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FLEXIBLE VIRTUAL MANUFACTURING SYSTEM

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Summary: Simulation allows the user to quickly analyze and understand the functioning of flexible manufacturing flows, somewhere between theory and practice. Virtual completion of flexible manufacturing systems to be achieved is an important step towards a higher quality rate of the future "real" technological flow.

The conditions which determine the existence of products on the market are: the permanent increase of quality and a continuous adjustment to changing requirements of manufacturing systems.

In order to obtain adequate quality which assures economic efficiency at the same time implies achievement of the best balance between the social order and science and technical resources of the industrial environment.

All these requirements can create the best balance in case when the production system is automatic at all levels of industrial structures.

Rendering production systems automatic implies integration of equipment functions so that proper systems are obtained for completion of production specific variable tasks.

Integration of equipment functions is made based on a well determined logistic plan in order to satisfy the need to coordinate well all activities related to machining, storing of parts and sending them in the packing areas.

For maximum efficiency, any organization should:

- Improve its performance by implementing an efficient quality management system
- Identify the current and future requirements of customers, ensuring their complete satisfaction, because any organization depends on its customers
- Obtain the expected result as efficiently as possible
- Have a system based approach by identifying, understanding and managing the interrelated system of processes for a certain goal, thus contributing to assurance of organizational efficiency, etc.

Monitoring the completion of these items, can be easily achieved at this moment with the help of software specialized in designing and simulation of the process to be tested. Thus, the given situation is analyzed, determining the goals, assessing and monitoring the extent to which the system can comply with requirements, what modifications are necessary for this purpose, which are the most important results obtained, whether available data is enough and what new information is necessary. Based on obtained results priorities are set, and a potential improvement plan is prepared or the application of simulated information based on completed assessments.

Development of computer assisted simulation and designing techniques is the result of increased complexity of electronic systems and of the need to reduce research-designing-manufacturing cycles of the new systems.

The advantage of analyzing and testing flexible manufacturing systems without the need to complete them led to an “explosion” of specialized software.

Simulation allows the user to quickly analyze and understand the functioning of flexible manufacturing flows, somewhere between theory and practice, and the practitioner is provided with the best solution much faster.

The technological manufacturing process implies defining of requirements the process imposes, designing and monitoring of its layout.

For an efficient simulation the steps indicated in figure 1 below shall be completed:

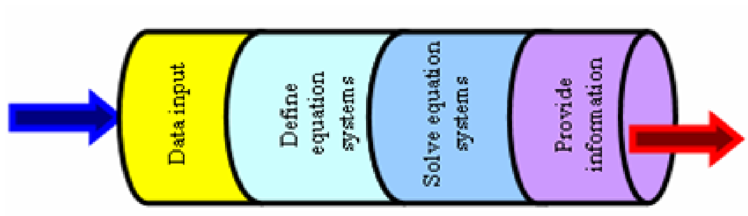


Figure 1

We know that the model of a production system (fig. 2) is:

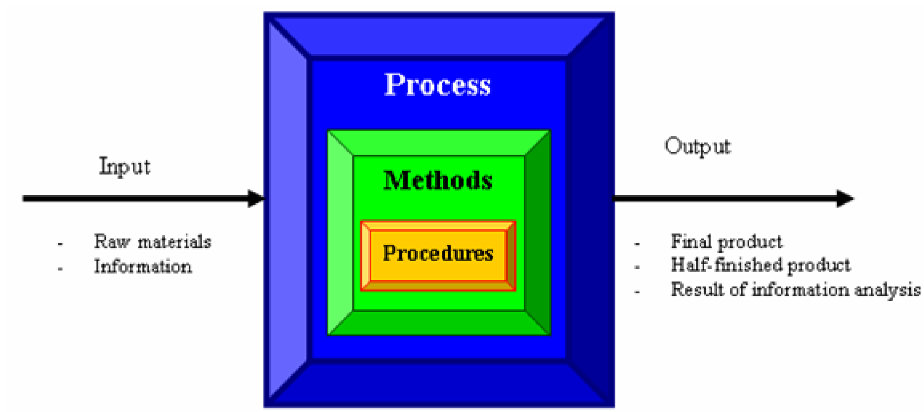


Figure 2

The defining model for simulation (fig.3) is:

