applied methods, which are involved in the improvement, the result was supported by research. Attention was focused on the gradual improvement of processes using Kaizen and subsequent development into the needs of companies in the Czech and Slovak Republics. Impact on improving the company has been supported by educational methods and testing them on campus. The article is also an improvement workshops and applications, which is illuminated at the end of the contribution to the case study.

ACKNOWLEDGMENT

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Modelling and simulation, theory of constraints

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ANALYZE OF PRODUCTION PROCESSES AIDED BY THE MODELLING AND SIMULATION TOOLS

Abstract

There is presented the practical application of the modelling and simulation on in analyses of production processes, in the paper. In all enterprises the main problem connected with realization of production ordersisthe constraint existing in every production system. Searching and increasing of the bottleneck (constraint) should be the first step in situation, when exist necessity to increase production. In the paper, there is demonstrated that the computer simulation is very useful aiding tool for finding constraints and facilitating the analysis of proposed changes in production systems.

1. INTRODUCTION

The activities of a company in conditions of a free market economy make managers undertake increasingly complex tasks. The consequence of this is the necessity for the synchronisation of increasing quantities of technological factors. This leads to more effective methods of controlling the production processes. Control of production planning is one of the most important tasks of a company. The target of these activities is to manufacture the products at the planned time. Furthermore, they have to fulfil qualitative requirements, and their manufacturing costs should be as low as possible.

New tendencies within a company's organisational field, which also have an influence on computer systems, have a meaningful influence on the development of production planning and control. Among them, the most important are: Enterprise Resources Planning (MRP/ERP), Just in Time (JIT), Lean Production and Intelligent Manufacturing Systems (IMS). Furthermore, modelling and simulation is a more substantial method to aid production management.

2. MODELLING AND SIMULATION

Several stages of development of the computer simulation method can be distinguished. They are connected with development of programming languages and development of data processing

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techniques. The development of both software and equipment, caused that the method of modelling and computer simulation is more popular.

Presently on the market are available different simulation systems from the simplest, which are created on the basis of mathematical models, to the most complex, with environment for creation ofanimation, 3D graphics, virtual reality and with the possibility for integration with the companyinformation system.

Simulation systems such as ARENA, SIMIO and QUEST offer a comprehensive set of advanced information tools, which are designed to analyse the processes of production enterprises [7]. The range of uses cover the whole manufacturing process, from planning to assembly of final products. This givethe ability for creation of the complete design and analysis of manufacturing processes.

The simulation of production systems becomes the tool, which is used in designing, planning and controlling of production systems. The simulation finds use on all levels of enterprise management. Not only in themanufacturingarea, but also on the lowest level of management, in range of storing, inter-department and workplace transport, through tactical tasks realized on average management level, to strategic tasks realized on the highest level of the management enterprise [3, 4, 5, 6].

Creating of a simulation model consists of selecting and locatingdifferent component elements in the defined space. At the same time with defining of logical connections among the component elements of the modelled system, the main parameters to present the animation and to collect data for statistical analysis are specified. Defined parameters of the graphic model can be edited and modified if necessary.Creating of a model is only a part of the simulation project. Each project begins with defining the problem and collecting data suitable for execution a representative simulation – figure1.

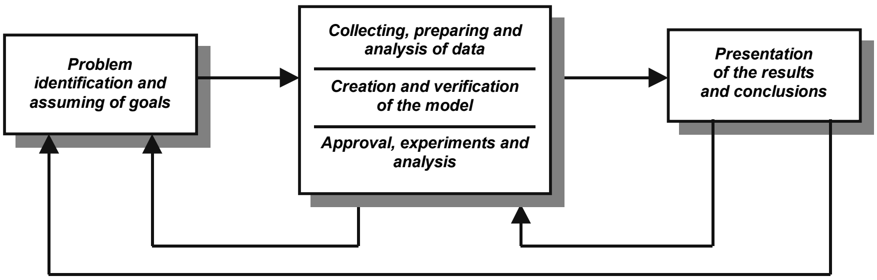

Fig.1. Stages of the simulation project

The model of manufacturing process can be considered as the system consisting from inputs, outputs and realized processes. The inputs are mainly raw materials and on other side the outputs are final products. The manufacturing process is the series of following operations, for which the exit of previous operation is the piece of entry next. The input material possesses already imposedqualitative characteristics from previous operation, which have on realization of analysed operation essential influence.

After that, when the model is ready, it should be verified, whether it works correctly and then the output data, which areobtained from simulation should be analysed.Through the analysis of these data, critical areas of the modelled system can be determined. We can also drawn out main conclusions and required modifications of the system, which are necessary for efficient realization of thedefined goals.

3. THEORY OF CONSTRAINTS (TOC)

The Theory of Constrains (TOC) is the philosophy of management, which directs the main attention on a bottle-neck of productionsystem, that is the part, which decides about efficiency of the whole system. Improvement of the bottleneck gives the largest progress in process of company development[1, 2, 8].

According to Theory of Constraints every activity in each part of organization has to be estimated from the point of view of their influence on the whole organization. All organizationshas to be treated as the system of joined processes– chains of activities [2]. All systems have“the weak link”, which is the constraint and which determines the efficiency of the whole organization. Strengthening of other links, beyond the weakest, will not strengthen the chain of processes.

The modelling and simulation method is the perfect tool, which enables finding of this weak link [5]. It meansthe workplace, which is maximally loaded and before which comes into being the largest queue of pieces waiting on processing. The bottleneck of a production system is possible to find throughanalysing information included in the report from simulation, and also through observation of animation from computer simulation.With the help of simulation it is possible to realize next activities leading tothe system improvement and connected with the theory of constraints – checkingpossibilities of the bottleneck from the point of view of maximum utilization, checking possibilities for his strengthening, adaptation of the supply and manufacturing schedule to the possibilities of the bottleneck.

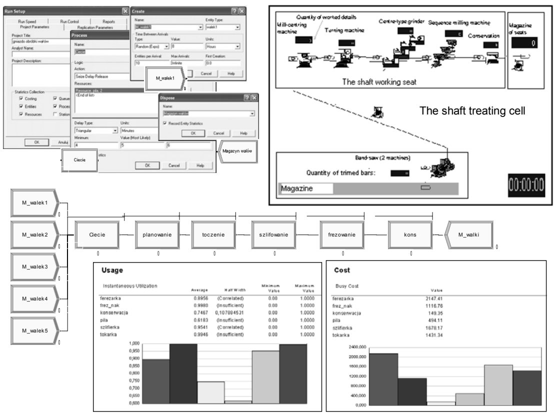

Fig.2. Simulation model and results from simulation

4. PRACTICAL EXAMPLE

The example ofproduction process of machine elements, simulation model and results from simulation are presented above on the figure 2.The aim of this study was to test different possibilities for improvement of the present system.

After preliminary analysis of the whole productionprocess it turned out, that the presented above manufacturing process is the constraint of the whole system. This process is the main process in the analysed firm, and one workplace (turning machine or mill-centring machine) in this cellisthe bottleneck of the whole production system. Therefore, there was executed more detailed analysis of this cell using the modelling and simulationmethod.

From simulation of monthly production there were got information about duty of workplaces, size of queues before workplaces and the time of realization of planned production. It made possible identifying of the bottle-neck.The bottleneck of the analysed working cell is the milling-centring machine characterizing by the largest duty and the largest number of waiting pieces in the queue. According to the theory of constraints this workplace should be better organized and modernized. The proposed improvement allowed to achieveshorter process time about 10%.

With help of computer simulation we can realize other analyses connected for example with costs. In the ARENA software package we can define the direct material cost,activity cost, machine-hour cost and waiting cost. After conducted simulation in the final report we will find different compositions of costs– forindividual workplacesand entities.

CONCLUSIONS

All improvements of the bottleneck give the advantage for the enterprise. Projects of improvements we should not realize “once on some time”, but they should be the basis of the continuous improvement of the production system. All enterprisesshould realize the improving projects, if they want to stay on competitive market. In this paper was presented only one example of simulation. In practice,in such analyses there are more variants.They are more detailed and they take into account more aspects of the analysed production systems.

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Tecnomatix, robotics, simulation

Patrik POLÁŠEK*

THE USE OF TECNOMATIX SOFTWARE IN THE DESIGN OF ROBOTIC WELDING WORKPLACE

Abstract

This paper describes use of Tecnomatix software in designing robotic welding workplace. It focuses on the description of basic parts of this software such as designing layout of the workplace, creating individual processes and operations. Includes description of basic tools like detecting collisions tool or tool for determining the range of robot.

1. INTRODUCTION

The use of robots and robotic cells, as well as the development of most of the machinery branch, has greatly contributed, especially in the past, the automotive industry. Originally, the robots was used only for handling, but later expanded their use for welding, painting and various other tasks. The largest use of welding robots is still in the automotive industry, but we meet them in other engineering branches. Robots working without fatigue 24 hours a day, seven days a week, without however losing their job performance. They offer a high level of productivity and assist in achieving excellence. Industrial robots can thus significantly reduce production costs, improve quality and shorten time of release new products to market.

Tecnomatix software from Siemens company is a complete digital production solution that helps companies to quickly identify the best strategy to increase productivity and reduce costs.

Tecnomatix software enables manufacturers to develop, simulate and commission robotic and automated manufacturing systems, including highly automated equipment. With this tool we can in a virtual environment planning and validating production systems from single cells to complete production lines and systems. Robotic programming and simulation in software Tecnomatix minimizes risk and improves the quality of the process. Tecnomatix enables off-line robotic programming, so at the customer, so it is not necessary to workers spend long time at the customer.

Siuda Company estimates that improved productivity, which enabled the Tecnomatix software, increase the profitability of each project by 30 percent due to elimination of inaccurate downtime and installation costs for remediation.

Due tools for detecting collisions Siuda company eliminated more than 90 percent of the situations in which previously observed discrepancies.

In this article I will describe the use of Tecnomatix software, or Tecnomatix Process Designer and Process Simulate for design of robotic welding workplace.

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2. DESCRIPTION OF THE ROBOTIC WORKPLACE

This workplace is for spot welding two metal parts. These two metal parts are inserted by worker from prepared boxes to welding jig, which is mounted on a turntable. After both parts are inserted into welding jig, beginning automated welding process. It consists of closing the welding clamps, turn table to welding robot and welding two metal parts. Welding robot is equipped with welding tongs for spot welding. Automated process is started by worker on the control panel. During welding first batch, worker inserting an additional batch to the welding jig. After welding, the table turns, robot starts welding a new batch and the finished weldment worker inserted into the box ready for the finished workpieces. The entire welding process is performed by welding aggregator.

For welding are use most standard six axis manipulators – robots. With its concept are ables to move deftly enough and can weld very exactly.

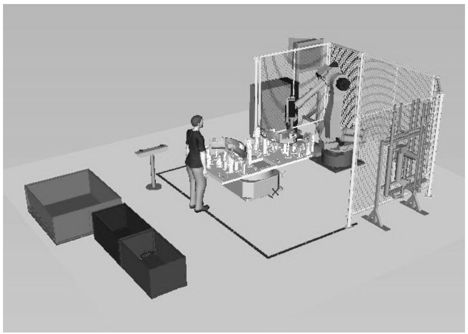

Fig.1. Welding workplace

3. SETTING RESOURCES, PROCESSES AND PRODUCTS IN TECNOMATIX PROCESS DESIGNER

Workplace preparation is done in Tecnomatix Process Designer module, where by drawings documentation will created exact layout of welding workplace. Sets here the individual resources, products and processes. Individual models can be created in any modeling software and then are converted into a standardized format that uses Tecnomatix software. It is also possible create individuals models in the Tecnomatix software. Welding robot model and welding gun model can be accessed directly from the manufacturer of the type of robot or guns. These models are supplied already with their kinematics. Model of worker is part of the Tecnomatix software, which includes many features from gender to height or weight.

After creating all necessary resources and create layout workplace, must be create processes of individuals operations, which will be done on welding workplace. The last thing is define products, that is what will be produced in the workplace, in our case are these two metal parts, which are welded together by spot welding.

4. CREATION OF INDIVIDUALS OPERATIONS, VERIFICATION AND SIMULATION IN TECNOMATIX PROCESS SIMULATE

In Tecnomatix Process Simulate modul attend to motion whole system – simulation. Welding jig and welding gun were delivered without their kinematics. It is necessary adjust their kinematics directly in Tecnomatix. Kinematics includes features such as acceleration or velocity of the model, or set upper and lower limits of motion.

