Recent Wireless Wave in Component base Integrated Control Systems for the Textile Industry

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Abstract: *Future applications and platforms will be context-sensitive, adaptive, personalized and need to be run, in a reasonable and secure manner, on variety of execution environments: anywhere, anyhow, anytime, by anyone. Textile industry in the world is growing, as we advance into the knowledge age, objects and material technology will disappear into our material environment, turning unintelligent objects into active and intelligent. The market has also been boosted by changes in consumer lifestyles. This study addresses an emerging recent advance new field of research that combines the strengths and capabilities of electronics and textiles in one, electronics and information and wireless communication technologies will give rise to the area of intelligent textile. Success of wireless communications and mobile devices are stressing the need for the development of mobility-aware services and use them anywhere, anyhow, anytime, by anyone. Need to design middleware architecture to ease mobility-aware service development, and develop new systems which monitor any machine, anywhere, anyhow, anytime, by anyone. Using wireless technology and machine data may be accessed from anywhere, anyhow, anytime, by anyone in the Wireless-World.*

Keywords: *Software Engineering, Wireless Control Systems, Supply Chain, Information flow, Process Control, Business Intelligence, Multi Agent System, Data Warehousing, Data Mining, CMMI, Fuzzy Logic.*

INTRODUCTION

During the last two decades consumers have become increasingly sophisticated, demanding more frequent innovation, greater exclusivity, more choice and better service. At the same time, the growing trend towards more informal and active lifestyles has created demand for new fabrics and garments, while demand for more traditional formalwear has declined. These changes have not only increased the diversity of products on the market, but future needs have become more uncertain and subject to more frequent change. These have developed as a result of a convergence of lifestyles towards an industrialized, urban, consumer lifestyle model [1,2].

With mechanization, the industry gravitated from homes into factories. As markets expanded through a combination of population increase, economic expansion, real price reductions and technological change, demand became more varied and subject to more change influences and the control systems from the machine level to the Supply Chain, Software Design, Data Monitoring, Processing, (CAD/CAM/CIM), Integrated Production, Software engineering, CMMI, business intelligence, multi agent systems, data warehousing, data mining, CRM (Customer Relationship Management). Significant next generation wireless storm connection of different manufactures and suppliers whole the world exchange the data between them through XML based framework and avoid the different proprietary data formats, this technology boast the future of wireless industry. Advances of the computer and network capability has given way to the explosion of sensing capability, storage, and process of that data for control. Earlier sensors did not come as standard equipment on most textile machines.

About Capability Maturity Models

Capability Maturity Model® Integration (CMMI®) provides the guidelines for Process Integration and Product Improvement and address product development and maintenance. Companies today want to deliver products better, faster, and cheaper. At the same time, in the high-technology environment of the twenty-first century, nearly all organizations have found themselves building more and more complex products. More commonly, some components are built in-house and some are acquired; then all the components are integrated into the final product. Organizations must be able to manage and control this complex product development and maintenance. SEI has found several dimensions that an organization can focus on to improve its business. Figure 1.1 illustrates the three critical dimensions that organizations typically focus on: people, procedures and methods, and tools and equipment. Manufacturing has long recognized the importance of process effectiveness and efficiency.

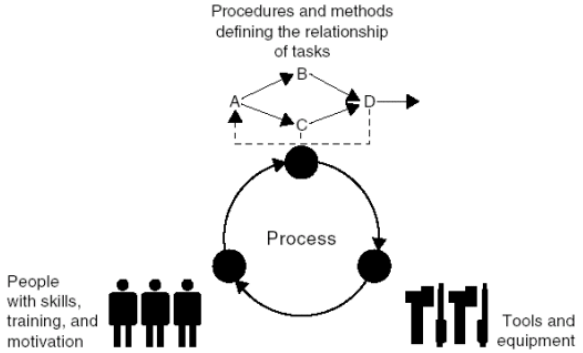


Figure 1. The Three Critical Dimensions [5]

Intelligent Agents and Multi-Agents Systems

Autonomous Agents and Multi-agent systems (MAS) represent a new developing area of research. This area of research is now reaching a level of maturity, enough for MAS to be applied as a technology for solving problems in an increasingly wide range of complex applications. MAS are inspired by models from biology (ecosystems) and economics (markets). They represent a new way of

analyzing, designing, and implementing complex software systems. Our aim in this project is to point the most important theoretical concepts and practical issues associated with the design of intelligent agents and Multi-agent systems. Agent theory concerns the definition of agents and Multi-agent systems, properties, architectures, communication, cooperation and coordination capabilities [6].

