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Recent Trends in Manufacturing

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Abstract- The purpose of this paper is to present an interpretation of recent progress in manufacturing systems from the perspective of control. We believe that this community has a vocabulary and a view of systems that can be helpful in this area. However, in order for this group to make that impact, it is essential that they learn the problems and terminology and become familiar with recent research directions. This paper is intended to present certain issues in manufacturing management in a way that will facilitate in this direction by providing actions to be taken by the concerned enablers.

Keywords- *Manufacturing Trends, Lean Manufacturing, Demand Flow Manufacturing, Just-in-Time, Agile Manufacturing.*

1. Introduction

Manufacturing is the use of machines, tools and labour to move things for use or sale the term refers to the range of human activity from handicraft to high-tech but it is most commonly applied to industrial production, in which raw materials are transformed into finished goods on a large scale. The increased integration of technology, operating and quality models, and integrated business models will be essential to helping the US manufacturing sector survive and remain competitive in the global economy.

But which are the best methods, systems and practices to employ and how they can most effectively be implemented?
What is the business strengths required for sustainable competitive advantage?
What are the current business weaknesses, and how are they corrected?
What is the value that each process and system delivers?
What are the risks?
Do the systems driving each process deliver the appropriate information for optimal process and business performance?
How do these processes and systems interact and what are their interdependencies – both internally and externally?
What processes and systems need to be improved or abandoned?
What skills are required to support each process and system?
Who has business ownership and accountability for each process?

2. Literature Review

2.1 Current Manufacturing Trend and Its Lack of Competence:

Currently manufacturing "Leaders" are looking to more effectively integrate their shop floor control systems, production demand management and execution systems, and Enterprise Resource Planning (ERP) systems. Manufacturing "Followers" are still in the Manufacturing Execution System (MES) and production demand management system implementation level of maturity, while the "laggards" are still struggling with implementation and effective utilization of basic Lean Manufacturing and ERP principles.

In spite of all the improvements made over the past two plus decades, some of the same issues continue to plague the manufacturing sector [5]:

- Increased global competition
- Increasing market demand for high quality products at lower cost
- Escalating costs
- Increasingly dynamic market changes and patterns of customer demand
- Shortage of appropriately skilled resources

2.2 Need for New Manufacturing Trends

Some more recent dynamics that have created more pressure manufacturers include the increased global demand for raw materials and other resources, as well as the wildly fluctuating currency markets. All of these issues drive the need to:

- Reduce operating costs, while maximizing long-term profitability and increasing product quality
- Improve ability to quickly respond to market changes and customer demand
- Improve supply chain efficiency
- Improve demand planning scope and accuracy
- Improve availability and visibility of key information needs
- Close functional gaps and increase integration between back-office and shop floor systems. [2][3][10][11]

2.3 Globally Emerging Manufacturing Practices

The increased use of technology and best-in-class operational and quality methodologies has resulted in a slight increase in the U.S. share of global manufacturing since 1980. But there are many commonly known practices used today that facilitate cost reduction, quality improvement and flexibility in the manufacturing environment. Some examples of these are:

(a) Lean Manufacturing
(b) Demand Flow Manufacturing
(c) Just-in-Time
(d) Agile Manufacturing
(e) Rapid Manufacturing
(f) Flexible Manufacturing System
(e) Advanced Planning and Scheduling

Each of these practices has its unique focus, strengths and inherent weaknesses. In addition, many of these practices and their supporting technologies are implemented, with limited integration between each other, ERP systems and external demand planning systems.[1][12][13]

For example, Lean Manufacturing focuses on elimination of waste. Lean practices are inherently less flexible than Agile Manufacturing practices, performing best when there is a stable demand pattern. Conversely, Agile Manufacturing tends to create more waste. Demand Flow Management combines the best of Lean and Agile, but requires the ability to manufacture based on real demand and product delivery within customer specified time frames. Just in Time focuses on strict management of delivery schedules, reduction of inventory, and related carrying costs, but calls for upstream suppliers to carry much of the burden of these tighter requirements.