It is also necessary to define welding jig as a gripper tool. So that the welding jig really caught product (metal part).

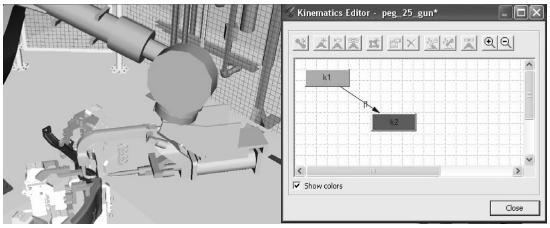

Fig.2. Gun kinematics

Before welding start, it must be define the welding points. These welding points are supplied directly from designers and imported into the environment or must be define manually in Tecnomatix software. These welding points must be projecting after their creation. This means that determines which parts of metal plates are welded together. After projecting welding points can be set their orientation according to how we want to welding tongs welding.

Tecnomatic software includes functions for detecting collisions. Functions for detection collision enables define and detect collisions, identify their causes and enables their elimination. In this case was defined welding gun welding jig, turntable and the product itself.

After start simulation we can see where are collisions and then adjust robot motion so that to avoid them in the future.

Tecnomatix software also includes function reach test. This function enables testing the reach of robot, rather welding gun to welding points. Each robot has different kinematice, other dimensions and properties and we can use this tool to optimize layout of workplace.

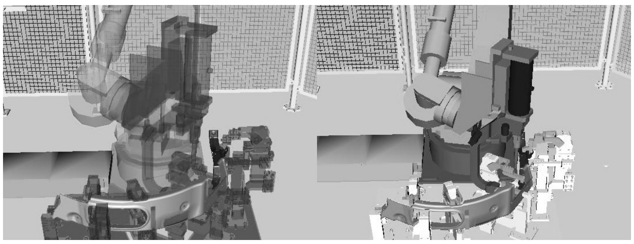

Fig.3. Detecting collisions

The motion of robot is defined by joints. The robot motion is adjusted gradually to the point of welding place, where welding operation is adjusted and Tecnomatix software alone done welding operation. In welding operation can be set welding angle of welding gun. This is prevent to avoid collisions during welding. These properties can be defined for al welding points by duplication.

The last part is the union of all processes together using sequence editor. This will create a complete simulation of welding workplace.

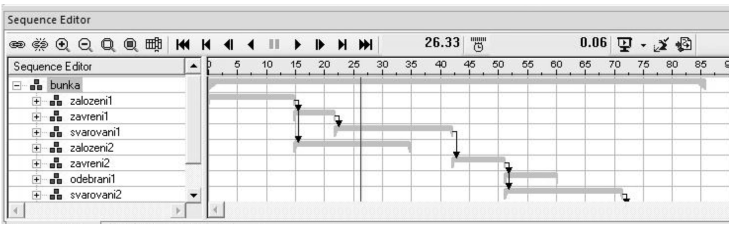

Fig.4. Sequence editor

5. CONCLUSION

In today's globalized era, Ahead of the competition means a distinct advantage in the market in today's globalized era. Every investment should be very well considered. The biggest advantage of the Digital Factory is that everything happens in the virtual world.

With functions and tools of Tecnomatix software, we can designed in a very short time the best solution for our workplace. Optimize and improve some problematic part sis less time consuming. Tecnomatix software allows us to cover many of required functions in one environment.

ACKNOWLEDGMENT

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Facility management, building, administration

Peter POÓR[*], Nikol KUCHTOVÁ[**]

FACILITY MANAGEMENT - METHOD FOR EFFICIENT BUILDING ADMINISTRATION

Abstract

Presented article deals with methods for efficient building administration and management – Facility Management (FM). In first part. Facility management and building administration are theoretically defined and clarified. A practical example of building (warehouse hall) is presented. In next part a CAFM (computer aided facility management) software ProFM and its application in Facility management is presented.

1. INTRODUCTION

Facility Management is developing in various European countries. Driven by certain historical and cultural circumstances, organisations and business areas have built different understandings and approaches. In general, all organisations, whether public or private, use buildings, assets and services (facility services) to support their primary activities. By coordinating these assets and services, using management skills and handling many changes in the organisation's environment, Facility Management influences its ability to act proactively and meet all its requirements. This is also done to optimize the costs and performance of assets and services.

The main benefits of Facility Management approaches in organisations are:

- Clear and transparent communication between the demand side and the supply side by dedicating persons as single points of contact for all services, which are defined in a Facility Management agreement.
- Most effective use of synergies amongst different services, which will help to improve performance and reduce costs of an organisation.
- Simple and manageable concept of internal and external responsibilities for services, based on strategic decisions, which leads to systematic insourcing or outsourcing procedures.
- Reduction of conflicts between internal and external service providers.
- Integration and coordination of all required support services.
- Transparent knowledge and information on service levels and costs, which can be clearly communicated to the end users.

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- Improvement of an organisation sustainability by implementing a life cycle analysis for the facilities.[1]

Building administration (BA) is according to [2] an interaction of all economical outputs of building operation, including construction and technical equipment on basis of common strategy. This is related to infrastructure and business activities and performances. Building administration is focused on strategic concept, organization and control to integral objective when optimizing individual performance. We are talking about several parts of building administration:

- Technical BA according to DIN 32736 includes all services that are needed to qualitative secure building. This represents, operating, maintaining, documenting, energy and information management, modernizing, checking and revision. Furthermore, ensuring maintenance of building and its reconstruction, monitoring of technical parameters and performance.
- Infrastructural BA assures in accordance with DIN 32736 performances of supporting components such as security and care services, computer services, mail, copy, concierge services, gardening, parking and cleaning, security, migration, logistics, winter maintenance, communications, security, supply and removal of all necessary media,
- Trading BA provides all services related to business with preceding paragraphs of BA with an emphasis on economy,
- Surface BA ensures area optimizing with regard to their use and evaluation. Its services are cross-cutting for all of above BA and have large impact on overall operating costs. In this section, all details of the building, rooms, etc., such as numbering rooms, method of use, equipment (such as flooring, lighting, connectors, signaling, etc.) and then cost places, allocation of personnel, etc. are used.

Practical example of building (warehouse hall) information is shown in table 1.

Tab. 1. Building information

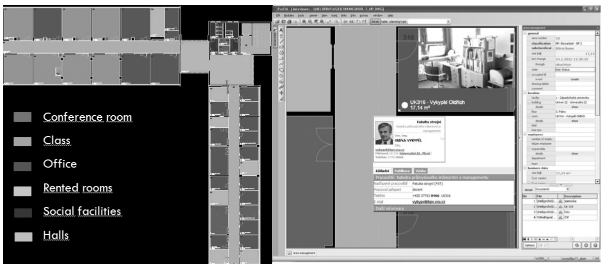
Označení – název	Warehouse hall
FM inventory number	08123
Classification	34
SAP number	08123/034
Actual use	Height rack
Earlier use	Production hall
Built	1988
Put into use	1/1/1999
Street and number	Am Brandrein 2
ZIP and place	06110 Halle
Cost place	1112
Cost carrier	
Owner	Hageth GmbH
Changes	Widdow table change – 10/9/2002
Plan lenght	35,5 m
Plan widht	23,4 m
Building height	15 m

Height to drainpipe	15 m
Area	830,7 m2
Utility area	570 m2
Roof area	860 m2
Number of fire compartements	23
Floor numbers	2
Gross capacity	12460 m3
Fire insurance value	€
Floor load	123 N/m2
Maximal traffic load	kN/m2
Cellar	Fully
Roof construction	Flat roof

2. COMPUTER AIDED FACILITY MANAGEMENT - PROFM

CAFM (Computer Aided Facility Management) Systems as well as other IT systems are deployed primarily for decision support, planning and control – for control, in this case facility management. Computer-Aided Facility Management (CAFM) is the support of facility management by information technology. The supply of information about the facilities is the center of attention. The tools of the CAFM are called CAFM software, CAFM applications or CAFM systems.

Computer-aided facility management (CAFM) is software system for management of support processes based on graphical representation of management area (CAD), endowed with strong database support information. The aim of CAFM system use is to streamline support operations, exactly address cost items and create an information base for quick decision-making management.



Picture 1: Graphic representation of ProFM software

In January 2012 at the Department of Industrial Engineering and Management at University of West Bohemia in Pilsen was launched a pilot project and installed facility management software ProFM®. ProFM® is an advanced software for facility management developed by German company Projecteam AG. ProFM® is user friendly, graphically oriented CAFM system integrating AutoCAD with direct connection to Oracle database. Modular software design offers great flexibility and can be used for all types of business. ProFM® includes all the technical, business processes and infrastructure, and is composed of 19 different modules that manage different areas of FM and are interrelated.

In pilot project we filled every room in department of Industrial Engineering and Management with these data: Inventory, Personnel, Size, Type /class, office, room…/, Number of employees, Keys, Documents (CV, Photo, Door photo, Office photo). Grapical representation of software in shown on picture 1.

3. CONCLUSION

During Pilot project we implemented and introduced practical use of ProFM software. As pilot facility we used floor, where is situated Faculty of Industrial Engineering of University of West Bohemia. Modules used were: Room management, Area management, Inventory, Personnel, Keys, Safety… and others. We also did a 3D visualisation of whole floor in software VisTable, which is shown on picture 2.

Picture 2: VisTable 3D visualization

In conclusion, we would like to express thanks for the support of the projects CZ.1.07/2.3.00/09.0163 titled " Kvalitní výzkumný tým zaměřený na problematiku řízení životního cyklu výrobku v prostředí digitálního podniku" dealt with in the Operational Programme Education for Competitivenes and SGS-2012-063 titled "Integrovaný návrh výrobního systému jako metaproduktu s multidisciplinárním přístupem a využitím prvků virtuální realit" dealt with in Internal grant agency of University of West Bohemia.

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Ergonomics, detailed ergonomic design of workplaces (DEDW), software support

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SELECTING SOFTWARE PRODUCT AS A SUPPORT TOOL ERGONOMICS

Abstract

Research in detailed ergonomic design of workplaces, (DEDW),I was dealing with the selection of a suitable software product for ergonomics. Such software products, to facilitate detailed planning, more transparent and efficient. Most these software products will provide assistance in the evaluation of space requirements and collision situations, evaluation of physical activity, time and motion study, possibility to create animations and the like, which are actually different groups of features that should the software product as a tool to support modern ergonomics contain.

1. ALGORITHM FOR SELECTON OF THE SOFTWARE

The first step of the present algorithm is analysis of available software. Following detailed analysis of data on the software's, so we get a database of collected data about software model is shown in fig.1 on the left.The second step is to establish selection criteria for decision-makers, and decision-maker is a company or individual, who wishes to appropriate software for DEDW. This database is obtained by setting the selection criteria, is shown in Fig.1.on the right.

Name of software	Possibility of simulation	Analysis of manipulation	Collision detection	Fatigue analysis	...
Delmia DPE	N	Y	N		
Delmia V5 Human	Y	Y	Y		
TX – Jack	Y	Y	Y		
eM-Human	Y	Y	Y		
TiCon	N	N	N		
EnvisionErgo	Y	Y	Y		
...	...	...	...		

GENERAL CONDITIONS OF INPUT		
1	Creator of software.	
2	Software distributor.	
3	Requirements for the PC:	Operating system.
4		The required RAM.
5		The requiered disk space.
...	...	
SPECIFIC REQUIREMENTS FOR DEDW		
17	The ability to insert DHM.	
18	The possibility of animation/simulation.	
19	Evaluation of manipulation space arm.	
...	...	

Fig.1. Preview the final analysis of the available processing software and the criteria for selection of suitable software tool ergonomics

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If you don´t meet the established criteria and decision-maker their wants before the main part of the algorithm, Fig.2.adjust, they may be amended or its selection of current needs.

Once sufficient information, followed by the main part and that is the comparison criteria using SAATY matrix.

