ANNALS OF FACULTY ENGINEERING HUNEDOARA
– INTERNATIONAL JOURNAL OF ENGINEERING
Tome IX (Year 2011). Extra Fascicule. (ISSN 1584 – 2673)

[1.] Martina KUSÁ, [2.] Miriam MATÚŠOVÁ, [3.]Marcela CHARBULOVÁ

OPTIMALISATION METHOD OF MATERIAL FLOW AT MANUFACTURING PROCESS

[1-3.]SLOVAK UNIVERSITY OF TECHNOLOGY, FACULTY OF MATERIALS SCIENCE AND TECHNOLOGY,
INSTITUTE OF PRODUCTION SYSTEMS AND APPLIED MECHANICS, TRNAVA, SLOVAKIA

ABSTRACT: A today trend in manufacturing is characterized by production broadening, innovation cycle shortening, and products having new shape, material and functions. The production strategy focused to time needs change from traditional functional production structure to production by flexible manufacturing cells and lines. Production by automated manufacturing system (AMS) is a most important manufacturing philosophy in last years.
KEYWORDS: production system, manufacturing, material flow, layout optimizing

❖ INTRODUCTION

This paper was created thanks to project Operational program RESEARCH and DEVELOPMENT (OPVaV-2009/2.2/03-SORO) number ITMS 26220220094 named „Manufacture technical level and control effectiveness increase in the field of plastics component production“. Faculty of Material Science and Technology of Slovak University of Technology in Trnava is realized this project in cooperation with HANIL E-HWA AUTOMOTIVE SLOVAKIA s.r.o. in Považská Bystrica in Slovakia.

The main target of project is a manufacturing and control processes effectivity increasing at plastics parts production process. Goal of effectivity increasing is competitiveness increasing at automotive manufacturing market by knowledge and technology transfer and joined research and development activities between industrial and academic sphere.

This project is covered by the category of applied research. It is focused to planed research for new knowledges and skills acquirement for new plastic component development (tools for plastics molding), processes (new processes in manufacturing) and significant quality increasing of existing products (existing tools and processes optimizing).

Rationalization of production system allows elimination of negative influences on production costs and product price. Rationalization projects starts with data acquisition followed by analysis and evaluation of data. Once aims of rationalization are clearly defined a new production system or innovative production process is designed. Designed changes cannot be implemented during production of the factory, because effectiveness of proposed alternatives is not guaranteed. Due to this reason, simulation of proposed alternatives using various simulation computer programs gains on importance. Simulation is a suitable tool for elimination of imperfections in production process. Furthermore, it allows searching for possibilities of increasing effectiveness of production as well as for problems, which may interfere with continuous production cycle of a factory.

Main aim of rationalization projects is an improvement of production processes and prevention from losses and wasting of all possible kinds of production resources (material, energy, production area, production time, production facilities, etc.), this all from material purchase from supplier to dispatch of finalized products to customer at all workstations as in case of production preparation so as during production itself.

❖ LAYOUT OPTIMIZATION

Principe of systematic application of logical thinking during solution of difficult issues and elimination of losses and wasting during production process is aimed predominately at 4 essential areas:

1. Minimization of stock size and supply and release of financial resources and also lowering the logistics expenditures for storage, manipulation, etc.

2. Constant improvement of all activities of logical chain: suppliers – product – customer (lowering the production costs, shortening the production time, improvement of work environment, etc.)
3. Concentrate attention at sites, which are decisive for quality, competitiveness, perspective, productivity, costs, etc.
4. Optimize system of material and information flows – eliminate losses, which may cause irregularity or overload of production, complexity of material flows, downtime caused by organization imperfections, etc..

Solving the optimization of production requires detailed information about whole production process. Because technological procedure of production is given, it is possible to adjust material and data flow. Fig. 1 shows former structure of material flow through production. Aim was to provide continuous production process in automotive area of Hanil company.

