SIEMENS

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On Track for the Intelligent Factory

Pictures of the Future in Automation and Control

- Check against delivery -

Ladies and Gentlemen,

It gives me great pleasure to meet you here in Hanover for the fourth time since 2001 and to share with you the latest developments in the field of automation.

“On track for the Intelligent Factory” – automation is a textbook example of how Siemens consistently sets technology trends to create sustained benefits for its customers. Let us all take a look into the future: How will industrial automation develop? What are the general conditions and challenges which will govern this development? And to what extent does Siemens live up to its claim to be a trendsetter in this technology?

Pictures of the Future

With our innovation approach under the name of ‘Pictures of the Future’, we have also taken a look ahead into the future of our business segment ‘Automation and Control’. We believe that five trends will largely determine the future of this complex field of technology: Standardized platforms, micro-system techniques, mechatronic solutions, the growing performance of IT and industrial communications, and the convergence of product life cycle management (PLM) and automation. Let me explain where we stand and what the next steps will be that Siemens will take in relation to these trends.

Platform strategy: Totally Integrated Automation

With the launch of Totally Integrated Automation (TIA) in 1996, we succeeded in advancing the integration of engineering, data management and communications to unprecedented levels of performance. TIA has remained the yardstick generally applied to the world of automation, meeting customers’ requirements to increase their productivity on the one hand and reliably protecting their investment on the other. TIA is a unique approach to automation which covers all levels of the automation pyramid. All components interact; they are interconnected through high-performance communications with the main aim of cutting engineering costs on the one hand and reducing life cycle costs on the other – always bearing in mind the overall automation task. Thanks to TIA, we are the sole supplier capable of providing integrated and reliable solutions for converging factory and process automation in the form of hybrid automation.

We are poised to forcefully drive TIA’s further development. This means bringing new technologies into the automated world and linking production systems with product design and merchandise management systems. In a highly fragmented industrial software market we are the ones who, by placing the emphasis on extending our portfolio in the field of PLM and MES (Manufacturing Execution Systems), are again setting the trends. What our customers require is consistent solutions and the integration of the most diverse software technologies into a meaningful and lasting solution.

Simatic technology used across several Siemens Groups

Over the years, Simatic controllers have developed into the world’s leading automation system, representing today a quasi-standard on which the great success of TIA is based.

The breakthrough came in the 1980s when S5 controllers were first introduced. Microprocessors with unprecedented performance were applied, and the Step 5 programming language created universal flexibility. In those days, use was mainly focused on machine automation. It was only logical, therefore, to continue with automating entire manufacturing lines, including monitoring production data using operator panels, monitoring messages and recording operating data.

Today, Simatic and TIA solutions are applied in the most diverse industries ranging from individual machines to entire production plants, be they in classical industrial projects, in transportation, buildings, power plants or power transmission. Simatic stands for a powerful, open and scaleable system which we supply to our customers across all industries.

Simatic in railway technology

Siemens establishes industrial standards and uses them as a basis for the most diverse applications. For us it facilitates innovation and further development, for our customers it makes new design affordable and modernization a lot simpler. Simatic controllers are used not only in factory and process automation but also in railway systems. The use of standard industrial components such as our Simatic S7 controllers in interlockings offers a number of advantages:

Interlockings based on Simatic components are low-cost, scaleable to all applications and easily extendable. This allows new product generations to be easily integrated into existing installations. All the tool environment is there, and no adaptations are required to suit individual countries' needs. Below the line, the use of Simatic significantly reduces the time and money spent on general development, engineering, configuration and maintenance. In the example of a Simatic interlocking system introduced in South Africa, the cost was only ten per cent of what a usual market launch in interlocking systems would have cost.

Micro system technology

Another key area for the future of automation is in micro-scale and nano-technology. In combination with software and micro-chip technology, it uses micro-mechanical components, thus driving major technological developments.

Microsystem technology is based on the manufacturing process of micro-electronics. New products are being developed, beyond electronic and opto-electronic components, including micro-sensors, micro-actuators and even micro-reactors which can be applied in process technologies. Reactors in micro size can be made in modular units and switched in multiple parallels which is a great advantage in such industries as pharmaceuticals and fine chemicals. The corresponding automation is due to follow these concepts of size and distribution in the medium term and become an integral part of micro-system technologies. As soon as we get there, this will open up entirely new saving scales.