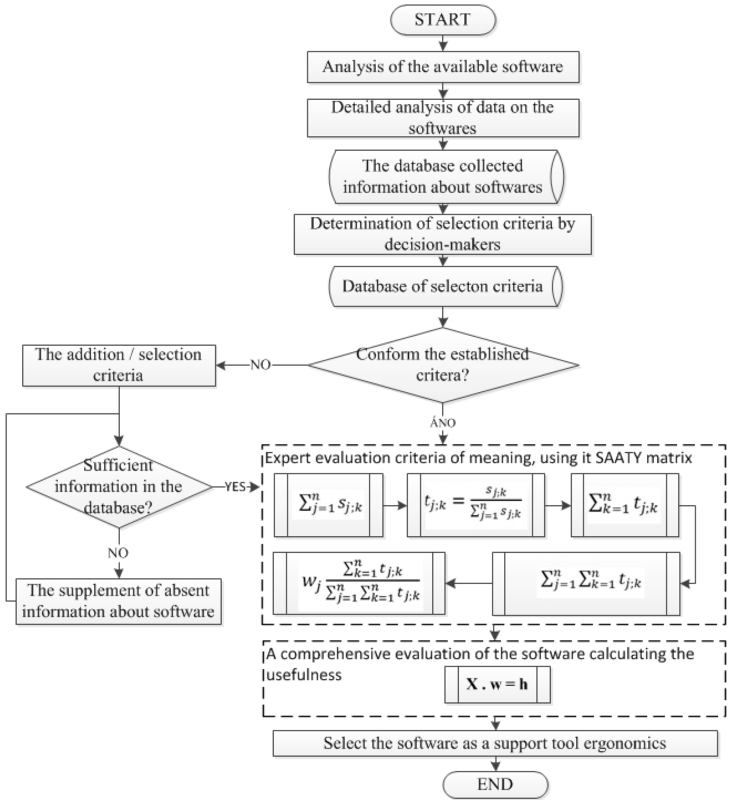


Fig. 2.The algorithm for selecting the software tools of modern ergonomics. (source: author)

1.1 Expert evaluation criteria using the meaningsSAATY matrix.

SAATYmatrixis fully quantified pairwise comparisons. It is based on an expert assessment of relative importance to the comparison of pairs of times the first element in the pair as the second major element. To the square matrix, Fig.3.is recorded in the appropriate boxes expert statements either in whole numbers „v_{ij}" is the appropriate number of times the i-thindicator greater than the j-th. (DOSTÁL, 2009)

The first step of the solution was to build the ranking of criteria, I used paired comparison. The assembled table, I identified individual lines and columnsas characteristics of the evaluated parameters, and I mutually compared according to their importance in DEDW. Based on this method of comparing each pair of variables, I got the resultant crude ranking criteria. Then I checked the order. The solution I have used 5-point calculation procedure by SAATY matrix, with the final calculation formulas for calculation of quantified values of the relative importance of criteria for normalization of line sum.

1. Calculate the totals for all **n** elements $s_{j;k}$ for each **k**-th column of matrix:

$$\sum_{j=1}^{n} s_{j;k} \tag{1}$$

2. These accounts are separated with individual elements of each column. This is calculated by the elements $t_{j;k}$ a new matrix **T:**

$$t_{j;k} = \frac{s_{j;k}}{\sum_{j=1}^{n} s_{j;k}} \tag{2}$$

3. In this calculated matrix **T** is calculated totals for all **n** elements $t_{j;k}$ for each **j**-th line of matrix:

$$\sum_{k=1}^{n} t_{j;k} \tag{3}$$

4. Line totals in the matrix **T** are added together:

$$\sum_{j=1}^{n} \sum_{k=1}^{n} t_{j;k} \tag{4}$$

5. Quantified values relative importance of indicators **„w_j“** is then calculated by normalization of line totals:

$$w_j \frac{\sum_{k=1}^{n} t_{j;k}}{\sum_{j=1}^{n} \sum_{k=1}^{n} t_{j;k}} \tag{5}$$

Variable	1	2	...	j	...	k	...	n
1	1	$s_{1;2}$	...	$s_{1;j}$	...	$\frac{1}{s_{1;k}}$	...	$s_{1;n}$
2	$\frac{1}{s_{2;1}}$	1	...	$\frac{1}{s_{2;j}}$	...	$s_{2;k}$	...	$s_{2;n}$
⋮	⋮	⋮	1	⋮	⋮	⋮	⋮	⋮
j	$\frac{1}{s_{j;1}}$	$s_{j;2}$	...	1	...	$\frac{1}{s_{j;k}}$	...	$s_{j;n}$
⋮	⋮	⋮	⋮	⋮	1	⋮	⋮	⋮
k	$s_{k;1}$	$\frac{1}{s_{k;2}}$	⋮	$s_{k;j}$	⋮	1	⋮	$s_{k;n}$
⋮	⋮	⋮	⋮	⋮	⋮	⋮	1	⋮
n	$\frac{1}{s_{n;1}}$	$\frac{1}{s_{n;2}}$	...	$\frac{1}{s_{n;j}}$	...	$\frac{1}{s_{n;k}}$	...	1

Fig.3.The general form of SAATY matrix (Dostál, V. 2009)

1.2 A comprehensive evaluation of the software calculating the usefulness

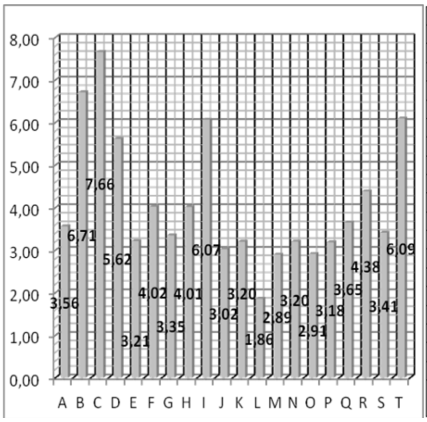
The calculation is based on the logic of the evaluation method of multicriteria evaluation of alternatives. After obtaining the weights of criteria **„w“** using SAATY matrix and obtaining the partial evaluation points variations **„x“** (inscribed on matrix) is obtained by weighted utility **„h“** for each variant of software. This level of utility obtained by multiplying together (6):

The usefulness of each variant of software, „h“.I got to use the product weights of criteria „w_j“ using itSAATY matrix and evaluation criteria, sub-point software „$x_{i;j}$“.

$$\mathbf{X} \cdot \mathbf{w} = \mathbf{h} \tag{6}$$

1.3 Selection of a suitable software product as a support tool ergonomics

Based on the ordinal scale is set to any software, the rating assigned depending on which level meets the criteria for evaluating software.Sub-score variants of „$x_{i;j}$“ based on the above scale are written in a matrix „X“. The graphical comparison, Fig.4.say that the software that best meets is TX Jack and leas compliant software is MVTA.Expert assessment, I realized how ergonomic user software.I proceeded on my previous knowledge and experience with software products and ergonomics at the same time in accordance with the needs of today´s modern ergonomic design detailed to address in our individual workstations.



SIGN	SOFTWARE
A	Delmia – DPE
B	Delmia – V5 Human
C	TX Jack
D	eM-Human
E	TiCon
F	EnvisionErgo
G	MASSoft
H	ErgoMAS
I	RAMSIS
J	3D SSPP
K	HumanCAD
L	MVTA
M	Anthropos ErgoMAX
N	ErgoEASE
O	SAMMIE
P	Ergointelligence
Q	BHMS
R	MANECROS
S	ErgoFellow
T	TX Process Designer & Process Simulate

Fig.4. Final evaluation of software with software named.

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Ergonomics, method, working conditions, productivity of work

Martina SMUTNÁ*, EvaSLAMKOVÁ**

METHODOLOGY TO IMPROVE WORKING CONDITIONS OPERATORS IN ORDER INCREASING PRODUCTIVITY OF WORK

Abstract

It´s now a growing demand for ergonomic solutions in the industry, although so far mostly by foreign industrial firms in Slovakia. These companies try to improve working conditions and the operator to maintain the safety of their workers and their health. On the Department of Industrial Engineering was created in ergonomics research and practice requirements, methods to improve operator working conditions. This methodology has been validated in three industrial companies.

1. METHODOLOGY TO IMPROVE WORKING CONDITIONS

The proposed methodology consists of a set of steps which are written in the form process flow diagram.A framework approach is developed for two alternatives.The first is that a workplace exists, so it is reactive ergonomics. The second alternative is that the workplace is in draft stage, designed according to the requirements of the project sponsor and all the principles of design and ergonomics. In this case it is the proactive ergonomics. The stages are prepared in the algorithms. The most important is just the sixth stage of the algorithm. The basic methodology followed by the presentation of content items in various stages:

1. stage – Collection of data input and verification.
2. stage – Processing of the data.
3. stage – Detailed assessment of the spatial conditions and physical load.
4. stage - Detailed assessment of the work environment.
5. stage - Draft of corrective actions.
6. stage – Evaluation of performance options and productivity of work (p_p).

1.1 Evaluation of performance options and productivity of work.

The input into this stage.Fig.1.is already created 3D animation model of the operator, Fig.2. At the same time entering stereoscopic video, which allow to monitor the movements of economics, if the animation model is detailed and 100% accurate in therms of movements and his times.

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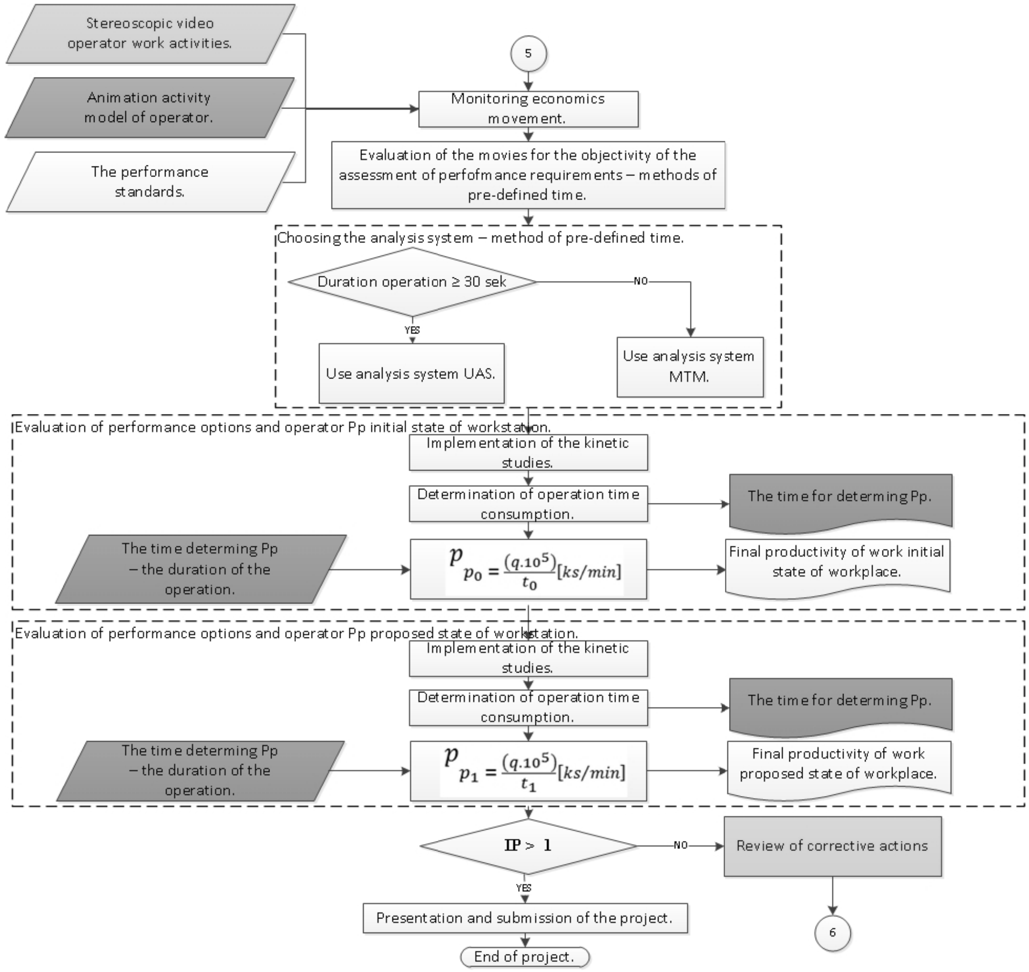

Fig.1. Algorithm performance evaluation assessment of possible the operator andp_p

By tracking of movements economics, understand and describe the analysis of individual movements. As input the process at this stage can also serve as performance standards of the company, for comparison with the real situation.Then selects the appropriate system – a method of pre-defined times. Currently the most commonly used are MTM and UAS. Because the experience is a method for MTM operation lasting more than 30 seconds is difficult to use, was at this period of work designed system UAS.Following assessment of the operator performance options and $p_p$initial state and then proposed state.The resulting value of the$p_p$we obtained by the time interval duration of the operation of the methods implemented. Since the obtained time value is the time unitTMU, it´s necessary to calculate the time on the clock as the input for the expression of$p_p$is the time in hours. The necessary convention: 1 TMU→ 0,036 second→ 0,0006 minute→ 0,00001 hours→ $1/10^5$hours.

