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MATERIAL FLOW ALTERNATIVES OF FLEXIBLE MANUFACTURING SYSTEM

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Abstract: In dependence on manufacturing programmes of factory there are designed the innovations to increase manufacture productivity with usage of sensory devices and robots. The flexible substitution of human work is designed in several steps of subsystems, as production, logistics, storage, maintenance, directing of information data transmission. Within designed modifications in manufacturing process there are analysed designs through the virtual industrialization to provide for manufacturing processes their modifications, reconciliation and if there are set up to operation in the real time.
Keywords: manufacturing, flexible, storage, assembly, iCIM 3000

1. INTRODUCTION

In the present, automation manufacturing systems are used nearly in the each manufacturing factory. Automation manufacturing systems designs for manufacturing process are necessary to analyse in several levels of development. Concrete, from the preparation of manufacturing process through the technical realisation, to estimated development prognosis. Flexible adaptation to the requests concrete to manufacturing process modifications to make possible the flexible manufacturing lines. There is possibility to modify or to adapt these lines overall or partially according to changes of production process. These modifications occur if the manufacturing process was innovated or if the production program was changed. Modifications have to minimalize the logistics costs. These costs influence the optimized distribution of workpieces material in manufacturing process that is conditioned decreasing of manufacturing times. Logistics modifications in manufacturing process is possible to realise according to the particular criterions and assessments of several variants of possible modifications. To be effective the choice of modification is realised by team of experts and they are interesting in material flow study via various logistics methods and simulation programs. The selection of suitable method or simulation program depending on specific conditions of manufacturing processes.

2. DIVISION OF FLEXIBLE MANUFACTURING SYSTEMS

In present there is exists several types of flexible manufacturing systems that they are divided according to several divisions. In the picture 1 is shown division of flexible manufacturing systems. Definitions of the most important and the most used types of manufacturing systems are the follow:

- Flexible manufacturing system – functional configuration of manufacturing devices that are related with material and informative flow, to make possible the effective producing the small number of particular products.
- Unitized manufacturing system – flexible configuration of compatible elements and their mutual relations that is extended with the new elements and with intention of system parameters modifications.

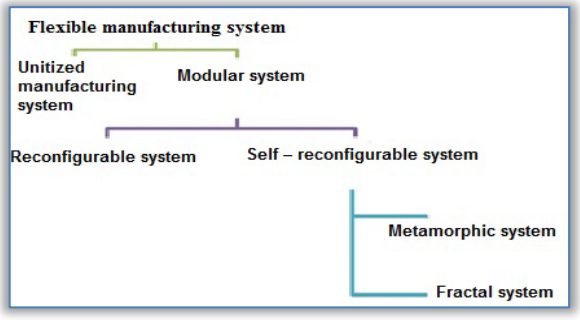

Figure 1. Selection of flexible manufacturing systems

» Modular system – flexible configuration of unification modules of functional logical configuration into higher level functional entity.
» Reconfigurable system – modular system with configuration ability of their own modules to create innovative system.
» Self – reconfigurable system – reconfigurable system that is able to make independently the modification of own module configuration to create innovating system.
» Metamorphic system – closed self – reconfigurable system.
» Fractal system – open self – reconfigurable system that is consists of proactive active elements (fractals). Their structure repeats and monitors of mutual aims. [1]

3. FLEXIBLE MANUFACTURING SYSTEM iCIM3000

Manufacturing system consists of production machines with designed manipulation and auxiliary devices that will be as support for production of asked production object. Manufacturing system is process unit with all activities, processes and devices that are necessary for preparation of production plan and for production of asked production object.
Internal subsystem of manufacturing process is divided into:
» Technological subsystem – consists all production machines and devices that realise technological operations producing the technology of production object.
» Transport and manipulation subsystem – consisted all devices realising manipulation with all material objects related with production realisation of the object in the concrete manufacturing system.
» Storage subsystem – consists of all devices realising the operational storing of all material objects related with production realisation of the object in the concrete manufacturing system.
» Control subsystem –consists all devices and elements that participate on control of quality production capacity and on accuracy control of activity of very manufacturing system.
» Directing and information subsystems –consists of all facilities (HW, SW) participate on directing and on control- informational provision of manufacturing system. [2]

4. LOGISTICS METHODS

Generally, logistics methods are divided into exact methods, heuristics and combine methods. The aim of each method is to optimise logistic system in factory that means directing of purchase, of production and layout of manufacturing processes. The selection of suitable method influences on mutual comparison between original and new method. The base methods used in logistics are: Sankey diagram, checkered table, circulatory diagram, the flow methods for one and more products, method of alternative questions, method of coordinates, CRAFT method, the triangle method, triangle table of relations, method of centre of gravity, circle method, method of mathematical and logics model, method of classification, decide tables and graphical trees, time studies, moving studies. There is very important to research the material flow of system iCIM 3000. Material flow in iCIM 3000is read like the organised.