Micro-reactors are used to optimize lab processes, making it easier to transfer them to the industrial manufacturing process. Once a production process has been certified at pilot-scale and is multiplied thanks to a standardized process, both the capital expenditure and the time-to-market are bound to drop dramatically for the user. Moreover, it suits individual requirements in small batch production as is the case with active pharmaceutical ingredients. If the production output is to be increased, standardized components are multiplied and run in parallel. “Number up” instead of “scale up”.

Bio-sensor systems are used in in-vitro diagnostics, in large volume screening or bio-detection systems, and in miniaturized sample preparation in bank card format. In the autumn of 2004, researchers at Fraunhofer, Infineon and Siemens were selected for the German Future Award given by the German Federal President for a project called “Laboratory on a chip – electrical biochip technology”.

All these new technologies create the basis for the next step in intelligence distribution. As a vision one could imagine networks of self-monitoring, self-configuring components, with each component dealing largely independently with the task assigned and sharing the information gained with all other components within the network.

Micro-mechanical gas chromatography

One of the areas in micro-technology which has already gained relevance in today’s automation world is micro-process analytics. By using silicon for micro-mechanical structures such as tubes, metering pumps and valves, we have succeeded in developing gas analyzers which are as small as a football. Such devices used to have the size of a cabinet; they were housed in a separate building and connected to the gas ducts via long slotted lines. The new micro-technology-based analyzer is fitted directly in the relevant tube to be tested. Any deviation is detected and corrected on the spot. Such components are applied in low-cost real-time process analyses in places which would have been impossible to reach in the past. In the future, such components will be additionally complemented by “virtual” sensors. These are mathematical models deducing further information from measured data.

Automated micro-process system

Another example of micro-technology relevant to automation is that of micro-reactors such as Siprocess, our modular, automated micro-process system for chemical synthesis in the chemical and pharmaceutical industry. It is mainly used in chemical fluid-to-fluid reactions and has been designed for process development and product manufacturing in the lab.

The system consists of compact, easily exchangeable modules which accommodate all the required functions: from metering and reaction to sampling, attemperation and pressure control. Up to three material flows are combined by means of integrated micro-pressure sensors, a micro-reactor and a detention vessel at a pressure of up to 25 bar. Modules are easily and quickly connected by means of connectors, making it easy for users in the different industries to flexibly combine the components they require for a specific application.

Innovative mechatronic combinations

Mechatronics is not a new trend, but a consistently important one which shows to what extent consumer habits are reflected in production technology. Since consumers are increasingly asking for more personalized goods and products, manufacturers must be able to cope with production on demand and real-time production planning.

In technological terms this is achieved via smart modular mechatronic systems which can be quickly and easily exchanged whenever required. Mechatronic systems are changing the conventional form of mechanical engineering. Machine functions which used to be defined by mechanical components will now be realized through an interplay of mechanics, electronics, and software – in short “mechatronics”. It allows the development of new machine designs at considerably less cost and much greater performance and efficiency. Such systems can also be used to analyze existing machines; based on a well-founded optimization of control loops, we can make the most of such equipment.

Moreover, software tools and services supporting a machine's entire life cycle are gaining importance. They assist in the mechanical engineering and automation design, in optimizing and commissioning the machine, as well as during operation and service at the facility of the end-users, who are getting involved in the early design phase where the machine's properties and functions are virtually determined. This allows to predict, already during the design phase, how a prototype will behave, for example by using kinematic models which simulate its motions for collision control.

Enormous development, material and cost savings can be made if machine maker, end-user and automation partner work closely together throughout the entire design process, from the initial idea, through simulation to the finished machine. Benefits to the user extend from faster machine design and verification of user software to ensuring the proper processing time of the machine later on. Major benefits are also manifest in the form of a safe start-up, risk-free program optimization, and first run training activities.

Growing significance of information and communication technologies

IT software and industrial communications are dominating base technologies which are also playing an increasingly important role in automation. In about 40 per cent of our Siemens business sectors we design components containing software. We generate almost 60 per cent of our sales with products, systems and applications for which we develop the necessary software ourselves. Over 30,000 Siemens engineers worldwide are engaged in the development of software.

The functionality of our products, especially our embedded systems, is increasingly realized by means of software. The improvement of software and engineering processes provides the key to better quality, shorter development times and increasing productivity. Some of the challenges of automation which we are tackling together with our customers include the transition from proprietary systems to open systems and the reduction of high maintenance and further development costs caused by inflexible system architecture.