A formulla(1) is used to express the current state ofp_p, in which the expression ratio of the quantity produced and the duration of the conversion with the addition of TMUin hours:

$$p_{p_0} = \frac{(q.10^5)}{t_0} [pcs/hour] \tag{1}$$

Under evaluation for p_p state department used a similar formula (2), while there is a change index from 0 na 1, since it is a proposed condition.

$$p_{p_1} = \frac{(q.10^5)}{t_1} [pcs/hour] \tag{2}$$

p_{p_0} – productivity of work base period – the initial state[pcs/hour],
p_{p_1} – new productivity of work – current status implementation in VR [pcs/hour],
q -quantity of the product –it is assumed constant 1piece[ks],
10^5– constant value required for the conversion of the TMUto hours [/],
t_0 - output time value base of operator actions MTMorUAS [TMU],
t_1 - output time value from the operator´s activities MTM orUAS [TMU],
I_{P_p} – Index productivity of work.

Finally, it is necessary to quantify the development of p_p (3), to enable the project team in the output report for the project sponsor to make changes in size, which reflects the rights to this indicator.For the verification of design between the current and desired state can use the index of productivity of work.

$$I_{P_p} = \frac{p_{p_1}}{p_{p_0}} \tag{3}$$

In this methodology is evaluated in detail a workplace. If we want to evaluate the p_p for several workplaces, we can use the Laspeyres index p_p (4). The calculation applied to considering the issue of „n“ as assessed by the number of workplaces.

$$I_{P_p} = \frac{\sum_{i=1}^{n} t_{i_0}.q}{\sum_{i=1}^{n} t_{i_1}.q} \tag{4}$$

1.2 Verification stage of evaluation of performance options in practise

Using 3D animation models and performance standards of X was carried out this phase of the project. Supported videos have studied economics of movements.After evaluation of the movies it was selected time study UAS.

The requested output times were necessary to carry out assembly operations at individual workplaces. CompanyXhas determined consumption time the operator, which was for the final verification of the presented methodology necessary time value. For the demonstration is below the conversion work for AG07, Fig.2.company X.

The resulting p_p originalstate of workplace was compared with a possible p_p as a result of temporal analysis of UAS.Index p_p increased, due to the spatial arrangement of the workplace and improve working conditionsin the workplace in the previous stages.

$$p_{p_0} = \frac{(q.10^5)}{t_0} = \frac{(1.10^5)}{757} = 132{,}1\ [pcs/hour]$$

$$p_{p_1} = \frac{(q.10^5)}{t_1} = \frac{(1.10^5)}{634} = 157{,}7\ [pcs/hour]$$

$$I_{P_p} = \frac{p_{p_0}}{p_{p_1}} = \frac{157{,}7}{132{,}1} = 1{,}19 > 1 \quad (5)$$

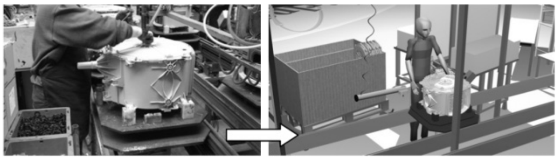

Fig.2. Workplce X of the real state versus 3D model after ergonomic assessment

Furthermore, the calculation of the index$p_p$byLaspeyresanalyzed for all departments of X, n=15 Values$t_i$are in TMU, because after substituting constant values needed for the conversion of the TMUhours 10^5 will not be affected by the resultingI_{Pp}.

$$I_{P_p} = \frac{\sum_{i=1}^{n} t_{i_o} \cdot q}{\sum_{i=1}^{n} t_{i_1} \cdot q}$$

$$I_{P_p} = \frac{[(803{,}33) + (590) + (783{,}33) + (791{,}11) + (756{,}67) + (916{,}67) + (842{,}22) +}{[(650) + (505) + (679{,}44) + (664{,}44) + (634{,}44) + (681{,}11) + (657{,}22) +}$$

$$\frac{+(712{,}22) + (931{,}94) + (940) + (1115) + (1100) + (776{,}11) + (861{,}67) + (920{,}83)].1}{+(582{,}22) + (635{,}56) + (710) + (711{,}67) + (710) + (656{,}11) + (671{,}67) + (675{,}83)].1}$$

$$I_{P_p} = \frac{12841}{9824{,}72} = 1{,}3 > 1 (6)$$

CONCLUSION

Using the methodology of modern methods can be improved ergonomics ergonomics workplace and thereby increase productivity of the work in the workplace. They are used in the selected high-quality ergonomic evaluation methods so that the resultant effect of improving working conditions with regard to worker health and increase the productivity of the worker.

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SupplierRelationship Management, Purchasing process, E-sourcing, E-purchasing

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TRENDS IN PURCHASING PROCESS COST REDUCTION

Abstract

The paper introduces and discusses modern concept of purchasing process and supplier relationship management in an industrial company.The goal is to provide readers with standard mechanism of purchasing processes and introduction of new trends and mechanism in supply chain management related to supplier's relationship.

1. INTRUDUCTION

The modern economical environment is gaining far reaching complexity and competition. Companies of all sectors are facing continues changes in the market forces due to the liberalization of trade and the impact of new communication means, improved logistical services and electronic banking systems and other factors, that havelead to a clear increase in global competition[2]. This new economical environment and the globalization process are changing competition behavior across industries. These changes are leading to revolution in business strategy and its main processes.

Organizations have to re-think their way of doing business, based solely on their internal resources toward a more dynamic strategy, benefiting from their internal improved processes, closer communication with business partners and reasonable use of modern digital technologies to overcome mentioned challenges.

The modern information technology is making traditional borders obsolete. There is no longer possible to compete as an entity without further information and access to global supply chain network. Information has become the most valuable asset for a company which needs to be managed and shared with stakeholders. Applications of modern information technologies and electronic networks have become an important tool in managing procurement and purchasing process within acompany[1].

2. STANDARD PURCHASING

Purchasing is the act of buying the goods and services that a company needs to operate and/or manufacture products. Given that the purchasing department of an average company spends an estimated 50 to 70 percent of every revenue euro on items ranging from raw materials to services [2], there has been greater focus on purchasing in recent years as firms look at ways to lower their operating costs. Purchasing is now seen as more of a strategic

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function that can be used to control bottom-line costs. Companies are also seeking to improve purchasing processes as means of improving customer satisfaction.

The traditional purchasing process involved several steps—requisition, soliciting bids, purchase order, shipping advice, invoice, and payment—that have come to be increasingly regarded as unacceptably slow, expensive, and labor intensive. Each transaction generated its own paper trail, and the same process had to be followed whether the item being purchased was a computer or a new component. In this traditional model, purchasing was seen as essentially a clerical function. It was focused on getting the right quantity and quality of goods to the right place at the right time at decent costs. The typical buyer was a strong negotiator whose primary responsibility was to obtain the best possible price from suppliers and ensure that minimum quality standards were met. Instead of using one supplier, the purchaser would usually take a divide-and-conquer approach to purchasing—buying small amounts from many suppliers and playing one against the other to gain price concessions. Purchasing simply was not considered to be a high-profile or career fast-track position.

The standard type of purchasing process is considered to be cost demanding because of process and administration costs. The main issue is estimation of cost of purchasing process itself. Without knowing the costs of purchasing of a company we could say that the main cost related activity is time spent on evaluation and creation of a purchasing order. These are several non value-added activities in this process that canbeeliminated by implementing new options and ways of purchasing mentioned in next chapter.

3. NEW TRENDS IN PURCHASING PROCESS

New trend in purchasing process is more or less oriented on supplier relationship management (SRM) being a part of supply chain management which deals with all aspects of the business relationship between a company and its suppliers. On the other side it describes the business structure and processes required by companies to communicate with their suppliers, while providing methods, processes, tools to support the different phase of direct supplier relationship [2].

3.1. E- Sourcing

Sourcing activities take place at the beginning of purchasing process. It has the main focus on negotiation process of direct goods and raw materials and it is critical element of strategic purchasing. At this stage supplier strategy and its execution should be defined. The main goal of these systems is to support buyers to find the most appropriate suppliers. Foreground is negotiation phase of procurement process in which buyers search for the most efficient product source for a company based on price and other established criteria.

Electronic auctions and electronic request for quotation (RFQ) are two most known negotiation forms applied and are often used in practice as a synonym of the term. Auction is a form of a bid to establish selling price thru a transparent process. At the beginning, e-action process focused exclusively on price negotiation ignoring other relevant negotiation factors such as quantity, quality, delivery time and conditions. Nowadays, new generation of action system based on business intelligence technology allows user negotiation of multiple criteria during the online action and continues control of supplier performance. The RFQ process is very similar to action process. The main difference between RFQs and actions is in the lack of standardization in term of explicit, formal rules and regulations in RFQs[2]..

3.2. E- Procurement

The definition of e-procurement is not that clear, but following the literature, the general definition described e-procurement as technology which allows the purchase of suppliers using the Internet. The wider perspective is to specify e-procurement as a software solution that enables organizations to purchase indirect and some direct goods online automates buying processes and centralized all spending data. The technology has progressed from enabling simple transactions to cover broader categories such as services procurement, invoicing, reconciliationand settlement. The main focus of e-procurement solutions is on reduction of purchasing department's administrative costs by electronic support and automation of operative purchasing processes which represent around 5% of purchasing volume, but generates up to 80% of total purchasing costs of a company, 60% of orders and 70% of suppliers[3].
E-procurement system enables companies to change their traditional centralized structures to a more decentralized one, allowing employees to realize their requisitions directly from their workplaces applying web applications, where companies could established specific rights and budgets to their internal customers to place orders, their supervisors to authorize the requisition, warehouse to acknowledge delivery and finance department to emit and pay invoices. The core component of this purchasing system is to create a catalogue engine for searching and selecting goods online, in case of organization applies a multi supplier catalogue approach.

3.3. Supplier enablement

Most of the key business players realized that their success in e-business activities depends on their business process synchronization with their trade partners, by connecting their organizations directly or indirectly with the back and frond end systems of both organizations using appropriate channel to exchange commercial and marketing information. Supplier enablement is the channel that enterprises use to integrate with their business partners and realize e-sourcing and e-procurement activities. The two main forms of supplier enablement are thru application of supplier portals and e-marketplaces [2].

A company portal is mainly a web based application that makes available personalized content as well as the rights to operate specific collaboration process among several companies. In case of supplier portals, they create the basis to connect suppliers with their buyers, with focus on purchasing process and the exchange of transactions data. E –marketplace could be described as a virtual online market where buyers, suppliers, distributors and sellers find and exchange information, conduct trade and collaborate with each other via an aggregation of information portals and trading exchanges. In addition, supplier portals and e-marketplaces should include user friendly functionalities, a number of features to facilitate and secure their use by company's employees. Navigation and search tools, reporting and notification functions is a must, since the acceptance and success of those channels depends on willingness of users using these engines in their daily procurement activities.

4. SUPPLIER RELATIONSHIP MANAGEMENT

The universal trend in area of supplier relationship management goes towards the process cost reduction and compliance. Nowadays, the interest of the organization is to build flexible electronic processes that support and customized their business processes. At the same time that they are able to adapt the enterprise to the constant market changes. There are several software vendors which try to provide a single SRM solution that works a combination of stand-alone modules specialized in part of procurement process, building a set of functionalities that enable the communication and integration of multiple channels and automation of purchasing and sourcing process between two or more independent organizations consisting of electronic sourcing, electronic procurement and supplier enablement. The main players on the market are Ariba-FreeMarkets, Oracle-Peoplesoft, SAP-Fricionless. Some of functionalities are also offered by Dutch company called Compass well established in Czech and Slovak republic.

5. CONCLUSION

Purchasing is an important part of every business so it needs to undertake regular process analysis to ensure that it is making the best use of hard earned money. Purchasinganalysis is the analysis of what goes on in purchasing department, is it keeping to the purchasing strategy and are inventories being kept to the optimum levels? With respect to suppliers, are the best suppliers been chosen and are they offering the best prices and terms. This analysis should be the first step by implementing the best possible practices that could be used in this process.
Supply chain management and purchasing performance are increasingly recognized as an important determinant of a firm‘s competitiveness. Therefore, in order to support the great variety of product and services purchasing process and to integrate different business partners in an electronic network. Supplier relationship management systems were developed to coordinate and automate the process concerned with the supplier integration and communication.

