

Editors Note: With increasing focus on eCommerce for delivery of information and products, the educational enterprise is attempting to relate Internet marketing to their needs. This is especially true of distance learning, which has already adopted the Internet as a primary means of communication and distribution for its products. This article challenges us to examine parallels between the industrial internet and the needs of education? Frost & Sullivan kindly permitted us to republish this report.

The Industrial Internet: A 'Total Digital Enterprise' Mindset

By Lance Gordon

The Working Internet

For manufacturers to successfully transform their key business processes to accommodate the new technologies inherent in e-commerce, the common misperceptions of the 'selling Internet' must be replaced with an understanding of the full impact of the 'working Internet' on the factory floor. Today this technology is not just e-business. It is e-production. Management must acquire the new 'total digital enterprise mindset' to more fully exploit these technologies where 'Internetworks' impact key constituencies including production, suppliers, distributors, customers, and employees.

The Industrial Internet is Internet-based management and collaborative enterprise networking for industry. To obtain a 'total digital enterprise' mindset, managers must target the market within Industrial Internet Initiative Technologies, primarily focusing on Internet-enhanced Supply Chain Planning (SCP) and Management (SCM), showing the advancement of Enterprise Resource Planning (ERP) vendors into the SCM market segment. Included, is a view of the Customer Resource Management (CRM) sector as well as a total view of all Industrial Internet applications. Figure 1. shows the multi-level infrastructure of the Industrial Internet. This view spans the market from Internet-enabled Manufacturing Execution Systems (MES), representing the lowest level of application, Web-enabled Decision Support Systems (DSS) and security support technologies, up to the highest level of Web Presence Development Services (WPDS).

Preparations for An Industrial Internet Strategy

Placing the 'e' before e-commerce, as it relates to industry today, calls upon strategic decision-makers at all levels to attain a competency-level grasp of applicable technological concepts. To achieve this, a multiple tier construct is presented with each level described in enough detail to establish relevancy.

Building Blocks for The Industrial Internet: ERP, SCM, CRM and MES

The challenge of this report is in establishing a workable vision of what the Industrial Internet is and being able to create a workable strategy that extends to each of its building blocks. This includes acknowledging valued positions in each of several market spaces or segments. There are different players in different market spaces. Whereas SAP or BAAN might have a dominant influence in the ERP space, companies on the supply chain management or SCM side will differ from the customer relationship management or CRM side. There are also competencies in the manufacturing execution systems (MES) space, as well as the plant floor management, control and automation expertise. And, certainly, there is expertise overlap.

The Industrial Internet infrastructure is made up of six distinct groupings of technologies and their associated products and services. Figure 1 shows this five-level configuration. Progressing upwards from the factory floor are:

- Level I. I-MES: Internet-enabled Manufacturing Execution Systems. Web-enabled interface for plant floor management and execution.
- Level II. I-SCM: Internet-enabled Supply Chain Management
- Level III. I-MRP/ERP: Internet-enabled Manufacturing Resources Planning & Enterprise Resource Planning
- Level IV. I-CRM: Internet-enabled Customer Resource Management
- Level V. DSS/PKI: Web-enabled Decision Support Systems & PKI Technology
- Level VI. WPDS: Web site Presence and Development Services

**Figure 1. Industrial Internet:
Multi-Level Infrastructure of the Industrial Internet, (World), 2000**

Industrial Internet Application Level	Application Technology
I. I-MES Internet-enabled Manufacturing Execution Systems	<u>Plant floor management and execution</u> with web-enabled interface at the device and control level. AS-Interface at the device level. Web-enabled control products with the ability to monitor machine operations anywhere in the world. Web-enabled controllers collect machine control information and store it on the controller as Web pages. The information can then be viewed over the company's Internet/intranet via a web browser.