The trend towards networking, distributed intelligence and powerful engineering tools has made the share of software development grow rapidly among all automation producers. With a view to reversing the increase in R&D expenditure, manufacturers are taking a variety of measures, such as improved software development processes and clearly organized stable long-term software platforms such as Simatic IT, our rapidly growing MES proposition.

Networked production environments require powerful and stable communication networks capable of providing the required information at any point in time. These networks must be designed to cope with future requirements in order to better organize growing data volumes arising from the convergence of both office and automation environments.

The communication channels required for successful business reach a high degree of complexity. To make all partial processes interact in a fully functioning and economically meaningful network, these processes must be analyzed first; and communication by fieldbus and ethernet must be well thought out and carefully planned.

Siemens has many years of experience and expertise in the field of industrial networks. We were the first to broaden the industrial communication base and persisted in those efforts as no other competitor of ours did. Besides automation networking using Profibus, Siemens has installed over half a million ethernet nodes for industrial use since 1985. The demand continues to grow: The number of newly installed ethernet nodes in industrial use is expected to more than double the 2006 figure by 2010. The number of ethernet nodes Siemens supplies every year has almost tripled since 2000.

CIM – a vision gets back on track

The dream of every factory designer and automation specialist is the ‘Digital Factory’. In the same way as a product and all its components is designed, displayed, and simulated as a digital and virtual CAD model, complete factories are also supposed to be designed and simulated by computer. The automotive industry is paving the way here. In the future, new car models will only be produced after their digital counterparts have been successfully run through production simulation and all possibilities of optimising product design and production have been fully exhausted. The engineering system automatically reviews both the entire vehicle and the factory design whenever any detail is modified. Based on such a highly precise planning phase, the start-up time for a plant will be only a fraction of what it is today.

This ambitious vision was born in Germany in the mid-1980s under the name of CIM – Computer-Integrated Manufacturing. As early as 1986, at the newly created trade fair on ‘Industrial Automation: Distributed process control systems and controlling systems’ as part of Hanover Industrial Fair, the terms 'CIM’ and 'Factory of the Future’ were all the rage. CIM was to be realized at company level on the basis of existing data processing and automation solutions in a kind of interdisciplinary approach. Design, work planning and actual manufacturing were to be interlinked. This project was to comprise not only the digitization of design, work planning, NC programming, manufacturing, maintenance and quality assurance, but also production planning and control. Even in those days there were visions of linking plant engineering with in-line production.

During this early phase there were many activities going on, including some of the projects initiated and supported by Siemens at a number of universities to study the flexibility of automated production systems. Over the years, this interdisciplinary work between the research, teaching and business communities has borne fruit and produced solid ties, even if the vision as such was not realized. In retrospect, we can see now what was lacking then: integrated communications, powerful processors and database systems.

What has changed since then?

Communications and processors have advanced to performance levels which were unimaginable 20 years ago. Ethernet existed at Siemens in 1985 with a data rate of ten Mbit per second and the legendary Sinec-H1-Yellow Cable. In 1990, the 10BaseT-Twisted Pair was added for communicating in a star-shaped structure; in 1991 it was switches for isolating individual network segments, thus increasing throughput; in 1995 it was 100BaseT, and finally in 1999 it was 1000BaseT, which constituted another performance leap of an entirely different magnitude in communications.

What is more, the processing speed and in particular the memory capacities of PCs have grown exponentially. What is affordable today with PCs used to be unprofitable with CIM in mainframe computers in the past. Moreover, database technology for joint data management of individual programs has reached a much higher performance level, enabling today what we could only have dreamt of in the 1980s.

Convergence of mechanical and process design

Although the advance of technology has made automation infrastructure much more powerful than 20 years ago, manufacturers today are still facing enormous challenges in the field of IT. Alongside integrated IT systems for asset management, HMI (Human Machine Interface) and MES (Manufacturing Execution Systems), it is mainly new developments in digital engineering which are now generating productivity gains. When all is said and done, it is not just the production, but also the design, dimensioning, construction, commissioning and conversion of production plants that are coming under growing time and cost pressure.

In the long term, mechanical design and automation will converge. We believe that this convergence will lead towards the integration of mechanical design, automation and control, with PLC codes being automatically generated via code converter.

