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Analysis of E-manufacturing capabilities and characteristics

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Abstract - *E-Manufacturing as a term was introduced some years ago by semiconductor industry, enabling to handle large production quantities in different locations. Due to globalization, nowadays individual and small-batch production oriented tooling companies need web-based simple manufacturing, planning and monitoring systems that could include larger sensor systems and databases. E-Manufacturing is the application of open, flexible, reconfigurable computing techniques and communications for the enhancement of efficiency of the whole supply chain. As e-Manufacturing is supported by information technology and has the capability in multi-site management it will foster and improve the competitive capability of manufacturing in the global competition. E-Manufacturing can be determined as IT-based manufacturing model, optimizing resource handling over the entire enterprise and extended supply chain. Hence it is necessary to identify the functional elements of e-Manufacturing to exchange transparent and automated information between shop floor and enterprise.*

Key Words: E-Manufacturing ,supply chain, WOMS, Modular architecture, Virtual Private Networks.

1. INTRODUCTION

The real-time production information should be made available to the entire organization, including managers at the top floors and machine operators at the plant floor in order to successfully apply proactive maintenance to achieve near zero downtime of the systems and then, e-Manufacturing can target to optimize supply chain execution. Further there are four competencies (design, operate, maintain and synchronize) that are required for any manufacturer to be a world class manufacturing company.

Thus e-Manufacturing gives the company agility to react quickly to the changes in market, technology, and customers by operating as a virtual enterprise and e-Manufacturing is also called as Web Oriented Manufacturing Systems [WOMS]. Using the internet and tools that support commerce functions, one can find new customers; reduce the costs of managing orders and interacting with a wide range of suppliers and trading partners, and even develop new types of information based products, such as remote monitoring and control software and other online services.

1.1 Major Functions of e-Manufacturing

It is necessary to identify the functional elements of e-Manufacturing to exchange transparent and automated information between shop floor and enterprise.

1. Transparent, seamless, and automated information exchange process.
2. Total asset management that aims improving the utilization of plant floor assets using a holistic approach combining the tools of predictive maintenance techniques.
3. Sophisticated customer service system that serves customers utilizing the latest predictive intelligence methods and tether-free technologies.

1.2 Modular architecture

At present e-Manufacturing models have been developed with modular architecture as shown in Fig-1 describes each of modules and how these modules fit together to form integrated e-Manufacturing model.

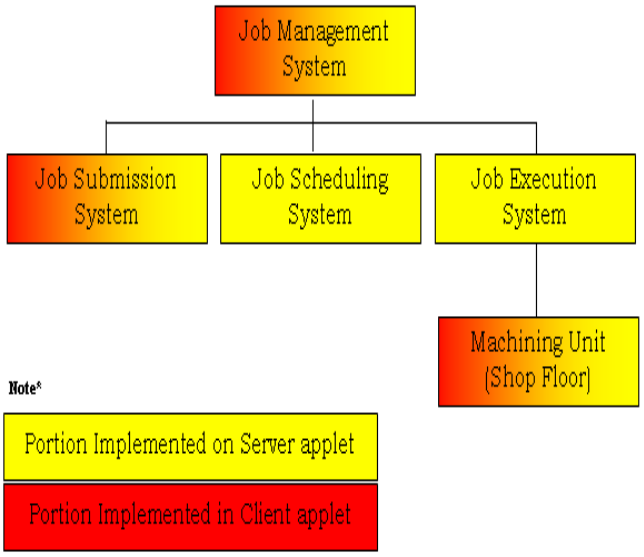

Fig -1: Modular architecture of WOMS model

2. SECURITY MANAGEMENT

To enable optimal and secure collaboration between collaborative partners, three levels of security must be used sequentially in e-Manufacturing.

The first level is to limit network access through hardware controls, such as creating Virtual Private Networks (VPNs) and using firewalls. This first step essentially removes the company's intranet from the public Internet, thereby creating a privatized network connection and establishing a secure infrastructure between remote sites minimizing the risks of targeted denial of service attacks.

