An overview of Manufacturing IT From Perspective of Enterprise and Manufacturing Systems.

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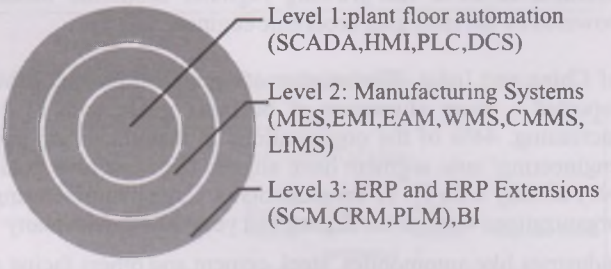
Introduction:

The paper presents a birds eye view about the involvement of Information Technology in manufacturing operations from a business, managerial, strategic and decision making point of view. The article discusses various present and future industry trends, challenges and concerns from a global and Indian perspective of industries of various domains and sizes across geographies which involve manufacturing processes of various scales. IT has become an indispensable part of almost every business process of manufacturing and a single change in any process can have major impact on overall production cycle. A basic 3 level Model has been followed which involves Manufacturing systems at 2nd level and enterprise systems at 3rd level.

Basic Framework of IT in Manufacturing Structure:



Challenging times before Manufacturing Industry

To succeed in today's competitive marketplace, manufacturers need to pay careful attention to several areas including operational excellence, compliance, and supply chain synchronization.

Manufacturers know that achieving and sustaining profitability is getting more challenging. Uncertainty and volatility in the cost of energy, raw materials, water, and other resources continue to rise. Compliance and risk management are becoming increasingly complex and dynamic.
Leading consumer goods companies have discovered that today's powerful and cost-effective solutions, such as manufacturing and Enterprise systems can provide them with benefits in each of these areas.

Manufacturing Performance Drives Business Performance

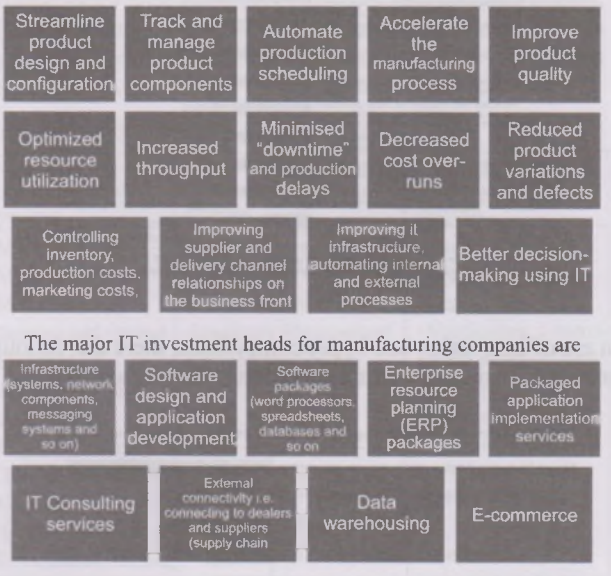
Manufacturers need to enforce and electronically document product quality throughout the production process and bring any product or production issues to engineering's attention to resolve quickly. Manufacturers must provide real-time operational information to ERP systems, provide traceability and genealogy for all products and components, and minimize energy usage, water consumption, and waste generation. Finally, changeovers to new products must be rapid and efficient. Therefore there is an urgent need of technological advancements.

What is Manufacturing IT ?

Manufacturing IT/software is a suite of comprehensive technology tools designed to improve the entire end-to-end process of designing, building, improving, rebuilding and finally delivering the finished product to sales department. From engineering and planning, through production and quality control, manufacturing software offer all the tools a business needs to develop the best possible product in the most efficient and cost-effective manner.

Manufacturing software packages empower businesses with advanced technologies needed to maximize efficiency and minimize overhead. Today production processes have become increasingly complex and multi-faceted, leaving many manufacturers challenged to find methods for simplifying and streamlining their activities. Additionally, as competition continues to heat up in all industries, they must constantly find new ways to reduce production costs, and pass those savings on to their customers in the form of lower prices.

