Annals of DAAAM for 2010 & Proceedings of the 21st International DAAAM Symposium, Volume 21, No. 1, ISSN 1726-9679
ISBN 978-3-901509-73-5, Editor B. Katalinic, Published by DAAAM International, Vienna, Austria, EU, 2010
Make Harmony Between Technology and Nature, and Your Mind will Fly Free as a Bird
Annals of DAAAM International

PLANNING OF MATERIAL FLOW IN FLEXIBLE PRODUCTION SYSTEMS

MUDRIKOVA, A[ndrea]; DELGADO SOBRINO, D[aynier] R[olando] & KOSTAL, P[eter]

Abstract: *The main aim of this paper is to resolve material flows in systems, by describing the situation of flexible manufacturing systems laboratory and making the designs of arrangement of these flows, to make design variants of spatial arrangement of this laboratory.*
We are planning to create at Institute of Manufacturing Systems and Applied Mechanics the laboratory of flexible manufacturing systems. This laboratory is planned to be equipped with turning and milling machine centers, conveyors, automated storage systems and industrial robots.
Key words: *material flow, laboratory, class works, manufacturing system, flexible manufacturing*

1. INTRODUCTION

Today market is characterized by strategy of consumer's individualization. This strategy is oriented to consumer's requests. At this strategy is most important parameter the time to new product giving into market. This time shortening mean a big benefit for producer. Consumers want new products and time becomes a fundamental task for their satisfaction. The production is broadening, innovation cycle is shortened, and the products have a new shape, material and functions. The production strategy focused to time need to change from traditional functional production structure to production by flexible manufacturing cells and lines.(2)

By some study about an existing manufacturing say that machines used only 30 to 40%. The other resources say that technological processes spend only 5% of time needed for manufacturing. The rest of time is spent by manipulation, transport and storage.

The system is characterized by its internal material and information flows. The manufacturing process represents a complex dynamical process including technological, manipulation and control operations.

2. MATERIAL FLOW

The material flow is one of the most expensive systems into production because it employs the most workers. For high efficiency of production, it is necessary to consider the high-usage of transport ways on base of transported material and the exploitation of single production system devices in the time of the project proposal.

2.1 Material flow planning

In the process of material flow planning, it is necessary to consider the fact that the aim of the plan is not the transport and storage of material as these activities are expensive and do not improve the material value. Current systems for handling, transport and storage provide a great number of possibilities for the application of expensive and complex systems. The optimal design should contain minimum storages, transport and handling. Hence, the suitable way before the elaboration of detailed system solution is to reduce mentioned activities to a minimum.(3)

It is necessary to take into account a great importance of the dependence of material flow and following elements of manufacturing system:

- Workstation and its capacity, incorrectly designed capacities induce unbalance materials flow, cumulation of resources, necessity of buffer stocks, containers and addition handling operations.
- Informational flow and the system controls, proper regulation of manufacturing tasks entering the system, synchronization of purchase, manufacturing and expedition, coordination of manufacturing system control by transport system, while all of them have a significant effect to material flow plan.

All features of a manufacturing system must be planned considering mutual interactions and verified by a simulation model before the system realization.

Material flow analysis is one of the main parts of production process analysis. The type, quantity, volume, mass and dimensions of manipulated material have strong influence to possibilities of manipulation, storage, packaging and transport. In time of material flow analysis we observe the important material movements between a material incoming and outgoing stations. The methods used for the analysis are similar for production processes and material flow processes (Sankey diagrams, CRAFT, coordinate methods, networking methods, linear programming, value analysis, and others).(4)
At material flow analysis we usually analyze the transport stream too, this is an analysis of transport devices organized movements. Observed information is characterizing the communications loadings. We can see the crossings of material flows, communications, loading and unloading stations and transport device capacity using and others. In base of this analysis we will have a view of the transport device quality and quantity too. The other useful information from this analysis is the needed structure of operators (number, qualification, position).

One of most usual method for material flow representation is the triangle net method. The triangle net of relations (Fig. 1) described the factors and relations between workplaces from which takes place the material flow. (1)
These factors and relations must be classified and evaluated.

