

SYSTEM APPROACH FOR PRODUCTION ORGANISM DESIGN

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ABSTRACT

Companies in these days fight with a huge market competition. The pressure on the quicker, cheaper and superior production increases. The tendency is also to make it more lean and effective. This trend brings for someone new for someone known conception – digitizing. Digitization helps engineers to plan, optimise and experiment without any hit to the real production. Hand in hand with production layout design must go ergonomic of individual workplaces and eventually of whole factory. Not only have the big companies realized that the ergonomics can be a tool for competitive advantage same as for company's culture support. Slowly but surely it begins to observe the rule, that the ergonomic studies must be included to the production planning process before creation of the final layout, because later ergonomical analyzing of workplaces shows as less efficient. In this paper the reader gets familiar with area of production system's digital designing according to the ergonomical criterion and with possible software tools that represent modern approach for disposition proposal of production system.

Keywords: system approach, production layout, ergonomics, digital factory

1. INTRODUCTION

The pressure from globalization hasn't avoided even the area of workshops, manufactures and whole companies' projection, where it has started to give pressure on flexible structures which are capable of permanent optimization and adjustment. Crucial is speed, high output and specialization ability according to consumers needs. Years ago factory projection was regarded as something extraordinary, as something, which is being created for decades. Though the company has expanded the old stayed unchanged for many years. Buildings lifetime was calculated for 80 years, but of course we know objects, which age is even 150 years and they are still being used in these days with a row of stress from past years.

Revitalization of production basis is therefore becoming a necessity. In many companies it will be necessary to carry out extensive rationalizations, somewhere even brownfield reconstructions, because efficient production basis is a foundation of each manufacturing concern. It is relatively frequent, that the spaces of these companies were to be designed without any regard to workers safety and comfort.

Every production consists of several resources like machinery, equipment, personnel etc., which must be carefully chosen for individual operations and also suitably dislocated in single productions and warehouses. This is becoming crucial for efficient material and informational flow.

2. SYSTEM APPROACH FOR LAYOUT CREATION REGARDING TO ERGONOMIC ASPECTS

The projection of production spaces is no more understood as something extraordinary, but it is in these days comprehended like standard process or result. In the same way as with the product this requires system approach which takes into account many factors that effect the spatial disposition of

single workplaces. We must start finding the solution from those primary (smallest) elements, whose clustering comes to dispositional layout of individual groups of workplaces and finally layout of the whole company. This system approach for solving company's dispositional proposal is digestedly visible on the following picture (Figure 1.).

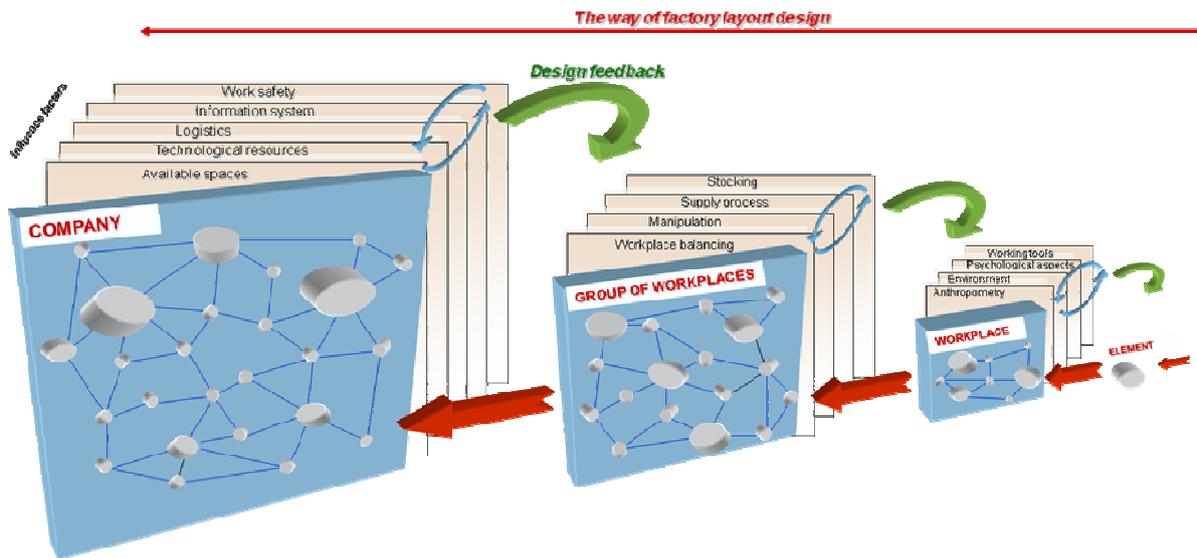


Figure 1. System approach for creation of production layout

The picture shows, that during layout design it is necessary to deal firstly with simpler, less complicated elements. It is necessary to analyse these elements, whether they are functioning effectively not only like independent element, but also as an element affecting the whole net. It is evident, that the cooperation of single subjects (as well as cooperation between ergonomists and designers) represents fact which must be during proposal of production basis (production layout) at present days taken into account by every industrial engineer.

3. PREMISES FOR PRODUCTION LAYOUT PROPOSAL

The reason why industrial building doesn't match the logistic requirements is from a little considered and elaborated block layout. The layout creation is above all coming - out from the building textures. From this reason it is very important at the beginning of proposal to utilize knowledge from logistician – specialist on operational processes.