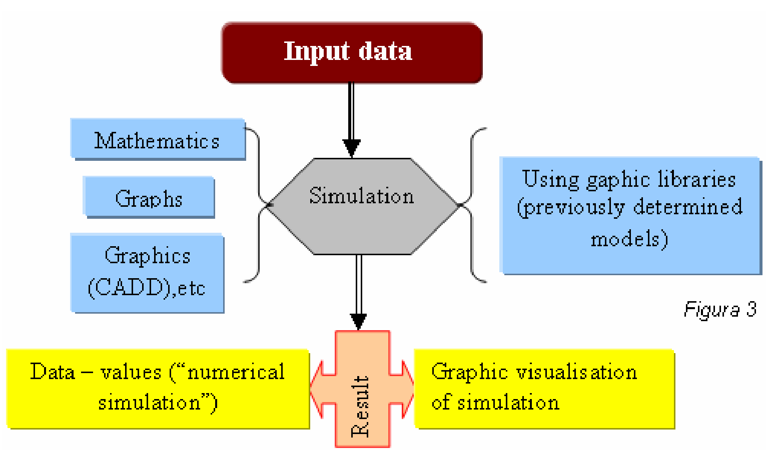


Figura 3

We also took into account this model when we wanted to complete a flexible manufacturing cell within the PhD thesis. Actually we completed a virtual cell, that we analyzed by applying 3 types of simulations:

1) GRAPHICAL-NUMERICAL SIMULATION

Starting from basic technological flow (fig.4) we passed on to graphical-numerical modeling and simulation by means of graphs (fig.5), using software specialized in this type of simulations. Further to simulation, charts and table values were obtained (fig.6) which highlighted the profitability of the simulated process.

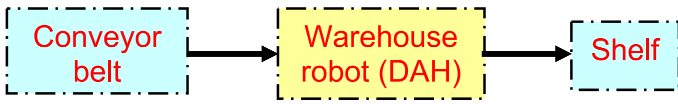


Figure 4

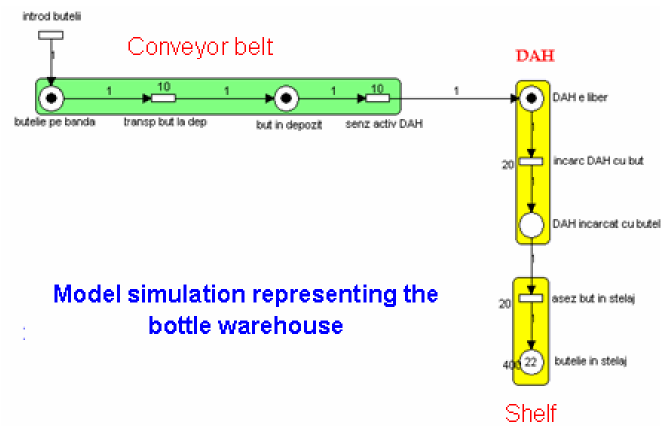
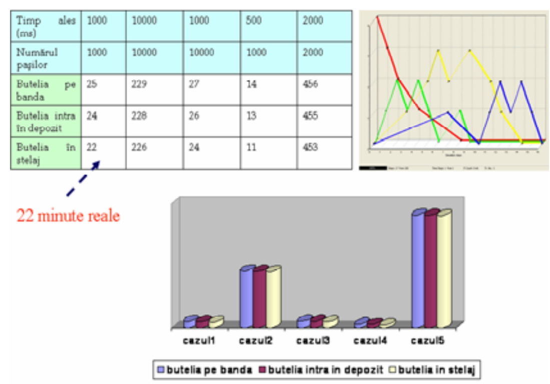


Figure 5



Timp ales (ms)	1000	10000	1000	500	2000
Numărul paşilor	1000	10000	10000	1000	2000
Butelia pe banda	25	229	27	14	456
Butelia intra în depozit	24	228	26	13	455
Butelia în stelaj	22	226	24	11	453

Figure 6

2) GRAPHICAL SIMULATION (CADD)

By means of another soft, this time specialized in CADD, we created the flexible cell, which strictly seeks during virtual "functioning" to obtain numeric results highlighted by graphical-numerical simulation. In other words, we achieved a virtual flexible system (fig.7).