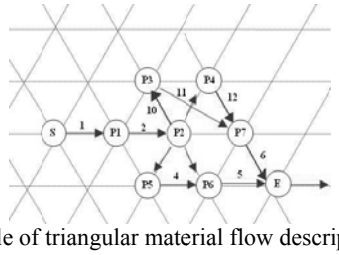

Fig. 1. Example of triangular material flow description

3. MANUFACTURING SYSTEM

In flexible production systems is included one to tree technological devices can works at an automated working cycle. This system can have a flexible reaction to manufacturing change in some limits.

After changing a program is possible to manufacture other type of products. The manufacturing and supporting devices are not specialized. This kind of flexible manufacturing systems are dedicated for batch production, where the changing produced parts are realized by data change in the machines control system.

The higher efficiency of production is a result of better using the flexible production systems devices (automated 24 hour working) and reducing the supplementary time.

A Disadvantage of flexible production systems is usually the higher investment cost, control system complexity and possible break outs of non standard devices.

The existing principles of machine plant design become to be improper and a completely new concept of manufacture and control design is gained ground.

The requirements for the new manufacturing system design are as follows:

- Flexibility,
- Productivity,
- Quality.

Requirements set by product to manufacturing space result from product size, mass, type of construction, from its position in manufacturing program structure and production volume. Size and mass of the product determine the needed manufacturing, operating and storage places. Product constructions assign the process of manufacture and the further technologically constraint task sequences which form the base for general plant design i.e. the manufacturing device arrangement and space structure formation. Entire plan comprises material, information, power and personal flows.(5) Signification of particular flows of manufacturing system composition is dependent on the manufacturing process of a given product. In case of transport demanding production, the arrangement of manufacturing centers focused on the materials flows is critical.

The material moving is realized by conveyor. This conveyor integrates the whole manufacturing system. Next device of this flexible system is the shelf storage for raw material and finished parts storage (Fig. 2).

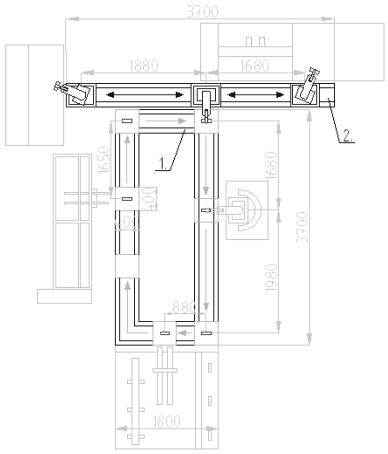

Fig. 2. Flexible manufacturing system layout
1 – conveyor, 2 – industrial robots rail

The flexible manufacturing system contains two CNC machines (lathe and milling center) for technological operation (machining) realization. These machines are served by one industrial robot on rail. (Fig.)

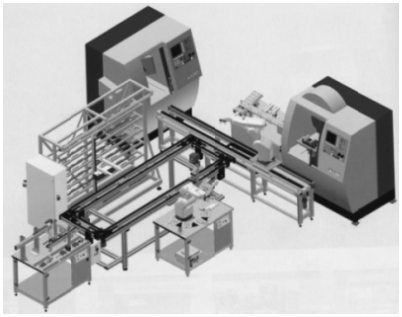

Fig. 3. Flexible manufacturing system

The second industrial robot serves the check station. In this station are realized the dimension and shape controlling operations by a camera system.

4. COCLUSION

The manufacturing cells structure enables to connect machines and to save the production time, space and production costs as well. Functions of machines are coordinated and the material flow can be fast.

Manufacturing process of components, parts or final products is usually not realized in single workplace. The manufacturing logistics solves the tasks concerning organization of material and information flow in manufacturing. The importance of manipulating and transport devices is underlined by the fact that more than 50% of time needed for manufacturing is spent by manipulation and transport. Automation level of these processes is generally smaller than automation level of technological processes.

5. ACKNOWLEDGMENTS

This article was created thanks to the national grant ASFEU "OPVaV-2008/2.2/01-SORO: 26220220055".

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