Basic determining parameters in production systems are shape, size and intensity of material flows. In fact the production system is also influenced by costs connected with realization of existing material flow, i.e. a part of logistic costs on production system.

During elaboration of material flows we examine the most effective sequences of material flows through out the necessary phases of production process, as well as intensity (range) of these movements. Efficient flow requires that material must proceed through production process progressively without useless circuits and counter movements. Material flows study is a backbone of projection above all there, where main part of production process is material movement, especially at the time, when material is big, heavy or numerous or there, where costs on transport and manipulation with material are higher in comparison with costs on manufacturing operation, stocking and control.

4. WORKPLACES

One of the first things, which we must do during workplace design, is determination of a workplace against the whole system (the layout of whole company). It is important to determine the relations to other workplace and company's infrastructure, because designed workplaces represents only individual modules. By linking these modules together with the help of single connectors, that are represented by inputs or output from workplace, we create more complex units such as groups of workplaces, lines, and finally the general layout. Only by this approach we can ensure so many times

above mentioned system approach for given problems solving. Following picture (Figure 2.) helps for better understanding of this idea. The workplace is here represented by so - called black box, which is already defined and well arranged according to ergonomical rules and where the transformation of products by the technological process happens. Further more all bindings or connectors, which are needed for clustering of the individual workplaces and creation of the overall layout, are illustrated here.

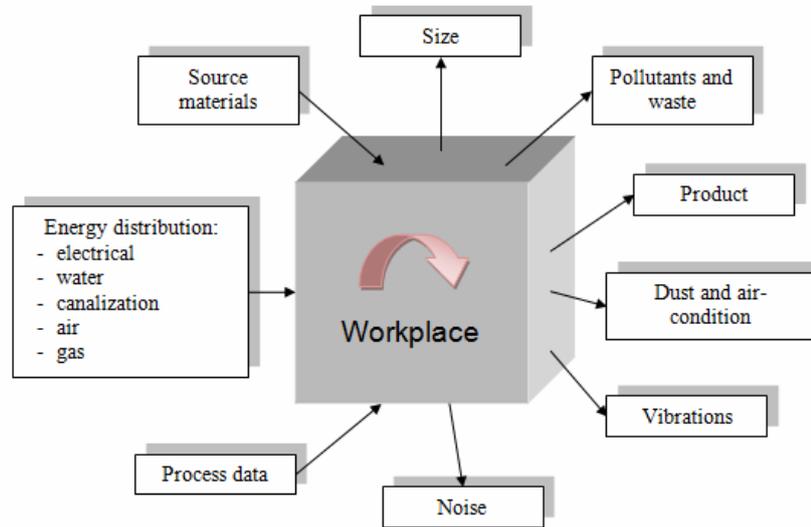


Figure 2. Workplace connectors for layout creation

5. THE USAGE OF DIGITAL TOOLS FOR VIRTUAL PROJECTION

Software tools from Digital factory area enable detailed view on production system - layout already in primary phases of proposal. Designers are then able to prevent risks, which are rising from bad proposal of production layout, workplaces disposition and from related material flows. Using some of these tools brings in this area following benefits:

- More effective intern company logistic (improved material flows)
- Increase of production flexibility.
- Manipulation and stocking quality grow.
- Disposition validation in virtual reality.
- Verification of suitable working postures with the help of simulation.
- Reduction of times needed for material manipulation, etc.

Of course we cannot forget one of the biggest advantage which is complete acceleration of overall production system proposal.

Table 1. Possible software tools for individual steps during layout creation

Single steps	Layout segment	Main areas of solution	Possible software tools	Preview
1. step	Analysis of individual workplace	Ergonomics Working conditions Time rationalization Disposition of individual workplace ...	Delmia Process Engineer Delmia V5 Human	

<p>2. step</p>	<p>Analysis of group of workplaces</p>	<p>Process analysis Disposition of workplaces Supply Inter-operational manipulation ...</p>	<p>Delmia Process Engineer VisTable</p>	
<p>3. step</p>	<p>Analysis of whole company layout</p>	<p>Process analysis Whole production layout regarding material and personal flow fluency</p>	<p>Delmia Process Engineer VisTable</p>	

6. CONCLUSION

In this paper we have tried to explain how important is that logisticians, ergonomists and designer should cooperated during layout creation. Further more it is very important to keep in mind the system approach to all individual phases during layout proposal. That's the only way how we can achieve the best configuration of production layout which pays attention to all important aspects. In the paper we have also mentioned several possibilities of Digital factory software tools that generally accelerate the dispositional proposals.

7. REFERENCES

- [1] Bureš M., Černý Z., Roubal J.: Increasing effectiveness in production planning with the help of the DPE module In: 1st year of international seminar MATEO, Železná Ruda, Czech republic, 2006, ISBN 80-7043-505-9
- [2] Hlavenka, B. : „Production systems projection“, Academic publisher CERM, Ltd. Brno, Czech republic, 2005, ISBN 80-214-2871-6
- [3] Dassault Systèmes,; DELMIA Solutions. <http://www.delmia.com>
- [4] visTABLE®, Hannover, <http://www.vistable.com>

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