(a) Lean Manufacturing: Lean manufacturing or lean productions, which is often known simply as "Lean", is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. Basically, lean is centred on preserving value with less work. Lean manufacturing is a generic process management philosophy derived mostly from the Toyota Production System (TPS) (hence the term Toyotism is also prevalent) and identified as "Lean" only in the1990s. It is renowned for its focus on reduction of the original **Toyota** *Seven wastes* to improve overall customer value, but there are varying perspectives on how this is best achieved. The steady growth of Toyota, from a small company to the world's largest automaker, has focused attention on how it has this [4] [2].

(b) Demand Flow Manufacturing: The most value and variation is created here: both in the product and the service of supply. Demand Flow Manufacturing starts with the method for combining demand and releasing orders into production.

(c) Just-in-time (JIT): This is an inventory strategy that strives to improve a business's return on investment by reducing in- process inventory and associated carrying costs. To meet JIT objectives, the process relies on signals or Kanban between different points in the process, which tell production when to make the next part
.

(d) Agile Manufacturing: It is a term of light to an organisation that has created the processes, tools and training to enable it to respond quickly to customer and market changes by still controlling cost and quality. Agile manufacturing is seen as the next step after leaning the evolution of production and methodical.

(e) Rapid Manufacturing: It is an additive fabrication technique for manufacturing solid objects by the sequential delivery of energy and materials to specify points in space to produce that part Crane practice is to control the manufacturing process by computer using a mathematical model created with the aid of computer.

(f) Flexible Manufacturing System*:* Flexible manufacturing is a manufacturing system in which there is some amount of flexibility that allows the system to react to the case of changes, whether predicted or unpredicted. This flexibility generally considered in two categories[14][15]:

- Machine Flexibility
- Routine Flexibility:

(g) Advanced Planning and Scheduling: This is also referred to as **APS** and **advanced manufacturing** where there is a manufacturing management process by which raw materials and production capacity are optimally allocated to meet demand. APS is especially well-suited to environments where simpler planning methods cannot adequately address complex trade-offs between competing priorities. Production scheduling is intrinsically very difficult due to the (approximately) factorial dependence of the size of the solution space on the number of items/products to be manufactured.

1. Theoretical Capability Analysis[1][5][6]**:**

The following table illustrates the actions, capabilities and enablers that best-in-class companies use to address these pressures:

2. Discussion:

This visibility allows a company to understand and obtain agreement on:

— How these processes and systems interact and their interdependencies.
— What each process and system delivers and how it produces those deliverables.
— What skills are required to support each process and system.
— Which business strengths are required for sustainable competitive advantage.
— Which business weaknesses exist and what are the required actions for Improvement.
— Who in the business owns and is accountable for each process

… as well as the ability to:

— Effectively and accurately measure performance
— Visually monitor actual performance against Key Performance Indicators
— Simulate change BEFORE implementing change

In the beginning there were just hand tools. All control and feedback was accomplished through eye-hand coordination. This continued to be the case for the most part (1950s), up until recently. The tools (lathes, drill presses. etc.) became larger and more complex, but the principle remained the same. Then computers were applied and numerically controlled (NC) machinery was the result. Here the position, feed, and speed of the tool relative to the part is controlled through standard feedback techniques. In addition, the different operations a part required could be programmed to occur automatically on one machine in the proper sequence.

Operation sequencing is generally performed open loop: there has not been sufficient reason to alter the sequence. This is changing in some environments where there is full automation. It may happen that a tool breaks part way through a "tape segment." If the part has to leave the machine and come back for any reason (quality-control check, extract broken tool. etc.), it is difficult to pick up where the processing left off. Moreover, with desperately needed improvements in agricultural productivity, there will be a shift towards manufacturing and services for jobs. Therefore manufacturing must pull its weight and contribute more for inclusive growth of the country. Therefore, we must develop an effective manufacturing strategy to achieve its goals. Strategy is about making choices about what to do to achieve the desired results [3].