On the other hand, the selection of suppliers based just on product prices has leaded to numerous disadvantages to suppliers and buyers. These disadvantages have made purchasing departments to change from a price based supplier selection to a broader selection model, in which suppliers are no longer selected based solely on price, but also in aspects such as product quality and warranty. The utilization of business intelligence technology to extract and analyze possible cost savings and support the design of supplier selection and evaluation and spend saving programs in a company is major goal of modern purchasing department.

The market of SRM applications is constantly growing so the ERP providers like SAP, Oracle or Ariba are strongly developing their functionalities in order to be able to survive in this competitive environment. Especially in the area of strategic sourcing much investment has been done with purpose to improve or reinforce current developments in the area of contract management, service procurement, spend and supplier intelligence and process integration among others. On the other side, it seems that the potential in the area of E-procurement to be exhausted.

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Manufacturing execution system, intelligent manufacturing system

Jana STRÁPKOVÁ *, Branislav MIČIETA**, Zuzana ŠPÁNIOVÁ***

UTILIZATION OF SYSTEM MES IN INTELLIGENT MANUFACTURING SYSTEM

Abstract

This article is focused on possibilities of utilization system MES in Intelligent Manufacturing System. The historical development of manufacturing systems identifies a number of important milestones. Increasingly challenging environment resulted in efforts to create a flexible and dynamically changing system that will be able to react on market requirements. In forward began to receive intelligent manufacturing systems that are able to satisfy with their flexibility requirements of environments. System MES can be a good support of this systems.

1. INTRODUCTION

Constantly changing condition in business environment leads companies to find different new ways how to increase their competitiveness and how effective can they utilize of emerging changes. For a better understanding of intelligent manufacturing systems is important to point out the traditional manufacturing systems and the differences between them.

We can say that manufacturing system is an integrated combination of several functions such as design, process planning, production planning, quality assurance, storage and so on. In each of these functions are carried out several activities. Set of activities within each process should be controlled as he creates a production environment. The transformation of manufacturing systems has occurred on the basis of several aspects [2]:

- technological progress,
- changes in production methods,
- changes in environment,
- changes in the way of management of the company,
- changes in customer requirements and their expectations.

In addition the aspects mentioned above have influenced the transformation of manufacturing systems also development and changes of information systems. Developments in information systems not only result in the integration of functions but also contributed to significant progress in their implantation. Development of information systems passed significant changes. While in the past information systems have focused on improving the use of computer support, today

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information systems have accent on obtaining the real value stream mapping. Ensure high transparency of the processes led to the requirement to mapping the value of real- time without unnecessary processes that involve high costs. Consequently the market began to appear modern manufacturing information systems that met these requirements. [3]

2. MANUFACTURING EXECUTION SYSTEM

The main purpose of the MES is providing on-line transfer of data from the process level to ensure current and correct data. These systems cover the collection and process data archives in real-time together with their mathematical and statistical processing, with complex visualization, monitoring and control of production, operational maintenance etc. MES systems allow you to:

- providing on-line transfer of data from the process level,
- elimination manual collection of data and transfer of data in production,
- more efficient management of production and related processes,
- monitoring, transmission and archiving of data,
- obtaining current and correct data,
- provide corrective measures for arising disagreements,
- reduction non-value activities.

Between level in company are changing a lot of different data. Each level in company provides specialized functions and has characteristic response times. This is shown in figure 1.

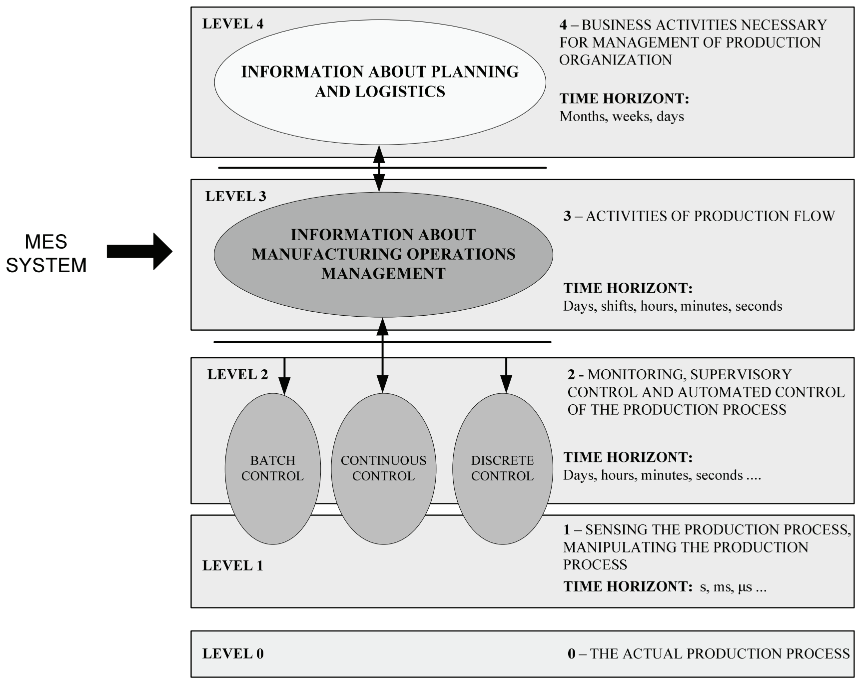

Fig. 1 Functional hierarchy of activities [1]

To design an appropriate methodology of utilization of MES system in intelligent manufacturing system is needed to understand the basic algorithm of the system MES. Each phase of the algorithm will be used in the cooperation MES with intelligent system. The algorithm functioning of the system MES in a company that has implemented this system consists these several phases:

- The first phase - Getting of the input information - initial phase of procurement of the input information necessary to start production.
- The second phase - Setting the MES system - configuration of the MES system according to the specific order,
- The third phase - Collect of the required data - in this stage is done collect of the selecting data.
- The fourth phase - Analysis of the collected data - the phase of analysis of collected data, of their evaluation and subsequent sending to the selected employees respectively to the selected systems.

Each of the above phases contains some basis steps that are necessary to ensure the efficient functioning of the system MES. The basic principle of functioning of the system MES is also used within the cooperation with intelligent manufacturing system.

3. INTELLIGENT MANUFACTURING SYSTEM

Intelligent manufacturing system includes software components that use artificial intelligence techniques. The type, complexity of intelligent elements depend the application of these intelligent elements. If you are creating an intelligent system, the system should have the behavior as it would be directed by the person. In defining an intelligent manufacturing system is necessary establish in particular:

- The structure and behavior of the manufacturing system - defining the overall structure and behavior of the manufacturing system.
- An architecture and the types of information systems in manufacturing - to define the structure of software and hardware of the information systems for exchanging information within the manufacturing system.
- Choice of artificial intelligence techniques and field where they will be used in the intelligent manufacturing system.
- Defining the level of intelligence - to define what level of intelligence will be used and what problem areas will be solve it.

Because the intelligent systems solve the tasks in such a way as to solve them person by his intelligence, is necessary to define the level of intelligence. The level of intelligence is talking about how much is involved in solving the problems selected toll of artificial intelligence and from when person (expert) begins solve this problem. The level of intelligence within the company can be as follows:

- intelligence on the actual process level - can solve the problems arising on process level,
- intelligence on the production management level - intelligence controls the production, provides all the necessary resources and foresees their shortage, if the problem is not resolved call the expert, of appeal to the superior level,

- intelligence on the business management level - intelligence managed company smoothly to minimize the adverse states and with minimal human intervention eg. due date of invoice, automated order taking etc.

In figure 2 is shown possibilities of areas of activity of intelligence within company.

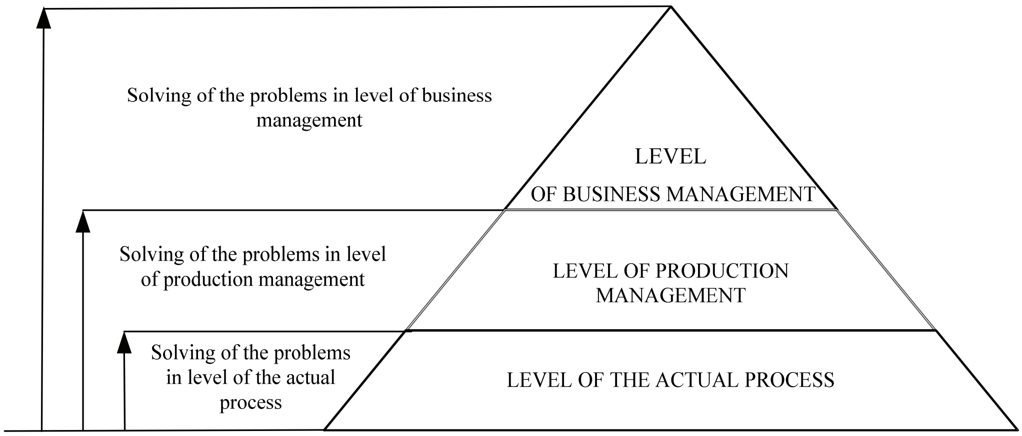

Fig. 2 Areas of activity of intelligence within company

Intelligence at every level of the company is able to solve problems at the most at his level. So if there is a problem that goes beyond the level of intelligence should be to resolve this problem participate superior level of intelligence (higher level of control or expert).

4. CONCLUSION

In proposed methodology of utilization of MES system in intelligent manufacturing system is important to design an appropriate way of their working. The common interaction depends on the extent to which is the manufacturing system intelligent. Because there are many views of understanding of intelligence of level, it is necessary to define degree of their cooperation to achieve cooperation in the design of the MES a intelligent manufacturing system.

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ERP, RFID

Zuzana ŠPÁNIOVÁ*, Branislav MIČIETA**

ERP AND RFID

Abstract

The article deals with ERP systems and RFID technology. The first chapter describes the terms ERP systems and RFID technologies, their basic properties and characteristics. The second chapter describes the possibility of cooperation between the ERP and RFID, advantages and method of communications in business.

1. INTRODUCTION TO ERP AND RFID

ERP systems – systems for enterprise resource planning – manage the internal and external data and information requirements of the whole organization. ERP automates the tasks involved in performing a business process. In general, ERP systems can characterized as systems that integrate business processes including manufacturing, distribution, finance, human, project management, maintenance and transport. ERP systems have four basic modules:

- manufacturing,
- logistics,
- finance,
- human resource.

Nowadays, ERP systems are usually extended by SCM (Supply Chain Management), CRM(Customer Relationship Management) an so on.

RFID – Radio Frequency Identification – describes any system of identification wherein an electronic device that uses radio frequency or magnetic field variations to communicate is attached to an item. There are two main components:

- RFID tag - RFID tag is an identification device on items, which we want to track.
- RFID reader – RFID reader is device which can recognize tags on items, and also can read information's stored on them.

As shown in the survey that I conducted implementation of ERP systems bring several important problems. In the next chapter I will discuss what is the one of the most serious problems and also about their solutions

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2. ERP PROBLEMS

Nowadays, ERP system is still the cornerstone of information and communication technologies in industrial environments. One of the most basic processes of ERP is planning and scheduling. And one of the most important problems is that the system puts too much emphasis on rigid planning rather than dynamic managing of resources.
An example may be mentioned the need for manual entry of data for the categories that are shown in the figure below.

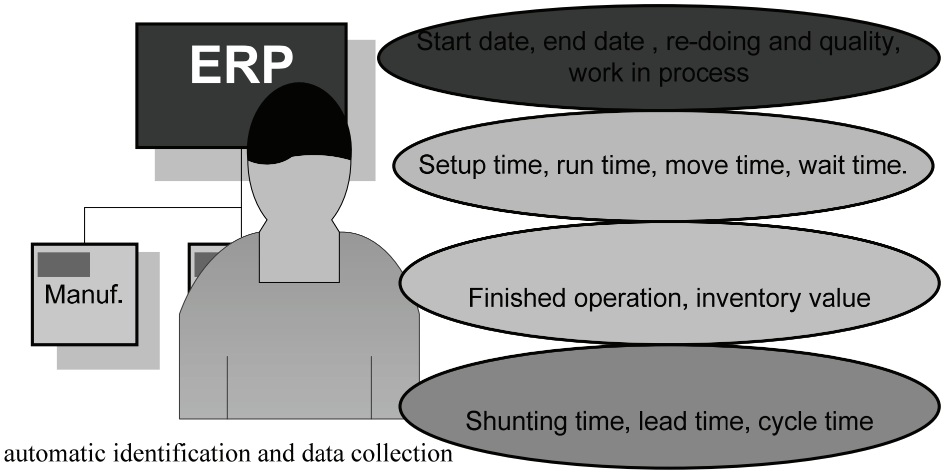

Fig.1. Manual entry of data

Two aspects of RFID technology have the potential to change the way that people use ERP for planning and scheduling

A lot of ERP providers usually use barcodes to track items. This way is very cheap and easy to apply. But it is very difficult to automate code capture operation. So haw we can see, RFID technology comes with a number of advantages. With RFID, real-time streaming data, filtering, processing, and response are possible. The information that RFID carries is encapsulated in a form such as the Electronic Product Code (EPC).