More and more manufacturing plants are turning to acturing manufacturing software applications to improve all facets of their production operations. Few Important benefits and roles of IT systems in manufacturing are:



The process manufacturing sector traditionally spends more on IT because of the larger population of companies engaged in this activity as well as their scale of operations. In general, the business and IT priorities of both process and discrete manufacturing are the same

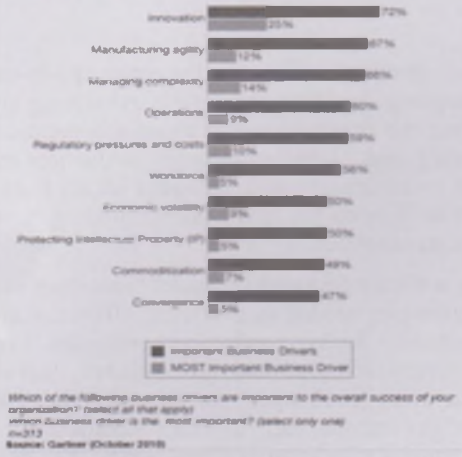
Does a Company Need Manufacturing Software ?

While service organizations, wholesalers, and distributors may have little or no need for a manufacturing software application, any business that designs and builds or produces a product – whether its large machinery, auto parts, small household appliances, clothing, or software – can achieve tangible productivity and cost reduction benefits from the implementation and use of one.

However, the manufacturers that will benefit most from the use of manufacturing software are those who currently use

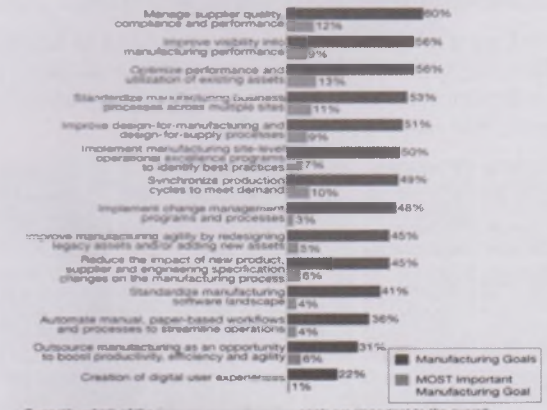
manual processes to manage key production related activities such as demand forecasting, scheduling, and materials management.

Figure 1. Business Drivers Impacting Manufacturing



Which of the following business drivers are important to the overall success of your organization? (select all that apply)
Which business driver is the most important? (select only one)
n=313
Source: Gartner (October 2010)

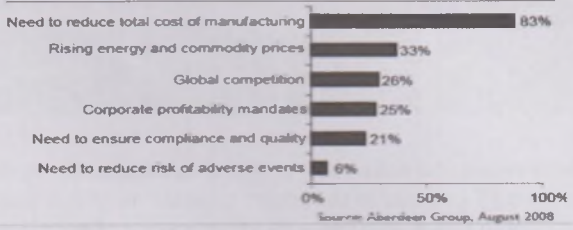
Figure 2. Current and Future Manufacturing Goals



Currently, which of the following manufacturing goals are important to the overall success of your organization? (select all that apply) Which will be most important 12 months from now? (select only one)
n=313
Source: Gartner (October 2010)

In era of innovation and hyper competition, there are various pressures on manufacturing operations. The vitals ones are:

Figure 1: Pressures Driving Focus on Manufacturing Operations



Source: Aberdeen Group, August 2008

Figure 2: Strategic Initiatives by Role in the Organization

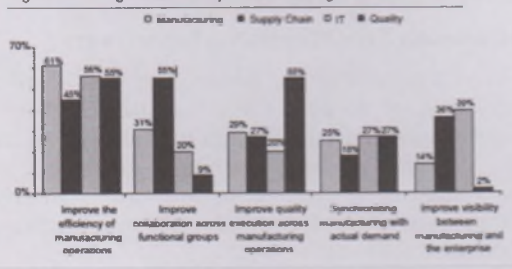
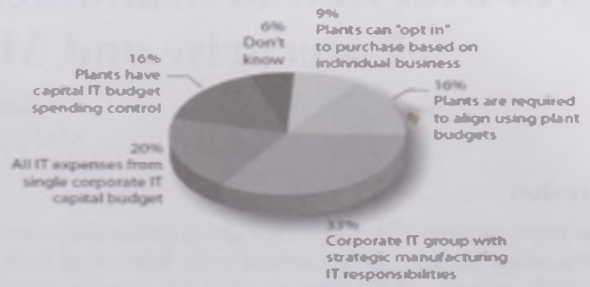


