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PROCEDURE FOR DRAFTING A PROJECT AND SELECT THE MOST APPROPRIATE VARIANTS OF SIMULATION MODELS FOR OPTIMIZING ASSEMBLY LINE DOORS OF CAR

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Abstract: The content of this paper is a proposal for assembly line doors of car and their components. It describes the Procedure for drafting a project for evaluate the suitability of alternatives using simulation models of these variants workplaces. These of variants each other qualitatively and quantitatively compares and describes effective and optimal. At the beginning of post briefly describes the theoretical knowledge of the field of simulation and clarifies their advantages and disadvantages.

1 Simulation and its use

The notion of simulation is presented as statistically - research method, which follows from the nature of the system under examination, from which are obtained information on the researched system. Output data using computer simulations give a realistic picture of the documents that are necessary for the development of downstream analyzes. The cycle uses the simulation model at an early stage is to build the model to the real system, where they carry out the necessary experiments. These are then interpreted correct results, which are constantly optimized to improve the understanding of the actual or future system. Computer simulation does not allow obtaining direct, optimal results, respectively. their solutions. Therefore, it is applied as a support system. With his help is possible to test different effects carried on the simulation models. The result is a solution that can help improve productivity and quality. The object of each generated simulation process is to identify the goals that are helpful to achieving specific results. When simulating systems, objectives determined by the structure of planning, experimentation and subsequent evaluation.

By help clearly defined objectives simulating and experimental systems, it is necessary to ask questions such as:

- What is achieved by a given stimulation?
- How much time is required to the simulation?
- Which aims are achieved using simulation?
- Why is needs aim achieved by the help a simulation?
- Who is responsible for target a simulation?

The main advantage of simulation lies in its method of interpretation of the simulated process. By using in the currently available simulation software can convert simulation in the process of the desired time (several minutes) to obtain the amount of output information in the form of the output message, such as use of machinery, downtime, efficiency, critical path.

Processes in which a suitable resp. inappropriate applied simulation are shown in Table 1.

Table 1 Suitability for use simulation in processes

Suitability for use a simulation	**Inappropriateness for use a simulation**
If it is necessary in a short time draw conclusions behavioral processes, which in real time was a longer	Simulation can be administered less accurate results than direct mathematical analysis
Creating a virtual presentation behavior of the new system using the selected animation	The need for financial resources exceeds the limit

Experimentation using simulation process does not disrupt the functioning of the real system	Been studied system can be addressed a mathematical way (analytically)
The use of simulation for verification of the analytical solutions - process control	Insufficient and inaccurate information to support the simulation experimenting
Removing badly proposed experiment and thus avoiding unnecessary disaster, waste of resources	The credibility and reliability of the models is low - simulation model represents only stochasticky system elements
Properties in under the examination system are changing (changing very quickly, resp. slow)	Required demanding hardware for of complex realistic simulation systems
Use as a tool to gain the experience, resp. workout, training	To create the model required expertise and training
More flexible presentation as mathematical simulation	

2 Proposal phase of the project

In this first phase, propose a model element halls for manufacturing doors,here are formed chosen models of machinery and auxiliary equipment. Designing takes place on the basis of technological production layout together with the implementation of compliance with technological and handling areas. The draft plan view of two variants of the line was used software AutoCAD Architecture (Fig. 1.2)