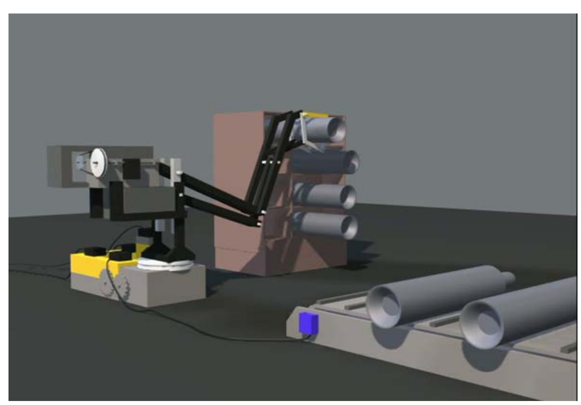


Figure 7

3) CIM SIMULATION

In order to confirm the performance of items designed in CADD, we used a third soft, named Simul8, to obtain more detailed information on the way the simulated cell functions (fig.8).

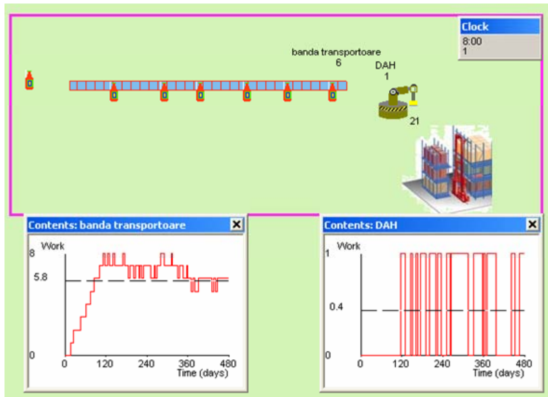


Figure 8

The importance of simulating flexible systems by using CADD type software, was discovered and sustained by important companies in this line of business among which we can indicate FESTO as well (important company which builds and implements industrial robots); its official site presents a series of simulations completed by means of the COSIMIR software. As an example I shall present the simulation of a handling robot, used at an assembling table. The first figure indicates it's designing in CAD and the second figure indicates simulation of its functioning on the job (fig.9).

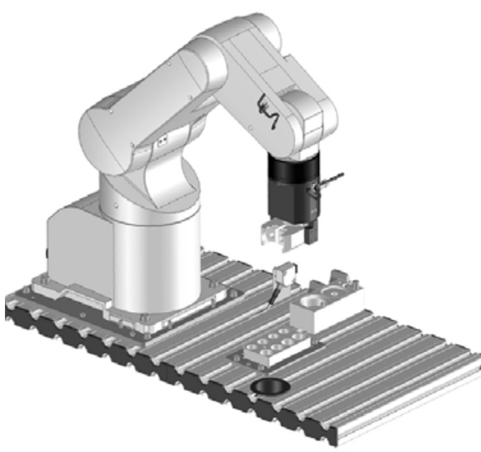
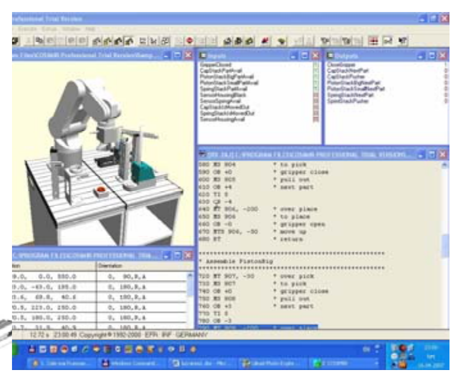



Figure 9

The indicated simulation ways achieve "preparation" for what follows: the virtual world where the interaction of the man with the environment shall occur by means of senses and limbs s/he has to act in a space, which until now was considered as being three-dimensional.