Figure 2: Approach to strategic software adoption in plants



Q. What statement best describes your organization's approach to strategic software tech adoption in the plants?

N = 240 U.S. respondents, % of companies shown

Source: AMR Research, 2009

Manufacturing IT : Indian Scenario

The manufacturing segment accounts for nearly 25% of the total IT spending in the country, which makes it an important segment. According to an IDC study, the manufacturing IT spending in the Asia/ Pacific (excluding Japan) or APEJ region, will reach US$22 billion in 2010. The APEJ region will continue to be a fast-growing regional economic block, powered by the emerging economic engines

of China and India. The number of organizations that have reported a close alignment of business goals with IT is increasing. 44% of the organizations in manufacturing and engineering/ auto segment have aligned their business goals very closely with IT. IT investments by large manufacturing organizations were on the decline last year(2009), with many

industries like automobiles, steel, cement and others facing a downturn in their business. Overall, many of the smaller manufacturing organizations, which have been traditionally poor in IT usage turned towards IT. Traditional large buyers like Bajaj Auto, Ashok Leyland, and TISCO, to name a few did not have any major IT project underway. Public sector steel companies slowed down the IT investments, whereas their counterparts in the private sector spent on ERP and plant automation. In the pharmaceuticals industry, the WTO agreement on patents has forced companies to get patents on their formulations. Clinical trials, a very data-intensive area, are fast emerging as an application in the pharmaceutical industry.

Many manufacturing organizations, especially in the private sector have messaging and groupware in place for intra-organizational communication. Network-centric applications continue to be developed.Maruti-Udyog is moving from its e-mail based messaging with dealers to an Internet-based one. Companies like IBM and Digital, which have a portfolio of solutions for the manufacturing industry through years of global experience, are bringing out newer application areas like e-commerce for Indian manufacturing organizations.

This study finds the AMT (advanced manufacturing technology) adopted in India are plant certification, computer aided design, local area network, quality circle, MRP/ERP, and wide area network. Clearly are directly in the IT area (CAD, LAN,WAN) or directly dependent on it (MRP/ERP systems),indicating a strong IT adoption rate as well as its

underlying supportive role in the overall AMT adoption in India. Indian firms adopted computer networks less and MRP/ERP and rapid prototyping systems more. Testing our survey also reinforce the hypothesis that larger companies are more likely to adopt AMT than the smaller ones.

Table I Classification of AMTs in three level

Criteria	Level I	Level II	Level III
1.Capital investment	Small or medium investment	Medium investment Middle range history	Large investment Newly emerges history
2.History	Well established history	Moderate complexity	Sophisticated
3.Complexity	Simple	stand alone, or based on	May demand several
4.Interdepend -ence	Stand alone	anther technology	technologies to work together
Technologies belonging to the group	1.computer aided design 12.Quality circle 14.Local area networks 15.Company-wide computer networks 16.Inter-company computer networks 17.MRP/ERP 22.Plant certification	2.Computer aided manufacturing 8.Rapid prototyping systems 9.High speed machining 11.Optimization techniques software 13.Automated systems used for testing 20.Multi-departmental design teams 21.Bench marking 23.Just-in-time intventory control 25.Statistical process control	3.Quality function deployment 4.Computer-driven material handling 5.Flexible manufacturing systems 6.Lasers for materials processing 7.Robots 10.Uniform machine loading 18.Computer integrated manufacturing 19.Automatic guided vehicles 24.Group technology