3. Conclusion

Choices must be made about which manufacturing will be more important for inclusive and sustainable growth of India in the next 25 years. Choices must also be made about the best ways to stimulate that growth.

Pressures	Actions	Capabilities	Enablers
Improve Supply Chain Operational Efficiency	• Optimize the supply chain network • Right-size capabilities and capacities of assets • Allocate demand to assets that meet service requirements for lowest cost • Improve processing operations through better use of technology, equipment layouts, material and information flow, methodologies, and labor and asset utilization • Minimize transportation spend without sacrificing OTD • Collaborate with supply chain partners • Fully integrate purchasing systems with production planning, demand and delivery systems	• Build flexibility into network operations, that handles fluctuations and exceptions • Have minimum inventory investment that achieves order fulfillment objectives • Position inventory to minimize costs/handling • Fully utilize cubic space in storage and on vehicles to minimize overall cost • Forecast finished goods demand at the SKU level • Better utilize labor across functional areas and over daily/seasonal fluctuations • Use strategies like postponement and supplier collaboration to add value • Use performance metrics results to improve • Employ Supply Chain Execution Systems • Achieve complete visibility of all inventory in supply chain	• Network Optimization Tools • Value-Stream Mapping • Process Flow Modeling, CAD, Simulation • Warehouse Management Systems • Demand Forecasting Tools • Transportation and Yard Management Systems • KPIs, Dashboards • Labor Standards, Planning Tools and Incentives • Advance Shipping Notices (ASNs) • Import/Export Systems • Technologies such as RFID, Voice-Direction • Unit Load and Outbound Vehicle Load Design • Inventory Slotting Tools

Improve Demand Planning Scope and Accuracy	• Evaluate desired Demand Planning capability based on costs and benefits
	• Refine the Demand Planning process
	• Manage forecasts over planning time horizon:
	  ▪ Predictive modeling
	  ▪ Item and Customer Hierarchies
	  ▪ Causal factors
	  ▪ Market trends
	  ▪ New product introductions and transitions
	  ▪ Simulation
	  ▪ Collaboration
	• Measure Demand Planning accuracy
		• Historical sales and other market forecast data are systematically integrated with Demand Planning and analytics systems
		• Flexible Demand Planning User Interfaces
		• Aggregated market and customer specific demand data is systematically interfaced with advanced planning, Lean and ERP systems
			• Full scope demand planning and analytics systems
			• Collection of relevant metrics and historical data
			• Financial planning and budgeting
			• Knowledge Management, KPIs, Dashboards
			• Integration between demand planning, analytics systems and demand manufacturing systems
			• Internal and External collaboration tools

Improving the physical infrastructure for manufacturing must be an essential element of the strategy. Here top policymakers must make choices.

- We have described a framework for many of the important problems in manufacturing systems that need the attention of people trained in control and systems theory.
- We have shown how existing practical methods solve those problems, and where they fall short.

- We have also shown how recent and on-going research fits into that framework. An important goal of this effort has been to encourage control theorists to make the modelling and analysis efforts that will lead to substantial progress in this very important field.
- The selection of manufacturing sectors that should get higher priority is not a trivial exercise because there are linkages between industrial sectors and also linkages with overall economic needs for inclusion and sustainability.
- A country's competitive ability lies in the capability of the collaborative process between producers and policymakers to produce effective strategies and policies.

Future Implications in India

There is concern with the relatively poor performance of the manufacturing sector. A principal concern is with the need to create more jobs in which the manufacturing sector should have a larger role to play at our stage of development. It is estimated that an additional 200 million Indians will enter the job market by 2025, with overall population growth and the large numbers of young people who will be joining the workforce [6-9].

In summary, growth numbers suggest that the panoply of reforms so far has been better for the overall economy than for manufacturing. The country needs a strategy for manufacturing to become a powerful engine for inclusive and sustainable double-digit economic growth.

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