Question 1: Is there a common thread between just-in-time, CAD, CAM, CIM, MRPII, flexible manufacturing, and mass customization?

Mass customization is driven by the need to respond quickly to rapidly changing and individualized customer requirements. It demands a manufacturing system that is able to produce effectively a large variety of products and to be reconfigurable to accommodate changes in the product mix and product designs. Manufacturing companies, even those operating in relatively stable conditions with good market positions, are facing fast and often unanticipated changes in their commercial environment. Being agile in such environments means being flexible, cost effective, productive and producing with consistent high quality (A.Gunasekaran and Y.Y. Yusuf, 2002.)

According to Gupta and Mittal (1996) , so-called "Agile, Flexible or Advanced" Manufacturing is a business concept that integrates organizations, people and technology into a meaningful unit by deploying advanced information technologies with design, purchasing, manufacturing and distribution technologies. Some of the common threads amongst all the technologies are greater interaction with customers; cooperating with competitors; organizing to manage change; and leveraging people and information.

The global supply chain management system integrates purchasing and planning that focus on MRP II fundamentals such as global sales and operations planning that can be used to analyze and optimize an entire supply chain from purchasing/suppliers through manufacturing and distribution using a streamlined logistics network and overcoming cultural, communications, and cross-functional obstacles (Hessney, 1997).

The variety of resources required for mass customization also include the integration of Information Technologies such as Internet, CAD/CAM, and CIM, which can be employed for effectively reducing product development cycles (Medhat and Rook,1997). In a global manufacturing environment, IT plays a dominant role of combining such tools as robotics, automated guided vehicle systems (AGVSs), Numerically Controlled (NC) machine tools, CAD/CAM, rapid prototyping tools, Internet, World Wide Web (WWW), Electronic Data Interchange (EDI), Multimedia and Electronic Commerce (Candadai *et al*, 1994).

What are their enabling benefits?

The flexibility and efficiency obtained in successful integration of agile manufacturing technologies can lead to substantial strategic marketing advantages. Benefits such as increased market share, reduced prices, improved responsiveness to change in the marketplace, the ability to offer a continuous stream of customized products, faster product innovation, and improvement of the company's image have all been attributed to flexible manufacturing. The adoption of automated technologies allows for a shift in the role of manufacturing from simply supporting marketing to playing a major role in strengthening a company's overall position in a particular market. (McClenahen, 2000).

As well, the adoption of flexible manufacturing has direct implications for the relationship with customers in at least two areas. First, the adoption of flexible manufacturing requires the firm to shift its manufacturing emphasis from a product orientation to a service orientation, when firms foster tighter links with customers for the

purpose of achieving quick response to customer demand. To achieve this, customers should be allowed to participate in product development. Second, the adoption of flexible manufacturing production should allow the manufacturer to reduce set-up time and produce in smaller lot sizes. Customer response to such capabilities might be to adopt a just-in-time (JIT) approach, thus increasing the number of orders.

Flexible manufacturing which incorporates just-in-time purchasing can also provide substantial economic benefits. According to George Stalk (1988), while economies of scale will reduce costs about 15 percent to 25 percent per unit when volume doubles, costs go up by 20 percent to 35 percent every time variety doubles. Just-in-Time, conversely, reduces the major contributors to the cost of variety. As for the relation with suppliers, since a flexible manufacturing is more conducive to JIT, it is believed that flexible manufacturing users should encourage similar flexibility in their suppliers. This requires the sharing of sensitive data between producer and supplier (Brandt, 1998).

What do they permit?

Flexible manufacturing incorporates the tools, techniques, and initiatives that permit a plant or company to thrive under conditions of unpredictable change. Flexible manufacturing not only enables a plant to achieve rapid response to customer needs, but also includes the ability to quickly reconfigure operations — and strategic alliances—to respond rapidly to unforeseen shifts in the marketplace. In some instances, it also incorporates “mass customization” concepts to satisfy unique customer requirements. In broad terms, it includes the ability to react quickly to technical or environmental

surprises, which is the key both to enhanced efficiency, but also to customer capture and retention.