Table 3 Current AMT adoption status in Indias

AMTs	Current status				
	Not implm. 1	Imp. in progress 2	Fully implm. 3	Ans rate	Rank
Design and engineering			(Percentages of establishment)		
1.CAD	3.13	21.88	75	100.0	2
2.CAM	21.88	34.38	37.5	93.8	9
3.QFP	21.88	37.5	34.38	93.8	10
Materials & production					
4.Computer - driven material handling	59.38	15.62	9.38	84.4	23
5.FCM/FMS	53.12	18.75	15.62	87.5	19
6.Lasers used in materials processing	75	3.12	12.5	90.6	24
7.Roboties	62.5	15.62	18.75	96.9	20
8.Rapid Prototyping Systmens (RPS)	65.62	15.62	12.5	93.7	22
9.High speed machining	25	34.38	28.12	87.5	12
10.Uniform machine/ assembly line loading	34.38	31.25	31.25	96.9	15
11.Optimization techniques software	50	28.12	9.38	87.5	21
Quality control and inspection			71.88	96.9	
12.Quality circle	9.38	15.62	31.25	90.6	3
13.Automated systems used for inspection / testingNetwork	28.12	31.25			13
communications			75	96.9	
14.LAN	12.5	9.38	56.25	87.5	
15.WAN	21.88	9.38	40.62	87.5	3
16.Inter-company network	31.25	15.62			6
Integration & control			46.88	93.8	11
17.MRP II / ERP	9.38	37.5	9.38	78.1	
18.CIM	40.62	28.12	3.12	84.4	5
19.AGV & roboties-automated guided vehicles	75	6.25	37.5	87.5	18
Business practice					25
20.Concurrent & Multi-departmental	15.62	34.38	18.75	84.4	
design teams			87.5	93.8	7
21.Benchmarking	18.75	46.88	25	93.8	
22.Plant certification	0	6.25	21.88	81.3	14
23.Just-in-time inventory control	34.38	34.38	34.38	90.6	1
24.Group technology	34.38	25	33.75	90.38	16
25.Statistical process control	15.62	40.62			17
Grand average	32.75	23.87			8

Appendix 1(full forms)

Optimization techniques softwares Optimization systems such as advanced planning, scheduling, MRP, inventory management,
forecasting, resource allocation systems as well as ERP systems

Enterprise Resourse Planning (ERP)

(Level 3)

An ERP system integrates business processes with its software modules. Typically, a business process
crosses multiple functions and is supported by multiple ERP modules that represent business functions.
So a successful ERP implementation should begin with well-defined business processes and bring ERP
modules to the processes.

To garner true benefits of ERP systems, companies should change the way they are managed and operated from function-oriented to process-oriented after ERP goes live. They can use the business processes identified
in this way as a basis of the new management style.

With its roots in Materials Requirements Planning (MRP) and a history that spans more than three decades, ERP has truly become a mature business application.

An organization doesn't consist of separate, isolated departments, each with a specific function. Instead it works as a single entity with process lines across several departments, all liked together. An ERP is an informatics system able to reproduce this exact behavior of an organization – functions interconnectivity.

Manufacturing Modules Overview

Production planning Components/sub-systems	Materials management Components/sub-systems	Quality management Components/sub-systems
•MRP •MPS •Manufacturing planning and control •IT ,EDM (engineering data management) •ECC(Engineering Change Control) •Configaurion Management •Lot Control ,Tooling	•Pre-parchasing activities •Purchasing •Vendor Evaluation •Inventory Management •Invoice varification	•Quality Planning •Quality inspaection •Certificates •Notification ,Control •Audit mannagement •Test equipment management •Stability study

Basic flow of functioning in manufacturing domain

FIGURE 4: ERP MODULES AND BUSINESS PROCESSES THEY SUPPORT

Business Processes	ERP Modules	
	Major	Minor
Fulfil Order	2, 3	4, 5, 6, 7, 9, 11
Develop Product	1	2, 3, 4, 5, 6, 7, 8,10, 11
Procure Material	4	1, 2, 3, 5, 7, 8, 9, 11
Assign People	5	1, 2, 3, 4, 6, 7, 8, 9, 10, 11
Maintain Facility	6	1, 3, 5, 7, 11
Assure Quality	7	1, 2, 3, 4, 5, 6, 11
Calculate Cost	8	1, 2, 3, 4, 5, 6, 7, 9, 11
Prepare Financial Statement	9	1, 2, 3, 4, 5, 6, 7, 8, 10, 11
Manage Investment	10	5, 9, 11
Manage Data	11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10,
Manage Payroll	5	1, 2, 3, 4, 6, 7, 8, 9, 10, 11
Manage Education/Training	5	11
Manage Benefit	5	11

ERP Modules and Numbers
Project Systems (1), Sales and Distribution (2), Production Planning (3), Material Management (4), Human Resource Management (5), Plant Maintenance (6), Quality Management (7), Controlling (8) Financial Accounting (9), Treasure (10), Master Data Management (11)

Implementing an ERP in large companies can be a very difficult mission. The total cost of ownership is high, the period implementation is long and changes must be done

inside the organization. Most of the time it is the organization that must change in order to embrace the ERP system, not the other way around. However, having an ERP shows many advantages. An ERP system is different from other software applications because of the concepts it is built on.