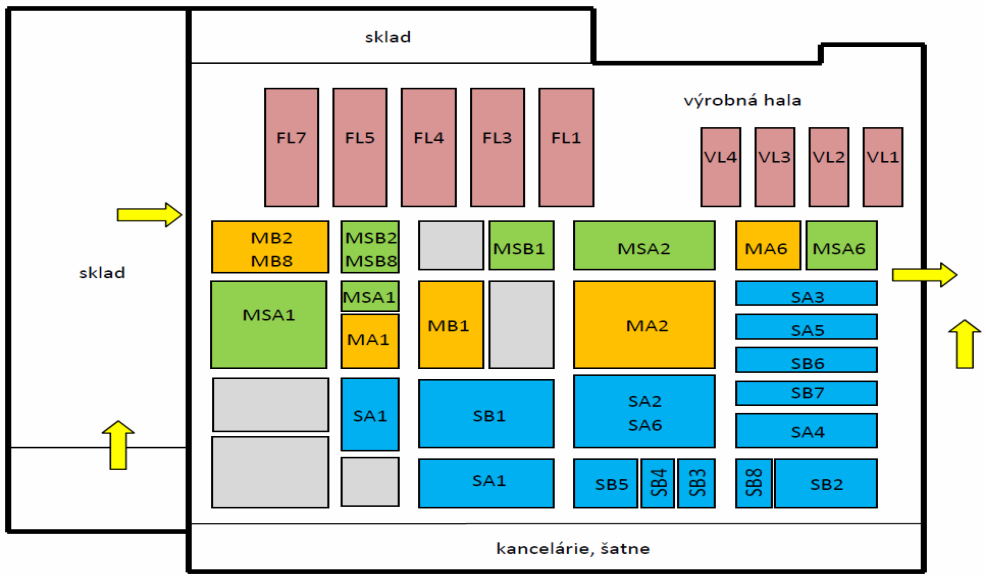


Fig. 1 Former layout of the company workshop

Wastage is present at each workshop, but it is possible to identify and solve it using 5S method, which is suitable for production and service oriented organizations. Applying the 5S method allows achieving an improvement and simplification of material flow, machine layout and stock.

Other benefits are:

- Quality, productivity and safety improvement
- Better company culture, people attitude, less apathy
- Improved work environment.

Method of 5S is under development and nowadays sixth S is also defined, know as safety. Reason is to realize all improvements at workplace in such manner, that employees are not endangered. Apart of this, it put emphasis on availability and unambiguous identification of all safety devices. The aim is to prevent from danger during work and limit occupational accident to a minimum possible.

The aim of material flow projection is solution of:

- Minimization of transport, manipulation and storage
- Simplification of system to minimum – minimum consumption of expenses and time ⇒ solution of important relationships,
- Workplaces and capacities – incorrectly designed capacity causes unevenly distributed material flow, stock accumulation, necessity of inter-stocks and buffers and additional manipulation activities,
- Information flow and control system – correct control of inputs of production tasks, synchronization of purchase, production and dispatch, coordination of system of production control with transportation system,
- All components of the production system have to be designed in mutual relations and it is ideal if all are verified before installation using simulation model.

Solving the given material flow requires specification of the aim of innovation of a given material flow.

The proposal of the layout of production lines is solved as a combination of concerned layout (according to a number of products declared in PQ diagram) and technological layout (consideration of a technology of injection and technology of forming). In the frame of detailed design were relocated beginnings MT on production facilities in order to eliminate intersection of MT directly in front of production facilities. In fact this change counts only for location of the product, which undergoes technological operation. Combination of products in the frame of one production facility remains with

respect to the available capacity unchanged. Respecting the MT proposal, the layout of stocks is realized close to dispatch, taking into account space required for expedition trolleys. Distribution of a part of trolleys with finalized products is realized in proposed annex building of dispatch stock with dimension of 10 × 70 meters.