The Mass Production Customization Era

As industrialization proceeded, mass production techniques were adopted by an increasing number of textile and apparel firms. Large-scale production of standardized products in vertically-integrated mills first began in the US in the early 1800s. However, it was not until the 1960s that the manufacturing philosophy established by the Waltham Company of Massachusetts in 1813 became more widely adopted outside of the US. Just as the craft era was replaced by the era of mass production, mass production is being replaced by the era of Mass Customization. Prior to the industrial revolution manufacturing was considered a craft. Products were typically custom made to meet the needs of a particular individual. IT and automation play a key role in mass customization in that they create the linkage between a customer's preferences and the ability of a manufacturing team to construct products based on those preferences [7].

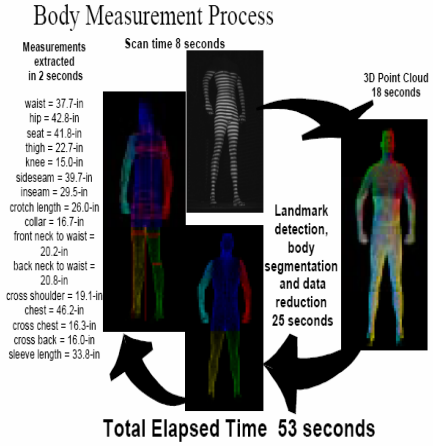


Figure 4. Body Measurement Process [4]

Knowledge Age: Dematerialization of Information and Wireless Communication Technology and The Rise of Ubiquitous Intelligence

We are advancing into a knowledge-based economy, where ideas and information mean capital and information access and communication systems are the drivers. Science is increasingly impacting on and permeating all aspects of our lives through products and services, as the market for technology products expand. According to Philips Electronics, Netherlands, ‘‘our environment of the future will consist of invisible interactive systems that will be embedded in our living spaces and clothing, creating an ambient intelligence that could form a natural part of our life’’ [8].

Intel Champions Emerging Wireless Broadband

For Intel, WiMAX mobile (WiMAXm) is the road map to the future. internationally developed IEEE 802.11 and 802.16 standards WiMAXm, ‘wireless mobile Ethernet’, portends development of product markets similar to those Intel has historically dominated. WiMAX and converged wireless and networking provide the flexibility, lower costs and mobility that will drive much of the productivity enhancements and entertainment value that will bring value in the future. The WiMAX effort can argue is not well suited for ‘the next and next after’ generations of WBB starting with 3.5G and 4G. Research conducted by leading cellular companies points to the advantage of shifting to OFDM for ‘beyond 3rd generation’ or B3G mobile systems. Advantages can be seen compared to CDMA as newer technologies. Even Qualcomm’s own CEO and similar leaders in the 3GPP effort admit that to achieve 4G capabilities, 3GPP will likely shift to OFDM technologies for the down link while, perhaps, maintaining the use of CDMA for the up link connection [11].

Wireless Mobile Takes Over

Communications and computing networks and device markets will largely determine growth of electronics in general and determine competitiveness in related fields. PCs can no longer be counted on as the future growth engine for Intel. And cellular products are becoming more complex and diverse pushing Qualcomm to take on a broader role. In other words, both companies must move into each other’s markets as wireless converges with broadband networking and computer fields [11].

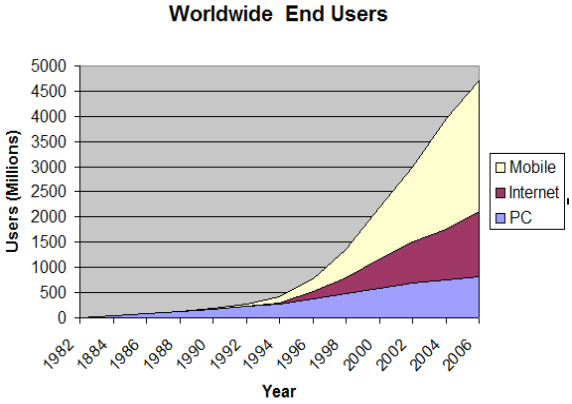


Figure 4. World End Users Wireless Mobile Takes Over

Changes During The Information Era

Since the late 1970s, the structure that developed during the 1950s and 1960s has increasingly broken down. Mass production and standardization have given way to an emphasis on variety, flexibility, speed, innovation, and brand positioning and promotion as a means to differentiate from competitors. These changes have encouraged the development of more flexible manufacturing and supply chain technologies, resulting in extensive de-integration as textile and apparel companies have focused on core competencies and striven for greater flexibility.

Data Connectivity

Data enablers have increased the communication ability between devices over time as seen in Figure 5. The ability to gather and pass along information in the textile industry has closely followed the technological advances in computers. Typically, these connections were unidirectional from the information being sent. If the machine had sensors, getting access to the data in real time or in batch time was impossible unless you tapped into the machine's PLC directly. The advent of the RS232 port (serial connections) opened up the machines to gain access to sensing data that was available. However, each machinery manufacturer utilized a different protocol to gain access with its machine. This was an attempt by the machinery companies to keep their programmers busy with customers as well as keep their data propriety for their control systems. Even as standard protocols for accessing the machine become more popular, machinery manufacturers did not share their data formats and still required major programming for customers to access the data [12].