An ERP integrates, in a single unified model, the data manipulation, it integrates all the functionalities inside a single platform. allows perfectly integrated system chaining all the functional areas together. The capability to streamline different organizational processes and workflows. The ability to effortlessly communicate information across various departments Improved efficiency, performance and productivity levels Enhanced tracking and forecasting Improved customer service and satisfaction

Implementing a different product instead of an ERP, inside a large or a very large organization is out of the question. It has to be an ERP because of the integration advantages It has to be a mature and verified ERP because developing one from scratch for a company almost impossible. It would cost a lot more, is not logically constant and there will be no guarantees either.

Advantages

Allows extensions to new functionalities	Allows process modification based on legal changes and requirements	Offers multi-dimensional financial analysis (project based, activity Based, company level).	Supports budget, planning and management decisions
Provides reports for any kind of activity in different languages and layouts	Provides financial consolidated reports using several systems,	Can consolidate more companies into one single group.	Improves the collaboration with clients and vendors
Eliminates data redundancy and enhances data integrity	Allows every body to use a single integrated system	Communication inside the company is better and more secure.	Erp system helps standardising the activities inside an organization.

While advantages usually outweigh disadvantages for most organizations, there are some

Disadvantages of ERP Systems

The scope of customization is limited in several circumstances	The present business processes have to be rethought to make them synchr -onize with the ERP	ERP systems can be extremely expensive to implement and take long time for implementation.
There could be lack of continuous technical support	ERP systems may be too rigid for specific organizations that are either new or want to move in a new direction in the near future	Integration issues or compatibility issues with other manufacturing systems

Figure 2: "Top Two" Business Drivers Impacting ERP Strategies

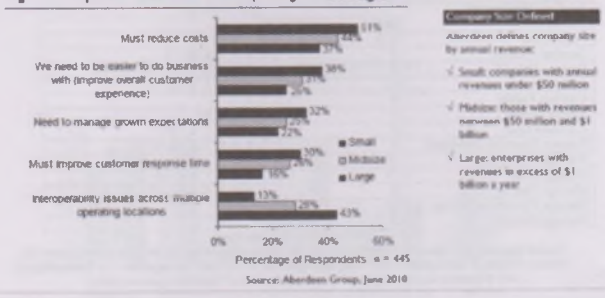


Figure 4: "Top Three" ERP Strategies

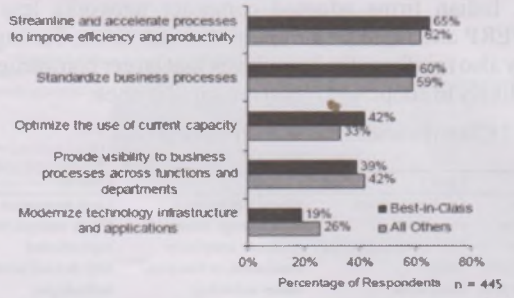


Figure 7: Current Release Status

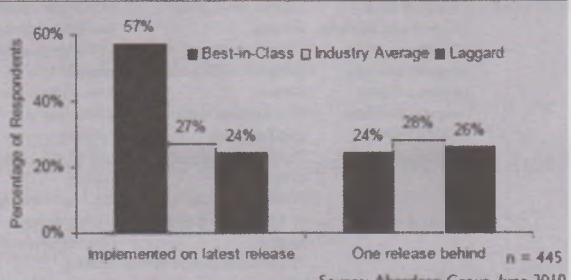
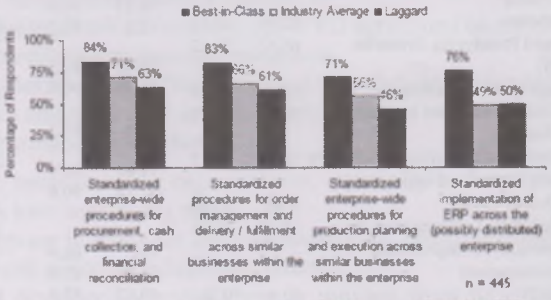