Second level is to create security policies that use authentication and authorization controls to establish access from the VPN to the application layer. Once the security measures are in place, one can use these resources to allow data filtering, to control file transfers, and to limit and monitor or deny remote equipment operations. Moreover, the second level should provide a full data audit trail of security so a collaborating wafer knows what data is to be accessed, when it is to be accessed and to whom it is to be distributed.

Third level provides a context related security gate around a specific set of conditions that defines the content of shared information. This conditional software addresses security, such as specific data items that can be accessed, commands that can be issued and under what conditions access is allowed.

2.1 VPNs and firewalls

2.2

Internet Layer Security Technology (ILST) developed a VPN solution called ServiceNet™ to address both the functional and economic factors in transporting data over the internet. Using a shared IPSec-based VPN model, shown in Fig-2, which isolates the server with a public address from public reach allows the server to dedicate its time to serving customers.

In addition, ServiceNet™ permits each constituent to create a single VPN tunnel that terminates in an isolated network hub, thus enabling a secure and cost-effective network connection between each company connected. Each constituent is isolated from others using firewalls. Data sent through the VPN tunnel is encrypted, so that only the intended receiver may decrypt transmissions

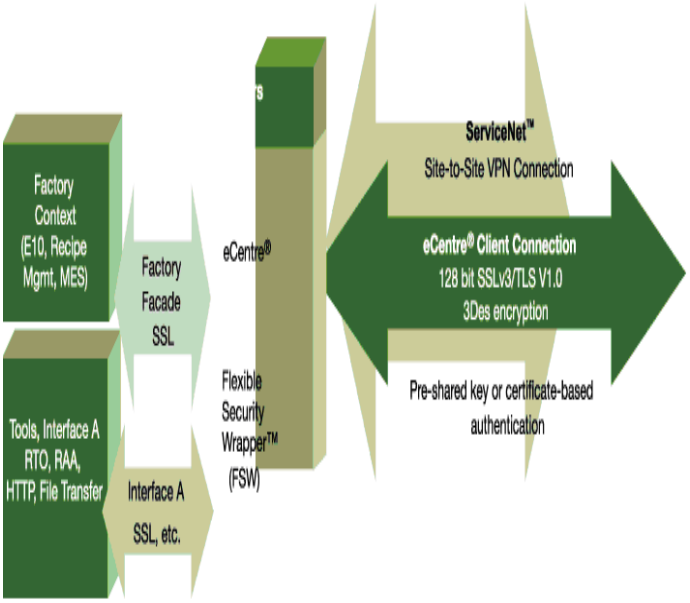

Fig -2: Network Security Management

Using the shared-VPN model reduces the security risk, provides much better performance and reduces overall cost by providing access to many constituents by having only a single 'hole' in the firewall, e.g. 'connect once, access many'

2.2 Authentication and authorization

Once security measures are in place, they allow data filtering, control file transfers and limit, monitor or deny remote equipment operations. Securing the data is not just a concern for connections outside the firm as many firms are now placing isolation networks around their production floor and treating their own intranets as a possible security threat.

Network software designs, such as ILS Technology's e-Centre®, provide additional levels of security through authentication, approval and auditing functions. User authentication can range from single factor authentication, such as user identification and password, to full three factor authentication.

The unique e-Centre design allows a firm to handle multiple forms of authentication within the same installation. By simply defining authentication servers and linking them to specific Lightweight Directory Access Protocol [LDAP] domains, the security administrator is able to support all types of security configurations. The e-Centre supports all of the industry standard forms of authentication certificate, SecureID, SAML, RADIUS, registration, biometrics and integrated windows.

Once the data is collected by the e-Manufacturing server, there must be assurance that the persisted data is logically separated by source. This is important to ensure that users have access only to the data that they are authorized to use and not competitors. This is accomplished by using different tables for each source or optionally different physical locations may be specified for data persistence of the different sources.

The resulting security system limits access to approved users only and controls user actions based on their approved privilege levels. In addition, user actions are audited and in some cases require further approvals from within the enterprise to be allowed. An upcoming feature of e-Centre will provide a layer of security that will enable communication between connected constituents in both directions.