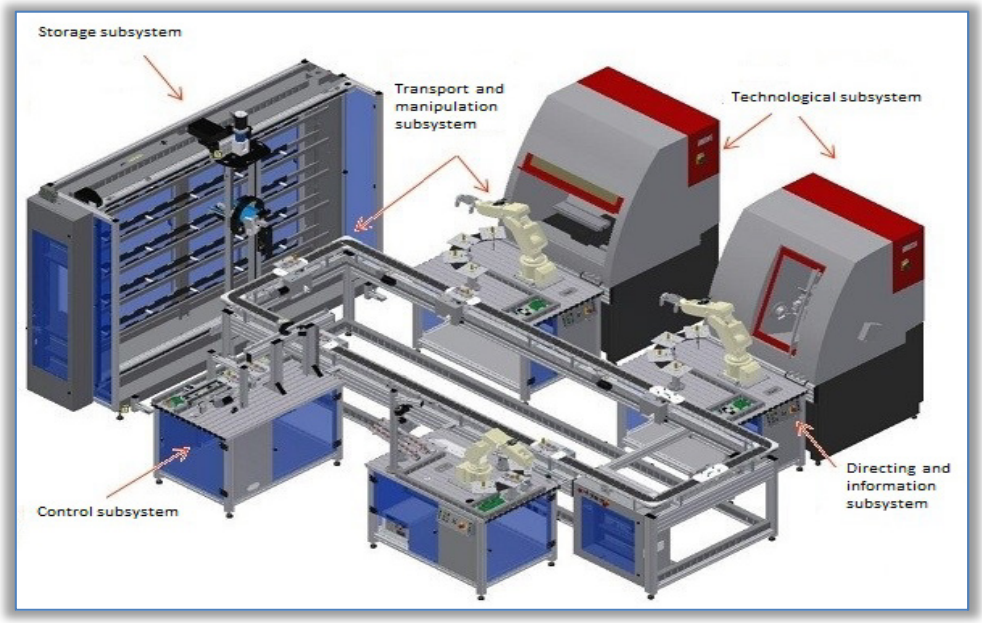

Figure 2. Model of manufacturing system iCIM 3000

Moving of material in manufacturing process. Material flow is characterized by intensity, by frequency, direction, by performance, by structure, distance and by character of transported material, by used manipulation and transport techniques.
The most important part of material flow is created by raw materials, base and auxiliary material, purchased products and semiproducts, spare parts, the implements, final and semi products, packs and waste. Material flow is essentially like a realisation of supplying chain with thorough logistics application that showing the using of optimisation methods in directing of material flow moving. [3]
Material flow consists of two base elements groups:

- Passive elements of material flow – material, raw materials, semiproducts a products.
- Active elements of material flow – transport – manipulation, storage operations.

Each material flow contains typical structure of realised operations related with active elements of material flow. Material flow consists of these five base operations:

- Technological operations.
- Control operations.
- Transport operations.
- Storing.
- Delaying.

Material flow is changed according to manufacturing program of the system. There are several combined variants of manufacturing program of the system:

1. Inventory receiving into storage + Storage + Technological operation 1 + Storage (the continuation of production)
2. Inventory receiving into storage + Storage + Technological operation 2 + Storage (the continuation of production)
3. Inventory receiving into storage + Storage + Technological operation 1 & 2 + Storage (the continuation of production)
4. Storage + Technological operation 1 + Storage (the continuation of production)
5. Storage + Technological operation 2 + Storage (the continuation of production)
6. Storage + Technological operation 1&2 + Storage (the continuation of production)
7. Storage + Technological operation 1 + Storage + Expedition
8. Storage + Technological operation 2 + Storage + Expedition
9. Storage + Technological operation 1 & 2 + Storage + Expedition
10. Inventory receiving into storage + Storage + Technological operation 1 + Storage + Expedition
11. Inventory receiving into storage + Storage + Technological operation 2 + Storage + Expedition
12. Inventory receiving into storage + Storage + Technological operation 1 & 2 + Storage + Expedition
13. Storage + Technological operation 1 + Controlling + Storage (the continuation of production)
14. Storage + Technological operation 2 + Controlling + Storage (the continuation of production)
15. Storage + Technological operation 1 & 2 + Controlling + Storage (the continuation of production)
16. Inventory receiving into storage + Storage + Technological operation 1 + Controlling + Storage (the continuation of production)
17. Inventory receiving into storage + Storage + Technological operation 2 + Controlling + Storage (the continuation of production)
18. Inventory receiving into storage + Storage + Technological operation 1&2 + Controlling + Storage (the continuation of production)
19. Storage + Technological operation 1 + Controlling + Storage + Expedition
20. Storage + Technological operation 2 + Controlling + Storage + Expedition
21. Storage + Technological operation 1&2 + Controlling + Storage + Expedition
22. Inventory receiving into storage + Storage + Technological operation 1 + Controlling + Storage + Expedition
23. Inventory receiving into storage + Storage + Technological operation 2 + Controlling + Storage + Expedition
24. Inventory receiving into storage + Storage + Technological operation 1 & 2 + Controlling + Storage + Expedition
25. Storage + Technological operation 1 + Assembly + Storage (the continuation of production)
26. Storage + Technological operation 2 + Assembly + Storage (the continuation of production)
27. Storage + Technological operation 1 & 2 + Assembly + Storage (the continuation of production)