RFID technology can solve the problems of ERP systems. There would be improved through direct monitoring of data on raw materials, work in progress, finished production, logistics flow, employees and so on. Advantages of RFID technology in cooperation with the ERP system can be summarized as follows:

- RFID technology can be used in a wet, hot or dusty environments with high vibration.
- Also allows use at high speeds without visibility.
- Helps to reduce labor costs.
- Reduce the cost of supply chain.
- Reduce properly losses in the company.
- Better visibility of inventory and material flow.

RFID technology as a form of automatic identification and data collection – AIDC operates on the principle reader base. The reader has two basic functions:

- Broadcast RF signal.

- Receive information from RFID tags.

All of this information's are entered into the ERP, or into the other enterprise system, where they are processed and used as a support management or for decision making.

The possibility how to use ERP system and RFID technology within the enterprise is available in two basic steps.:

- Create and launch a pilot project relating to acquired know-how in RFID.
- Design and implementation of data interfaces.

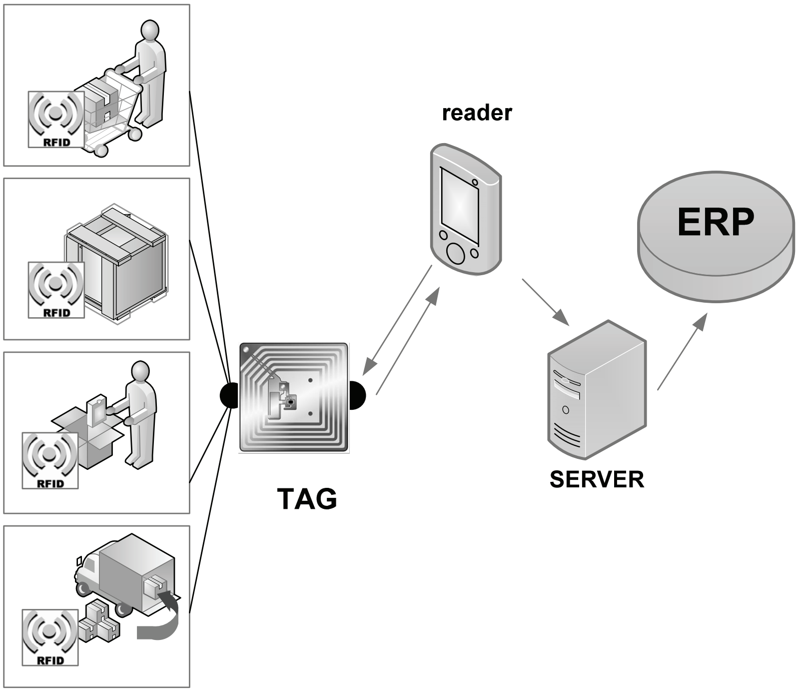

Fig.2. ERP and RFID

Consequently, it is very important to establish the necessary exchange of information. Because any software is able to manage so much information as we can find in company. The ideal would be that all data were recorded in real time and have been archived, edited and sent to the user, but now it is utopia. The data can be divided into three main categories:

- Strategic data.
- Production data.
- Raw data.

These data were previously collected manually. This data collection is time-consuming, error-prone, and does not provide actual data in real time. Therefore, the proper functioning of the ERP system, propose the necessary cooperation with RFID, which solves the problem of information exchange between the workshop and ERP systems.

There is also the possibility of implementing and ERP solution, which was designed for work with RFID.

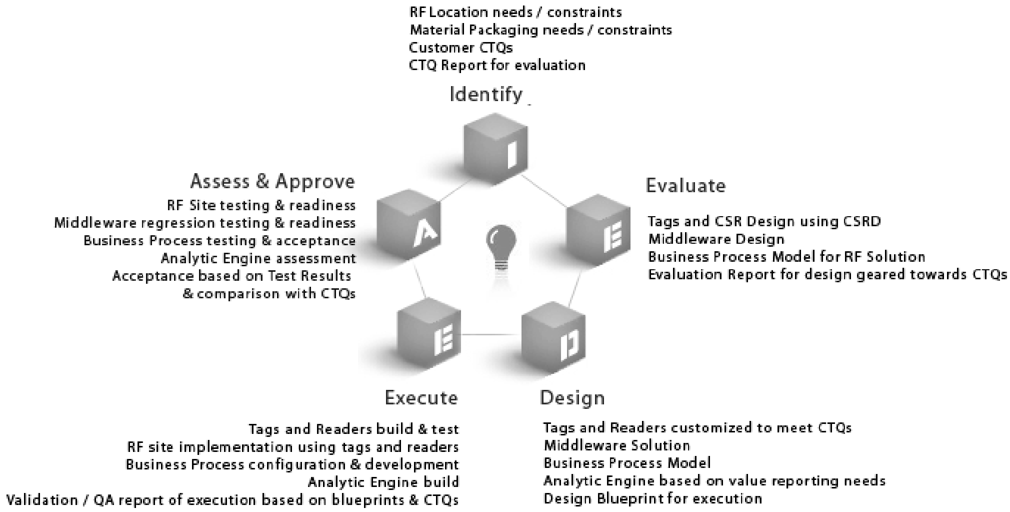

Fig.3. SAP Auto-ID
Source: www.qidtech.com

Here we should mention SAP, which is one of the leaders in innovation in a market where in 2004 came the first signs of a combination of RFID technology and systems for enterprise resource planning. System SAP Auto-ID receives data from RFID readers and RFID through the integrated directly into business applications. This application allows you to integrate all the communication and sensing devices such as: readers, printers, Bluetooth devices, bar-code equipment, intelligent controls, radio frequency identification and so on.

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METHODS OF INDUSTRIAL ENGINEERING IN NON-MANUFACTURING AND ADMINISTRATIVE PROCESSES

Abstract

The article focuses on the utilization of methods, philosophies and approaches of industrial engineering in non-manufacturing and administrative processes. By using these methods in the non-manufacturing processes companies may even more improve efficiency, reach their goals in better ways, and last but not the least increase their competitiveness.

1. INTRODUCTION WORD

At present we meet with abundant use of industrial engineering methods mainly in the spheres of production. We're used to the fact that in most manufacturing companies the processes are already properly adjusted and run constantly their improvement with help of these methods. At the same time we face the fact that non-manufacturing processes, administration, paperwork and ultimately services have got large gaps in the implementation and adjustment of these processes. In a better case, companies are beginning create standards and adopt methods of industrial engineering for non-production processes. In the worst case, companies do not consider to provide standardization or improving in these processes as necessary, although these processes are those that value usually do not add the final product, but increase costs and longer a delivery times and reduces productivity. Non standardization of these processes can prepare companies for customers, reducing competitiveness and ultimately increases the cost of products. An excellent example how to dissuade a client and increase the chance of the competitors....

Mr. Šíma had a credit by the HB bank (hereinafter referred to as HB). He knew that after six months ending time of fixation. He had to inform the bank about the change at least 6 weeks before the end of a fixation. He contacted several banks and considered the offers and chosen the best one for him. He contacted the dealer and told him that he would like a credit from their bank. (8 weeks before the end of fixation period). He wrote the necessary documents with a sales representative. The sales representative should send the documents to the headquarters. Meanwhile, he informed the HB about refinancing and termination of the contract. In three weeks he received a letter from headquarters that signed document is missing. This document was needed for approving of the refinancing. At the same day, Mr. Šíma arranged a meeting with the sales representative and gave him the signed document and by this should be the process of documentation already finished. Mr. Šíma waited two weeks for the

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confirmation of the credit and for sending money and after that time he called the agent. Sales representative told him that the process refrained headquarters in Prague, but he is trying to do things in correct way as soon as possible. The third week Mr. Šíma was getting nervous and contacted directly headquarters. He teamed up with the employee of the bank, who had his product on approval. The employee told him it was still waiting to sign the document that you requested from him three weeks ago. Mr. Šíma asked if refinancing is still possible to be done on time and the answer was, only if he delivers the document on the same day. Finally, Mr. Šíma had to visit the headquarters in Prague three times for refinancing his credit. Thanks to his initiative he finally managed things in time and since that experience he does not recommending this bank his friends.

This example shows us, how inaccurate and incomplete processes take place in a company whose main activity is the provision of services and where administrative and office processes create the company basis. In this case, the client solve the problem itself, he had time and options to do that. But are clients responsible for resolving the processes at providers? It's basically the same as if in the manufacturing process customer ordered the product and then being forced to deal with suppliers and finish product himself to avoid other additional costs. As the costs could incurred to Mr. Šíma if he had missed to transfer money into the original bank in time, which would increase interest rate and he would ultimately lose tens of thousands. The problem is that companies either in production or in non-production sphere placed little emphasis on administrative and office processes. Usually the basic standards are not built here, according to which workers should follow and what they should be responsible for. From the example above and I believe that they are occurring every day a lot which show us that in non-manufacturing types of businesses the processes are not standardized and cannot be subsequently improved. Due to these erroneous effects companies are losing credibility of customers, losing them and reduce competitiveness. It would be enough to take an example from manufacturing firms, which are mapping and improving their processes by using methods such as industrial engineering.

2. METHODS, PHILOSOPHY AND APPROACHES OF INDUSTRIAL ENGINEERING IN NON-MANUFACTURING AND ADMINISTRATIVE PROCESSES

Based on the research and information obtained from the literature we have chosen methods that are very useful for non-production and office processes. Some of these methods are presented in the article below. It describes the possible application of these methods in non-productive and administrative processes.

Just in Time (JIT) - JIT method is well applicable in non-manufacturing and administrative processes. The different is that in comparison with production processes we are trying on time and in necessary quantity use of for example the workers. Planning and using of the workers in required time and in sufficient quantities is very problematic and at the beginning it is very hard to be this process identified. In production processes we have well-defined requirements for terms and quantities. This condition is very badly defined in the non-production processes. Despite this the JIT method was implemented on these processes. *Example of usage: Application of JIT on the quantity of employees in the hospital; Application of method to transfer of the 3D data in the technical development during of development the new vehicle.*

JIDOKA-Using this method helps anywhere in the administrative process, office, maintenance services, to avoid errors in these processes.

5S – The method is well implementable in non-production areas, mainly office, if there is a workplace exists. Also the workplace in non-production process should follow 5 basic steps of this method. If someone is working on a confused table, where is placed many irrelevant documents, sheets and drawings then the worker still got a problem finding something. Of course, he loses time by focusing on the activity „search" instead on the activity which is its main workload. By laying documents into pile on the table worker could overlook a substantial document that he had to transfer to the computer or to send to the next worker. This causes other additional faults, which are transferring to other workplaces and workers. *Example of usage: The implementation of 5S in the secretariats of Škoda Auto a.s. (From sorting of items on a table to managing of a computer. Implement the same system because of substitutability).*

Poka Yoke – Even in non-productive well-defined process, the situation can occur that there are more options for the processing, but only one process may be correct. To avoid this situation we can use the Poka Yoke method. *Example of usage: Removal of safety features when purchasing goods (Cash desk with holes for inserting of safety devices); Transhipments store of electronics (Simple system for companies that need a store for further sorting);*

Kaizen – The philosophy based on three cornerstones with respect to elimination of the occurrence of all eight types of waste. With the help of using the Office Kaizen we can streamline work in non-productive and administrative processes. The three cornerstones - Visual Kaizen, Process Kaizen and Kaizen object - are implementable on each process of the company. Due to these cornerstones we are able to avoid the wasting, to define a fixed time to work in administration and reduce mistakes emerging of a disorder or bad work organization. *Example of usage: The introduction of Kaizen into research and development department in the Italian car maker [1].*

Cycles SDCA/PDCA – In non-manufacturing and administrative processes it is sometimes difficult to improve the process, increase productivity and reduce the wasted, because many of these processes are not stabilized. Workers can perform their job on their own and according to their discretion. In many companies, procedures and standard on how to perform administrative work still does not exist. Then these processes are very difficult to streamline and to improve, because the basis for process improvement is missing.