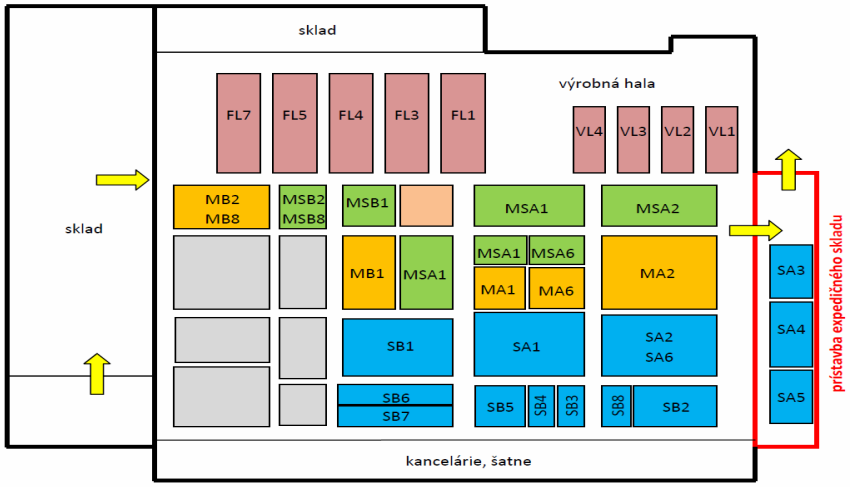


Fig.2 Innovation of the workshop

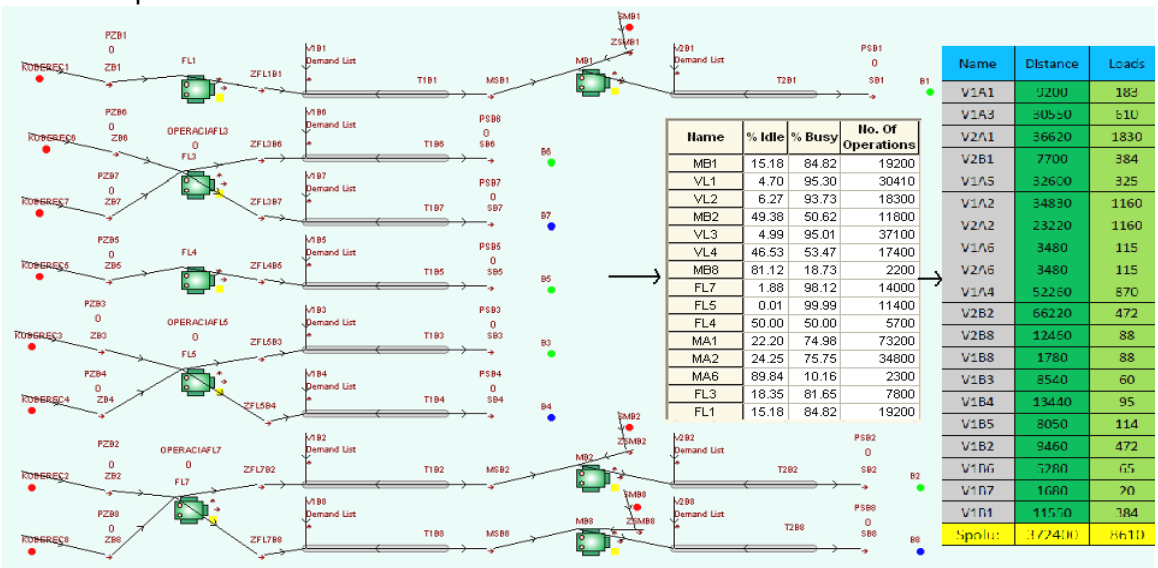
Simulation of the proposed change is possible to avoid unavailing loses during ineffective trials related with application of innovations. During simulation is required to fulfill production plan, which is documented in the form of a table.

Fig. 3 shows production plan, which is compared with values of outputs after the simulation is completed.

SOFT TRIM			MAREC							ROK 2010						
sk. B	VÝROBOK	počet ks v aute	ED 5DV	ED WGN	ED 3DV	KM	EL	počet áut	celkom ks/mesiac	ED 5DV	ED WGN	ED 3DV	KM	EL	počet áut	celkom ks/rok
1.	LUGGAGE SIDE s	2	4 550	3 900	1 150			9 600	19200	50 600	43 400	12 300			106 300	212600
2.	FLOOR CARPET FRT	1	4 550	3 900	1 150	2 200		11 800	11800	50 600	43 400	12 300	33 700		140 000	140000
3.	LUGGAGE CVR MAT	1	4 550		1 150			5 700	5700	50 600		12 300			62 900	62900
4.	LUGGAGE CVR BORD	1	4 550		1 150			5 700	5700	50 600		12 300			62 900	62900
5.	C/SELF	1	4 550		1 150			5 700	5700	50 600		12 300			62 900	62900
6.	LUGGAGE CVR"G CTR	1		3 900				3 900	3900		43 400				43 400	43400
7.	LUGGAGE CVR"G FRT	1		3 900				3 900	3900		43 400				43 400	43400
8.	FLOOR CARPET RR	1				2 200		2 200	2200				33 700		33 700	33700

Fig. 3 Production plan

Figure 4 depicts simulation of SOFT TRIM component production in HANIL company and partial tables with outputs from simulation.



Name	% Idle	% Busy	No. Of Operations
MB1	15.18	84.82	19200
VL1	4.70	95.30	30410
VL2	6.27	93.73	18300
MB2	49.38	50.62	11800
VL3	4.99	95.01	37100
VL4	46.53	53.47	17400
MB8	81.12	18.73	2200
FL7	1.88	98.12	14000
FL5	0.01	99.99	11400
FL4	50.00	50.00	5700
MA1	22.20	74.98	73200
MA2	24.25	75.75	34800
MA6	89.84	10.16	2300
FL3	18.35	81.65	7800
FL1	15.18	84.82	19200

Name	Distance	Loads
V1A1	9200	183
V1A3	30550	610
V2A1	36620	1830
V2B1	7700	384
V1A5	32600	325
V1A2	34830	1160
V2A2	23220	1160
V1A6	3480	115
V2A6	3480	115
V1A4	52260	870
V2B2	66220	472
V2B8	12450	88
V1B8	1780	88
V1B3	8540	60
V1B4	13440	95
V1B5	8050	114
V1B2	9460	472
V1B6	5280	65
V1B7	1680	20
V1B1	11550	384
Spolu:	372480	8610