Table 3: The Competitive Framework

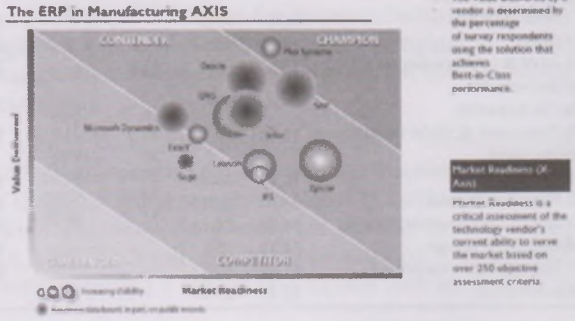
	Best-in-Class	Average	Laggards
Process	Standardized enterprise-wide procedures for procurement, cash collection, and financial reconciliation		
	84%	71%	63%
	Standardized procedures for order management and delivery across similar businesses within the enterprise		
	83%	66%	61%
	Standardized enterprise-wide procedures for production planning and execution across similar businesses		
	71%	56%	46%
Organization	Line of business ultimately owns the success of the ERP implementation		
	79%	62%	44%
	Cross-functional continuous improvement teams are responsible for improving operational performance		
	72%	52%	47%
	Manufacturing operations are integrated and coordinated with customer service, logistics, and delivery organization		
	74%	59%	51%

Figure 8: Process Capabilities

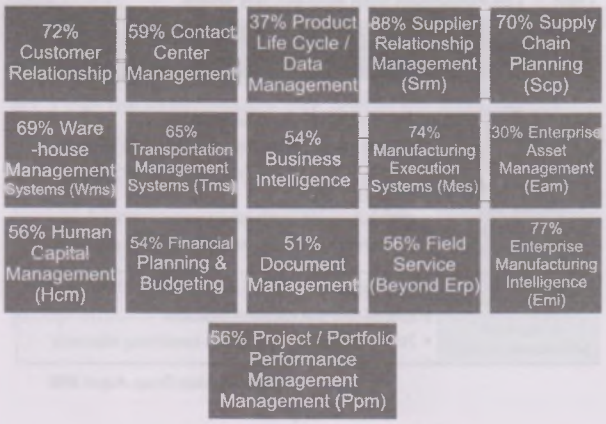


manufacturing organizations.

The ERP in Manufacturing AXIS



Percentage/share of ERP Extensions purchased from an ERP vendor:

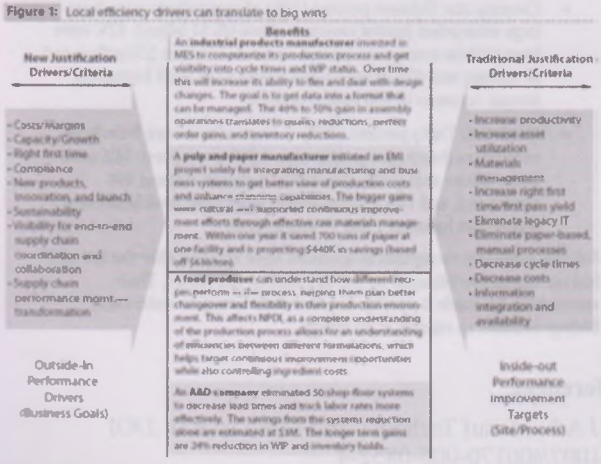


Manufacturing Systems
(Level 2)

MES (Manufacturing Execution system)

MES adeptly bridges the gap between enterprise systems and the factory floor. As more Web-based from systems are being used, one doesn't have to go workstation to workstation anymore to make changes. Manufacturers are refocusing on MES for three reasons.