Value Stream Mapping (VSM) - Helps to mapping any process. This may be a process of issuing the document, movement of the documents around the company, the process of the correct registration, procurement procedures, creation of orders, process design, etc. All these processes will swallow a lot of time and therefore is in the interest to reduce this time. We should try to eliminate these types of waste: the waiting for approval; the excessive paperwork; redundant approval; movement of documents thru many departments; The long journey of the internal mail; incomplete, incorrect information that sometimes missing.

Kanban - Kanban system can be used in all non-productive and administrative processes where one process is composed of several sub-processes and where each process performs other worker. *Example of usage: The Company deals with the information technology - processing of individual orders. (Allocation and fulfilment of the orders with help of the Kanban boards); ordering paper into the MFP Skoda Auto as.*

Six Sigma – It uses the DMAIC methodology, which follows on the PDCA methodology. However DMAIC puts more emphasis on the processes and is more complex. With its help we can achieve the improvements in the non-manufacturing processes. An example can be used in hospitals. The hospitals increased the quality of products and services and reducing dissatisfaction of the patient with help of this philosophy. It improves the system of a health care. *Example of usage: By implementing Six Sigma philosophy in the hospital managed to shorten the length of patients stays after heart surgery. [2]*

Total Productive Maintenance (TPM) - TPM can be used in offices from the reasons of increasing the productivity and the efficiency of the administrative functions and to identify and eliminate losses. The three pillars of TPM in the office are consisting of 5S, Jishu and Kobetsu Kaizen. *Example of usage: Network prophylaxis of school network (preventive maintenance, possible repairs, network optimization, data exchange between servers), Running anti-virus programs as a preventive maintenance.*

Balanced Scorecard (BSC) – Very successful system for the evaluation of the business performance that is not focuses only on financial indicators. It focuses on performance, strategy development, financial situation, customer satisfaction, employee's creativity and internal technological processes. *Example of usage: Using and adapting the BSC to evaluate the performance of the public unit.*

Theory of Constraints (TOC) – In most of cases and also articles the method used mainly in production processes. At present, we find that the practical verification of the ideas of this method another useful tools arisen in non-production spheres.

- Decision support for the main business activities
- Flow analysis - the main indicator of TOC
- Logical analysis of the TOC (the thinking process)

Example of usage: TOC as a tool for improving of the school education - close place is defined as "maximum knowledge which students have got"[3]

3. WHAT CAN BE SAID AT THE END

At present time begins to take of the importance using of the methods, philosophies and approaches of the industrial engineering in non-manufacturing and administrative processes. It is the reason that enterprises must strive to increase competitiveness, profits, efficiency together with reducing costs. In most enterprises production processes are already stabilized and the companies working on their further streamlining. Therefore it is important to involve non-productive and administrative processes, which can help us further to increase this efficiency. In this article the methods are applicable in non-manufacturing processes, which means that there is an effort to improve and streamline these processes and not only focus on manufacturing processes that have already reached their level. However, there is still a long way to go and all participants should understand that even changes in these processes and their standardization are as important as in manufacturing processes. This is the area where is still much space for the improvement.

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Hierarchical cluster analysis method, distance matrix, dendrograph

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THE PROCEDURE OF HIERARCHICHAL CLUSTER ANALYSIS METHODS

Abstract

Algorithms for hierarchical cluster analysis methods are associated with the construction of the tree structure of clusters, ie. dendrogram. The calculation procedure is the same for all clustering methods. It starts with the calculation of similarity between the coefficients of similarity (distance rates), which form the input data matrix and result in the creation dendrogram. In all steps of the method are associated objects or groups of objects that are closest to ourselves, ie. are the most similar.

1. THE PROCEDURE OF HIERARCHICAL CLUSTER ANALYSIS METHODS

1. Compile input distance matrix according to the selected distance rates
2. We find the smallest distance in the distance matrix - 1.cluster.
3. We connect all the remaining objects to the first cluster and next calculate a new distance matrix. This Langer$ distance matrix is calculated according to single methods of cluster analysis. Missing values in the distance matrix are specified from the input matrix.
4. From this distance matrix again we choose the smallest distance – second cluster. We connect the remaining objects, or clusters to the second cluster, and calculate a new distance matrix. Objects with this distance are another cluster.
5. The procedure is repeating again, until all objects, clusters are connected.
6.The output is a dendrograph.

1.1. Example of hierarchical methods

We have given the input data matrix, which consists of 5 objects defined by two features. The procedure of cluster analysis is applied to a given input data matrix, which is listed in Tab.1 and graphically illustrated in Fig. 2.

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Tab. 1 The input data matrix

Object	1.	2.
1	1	1
2	1	2
3	6	3
4	8	2
5	8	0

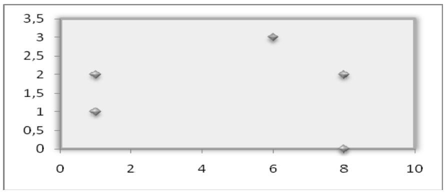

Fig. 1 Graphical representation of input data

From the input data matrix are to be determined the levels of the single distances for pairs of objects. We use to calculate the square Euclidean distance for metric, which relationship for the calculation is as follow:

$$d_E^2 = \sum_{j=1}^{m}\left(x_{kj} - x_{lj}\right)^2. \quad (1)$$

On this basis, the value of the distances of pairs of objects are:

$d_E^2(1,2) = (1-1)^2 + (1-2)^2 = 1$
$d_E^2(1,3) = (1-6)^2 + (1-3)^2 = 29$
$d_E^2(1,4) = (1-8)^2 + (1-2)^2 = 50$
$d_E^2(1,5) = (1-8)^2 + (1-0)^2 = 50$
$d_E^2(2,3) = (1-6)^2 + (2-3)^2 = 26$
$d_E^2(2,4) = (1-8)^2 + (2-2)^2 = 49$
$d_E^2(2,5) = (1-8)^2 + (2-0)^2 = 53$
$d_E^2(3,4) = (6-8)^2 + (3-2)^2 = 5$
$d_E^2(3,5) = (6-8)^2 + (3-0)^2 = 13$
$d_E^2(4,5) = (8-8)^2 + (2-0)^2 = 4$

Input distance matrix based on the calculation, which is shown in Tab. 2.

Tab. 2 Input distance matrix

	1	2	3	4	5
1	0	1	29	50	50
2	1	0	26	49	53

3	29	26	0	5	13
4	50	49	5	0	4
5	50	53	13	4	0

The clustering of objects from Tab. 1 we use the nearest neighbor method. Input distance matrix is a matrix of distances E_1, which shows that the minimum distance between objects (1.2) and combining them we get 1. cluster.

Tab. 3 Matrix distance E_1

	1	**2**	**3**	**4**	**5**
1	0	1	29	50	50
2	1	0	26	49	53
3	29	26	0	5	13
4	50	49	5	0	4
5	50	53	13	4	0

$d(1,2) = 1$ 1.cluster

The following is the compilation of the distance matrix for the remaining objects E_2 cluster analysis. In the principle method of nearest neighbor distances are equal:

$$d(1,2)3 = \min(d_{1,3}; d_{2,3}) = \min(29;26) = 26$$
$$d(1,2)4 = \min(d_{1,4}; d_{2,4}) = \min(50;49) = 49$$
$$d(1,2)5 = \min(d_{1,5}; d_{2,5}) = \min(50;49) = 50$$

E_2 is a distance matrix, thus its form is Table 4.

Tab. 4 Matrix distance E_2

	(1,2)	**3**	**4**	**5**
(1,2)	0	26	49	50
3	26	0	5	13
4	49	5	0	4
5	50	13	4	0

Based on Table 4 is the smallest distance between objects (4.5), so these objects merge and then create 2. cluster and re-calculate a new distance matrix E3 again. In this way we proceed until all objects, clusters are merged into one cluster.

$d(4,5) = 4$ 2.cluster

$$d(4,5)3 = \min(d_{4,3}; d_{5,3}) = \min(5;13) = 5$$
$$d(4,5)(1,2) = \min(d_{4,(1,2)}; d_{5,\{1,2\}}) = \min(49;50) = 49$$

Tab. 5 Matrix distance E_3

	(1,2)	3	(4,5)
(1,2)	0	26	49
3	26	0	5
(4,5)	49	5	0

$d(4,5)3 = 5$ 3.cluster

$d[(4,5)3](1,2) = \min(d_{(4,5),(1,2)}; d_{(1,2)3}) = \min(49;26) = 26$ 4.cluster

Figure 3 shows the dendrograph of nearest neighbor methods applied to the input data matrix of Table 1 using the statistical software STATISTICA.

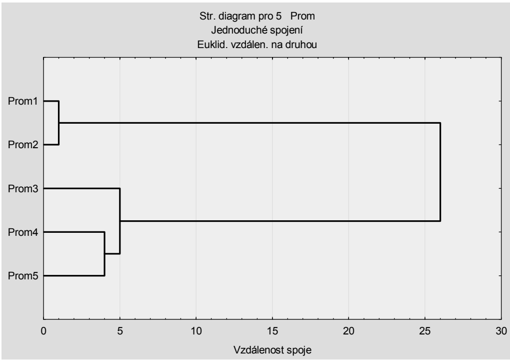

Fig. 3 Dendrograph of nearest neighbor method

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Financialanalysis,discriminantanalysis, anindicatorvalue

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DETERMINATION OF THE LV MODEL

Abstract

ThearticleexplainsthemethodofdeterminingthevalueoftheLV, whichisbasedon theprincipleofdiscriminantanalysis. Themodelhas beenestablishedincollaborationwiththeStatgraphics. LVhelpsin decisionmaking andpredictedthefinancialhealthofthecompany.Itisbasedon theconditionsofindustrialenterprisesoftheSlovak Republicforthe 21century.

1. INTRODUCTION

Comprehensivefinancialanalysisisoftenconsidered to belengthyandthedifficult. Increasingly,thepracticeofusingrapidtestsbywhich todiagnosethe state ofthecompanybya simplecalculationofselectedparameters. Resultsofrapidassessmentmodelssuggested by theexpertsfrom Western Europeand Americaare in ourtermsoftenusedbutthedistortedeconomicdisparity.

2. DETERMINATION OF THE LV MODEL

Theproposedmodelis amodel ofLVtestforthediscriminantanalysisbasedontheresultsoftheindustrialenterprises. To determinetheparametersanddeterminetheirvalueinthesubsequentrapid testmethodwasuseddiscriminantanalysis. Thedatasourceforanalysisisthebalancesheet and profitand lossaccountin fullfrom 60randomlyselectedcompaniesfromtheindustrialenvironment. Fortheneedsofanalyseswerecalculatedforallbusinesses42coreindicators, includingfinancialanalysisratios, used byAltmanandTaflercoefficientmodel. Beforetestingcompaniesweredividedintotwogroups–businessesthrivingandslack. Thethrivingbusinesswasconsideredforanalysisneedscompany, whichforthreeconsecutiveperiods(2008-2010)amounted toa profitandreturn on equityof more than8%, whichisconsideredthethresholdatwhichtheownersofthecapitalretainsrealvalue. In casethecompanydidnotmeettheabovecriteria,wasconsidered to beslack. Forallsurveyedcompaniesselected set ofindicatorshavebeencalculatedestimatesofmeanvalues–average

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{N} x_i \tag{1}$$

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andestimatesofsamplingvariance

$$s'^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1} \quad (2)$$

usedforbothsetsofcompanies – aprosperous andslack. Thesetwosets(selection)ofenterprisesforeachindicatorI havedoneF-test, whichverifiestheequalityofvariancebetweensamplesetsslackandprosperousbusiness. Theresultofthis testwillaffectthenext step, in which Iset themajordistinguishingcharacteristicsofbusinessesprosperous and slack. TheF-TESTbuildsandverifythehypothesisH0:
$\sigma'^2_{prosperous} = \sigma'^2_{slack}$(thevariancesofthetwosetsare thesame) againstthehypothesisH1:
$\sigma'^2_{prosperous} \neq \sigma'^2_{slack}$(thevariancesofthetwofilesare different). Test criterionis F statistics:

$$F = \frac{s'^2_1}{s'^2_2} \quad (3)$$

where s'^2_1estimatethesamplingvarianceforthegroupofprosperousbusinesses and s'^2_2estimatethesamplingvarianceforthegroupofslackbusinesses. To calculatetheestimatedsamplingvarianceh-thselection(h = 1, 2, 1forprofitablefirms, 2 slackforbusinesses) applies

$$s'^2_h = \frac{\sum_{i=1}^{n_h}(x_{h_i} - \bar{x}_h)^2}{n_h - 1}, \quad (4)$$

where s'^2_h issamplingvarianceofh-thfile (selection), n_h isthenumberofobservations (companies) intheh-file(selection)x_{h_i}isthei-thvalueofindicatorxintheh-file, $\bar{x}_h$istheaverageofindicatorx intheh-file. TheFstatistichas aprobabilitydistributionwithdegreesoffreedom

$$v_1 = n_1 - 1$$

and

$$v_2 = n_2 - 1,$$

where$n_1$isnumberofprosperousbusiness (sighting) and$n_2$is number ofslackbusinesses (sighting). ThistestI performedatthesignificancelevel α = 0,99. Thetabulatedvalues forFprobabilitydistributionspecifiedsignificancelevelαanddegreesoffreedomv1andv2, I identifiedthecriticalfieldW

$$W = (f_{\frac{\alpha}{2}[v_1;v_2]}, f_{1-\frac{\alpha}{2}[v_1;v_2]}), \quad (5)$$

where

$$f_{\frac{\alpha}{2}[v_1;v_2]} \text{ a } f_{1-\frac{\alpha}{2}[v_1;v_2]} \quad (6)$$

aretabulatedvaluesfortheparametersoftheStudenthdistribution.
IfthecalculatedvalueofFstatisticswasin thecriticalfieldW, I didnotrejectthehypothesisH0 and

I continuedwithT-testofmeanvalues oftwochoiceswiththesamevariance,ifFstatisticswasfalloutsidethedesignatedcriticalfieldW, thenI rejectthehypothesisH0andH1hypothesisadoptedandcontinued onT-testofmeanvalues oftwochoiceswithdifferentvariancesoftwochoices(files).

