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Concept of virtual manufacturing- in design and production

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Abstract

Virtual Manufacturing can be defined as a combination of manufacturing and computer which can explain one or several levels of decision and control in manufacturing process. Several domains can be addressed: Product and Process Design, Process and Production Planning, Machine Tool, Robot and Manufacturing System. As automation technologies have substantially shortened the time required to design products, Virtual Manufacturing will have a similar effect on the manufacturing process thanks to the modeling and simulation of the product and the processes involved in production. This paper tackles the subject from design to production with the help of virtual manufacturing concept. Future and application of virtual manufacturing are also discussed. The aim of this paper is to present an updated of virtual manufacturing (VM) by different aspects

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Introduction

Manufacturing systems show the tendency to be large, complex and expensive to construct and operate. In this complex and evaluative environment, manufacturer must know about their processes before trying them in order to get it right the first time. More over manufacturing enterprises may be widely distributed geographically and linked conceptually in terms of dependencies and material, information and knowledge flows. To achieve this concept, the use of a virtual manufacturing (VM) will provide a computer-based environment to simulate individual manufacturing processes and the total manufacturing enterprise. The idea of virtual manufacturing is to allow designer to follow that instinct, but with the added luxury of cost-free second thought. The system is virtual world representing a machining shop in which engineering component can be made virtually on computer. With the help of Virtual Manufacturing system we can early optimization of cost, quality and time, achieve integrated product, process and resource design and finally achieve early consideration of producibility and affordability. The aim of this Paper is to present an updated vision of Virtual Manufacturing (VM) through different views. The expected technological

benefits of VM will also been presented. Engineers can obtain information about the product or the process, that is not either feasible to be determined with traditional design methods or traditional design methods require significant higher cost and time. Virtual manufacturing has also led to the development of new tools and techniques, for studying production processes focused on the study of specific production process parameters, like machining operations, assembly paths, etc. and supplement the conventional simulation systems.

Virtual Manufacturing

With the advance of computer technology, virtual reality systems could contribute efficiently in various Applications. Virtual manufacturing (VM) is one of the applications of applying virtual reality technology in manufacturing applications. Virtual manufacturing is defined as a computer system which is capable of generating information about the structure, status, and behavior of a manufacturing system as can be observed in a real manufacturing environment.

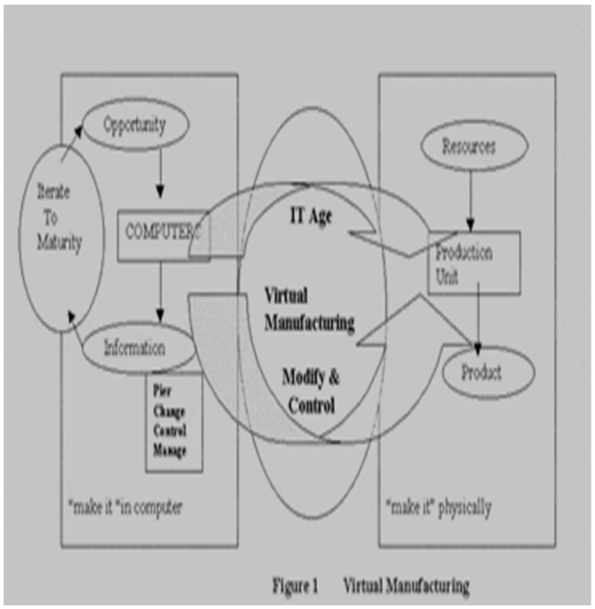

Figure 1 Virtual Manufacturing

In Lawrence Associates' Virtual Manufacturing User Workshop report, Virtual Manufacturing (VM) is defined to be an integrated, synthetic manufacturing environment exercised to enhance all levels of decision and control.

A. Synthetic: a mixture of real and simulated objects, activities and processes.

B. Environment: supports the construction and use of distributed manufacturing.

simulations by synergistically providing a collection of analysis tools, simulation tools, implementation tools, control tools, models (product, process and resource), equipment, methodologies and organizational principles.

C. Exercising: constructing and executing specific manufacturing simulations using the environment.

D. Enhance: increase the value, accuracy, and validity.

E. Levels: from product concept to disposal, from the shop floor to the executive suite, from shipyard equipment to the enterprise and beyond, from material transformation to knowledge transformation.

F. Decision: understand the impact of change (visualize, organize, and identify alternatives)

G. Control: predictions effect actuality.

The most comprehensive definition has been proposed by the Institute for Systems Research, University of Maryland: Virtual Manufacturing is defined as "an integrated, synthetic manufacturing environment exercised to enhance all levels of decision and control" (Fig. 2).