II. I-SCM: Internet-enabled Supply Chain Management	<u>Internet-enabled Supply Chain Management</u> . Enable manufacturers plan and schedule production and related operations i.e. raw materials procurement to product delivery. 'Vortals' or vertical portals in an e-procurement value chain.
III. I-MRP/ERP: Manufacturing/Enterprise Resources Planning	<u>R2/R3. Internet/intranet-enabled Manufacturing Resources Planning and Enterprise Resource Planning</u> : centralized integration of the enterprise. Beyond original manufacturing/distribution linkages toward uniting other enterprise-centric processors.
IV. I-CRM: Internet-enabled Customer Resource Management	<u>Internet Commerce</u> , B2B supplier and barter transactions Internet Commerce solutions for Industry. Industry-specific Internet commerce solutions through platforms linking suppliers to their customers in the electronics, industrial and automotive markets. E-commerce portals where targeted industries can liquidate or buy surplus inventory.
V. DSS/PKI: Web-enabled Decision Support Systems & PKI Technology	<u>Web-enabled Decision Support Systems</u> and security support technologies.
VI. WPDS: Web site Presence and Development Services	<u>Web Presence Development Services</u> . Web site development, Interactive product information, online trade shows, Catalogs and sales literature development, blueprint archiving, multimedia presentations, Training programs, sales force automation, database management, videoconferencing services

Source: Frost & Sullivan

Implementing the 'Industrial Internet Strategy'

There is a growing quantity of research available on business-to-business (B2B) and e-commerce subjects in the media that portray the market with little regard to network connections accessing the factory floor. This is of paramount concern to industrialists who are in the process of tying data into their ERP system. Most enterprise resource planning (ERP) systems and supply chain management (SCM) software model the factory floor. But these systems really don't go in and bring up real data.

Many progressive manufacturers have exchanged their traditional 'dumb' market identities for 'smart', information age images...from information-poor networking capabilities, to 'information-intensive' competitive

strategies. In doing so, isolated production floors and Stone Age manufacturing outposts have been thrust into the light of a new, dynamic and turbulent, information-rich, highly competitive marketplace. Many in management have been caught off guard and search eagerly for the key concepts to help them capitalize on strategic Internet-applied advantages.

The formulation of an 'Industrial Internet Strategy' can be visualized as having several levels of application:

- The incorporation or *imbedding* of Internet web server connectivity into the company's products
- Installing control and maintenance web-connectivity to the enterprise network, from the front office to the factory floor.
- Web-enabling ERP/MRP transparency to the corporate network
- Building B2B and private sector Internet Commerce capabilities for the enterprise

What B2B offers is opportunities in leveraging open standards industries hungry for trading network solutions. Industry today is in great need of ways to create new revenue opportunities, strengthen relationships with customers, and reduce supply chain inefficiencies.

Acquiring a confident determinism in strategic implementation has nothing to do with luck and everything to do with acquiring a working knowledge of Internet technologies. For networking building, decision-makers must take a good, hard look at what technologies are going to be implemented on the factory floor now and in the future. The technology decisions that are made early on will either provide 'enabling' or 'obstructive' methodologies to future available optional directions of systems growth. Winning strategies include systems that support highly open protocols and physical networks. To most strategists that means TCP/IP and Ethernet.

The New Mindset: Totally Integrated Manufacturing Systems (TIMS)

The new definition of *competitive advantage* for industrialists today must include the words 'Industrial Internet'. This definition should also include words or phrases such as: net-ready, central engineering location (CEL), remote diagnostics, fuzzy-driven technology, IEEE 1394, plug-n-play, and totally integrated manufacturing systems (TIMS), just to name a few. The technology of the Internet is changing the way manufacturing network systems work and the way companies compete.

But Industrialists today (2000) have a shocking lack of knowledge or experience concerning these technologies. Industry has begun to recognize the competitive benefits inherent in Internet technology. These benefits range

from manufacturer order tracking, on-line ordering, estimating, coding, and the development of virtual enterprise management capability. The industrial marketplace as whole, however, demonstrates a ‘sluggishness’ toward the adoption of new or hybrid technologies, and seems saturated in a confluence of decade-old ideas.