By acquiring UGS and integrating PLM software technology into the Siemens portfolio, we have addressed this new technological trend. Whether CAx, PDM, or ‘Digital Factory’ – it is the combination of the PLM portfolio with hardware and software at A&D which provides our customers with the decisive benefit of making both the design and production of their products more efficient. This is the step where we reduce the number of system interfaces and interlink data from product planning, plant design and physical production in very much the same way as was thought out in the CIM vision of the 1980s. Isolated stand-alone solutions that used to be commonplace in product design, production and service software will increasingly change and turn into an integrated system business.

Software-based innovation networks

Let's take a look even further ahead into the future. What kind of support will we get from PLM software in realizing our vision?

In product and plant design in 2020, all processes along the production life cycle will be virtually supported, ranging from planning via mechanical and electrical design, programming and commissioning of the plant all the way to its operation. Irrespective of the software in use, all data will be read and merged into the digital engineering environment. The creation of a product will be holistically mapped in the digital engineering process. Once virtual commissioning has been completed, the data is directly applicable to the real plant, and the automation solution is generated automatically. This covers PLC programming, visualisation – including diagnostic information – and the creation of the relevant plant documentation. The automation of automation will become reality.

All our future software and hardware products will support the established interfaces and standards, truly merging the field of engineering with that of automation. Our integrated software portfolio opens up an entirely new dimension of efficiency, irrespective of whether our customers are producers, engineering partners, system integrators or machine builders. We will use information technology to connect people equipped with the most diverse skills across a company's entire value chain, making the exchange of information more efficient. Not until we have genuine software-based collaboration within global networks will we have an environment in which the information needed to guarantee efficient production processes is available to all partners involved.

With PLM software towards the 'Intelligent Factory'

The globalization of economies has already led to an internationalization of industry. To be competitive in a global market, producers are operating geographically distributed production facilities which form a globally linked production network. This trend is set to continue: Network environments are being created that work beyond corporate boundaries, bringing users closer to on-demand production. For those included in the value chain – product designers, machine makers and engineering companies, as well as suppliers, service providers and distributors – readily available information is the key to business success.

In this connection, PLM software in our 'Picture of the Future' plays a pre-eminent role at various points in the value chain because it further strengthens our portfolio, increasing our customers' productivity across the entire product and production life cycle.

CAD software tools, digital product data management and the simulation of manufacturing processes help to create both the product design and the product data and to simulate the products' physical properties. This package also includes the simulation of the products' actual making. Storage, administration and availability of product and production data allow the user to access any information throughout the entire product life cycle.

Since products are being designed, planned and simulated with the aid of computers, the existing data serves as a basis for searching for suitable automation suppliers and machine tool suppliers in the various markets. The production facilities identified can then demonstrate and prove the required quality levels by means of virtual commissioning and plant simulation. The advantages are obvious: Time-to-market will be dramatically reduced and prototyping will eliminate almost all machining needs. Moreover, the process is not only forward looking; it can also be traced back at any point or re-launched.

By integrating PLM software, Siemens is creating the basis for the 'Intelligent Factory'. In contrast to the 'Digital Factory' which is focused on designing a production plant, our Intelligent Factory will cover the entire life cycle of a production plant, including the network linking product design, purchasing, sales and service. All relevant information will be available to the different user groups throughout the product entire life cycle and updated whenever required.

For this reason, production plants will be based on 'intelligent modules' to cope with growing complexity. Each of these modules will be a functional unit in its own right, having all the information required to perform its own task in production. The intelligence built into the module will enable it to act autonomously in matters such as self-configuration or self-optimization. This means that production will be selfoptimizing and self-healing. Integrated system function will provide escape strategies, thus relieving the operator of stressful work. Visualization and operation will be guided by the individual user's needs, making relevant information available even in the user's own language.

Ladies and Gentlemen,

The 'Pictures of the Future' within the Siemens business segment 'Automation and Control' are as diverse as the technologies involved. I trust I have been able to give you an overview of the technologies we believe are relevant on the track towards the 'Intelligent Factory'. The CIM example shows that you need a great deal of patience and stamina to advance digitization in automation. We at Siemens have that patience and stamina, and we will be the first to fully integrate product design, production, sales and services and the plants in which those products are made. We will continue along this path, consistently pursuing our own innovation strategy as industry supplier and, in so doing, paving the way for our customers' own innovations.