ABSTRACT OF THE PHD THESIS

Researches on the design and management of manufacturing systems

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The PhD thesis is being structured on seven chapters. Each one of them begins with a set of objectives and it ends with the conclusions.

Chapter 1 makes an introduction in the problem of manufacturing and contains an evolution of the manufacturing concept since its existence until today. The objective of a manufacturing system is to manufacture products, in the quantity asked by the customers, with an adequate quality, within deadlines and with the lowest manufacturing costs.

Chapter 2 presents an overview of the manufacturing systems design. The manufacturing systems design starts with an economical and technical study concerning the life-cycle of products, prognosis, manufacturing technologies and the layout of the manufacturing system. In this chapter is presented a manufacturing system design, organized in six phases.

The manufacturing system location is a complex process. It has a macroeconomic approach (geographical area determination) and a microeconomic approach (the locality determination). In this chapter are presented some methods used for manufacturing system location. In the last part of this chapter are presented some particularities encountered in the design process.

Chapter 3 presents the computer integrated manufacturing (CIM) concept and its components: computer aided design (CAD), computer aided process management (CAPM) and computer aided manufacturing (CAM).
Facing intensified competition in a growing global market, manufacturing enterprises have been reengineering their production systems to accomplish CIM. The main goal of the computer is to integrate the multiple enterprise operations: research and development, manufacturing, planning and management, to ensure an efficient activity of the factory. Hence are identified advantages and disadvantages of the CIM implementation.

Chapter 4 presents aspects concerning the modern manufacturing management. A Japanese saying mention: “a step ahead made by a hundred peoples is more valuable than one hundred steps ahead made by a leader.” The Japanese management prefers to obtain development through “small steps”. This way of sustaining the innovation is called by the Japanese Kaizen. Kaizen implementation in every organization structure provides the loss removing.

In this chapter have been analyzed the following concepts: Kanban system, OPT (Optimized Production Technology), Jidoka, Poka-Yoke (used for prevention the appearing of an unexpected error during manufacturing), Smed. It was described JIT (just in time) method and MRP/MRP2 (material requirements planning). In the last part of this chapter, was presented the Lean Manufacturing method. For all the concepts presented above were identified advantages and disadvantages.

In chapter 5 were studied the new paradigms of manufacturing system (holonic, fractal and bionic manufacturing systems). In order to respond to a rapidly changing manufacturing environment, manufacturing systems must be flexible, adaptable and reusable. The goal of the holonic manufacturing systems is to attain in manufacturing the benefits that holonic organization provides to living organisms and societies, for example: stability in the face of disturbances, adaptability and flexibility in the face of change, and efficient use of available resources. The fractal manufactory system is based on the concept of autonomously cooperating multi-agents referred to as fractal. The bionic manufacturing system draws parallels with biological systems and proposes concepts for realising essential properties of future
manufacturing systems. In the last part of the chapter is made a comparison between the concepts.

Chapter 6 presents the genetic algorithms (the optimization method used in the following chapter). Hence are presented the advantages of this optimization method in comparison with traditional ones.

Chapter 7 is the chapter which includes the results of the practical research. It were optimized four manufacturing systems approaches (optimal design of the cellular manufacturing systems, static configuration of a flexible manufacturing system, optimal design of the customers allocation and optimal design of a flexible manufacturing system scheduling).

In the first approach, hence from input parameters, the optimization returns the design of the manufacturing system.

In the second approach, hence from operation sequence, the optimization returns the number of machines which compose the flexible manufacturing system. The optimization attended the system loading maximization.

The results obtained confirm that genetic algorithm is an efficient optimization method used for manufacturing systems design.

In the third approach it has been optimized the customers allocation’s design of an enterprise which manufactures chain products. The optimization minimized the total shipping cost related to satisfy the demand for all customers.

The final approach from this chapter presents the optimal design of a flexible manufacturing systems scheduling. The input parameters are the transition costs (the costs generated by the commutation of the system from a technology to another, in agreement to the change of the products that enter the system). In this approach, the adaptation effort (from economical point of view) of the system to the manufacturing task has been minimized. It has been obtained significant improvement of the adaptation efforts of the manufacturing system.

The main contributions of this thesis are:
Based on the theoretical and practical arguments, were synthesized researches from manufacturing systems field;

Were synthesized researches from design of manufacturing systems field and were presented some methods used in manufacturing system location;

Were analyzed the next generation of manufacturing systems - a globally distributed assembly of autonomous work units, connected by the goal of profitably serving customers, while operating in an environment of abrupt, often unpredicted, change.

Consulting a wide bibliography, were systemized a great number of information concerning the genetic algorithms;

Optimal design with genetic algorithms of a cellular manufacturing system;

Static configuration with genetic algorithms of a flexible manufacturing system;

Optimal design with genetic algorithms of the customers allocation;

Optimal design with genetic algorithms of a flexible manufacturing system scheduling.