Industrial Internet Spending Tops \$80 billion by 2004

Most manufacturers are not necessarily using the Internet and their web sites to offer their products for sale in the commercial sense. Most Internet investment in industry is focused on off-line distribution channels, B2B supply chains, and supplier connectivity. Although, improving customer relationships via interactive information and sales software implementation is on the rise. Customer relationship management (CRM) and sales force automation (SFA) software configurations are very much a part of initiatives to utilize the ‘prospect relationship management’ powers of the Web.

Figure 2 shows spending on Industrial Internet technology initiatives, with large enterprises spending over \$30 billion in 1998. This represents an evolution in the importance of corporate performance evaluation and communications among suppliers, customers, business partners and customers. By 2002 that investment figure had more than doubled, and by 2006, it had more than tripled, with a CAGR of 13.2 percent from 1998 to 2006. By 2004 companies of more than 1,000 employees will be spending from 15 to 25 percent of their total technological budget on Industrial Internet initiative technologies.

Figure 2. Industrial Internet: Large Company Internet Initiative Technologies Spending Forecast (World), 1998-2006

Year	Spending Growth Rate	
	(\$ Billion)	(%)
1998.....	31.5	
1999.....	40.0	27.0
2000.....	49.3	23.3
2001.....	58.1	17.9
2002.....	67.4	16.0
2003.....	74.1	9.9
2004.....	81.5	9.5
2005.....	88.0	8.0
2006.....	94.6	7.5
Compound Annual Growth Rate (1998-2006): 13.2%		

Note: All figures are rounded; the base year is 1999. Source: Frost & Sullivan

The Emergence of Industrial Internet Planning Vendors

It is estimated that manufacturers have been operating machinery on the factory floor in a manner often called 'running blind' for to up to 80 percent of their operation at any one time during the production process. This is the huge back-end or the industrial component of the industrial enterprise. The front-end has been benefiting from e-business or e-commerce technologies of the last decade. For e-production to work, new utilities must be built upon which this massive component can operate. Structure builders have stepped forward including Microsoft and 3Com, with planning vendors such as i2 Technologies and Manugistics Group leading the way.

With the turn of the century has come the emergence of this new breed of global companies serving industry in Internet planning, and strategies for client-server software. These companies have emerged on several competitive fronts including:

- I-PPA Internet-based Production Process Applications
- B2B Business-to-Business e-commerce software companies
- SCM Supply Chain Planning vendors
- CRM Customer Relationship Management Software companies

Business software companies, including SAP, Baan, J.D. Edwards, and PeopleSoft have shifted their energies away from the ERP market, and turned their focus toward the Industrial Internet. They have enjoined i2 Technologies, Manugistics Group, System Software Associates and many others in the drive toward the Industrial Internet or Internet-based production processes applications (I-PPA).

The I-PPA companies represent the powerful hubs and spokes of the global 'web wheel' that interconnects the Industrial Internet's virtual market. This market is still in its relative infancy, with many of the technologies at the cutting edge of software development.

Stakeholders in A Tumultuous, Seamless Environment

Figure 3 shows a list of **major stakeholders** relative to the variant levels of the Industrial Internet over its five levels. The Industrial Internet technology allows data and information to be shared among all stakeholders in a seamless environment. Systems designers and others, however, face a tumultuous reality in the merging of web-based systems to the factory floor.

Figure 3.Industrial Internet:
Major Industrial Internet Stakeholders (World), 2000

Application Level	Stakeholders
Level I.	Production Control, Web-enabled Controllers
Level I.	Machine Operations, Productivity data
Level I., II.	Systems Engineering, Vertical integration of control network
Level II.	Operations, Quality Control, and Maintenance, HMI
Level II.	Suppliers, Production, MRP
Level II.	Finance, ERP
Level II., III.	Customer Base
Level III	Sales & Marketing, CRM, SFA
Levels I. - V.	Systems Management
Level IV.	Decision Support Systems and consultants

Source: Frost & Sullivan

About the Author

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