28. Inventory receiving into storage + Storage + Technological operation 1 + Assembly + Storage (the continuation of production)
29. Inventory receiving into storage + Storage + Technological operation 2 + Assembly + Storage (the continuation of production)
30. Inventory receiving into storage + Storage + Technological operation 1 & 2 + Assembly + Storage (the continuation of production)
31. Storage + Technological operation 1+ Assembly + Storage + Expedition
32. Storage + Technological operation 2 + Assembly + Storage + Expedition
33. Storage + Technological operation 1 & 2 + Assembly + Storage + Expedition
34. Inventory receiving into storage + Storage + Technological operation 1 + Assembly + Storage + Expedition
35. Inventory receiving into storage + Storage + Technological operation 2 + Assembly + Storage + Expedition
36. Inventory receiving into storage + Storage + Technological operation 1&2 + Assembly + Storage + Expedition
37. Storage + Technological operation 1 + Controlling + Assembly + Storage (the continuation of production)
38. Storage + Technological operation 2 + Controlling + Assembly + Storage (the continuation of production)
39. Storage + Technological operation 1&2 + Controlling + Assembly + Storage (the continuation of production)
40. Inventory receiving into storage + Storage + Technological operation 1 + Controlling + Assembly + Storage (the continuation of production)
41. Inventory receiving into storage + Storage + Technological operation 2 + Controlling + Assembly + Storage (the continuation of production)
42. Inventory receiving into storage + Storage + Technological operation 1 & 2 + Controlling + Assembly + Storage (the continuation of production)
43. Storage + Technological operation 1 + Controlling + Assembly + Storage + Expedition
44. Storage + Technological operation 2+ Controlling + Assembly + Storage + Expedition
45. Storage + Technological operation 1&2+ Controlling + Assembly + Storage + Expedition
46. Inventory receiving into storage + Storage + Technological operation 1 + Controlling + Assembly + Storage + Expedition
47. Inventory receiving into storage + Storage + Technological operation 2 + Controlling + Assembly + Storage + Expedition
48. Inventory receiving into storage + Storage + Technological operation 1&2 + Controlling + Assembly + Storage + Expedition
49. Storage + Technological operation 1 + Controlling + Assembly + Controlling + Storage (the continuation of production)
50. Storage + Technological operation 2 + Controlling + Assembly + Controlling + Storage (the continuation of production)
51. Storage + Technological operation 1&2 + Controlling + Assembly + Controlling + Storage (the continuation of production)
52. Inventory receiving into storage + Storage + Technological operation 1 + Controlling + Assembly + Controlling + Storage (the continuation of production)
53. Inventory receiving into storage + Storage + Technological operation 2 + Controlling + Assembly + Controlling + Storage (the continuation of production)
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59. Inventory receiving into storage + Storage + Technological operation 2+ Controlling + Assembly + Controlling + Storage + Expedition

60. Inventory receiving into storage + Storage + Technological operation 1&2 + Controlling + Assembly + Controlling + Storage + Expedition
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66. Inventory receiving into storage + Storage + Assembly + Controlling + Storage (the continuation of production)
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70. Inventory receiving into storage + Storage + Controlling + Assembly + Controlling + Storage (the continuation of production)
71. Storage + Controlling + Assembly + Controlling + Expedition
72. Inventory receiving into storage + Storage + Controlling + Assembly + Controlling + Expedition

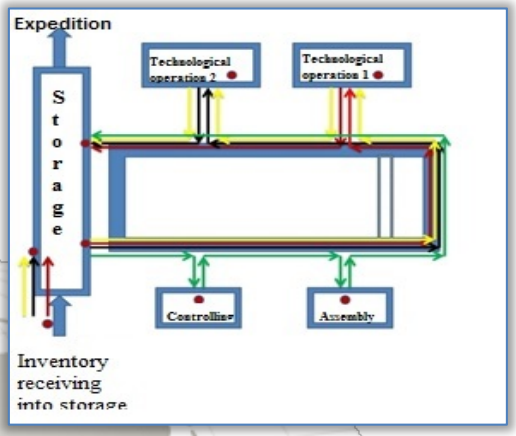

Figure 3. Selection of material flow alternatives in iCIM3000

Analysis of material flow is schematic described in Figure 3 and it is necessary to know that we need the transport operations, directing and together the partial operations. There is the base manufacturing process and operative manufacture registry within partial operations.

There is needed to know the exact workpiece base for manufacture – assembly system to convenient design of material flow. And have to answered follow questions [4]:

1. What we have to produce? (To assembly?)
2. How much and what have to produce? (To assembly?)
3. What is the cost structure of production? (Of assembly?)

4. CONCLUSION

Fast development in the area of designing and manufacture systems innovation in the factory makes to possible to use differently methods that take trustworthiness of users but after verification in the praxis. In present there are used the analyses of manufacturing systems through the simulation. Real system simulation is realised by particular simulation methods. The result of method is testing and definition of critical places of system.

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