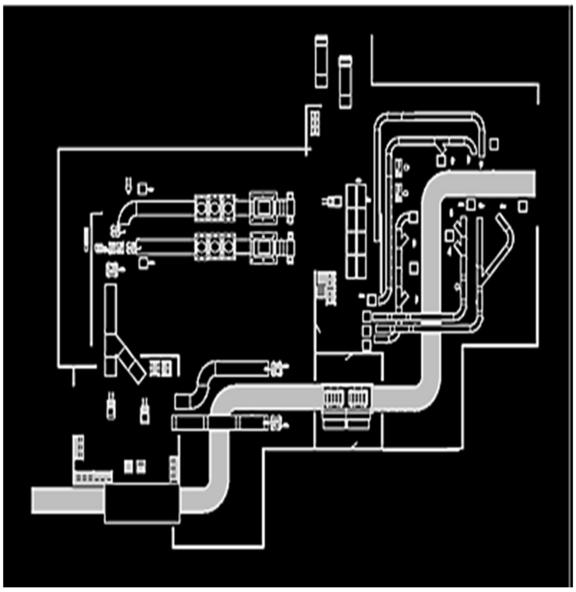

Fig. 1 Proposal layout in variant 1

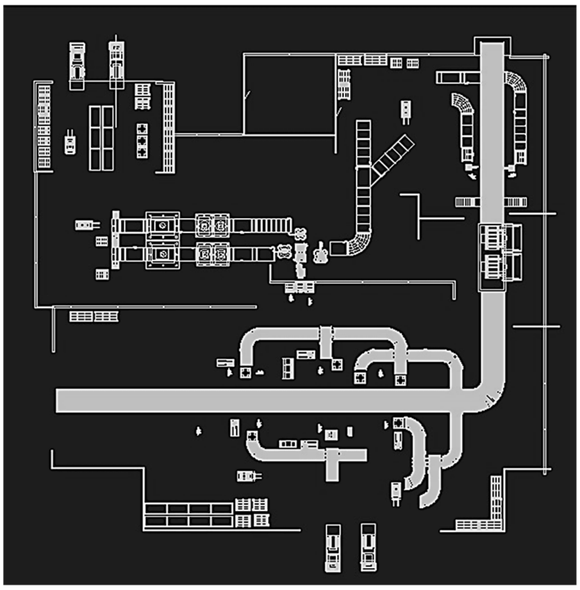

Fig. 2 Proposal layout in variant 2

3 Simulation and a optimization phase of the project

The simulation-optimization phase of the project was used alone simulation tool to create a simulation model of the production line. This tool was a software module Tecnomatix Plant Simulation. When processing simulation models was necessary to know all the components required for the manufacture and installation of doors and according to them layout design workplaces. At the Figure 3 shows the essential components of the door.

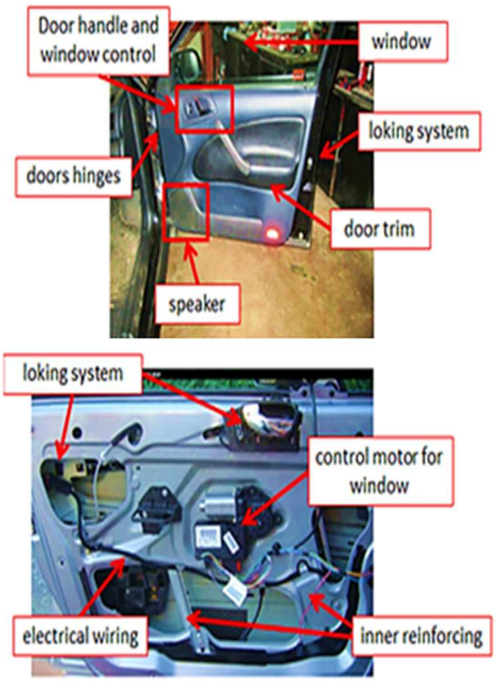

Fig. 3 Parts in the car doors

3.1 Proposal variants of production

Processing simulation models originated by the insertion of duplicate objects from the tree structure formed on a simulation desktop using drawing documentation of and technological operations.

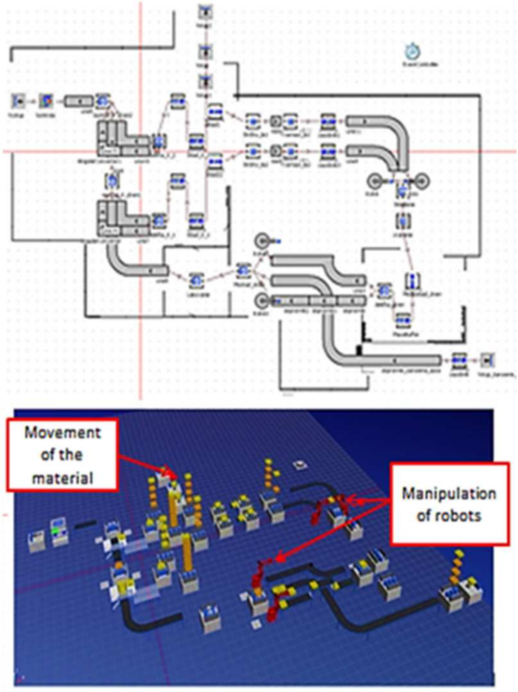

Fig. 4 Simulation model for Variant 1 in 2D and 3D

After entering the time horizons of all objects began tracking simulation process, which had to be constantly tweaking mostly conveyor time structure to achieve the desired parameters of the whole production line. This a lengthy process with the task of removing various deficiencies in the production process. As one variant is not possible to assess whether the correct and most appropriate for the production process, it is necessary to propose at least 2 variants. The second type of layout configuration plant and equipment was specific in that compared to Option 1 has two storages and shorter length of the conveyor to different sections of the production line. The second type of workplace generated 3D model (Fig 5) is different structure and length of the conveyor. Edit conveyor was also treated in a similar manner to the first variant.