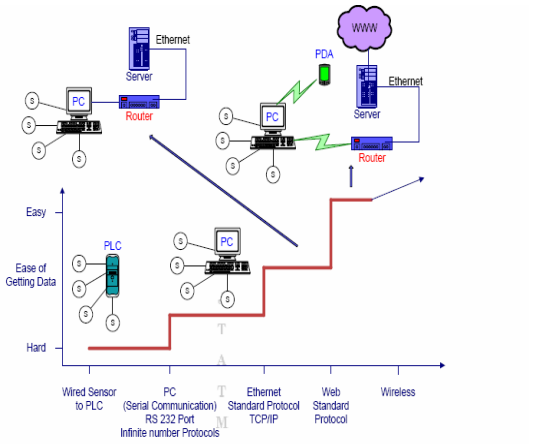


Figure 5. Historical Evolution of Data Connectivity [12]

Data Accessibility Information

Figure 6 shows the progression of communication ability or EDI (Electronic Data Interchange) over time. This interchange could be between machines within a plant, between plants in an enterprise, or more importantly between suppliers and customers. In the early days of manufacturing and financial computer systems, almost of the data was manually entered into the computer. For example, orders from a customer were either phoned or faxed in and then keyed into several different systems (i.e., financial, manufacturing, distribution, etc.) since they often did not talk with one another. The advance of Ethernet made it possible for companies to perform Business-to-Business (B2B) transactions more easily. However, in the early 90s most of the data that was sent via email or hardwired intranet was still being keyed into the computer, because companies could not agree upon a standard format or protocol [12].

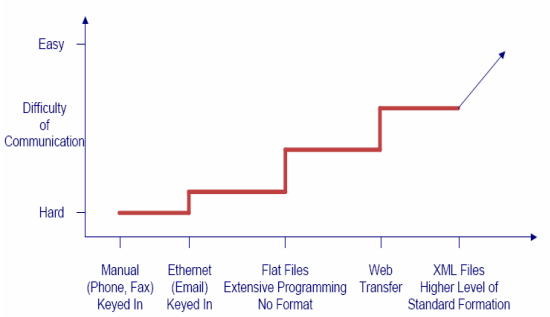
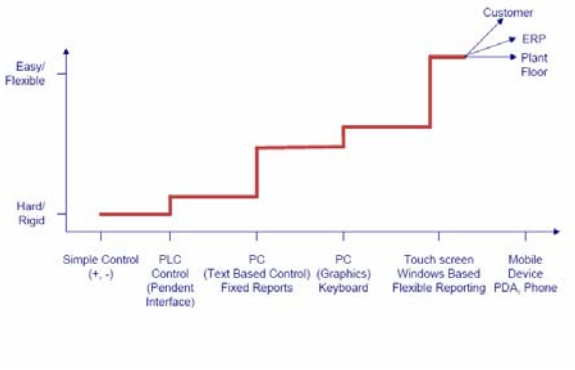


Figure 6. Historical Evolution of Accessing Processing Information [12]

Control System and Machine Interface

Like many of the areas, the control system interface closely follows the advancement of computing technology. As seen in Figure 9 the interfaces moved from a hard inflexible system to more flexible systems. Initially machines had basically on/off control, which was quite rigid. As sensing technology was added to these machines, the control system interface may have remained the on/off control, but the sensors were hardwired to stop the machine if certain conditions were met (i.e., an individual interfered with the path of a top feeder in an opening room, a delivery sliver ran out, or a broken end at weaving occurred, etc).

Since humans are a critical component of the manufacturing system, it is natural that advances in human interactions with the machinery paralleled advances in Control System Flexibility. The next step in sensing technology resulted in LED Text-Based readouts on each machine with Keypad entry to control or change machine variables. This was quickly followed by Text-Based Graphics [12].



Integrated and Information Systems

The degree of integrated Systems component varied from vendor to vendor. Suppliers of software systems often differed significantly on their visions of the future. Companies with historical roots in sensing technology frequently guard against any attempt to share the data collected on an open platform and larger integrated information systems with easily accessible and transmittable information. The maturation of ERP (Enterprise Resource Planning) was evident throughout, with the key word being modularization. ERP systems are usually broken down into modules such as financials, sales, purchasing, inventory management, and manufacturing. These systems usually have extensive set up options that allow some flexibility in customizing their functionality to meet specific business needs. Figure 10 depicts the evolution of management systems over time. Software applications throughout its 5 major areas of Enterprise Control: Planning, Manufacturing, Costing, Sales and Inventory & Purchasing. Information is readily transmitted using the World Wide Webb (WWW) coupled with XML language. Access to the system can be through Ethernet, PCs or PDAs (Portable Data Assistants). The system is sensitive enough to mine to an individual loom activity, which is, in reality, frequently a scarce resource [12].