3. DETERMINATIONOFSIGNIFICANTINDICATORS:

Thenext step wasnecessary to identifyindicatorsthat are significant to differentiateprosperousbusiness and slackbusinesses. To assessthesuitabilityofindicatorfortheneedsofdiscriminantanalysisforeachindicatorverifiesthevalidityofthehypothesisH0:=μ_1μ_2whereμ_1themeanvalueoftheindicatorsetin thethrivingbusinessesμ_2themeanvalueoftheindicatorin thefileslackundertakingscomparedwithhypothesisH1: μ_1 ≠ μ_2. Validity, respectivelyinvalidatethehypothesisweverifywitht-test. Theapplicationofthis test isimportantifthevarianceratio in bothgroupsofenterprises and thesameisknown or unknown, or. different. Thesetwovariantsoft-testsdiffer in thecalculationof test criteriacalledt-statistics (which has someprobability-distribution) and determinethenumberofdegreesoffreedom. Equality, respectivelyunequalvariancesforeachindicator, I checked in thepreviousanalysisusing F statistics (seeabove).

Calculationoft-statisticsanddegreesoffreedom vatthesamesamplingvarianceforprosperousbusiness and slackbusiness

$$v = (n_1 + n_2 - 2)$$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1-1)s'^2_1+(n_2-1)s'^2_2}{n_1+n_2-2}}\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} \quad (7)$$

Calculationofthet-statistic and itsdegreesoffreedom v ifthevariancesofindicator in theselectionof a prosperousbusiness and slackbusinessisunknown, respectivelydifferent:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s'^2_1}{n_1}+\frac{s'^2_1}{n_2}}} \quad (8)$$

$$v = \frac{\left(\frac{s'^2_1}{n_1}+\frac{s'^2_1}{n_2}\right)^2}{\left(\frac{s'^2_1}{n_1}\right)^2\frac{1}{n_1+1}+\left(\frac{s'^2_2}{n_2}\right)^2\frac{1}{n_2+1}} - 2 \quad (9)$$

In bothcases, thesamplevarianceiscalculatedusingtheequation:

$$s'^2_h = \frac{\sum_{i=1}^{n_h}(x_{h_i} - \bar{x}_h)^2}{n_h - 1} \quad (10)$$

Bothoftheabovet-testsforeachindicator I madeatthesignificancelevel α = 0.99. Thetabulatedvaluesof t 'forStudentprobabilitydistributionspecifiedsignificancelevel α and degreesoffreedom, I identifiedthecriticalfield W = (t'α / 2 in, t'1-α / 2 in). H0 hypothesisofconformityofmeanvaluesoftheindicator I rejectedifthecalculatedvalueoft-statisticsisthecriticalfield W, while I acceptedhypothesis H1 ift-statisticsvaluewasoutsidethecriticalfieldof W. The more thevalueoft-statisticsisawayfromthecriticalfield, the more relevantindicatorissuitableas a discriminant to distinguishfromslackbusinesses.

4. SELECTIONOFPARAMETERS

Based ontestingaccording totheprocedure(t-test), andexpertassessment(so that I avoidtheuseofrelatedindicators, iethosethatweresignificantlycorrelatedwitheachother), I selectedindicators:
x 1 – Short-termreceivables/sales* 365,
x 2 – equity/totalassets* 100,
x 3 – profitbeforetax/equity* 100,
x 4 – corporateliabilities/sales,
x 5 – currentassets/foreignsources.

$$LV = 0{,}011 * x1 - 0{,}02 * x2 + 0{,}01 * x3 + 0{,}0005 * x4 + 0{,}09 * x5$$

Fortheclassificationofcompaniesintodifferentgroups are designedfollowingcriteria:
Growingbusinesses**: LV> - 0,64**
Theaveragebusiness**: -0,74<LV< -0,64**
Slackbusiness**: LV< - 0,74**

Theobservedvalueforeachcharacteristicwasdetermined on thebasisofdatafrom 2007-2011. Forcontinuoustopicality model isappropriatethatthediscriminantanalysiswillbeperformedwiththeannualfrequency.

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Key words: innovation strategies, open innovation, User – Driven Innovation

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MODERN INNOVATION STRATEGIES – OPEN INNOVATION STRATEGY

Abstract

Innovative strategy is a part of the company's strategy that concerns innovative processes both inside and outside the company. The article presents the matter of open innovation strategy. Differences between a modern and traditional approach towards innovation are indicated. The concept of User – Driven Innovation is also discussed.

1. INTRODUCTION

The future of innovative companies depends mostly on the degree to which its managers adopt a strategic thinking. From the point of view of a future market position of the company, it is important to foresee technological changes that may influence the processes of product manufacturing or servicing, and even the creation of new branches of industry and services. Therefore, the creation of innovative strategy for the company should be a manifestation of managers' strategic thinking.

The selection of innovative strategy is mostly dependent on the extent of the company's innovativeness. In practice, it determines the organization's ability to create, gain and also adapt innovations to technical and organizational capabilities of the company.

Innovative strategies pay an important role in creation of the company's competiveness and, at the same time, in creation of proper conditions that enable the company to conduct an effective competition fight on the national and international market. In such a situation, both the object of innovative strategy and its quick accomplishment for the achievement of the greatest profits become more and more significant. As the company owners' and managers' awareness related to the role of innovation in the process of company development grows, there is also growth in demand for such a company management that will be innovation oriented. There emerge new concepts of innovation strategies that show the possibilities of adopting and creating innovation not only in big organizations but also in small and average enterprises. Open innovation strategy should be distinguished among the most known strategies.[1]

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2. TRADITIONAL APPROACH TOWARDS INNOVATION

Traditional linear model of innovation, elaborated in the fifties of the previous century, assumes that the source of innovation ideas is R&D activity. There is a one – direction chain of relations between the sphere of science and industry for which science provides solutions and then enterprises implement them and exploit in a commercial manner. Thus, classic linear model of innovation includes the following phases:

- basic researches as the source of ideas that may become an impulse for the commencement of innovation process,
- applied researches that aim at the modification of scientific ideas into strictly practical solutions,
- development works as a practical verification of the effects of researches applied by the trial exploitation of prototypes,
- first application,
- spread on the market (diffusion). [2]

The presented linear model is of a supply type, i.e., the elaboration and implementation of innovation is an effect of scientific research works; it is not an effect of demand for product or service. With the course of time this model has evolved changing into a model that takes into consideration customers' preferences and needs in the process of creation of innovation.

3. MODERN APPROACH TOWARDS INNOVATION – OPEN INNOVATION

The essence of open innovation strategy is the conviction that companies may and should use both external and internal ideas in their innovative processes. Open innovation strategy uses both external and internal sources of concepts without any fear that the taking the internally originated ideas outside the company will deprive it of drawing benefits from these ideas. On the contrary, in view of lack of possibilities for solely internal development of all emerging ideas, the companies that apply an open approach in innovation processes willingly share their knowledge with the surroundings, which leads to the emergence of a greater number of innovative products than in case of "closed" processes.

In the conditions of „openness" of innovation strategy the chief principle for decision –makers is maximization of value derived from various ideas that appear both inside and outside the company. It means that the formal frames of organization constitute only a conventional border in the flow of knowledge between the organization and its surroundings. Companies that apply open innovation strategy are equally willing to develop internal ideas which they did not create on their own as well as to make their concepts accessible to other organizations if they know that they will not work on them themselves.[3]

Within the concept of open innovation one can distinguish three models of innovation flow:

- process of innovation flow from outside to inside – enterprise gains knowledge essential for execution of innovative projects by taking over other companies or by purchase of patents, by absorption of knowledge provided by foreign entities, or by application of ideas submitted by customers or distributors,
- process of innovation flow from inside to outside – enterprise enables other external entities to use its own ideas by means of selling patents and know – how,

- process of innovation flow that joins both models described above – innovation flow happens as a result of cooperation within the framework of business network or strategic alliance.[4]

Table 1 shows a comparison of a traditional and modern approach towards innovation.

Tab.1. Comparison of a traditional and modern approach towards innovation [5]

Traditional approach towards innovation	Modern approach towards innovation
Closed type – innovations closed within the company	Open type – innovations are created inside the company but they equally often come from the surroundings
Company employees are the source of knowledge	The source of knowledge is constituted not only by the employees but, above all, surrounding – institutions, other companies
Creation and commercialization of knowledge nad technology	Diffusion of knowledge and technology
Supply type of innovation	Demand type of innovation
No consideration of consumers' needs or presentation of ready solutions	Involvement of consumers in the process of producing products and services
Creation of values	Co-creation of values

Open innovation strategy places emphasis on the use of consumers' knowledge in the process of creating innovative products. In this connection, enterprises take up intensive activities that aim at involvement of consumers in the process of creating new, innovative products. Customers change from the final recipients into active participants of various processes realized by the enterprise and driving at the presentation of an offer to a customer – beginning from designing new products and improving already existing ones, through designing innovative forms of work, looking for pioneer areas of operation, up to preparation of promotion campaigns.

The concept that applies the users' knowledge in order to develop new products, services and ideas and bases on the true understanding of consumers' needs as well as systematically involve them in the process of enterprise development is called User-Driven innovation.

Customers may be engaged in the innovative process by searching for concepts of new products, testing prototypes of new products, adjusting products to their individual needs.

While searching for ideas of a new product, the company may gain the most inspiration from its customers – if it can conduct proper research of their needs and collect the remarks related to the utilization of products. Such remarks are gained by means of service and repair points, contacts between salesmen and customers, organization of meetings with customers (e.g., "open door"), or web sites.

Cooperation with customers is for the benefit of the company also at the stage if designing and evaluating prototypes. At the time of creation of a new product customers may be involved in the company's activities on all levels, beginning from feasibility studies up to the creation of a prototype. If the company knows opinions about a new product at each stage of its development, it may quickly produce the product's improved versions even before a prototype is created. It permits the saving up of significant amounts of money and considerable reduction of time necessary for implementation of a new product onto the market. A long period of time necessary for implementation of a new product onto the market is very unfavorable because in the meantime the customers' expectations may change and a given product will not win recipients or there may appear a competitive product.[6]

4. SUMMARY

Creation of innovation in an enterprise is not a simple task. The ability to implement new ideas in an effective way is composed of many factors – from the market analysis up to management of projects and changes. A proper strategy of action is also extremely important. Open innovation strategy enables enterprises the achievement of many advantages owing to the possibility for using external sources of knowledge and technologies with no need to possess them. Open innovation strategy makes it possible to unite the efforts of customers, researchers, companies and institutions in one common process of creating innovation. As a result, new business opportunities, easier access to complementary resources and utilization of synergy effect open up for the company.

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