– *Environment:* supports the construction, provides tools, models, equipment, methodologies and organizational principles,

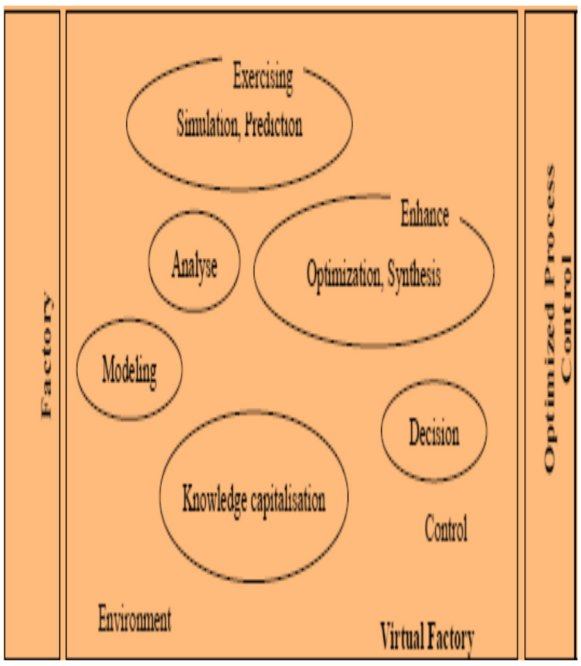

Figure-2 virtual manufacturing

– *Exercising:* constructing and executing specific manufacturing simulations using the environment which can be composed of real and simulated objects, activities and processes,

– *Enhance:* increase the value, accuracy, validity,

– *Levels:* from product concept to disposal, from factory equipment to the enterprise and beyond, from material transformation to knowledge transformation,

– *Decision:* understand the impact of change (visualize, organize, and identify alternatives).

Virtual manufacturing (VM) may play a significant role in distributed manufacturing, since it may improve design critiquing and process planning. These improvements will result in better designs and more informed partner selection. Furthermore, VM is expected to support distributed design if it provides protocols and computer aids for negotiation.

Virtual Manufacturing Approaches

Design-Centered: Evaluating the manufacturability of a proposed design involves determining whether or not it is manufacturable with a given set of manufacturing operations---and if so, finding the associated manufacturing efficiency.

Production-Centered: Distributed manufacturing is performed by virtual enterprises. A virtual enterprise is a partnership of companies that forms in response to a certain market opportunity. The partners, who may geographically distributed and of various sizes and technical sophistication, contribute their core competence to the enterprise, enhancing its ability to deliver high quality, cost effective products to the market in a timely fashion.

Distributed design is performed by multiple designers who may be distributed geographically and who employ heterogeneous design support systems.

Control-Centered: Addition of simulations to control models and actual processes, allowing for seamless simulation for optimization during the actual production cycle.

Ingredients of the Perfect Virtual Manufacturing

.New product development (NPD)

.Advanced planning and scheduling (APS),

.Computer-aided manufacturing (CAM),

.Computer-aided production engineering (CAPE), computer-aided production planning (CAP/CAPP),

.Manufacturing execution systems (MES),

.Manufacturing process management (MPM)

Benefits of Using Virtual Manufacturing

Virtual manufacturing will contribute to the following benefits:

A. Quality: Design For Manufacturing and higher quality of the tools and work instructions available to support production.

B. Shorter cycle time: increase the ability to go directly into production without false starts.

C. Producibility: Optimize the design of the manufacturing system in coordination with the product design; first article production that is trouble-free, high quality, involves no reworks and meets requirements.

D. Flexibility: Execute product changeovers rapidly, mix production of different products, return to producing previously shelved products.

E. Responsiveness: respond to customer "what-ifs" about the impact of various funding profiles and delivery schedule with improved accuracy and timeless.

G. Customer relations: improved relations through the increased participation of the customer in the Integrated Product Process Development process.

Application

Virtual manufacturing has also been successfully implemented in the following areas:

• Airport operations.

• Urban traffic study and development.

• Maintenance operations.

• National economy study.

• Waging military battles.

•Material and warehouse distribution systems.

Conclusion

The great potential of virtual manufacturing is that it can provide safe environment in which designer can experiment with different manufacturing technique. Virtual manufacturing technology will become an inevitable trend in the development of manufacturing industry in the 21st century due to the accurate simulation in the product life cycle and control ability of the product. As a conclusion of this paper, we can say that we have now reached a point where everyone can use virtual manufacturing. It appears that virtual manufacturing will stimulate the need to design both for manufacturability and manufacturing efficiency. The virtual manufacturing process is still under development, but it being planned to be user-extendable.

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