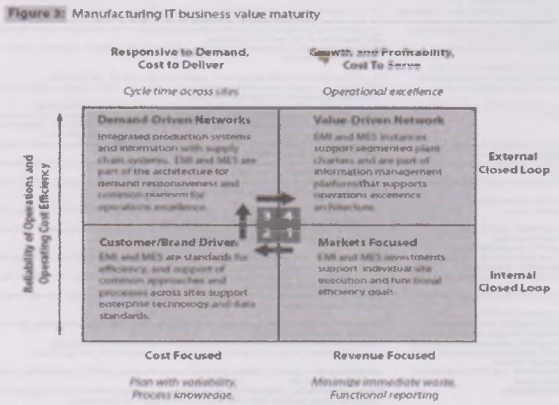
The first is the increasing need for track-and-trace and product-genealogy applications in the wake of a rash of product recalls .Tainted goods in verticals such as Regulations compliance is the second driver of increased interest in MES. The third reason is its relatively low cost compared with ERP."MES is 20% of the cost of an ERP implementation.MES projects are much smaller and more easily justifiable in today's economy."



Though Security of data control is still a critical issue. Integration with other systems is a problem but with advance in software integration technologies, it is improving. It has traditionally been a standalone real-time data monitoring and data collection software.

Enterprise Manufacturing Intelligence (EMI), or simply Manufacturing Intelligence (MI), is a term which applies to software used to bring a corporation's manufacturing-related data together from many sources for the purposes of reporting, analysis, visual summaries, and passing data between enterprise-level and plant-floor systems.

Enterprise Manufacturing Intelligence (EMI) provides companies with real-time visibility into manufacturing performance and tools for analytics and continuous performance improvement.

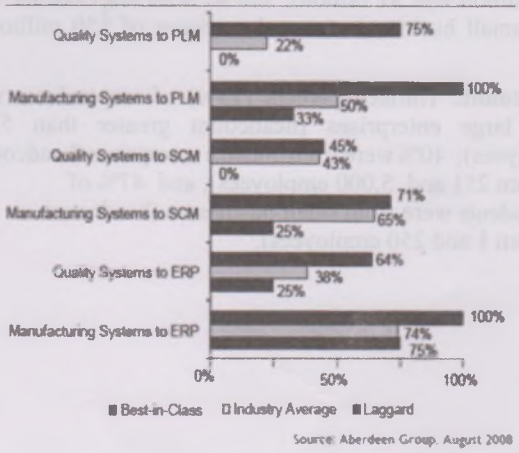


There are many other types of manufacturing systems also. For production management, performance analysis, quality and compliance, and human machine interface (HMI). Production management software provides real-time information about jobs and orders, labour and materials, machine status, and product shipments. Performance analysis software displays metrics at the machine, line, plant and enterprise level for situational or historical analysis. Quality and compliance software is used to promote compliance with standards and specifications for operational processes and procedures. HMI software is a form of manufacturing operations management (MOM) software that enables operators to manage industrial and process control machinery using a computer-based interface.
##3

	Best-in-Class	Average	Laggards
	Share of manufacturers currently using technology:		
Technology	• PFA: 39% • MI: 30% • QMS: 74% • APS: 45% • Lean Mfg: 50%	• PFA: 26% • MI: 14% • QMS: 63% • APS: 29% • Lean Mfg: 32%	• PFA: 22% • MI: 11% • QMS: 55% • APS: 28% • Lean Mfg: 26%