Fig.4 Simulation of innovation of workshop layout

❖ CONCLUSION

Proposal of new layout of production lines is adjusted for current capacity of production with aim to optimize material flows. Application of proposed solution is in fact possible to realize during full production process, because it counts mostly for relocation of dispatch trolleys. Relocation of those trolleys would be effective after finishing the building of dispatch hall at current dispatch site. Building

the dispatch hall would not affect production process, what is benefit of the proposed solution. Expected time required for building up the dispatch hall with dimensions of 10×70 meters is approximately one month. After finalizing the hall, zones required for different types of trolleys would be calculated and subsequently labeled zones for stock areas, service areas and transportation paths. After the trolleys relocation and clear out the spaces, workplaces for assembly would be relocated. This procedure would affect the production process significantly. This change would be implemented during weekends using internal employees of the company, predominately. Implementation of all changes is expected to last approximately two months. From economic point of view, most significant impact would have an investment into the new stock for distribution logistics. Expenses related with relocation of workplaces are negligible and could be realized also during full production. When comparing this investment with shortening transportation time between workplaces, return on investment is expected in few months. From the long term point of view and considering ambitions of the company, which are aimed at increasing volume of production, the investment into dispatch stock is in short term range necessity. Other advantage of building the dispatch stock is simplification of production process and establishment of space for dispatch trolleys with finalized products.

❖ ACKNOWLEDGMENT

This article was created with the support of the OP Research and development for the project **Manufacture technical level and control effectiveness increase in the field of plastics component ITMS 26220220094,** co-financing from the resources of European Regional Development Fund.

Operačný program VÝSKUM a VÝVOJ

Support research activities in Slovakia/ Project is co-financing from resources EU

Európska únia
Európsky fond regionálneho rozvoja

❖ REFERENCES

[1] DANIŠOVÁ, N. - ZVOLENSKÝ, R.: Intelligent manipulating and transport systems. In: International Doctoral Seminar 2007 : Proceeding. 13-16 May, 2007, Smolenice. - Trnava : AlumniPress, 2007. - ISBN 978-80-8096-011-7. - pg. 34-38

[2] HORVÁTH, Š. - DANIŠOVÁ, N.: Power elements of flexible manufacturing and assembling systems. In: International Doctoral Seminar 2008 : Proceedings. Smolenice, May 18-20, 2008. - Trnava : AlumniPress, 2008. - ISBN 978-80-8096-058-2. - pg. 130-136

[3] HRUŠKOVÁ, ERIKA - HOLUBEK, RADOVAN - VELÍŠEK, KAROL: The possibilities of increasing the flexibility of intelligent assembly cell. In: 10th Biennial Conference on Engineering Systems Design and Analysis (ESDA2010) : Turkey, Istanbul, July 12-14, 2010. - : ASME, 2010. - ISBN 978-0-7918-3877-8. - S. 1-10

[4] MUDRIKOVÁ, ANDREA - HRUŠKOVÁ, ERIKA - VELÍŠEK, KAROL: Logistics of material flow in flexible manufacturing and assembly cell. - registrovaný v ISI Proceedings. In: Annals of DAAAM and Proceedings of DAAAM Symposium. - ISSN 1726-9679. - Vol. 19, No.1. Annals of DAAAM for 2008 & Proceedings of the 19th International DAAAM Symposium "Intelligent Manufacturing & Automation: Focus on Next Generation of Intelligent Systems and Solutions", 22-25th October 2008, Trnava, Slovakia. - Viedeň : DAAAM International Vienna, 2008. - ISBN 978-3-901509-68-1, s. 0919-0920

[5] MUDRIKOVÁ, ANDREA - KOŠŤÁL, PETER - VELÍŠEK, KAROL: Material and information flow in flexible manufacturing cell. - registrovaný v ISI Proceedings. In: Annals of DAAAM and Proceedings of DAAAM Symposium. - ISSN 1726-9679. - Vol. 18, No.1. Annals of DAAAM for 2007 & Proceedings of the 18th International DAAAM Symposium "Intelligent Manufacturing & Automation: Focus on Creativity, Responsibility, and Ethics of Engineers" : Croatia, Zadar 24-27th October 2007 (2007). - Viedeň : DAAAM International Vienna. - ISBN 3-901509-58-5, s. 485-486

[6] PECHÁČEK, F.; CHARBULOVÁ, M.: Stavebnicové upínacie systémy. Modular fixture systems. In: Strojárstvo - Strojírenství. - ISSN 1335-2938. - Roč. 12, č. 9 (2008), 191/5-192/5

[7] VELÍŠEK, KAROL - JAVOROVÁ, ANGELA - KOŠŤÁL, PETER: Flexible assembly and manufacturing cell. In: Academic Journal of Manufacturing Engineering. - ISSN 1583-7904. - Vol. 5, No. 2 (2007), s. 141-144

ANNALS OF FACULTY ENGINEERING HUNEDOARA
– INTERNATIONAL JOURNAL OF ENGINEERING