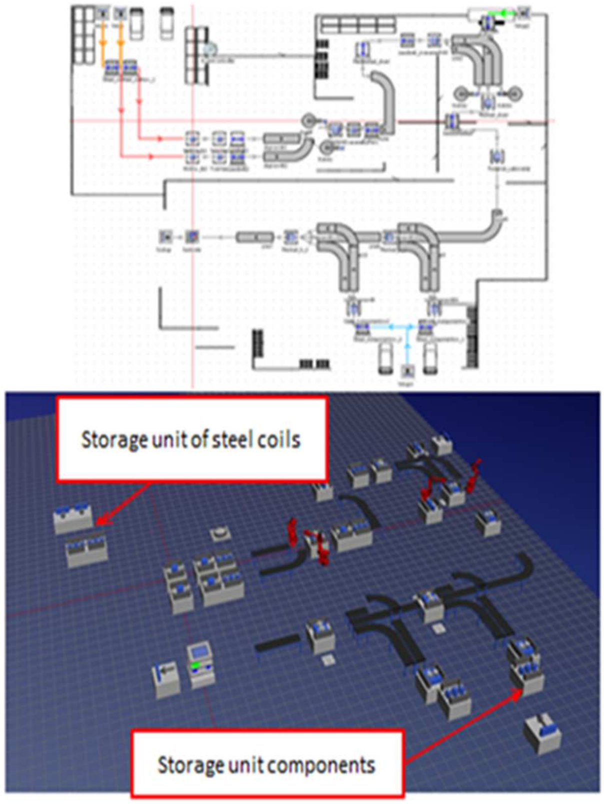

Fig. 5 Simulation model for Variant 2 in 2D and 3D

Manufacturing time of each operation are shown in Table 2. This is necessary to know the times for setting the different elements of the simulation and comparison at change layout workplaces.

Table 2 Manufacturing time of each operation

Operation	**Time of the operation (s)**	**Manipulation time (s)**
Shearing	20	2
Surface forming	30	2
Welding	120	10
Door assembly	120	50
Paint Application	300	10
Door dismantling	120	50
Assembly components	180	100
Inserting door and control	300	80
Together	**1190 s**	**304 s**

Output statistics needed for the evaluation is obtained by running the quick simulation, which are all referred to objects in the simulation area, the program generates detailed output statistics. Then carries out evaluation and appropriateness of the variarnst.

When comparing variants of assess data relating to the productivity of individual items in the simulation model, further compare, for example, material flow both

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variants. Table 3 highlights the difference between the two variants, and displays data on the use of machines or individual operations in the manufacture of a door.

Table 3 Comparison of productivity selected Machines

Activity / operation	Variant 1 %	Variant 2 %	The suitability of variant
Shearing press 1	17,27	23,37	V2
Shearing press 2	9,09	23,37	V2
Forming press 1	10,30	30,43	V2
Forming press 2	4,85	30,43	V2
Assembly reinforcement	9,09	33,70	V2
Welding	9,09	32,61	V2
Installation of doors on the car body	18,18	8,70	V1
Lacquering	45,44	21,74	V1
Assembly door components 1	18.18	21,74	V2
Assembly door components 2	18,18	21,74	V2

The evaluation of the output is defined optimum use of machinery and operations in favor of the second variant in ratio of 8/2, which is mainly reflected in the operations of pressing and folding operations along with welding.

Output statistics provide also information on the use of industrial robots KUKA in the manufacturing process of welding and material handling. Are taken into account data in the form of waiting times material when folding door reinforcement in the process of welding and assembly of components for bodywork.

Table 4 Statistics for manipulation KUKA robots

KUKA robots	Variant 1	Variant 2
	Waiting time for material%	Waiting time for material%
KUKA 0	23,28	94,14
KUKA 1	54,84	93,62
KUKA 2	1,85	90,56
KUKA 3	84,52	16,54
Average waiting time	41,12 %	73,72 %

In the process of waiting time in material handling is a useful first indications variant with an average waiting time 41.12%, compared to the waiting longer variant 2 with a 73.72% average waiting time. The use of robots in material handling in the production process (Tab.5).

Table 5 The range materials handling with of the robots

Variant 1

Object	Rotation Empty		Rotation Loaded	
	Portion	Sum	Portion	Sum
KUKA	0.08%	2.6565	0.09%	2.9517
KUKA1	0.29%	9.6565	0.26%	8.7468
KUKA2	0.12%	4.0000	0.15%	5.0000
KUKA3	0.00%	0.0000	0.03%	1.0000

Variant 2

Object	Rotation Empty		Rotation Loaded	
	Portion	Sum	Portion	Sum
KUKA	0.90%	49.7199	0.90%	49.5640
KUKA1	0.59%	32.5000	1.16%	1:04.0000
KUKA2	0.01%	0.2952	0.01%	0.6695
KUKA3	0.07%	3.7133	0.05%	2.6780

From the outputs listed in Tab.5 shows that Variant 2 is optimal, as it provides a greater range of operation of material handling processes compared to first variant. After an evaluation of selected parameters productivity of machines, as well as working and waiting times, along with other generated and selected data and statistics presented simulation software can be considered more appropriate Variant 2.

Conclusions

Simulation software facilitate the activity in decision-making process when comparing different variants of optimization and improvement of production efficiency. With The comparison of statistics, it is clear that in this case is for improve the process of making effective Variant 2. This assessment possibilities of improvement of the production can be conducted at any intended optimization of an existing of production, and also in the design of new production lines and halls. Therefore, the use of simulation and digitization of primary production processes highly preferred option and currently is becoming a necessity. Such verification of optimal variants in the planning process prevent problems during the implementation of production and saves money and time in debugging production factors. It has its advantages even when you are archiving data on the project and the formation of a similar project in the future, these data can be used and thus shorten designing time. The advantage is the fact that the Evaluation Team which working on a project need not be physically gathered at one place and time, but you can share the information and always have on hand the current version in which the project is located. Such backup and data editing helps in managing the full life cycle of the product and production

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