Figure 5. Planning Systems Over Time

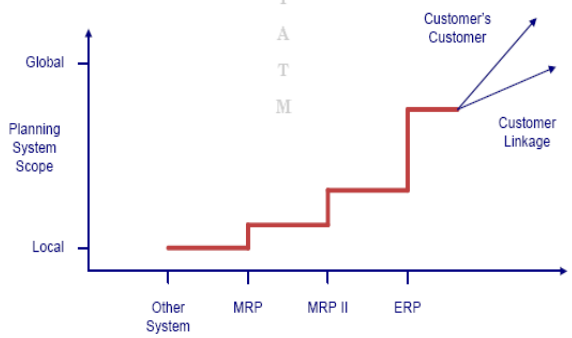


Figure 10. Planning Systems Over Time

Programmable Logic Computers

Arguably the most popular technology for plant automation has been Programmable Logic Controllers, otherwise known as PLC's. These units offer high quality input/output electronics as well as excellent real time monitoring capabilities and are specifically designed for the shop floor environment. Traditional PLCs used to be directly connected to the machinery's actuators and sensors, and its modular architecture made it easy to combine different types of I/O interfaces. However, complex automation systems are currently built using information intelligent field buses, so the main advantage of the traditional PLC to combine I/O interfaces and the process computer in one modular unit has lost its impact. Nowadays, in most process control applications traditional PLCs are currently reduced to a CPU with some communication and field bus interface modules. Due to the advances in PC microprocessors and field buses, integrating the functionality of PLCs into PC based controllers was the next obvious step in process control [12].

Wireless Process Control

The use of a PC open architecture and a Windows based operating systems allows for the implementation of wireless networks by using off the shelf components. Several manufacturers provide wireless devices that can be used as mobile control and supervision centers. Handheld PDAs and tablet PC are commonly used in these roles. Another advantage of using PC open architecture and TCP/IP protocols is the ability for most vendors to connect directly into the controllers. This level of connectivity allows the vendors to perform routine maintenance and software upgrades and reduces the response time for service requests as diagnostic tests can be performed prior to the visit of the technical service representative. In addition, process control and production engineers can easily monitor the processes from almost any computer equipped with an internet connection [12].

Figure 15. Tablet PC equipped with wireless communication used as a mobile control and supervision center. (Courtesy of Setex and Advantech)

Figure 12. Tablet PC Equipped With Wireless Communication Used as a Mobile

Fuzzy Logic Controllers

Fuzzy logic is an approach to computing that tries to bring reason to the vagueness usually found in human behavior or the unclear boundaries in physical processes. Traditional Boolean logic is based on a series of YES or NO answers, but fuzzy logic offers degrees of partial truth to a particular equation for a more human approach. Use of fuzzy logic in process control is currently increasing. While fuzzy logic is not needed for every application, it can prove helpful in hard to control situations, which may be susceptible to sudden process upsets or disturbances such as the dyeing and finishing operations. This type of optimization cannot be achieved with conventional PID controllers [12].

Figure 17. FONG's FC38. The first stand alone controller incorporating fuzzy logic for dyeing and finishing applications (Courtesy of FONG's)

Figure 13. FOMG's FC38. The First Stand Alone Controller Cooperating Fuzzy Logic.

Conclusion and Future Directions

Wireless connection of different manufactures and suppliers and exchange the data between them in the wireless-world, anywhere, anyhow, anytime, by anyone through XML based architecture and avoid the different proprietary data formats. In this paper we studied that over the next few years, we feel the XML explosion of information sharing will take over most EDI utilized by companies and equipment manufactures, automatic machine inspection system, which detects the defects of any product and generate defect maps contains the quality of the product in terms of defect types along with the location of those defects. Trends in wireless technology usage in industrial monitoring and control applications and comparison of proprietary and standard protocols, security and reliability considerations, application software needs, power source considerations, the benefits of wireless usage, problems with wireless usage, and solutions for these problems. Further study is still required to draw more firm conclusions. We also suggest that the scope of this study be further spanned to cover more achieving higher levels in process control integration and higher productivity requires the use of complete automation solutions with compatible communication protocols that allow seamless interfaces between the controllers in the shop floor and the planning and scheduling systems. Only this level of process control sophistication makes possible the dynamic optimization of the resources available. The evolution of wireless communication and mobile technologies gives promises for computational services and resources to support and influence work processes planned or performed in physical work environments.

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