In the virtual world we shall be in permanent contact with the environment we want to modify and simulation shall occur first in the human brain. Virtual reality is thus, a computer generated simulation of a three-dimensional environment where the user is capable to visualize and manipulate the content of that environment.

By means of specialized software for simulators, interaction programs and by means of VR equipment and technology (fig.10) (3D glasses, VR headphones - Head Mounted Display, 3D monitors, VR gloves, haptic and interaction 3D trackers – they track movements of the human body) **designing of the plant of the future,** of **flexible manufacturing systems** shall know a new dimension.

Figure 10

Currently almost everything surrounding us as image on different supports consists of plane images. The present "knocks at our door" to introduce us to the design accessories of the future:

- **3D monitors**: visualizing equipment by means of 3D stereoscopic. The main component of such a monitor is an optical device: matrix selection filter "in waves". Working at resolutions of 1024x768/16, 24, and 32 and with diagonals of 17", 19", 40" these monitors are more and more applied in interactive graphic presentations, in scientific applications and for 3D design programs.
- **3D volume displays** (fig.11). This device consists of 20 different LCDs placed one after another and a DLP projector behind them. For static or slow moving objects the 3D effect is remarkable. Their technology continues to develop.
- **3D space device** (fig.12): allows full-color display for static and moving objects which take a volume in space, allowing the user complete and circular visualization by 360 degrees in space.
- **Stereoscopic 3D display systems of high dimensions** (fig.13). These systems start to find their use in many fields where three-dimensional visualization without 3D glasses is required.
- **Stereoscopic 3D display systems with DLP 3D projectors** (fig.14)

Figure 11

Figure 12

Virtual reality is already included in information representation techniques. The virtual space shall slowly but certainly become the future laboratory of the scientist. Even if there are no sufficient instruments to build sophisticated 3D worlds yet, processes like tele - sensation (computer vision, computer graphics and telecommunications) offer the premises for representing information in a familiar, easy and complex form.

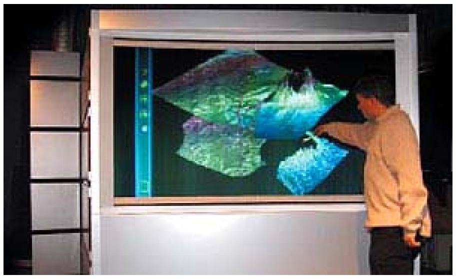


Figure 13

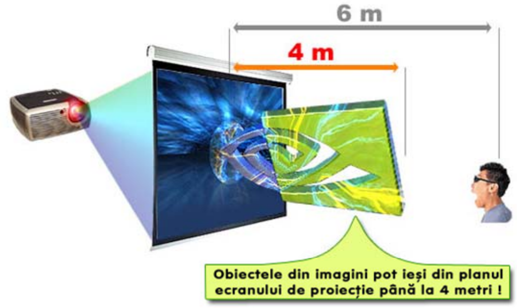


Figure 14

It is certain that continuous development of modeling and simulation languages shall lead to the appearance in the following years of some ways for intelligent data handling, by transferring our innovative ideas into the cyber space which is constantly transforming and expanding.

The future belongs to virtual reality, and virtual manufacturing shall be transferred from theory to practice, resulting in creation of a new dimension of knowledge.

CONCLUSIONS

So a virtual flexible manufacturing system is a system modeled and simulated by means of “computer assisted design process” and consists of 5 main steps: recognizing needs, defining the issue, analysis, project revision and its reassessment, assisted drawing.

The analysis of each step is made based on conventions specific to each simulation program, aiming to highlight numeric results of simulations.

Based on the model and simulations, the final manufacturing design is completed, to further serve the actual implementation of simulated flexible systems.

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