3. PRODUCT DEVELOPMENT AND COLLABORATION

When a product is manufactured, it undergoes different phases from the notion conceptualization to the finished product. Some of the important phases in the product development are design, process planning, production process, and marketing. Collaboration among different partners of the product development located geographically at different places through the forms of communication, coordination, negotiation, etc. plays an important role in e-Manufacturing, in addition to the conventional collaboration methods.
A different designer at different locations to model the geometry of the same product using web-browsers cyber view system is used. The product database used in this system is modeled using Standard for the Exchange of Product Model Data (STEP). Common Gate Interface programs are employed to convert the STEP-based geometric descriptions into Virtual Reality Modeling Language (VRML) based geometric descriptions.

Many computer networks and web technologies, such as file transfer, multimedia modeling, database management, and virtual reality representation have been employed to improve the quality and efficiency of Web-based collaboration functions. Cyber Eye system was introduced incorporating the technologies of HTML, ASP, Java, ActiveX, and Open Database Connectivity (ODBC) protocol in the development of a platform for collaborative product design. From the overview of the e-Manufacturing and its capabilities presented in the earlier sections the specific characteristics have drawn, which are indeed required for the assessment of criteria for suppliers' selection in conjunction with e-Manufacturing philosophy, because different situations require the use of different criteria with different preferences for suppliers' selection.

4. DATA MODELLING

During the different phases of product development, data is required to be stored properly. For example, in the design phase, the design data consisting of geometric data model and in the production process, the manufacturing process data model are required. With the advancement of new computer and network techniques, many database systems have been developed for modeling products, manufacturing resources including materials, machines and personnel, etc. in implementing advanced manufacturing systems. To improve the capabilities of modeling the databases in WOMS, many web technologies have been employed.

The geometric data models play key roles, among the different type of data models used in most of the WOMS. Web-based tools such VRML and Java3D are used to improve the geometric modeling functions of web-based applications. XML-based data modeling is used to model the product and production databases, because of its structured organization of web-based information and capability to extract required descriptions and display the descriptions in certain Web formats.

5. CHARACTERISTICS OF E-MANUFACTURING

From the overview of the e-Manufacturing and its capabilities presented in the earlier sections the specific characteristics have drawn, which are indeed required for the assessment of criteria for suppliers' selection in conjunction with e-Manufacturing philosophy, because different situations require the use of different criteria with different preferences for suppliers' selection. Thus the important characteristics of e-Manufacturing are enlisting below in order to find suitable criteria:

1. E-Manufacturing is a transformation system that enables the manufacturing operations to achieve predictive near-zero-downtime performance as well as to synchronize with the business systems through the use of web-enabled and tether-free (i.e., wireless, web, etc.) technologies.

2. In e-Manufacturing, the emphasis appears to be on the flow of information between partners, functions of design, delivery of quality products economically in a timely manner.

3. The real-time production information should be made available to the entire organization, including managers at the top floors and machine operators at the plant floor.

4 . E-Manufacturing gives the company agility to react quickly to the changes in market, technology, and customers by operating as a virtual enterprise.

5. Transparent, seamless, and automated information

exchange process between clients and manufacturing firm, i.e., It is an integrated information and decision making among data flow (of machine/process level), information flow (of factory and supply system level), and cash flow (of business system level).

6. CONCLUSIONS

Thus from the above mentioned specific characteristics it is understood that, when compared to the traditional manufacturing, e-Manufacturing is certainly different in functionality, structure, operations, transparency, security, flow of information, agility, lean capabilities, maintenance etc., and it is felt that capabilities are analyzed in the context of e-Manufacturing. Structural concepts of e-Manufacturing are discussed along with the software architecture requirements, capabilities of e-Manufacturing. The discussion also reveals the specific nature of e-Manufacturing and thus the characteristics of e-Manufacturing have been enlisted in order to assess the criteria to be considered for prioritization of suppliers.

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