In addition, the improved process capabilities of a flexible manufacturing organization can also affect other functional departments of the firm. Of particular relevance to manufacturing is the integration of design and R&D (Ghani & Jayabalan, 2000).

What advantage do they convey?

The experience of plants adopting flexible manufacturing indicates that major economic and strategic benefits of flexible manufacturing include the following (Shepherd et al., 2000):

- Decreased lead times
- Reduced delivery times
- Reduced set-up costs
- Reduced set-up times
- Reduced transportation costs
- Reduced investment in stock
- Reduction in batch sizes
- Improved quality
- Improved reliability
- Improved dependability

What is behind the development and deployment of the technologies?

Not only is information technology - especially the Internet - allowing customers to become more selective and demanding in wanting customized products, at mass-

produced prices and with superior quality, but the pressures of global competition are also driving the development and implementation of advanced manufacturing and distribution technologies. In the last several decades, the United States has experienced a decline in productivity (U.S. Bureau of Labor Statistics, 2001), while the world has seen a maturation of the global marketplace. Clearly, these innovations are driving a major transformation of the U.S. manufacturing base, such that manufacturing technologies and their implementations have assumed greater importance in overall manufacturing strategy. Companies have developed strong interest in how advanced manufacturing technology (such as flexible manufacturing) can be used as a competitive tool in the global economy to combat the phenomena of fragmented mass markets, shorter product life cycle, and increased demand for customization (Hottenstein & Casey, 1997).

References:

Brandt, J. R. (1998). Beyond the supply chain. *Industry Week*, November 2, 1998. vol 247, pp. 6-10.

Candadai, A., Champati, S., Herrmann, J. W., Minis, I. and Ramachandran, V., (1994). Information needs in agile manufacturing. *ASME Database Symposium*, 1994, pp. 101-109.

Gunasekaran, A. and Yusu, Y.Y. (2002). Agile manufacturing: a taxonomy of strategic and technological Imperatives, *International Journal of Production Research* (2002); vol. 40, no. 6, ppg 1357-1385. Retrieved 6 October 2006 from http://www.umassd.edu/charlton/birc/am_taxonomy.pdf#search=2relationshipbetweenjust-in-timeCCADCCAMCCIMCMRPIICflexiblemanufacturingCandmasscustomization.2

Ghani, A. K., & Jayabalan, V. (2000). Advanced manufacturing technology and planned organizational change. *Journal of High Technology Management Research*, vol 11(1), pp. 1-18.

Gupta, U. G. and Mittal, R. O., (1996). Quality, time, and innovation based performance measurement system for agile manufacturing. *Proceedings - Annual Meeting of the Decision Sciences Institute*, vol 3, 1996, ppg1511-1513.

Hessney, L. L., (1997). Global supply chain management for the next millennium: Fundamentals - integration - breakthrough. *Annual International Conference Proceedings* - American Production and Inventory Control Society, 1997, pp. 387-389.

Hottenstein, M. P., & Casey, M. S. (1997). Facilitation of advanced manufacturing technology: Implementation and transfer. *Industrial Management*, vol 39(5), pg 5.

McClenahen, J. S. (2000). Connecting with the future. *Industry Week*, 2000, *249*, pp. 44-50.

Medhat, S. S. and Rook, J. L., (1997). Concurrent engineering - processes and techniques for the agile manufacturing enterprise. *IIE Conference Publication*, 1997, No. 435, pp. 9-14

Shepherd, D. A., McDermott, C., & Stock, G. N. (2000). Advanced manufacturing technology: Does more radicalness mean more perceived benefits? *Journal of High Technology ManagementResearch*, vol 11(1), pg 15.

Stalk, George (1988). Time—The Next Source of Competitive Advantage, *Harvard Business Review*, July 1988.