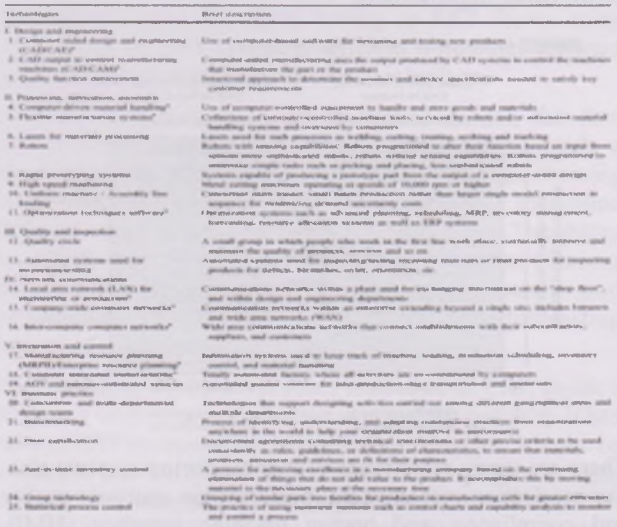
Source: Aberdeen Group, January 2008

Figure 3: Real-Time Technology Interoperability



Source: Aberdeen Group, August 2008

Appendix 1



Appendix 2

Best-in-Class Top 20% :	Industry Average Middle 50% :	Laggard Bottom 30% :
97% inventory accuracy 3.4 days to close a month of aggregate 96% manufacturing schedule compliance performance scorers 98% complete and on-time shipments 11% reduction in inventory levels	94% inventory accuracy 5.3 days to close a month of aggregate 88% manufacturing schedule compliance performance scorers 93% complete and on-time shipments 3% reduction in inventory levels	90% inventory accuracy 7.3 days to close a month of aggregate 73% manufacturing schedule compliance performance scorers 84% complete and on-time shipments Source

Industry: The research sample included respondents from the following industries: discrete manufacturing (54%); process manufacturing (25%);hybrid of discrete and process (21%) The study aimed to identify ,emerging best practices for ERP usage in manufacturing, and to provide a framework by which readers could assess their own management capabilities.

Geography: The majority of respondents (78%) were from the Americas. Remaining respondents included those from the Asia-Pacific region (7%) and Europe (12%), the Middle East and Africa (2%), South/Central America (1%)

Company size: Fifteen percent (15%) of respondents were from large enterprises (annual revenues above US $1 billion); 43% were from midsize enterprises (annual revenues between $50 million and $1 billion); and 42% of respondents were from small businesses (annual revenues of $50 million or less).

Headcount: Thirteen percent (13%) of respondents were from large enterprises (headcount greater than 5,000 employees); 40% were from midsize enterprises (headcount between 251 and 5,000 employees); and 47% of respondents were from small businesses (headcount between 1 and 250 employees).

Appendix 3 (mes)

Table 1: Top Performers Earn Best-in-Class Status

Definition of Maturity Class	Mean Class Performance
Best-in-Class: Top 20% of aggregate performance scorers	• 84% OEE • 95% on-time and complete shipments • 9.9 hours response time to non-conforming shipments
Industry Average: Middle 50% of aggregate performance scorers	• 81% OEE • 92% on-time and complete shipments • 17 hours response time to non-conforming shipments
Laggard: Bottom 30% of aggregate performance scorers	• 65% OEE • 75% on-time and complete shipments • 70 hours response time to non-conforming shipments

Source: Aberdeen Group, August 2008

Research Methodology

Between December 2007 and January 2008, Aberdeen examined the use, the experiences, and the intentions of more than 240 enterprises across different industry verticals regarding their manufacturing operations management

Aberdeen supplemented this online survey effort with interviews with select survey respondents, gathering additional information on their strategies, experiences, and results.

Responding enterprises included the following:

- *Job title / function:* The research sample included respondents with the following job titles: Manager (35%); Senior Management (31%); Director (19%); Consultant (8%); Staff (5%) and other (2%).
- *Industry:* The research sample included respondents from Industrial Equipment Manufacturing (20%); Automotive (17%); Metals (13%); Consumer Goods (10%); High-Technology (12%) Food and Beverage (9%) and Aerospace and Defense (9%).
- *Geography:* The majority of respondents (64%) were from North America. Remaining respondents were from the Europe (16%), Asia / Pacific region (12%), South America (4%) Middle East, Africa (4%).
- *Company size:* Eighteen percent (18%) of respondents were from large enterprises (annual revenues above US $1 billion); 42% were from midsize enterprises (annual revenues between $50 million and $1 billion); and 40% of respondents were from small businesses (annual revenues of $50 million or less).
- *Headcount:* Thirty percent (30%) of respondents were from large enterprises (headcount greater than 1,000 employees); 56% were from midsize enterprises (headcount between 100 and 999 employees); and 14% of respondents were from small businesses (headcount between 1 and 99 employees).

Solution providers recognized as sponsors were solicited after the fact and had no substantive influence on the direction of this report. Their sponsorship has made it possible for Aberdeen Group to make these findings available to readers at no charge.

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