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Industry Trends

Ethernet in Machine Construction

Part 2: Trends and challenges in industrial automation

Everything used to be very simple. The machines set the pace on the plant floor. Maintaining a perfect rhythm made the work more efficient. The rules are different in today's state-of-the-art production environments. Fast reaction to change has become an additional success factor which contributes to high productivity during normal day-to-day operations. No matter how well you prepare, you cannot plan for every eventuality. Order levels may be higher or lower than expected, customer preferences can force you to offer more product versions and innovation in the field of materials or technology may make it necessary to retire a product generation earlier than anticipated. To be successful, you have to remain flexible and adjust your schedule at short notice.

State-of-the-art solutions are now available which alleviate the conflict between efficiency and flexibility. Even very complex production lines can accommodate change if the individual components have sufficient built-in intelligence to exchange data and make the necessary modifications with minimal external intervention. Because hardware alone can only do this to a limited extent, software plays a crucial role in process control.

Multi-level planning and control

In practice, this does not mean that you use a single program. On the contrary, because tasks are performed at multiple levels, distributed solutions with specialized units have proven to be successful. These units have autonomous control, but they can communicate with each other. The goal of lean production is to continually improve the individual processes and allow the organizations that have the greatest expertise to implement innovative solutions locally without excessive bureaucracy. Centralized planning always generates additional overhead.

Coordination based on communication between distributed units determines the success or failure of this strategy. Several key elements must be in place including common networks and definitive data exchange standards. These elements form the basis for high-integrity, high-speed information transfer which enables the independent entities to run in sync and react in the most appropriate manner to the current situation.

Software standards

Significant effort is currently being invested to ensure that corporate management (Enterprise Resource Planning, ERP), procurement and logistics

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(Supply Chain Management, SCM) and production control (Manufacturing Execution System, MES) systems can talk to each other. Depending on the supplier and user, there can be a greater or lesser amount of overlap. The use of common identifiers for raw materials, basic processes, etc., standardized data models and data models for sending and receiving information will hopefully put an end to the current confusion. The International Electrotechnical Commission (IEC) is working on the IEC 62264 series of standards to achieve just that. However, progress in the various bodies and working groups is somewhat slow, because competing proposals are on the table. One of the reasons for this is the differing technical and business requirements on ERP and MES systems. Senior management wants to interpret detailed knowledge in the corporate context to ensure that the various departments work together and use the same set of data. A production control system (MES) collects low-level information from individual production lines. Technical parameters and control data are stored on these systems, which enable operators to change the output of a machine at the press of a button. ISA, the standards organization for the automation industry, has already developed standards for production control systems. Standard ISA S95 is widely used, and it is currently being adopted as IEC 62264.

The end of language problems

Software harmonization is only half the battle. Communication between systems in office and production environments is handled by totally different networks. It takes a lot of effort to establish communications between office applications and production controllers which are connected to a fieldbus.

Industrial Ethernet is expected to provide the solution. The goal is to use the TCP/IP protocol on all networks. That is the protocol which the Internet is built around. Data packages can be sent securely and efficiently from one address in the network to another. This provides the platform which makes it possible for the ERP system at corporate headquarters to exchange data with a controller in a chassis press at a remote site.

Migration to the Ethernet protocol eliminates a number of artificial barriers in the corporate environment, making interaction between a wide range of applications feasible. An injection molding machine can report the number of blanks which have already been produced to the accounting software. If welding robot diagnostics detect a defective drive, the robot can report the fault directly to the maintenance organization, and it can also notify the MES system, so that the capacity plan can be modified. The service team can load new software to a PLC from their desks rather than having to travel to the site.

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Network standardization

IEC is also working intensively on standardization of the networks which are used to send data to controllers and drives. System cabling and contacts have to be designed to withstand harsh conditions on the factory floor including dust, vibration and strong magnetic fields. Even in frigid temperatures or when the humidity reaches elevated levels, the data must arrive at the intended destination at the right time. Real time processing is needed to ensure that all steps in the production process run in sync. The applicable standards are IEC 61784-2 (industrial data communications networks) and IEC 61158 (industrial fieldbus data communications).

Since October 2007, the SERCOS III real time Ethernet solution has been part of mandatory IEC standards. The vote for SERCOS III as the international standard was unanimous. This reflects the worldwide importance of the SERCOS interface. SERCOS 2 was already standardized worldwide. In parallel to standardization of third generation SERCOS, IEC decided to incorporate the existing IEC 61491 SERCOS 2 standard into the new IEC 61158/ 61784-1 standards series. The SERCOS drive profile was included in the new IEC 61800-7 standard. All three SERCOS generations are now part of the IEC standards.

Extending the planning horizon for customers

The SErial Realtime COmmunication System (SERCOS) is one of the leading digital interfaces. It has been used for 20 years to provide communications between controllers, drives and distributed peripherals. The SERCOS interface was formally standardized by IEC in 1995. The faster and more versatile SERCOS 2 generation followed four years later. Third-generation SERCOS marks the introduction of Ethernet into the fieldbus world, and at data rates of 100 Mbit per second, it sets new speed benchmarks. Other new features include the use of CAT 5 copper cable in addition to the fiber optic technology which is already in use. Highly efficient networks can be installed using ring or linear topologies and peer-to-peer communications. A reduction in cabling requirements helps keep costs under control. A range of integrity functions guarantee fault-free real time operation. 2 million SERCOS nodes are currently installed worldwide, and the IEC decision is goods news for SERCOS developers and users. The evolution of SERCOS is characterized by continuity and a clear migration path. The common interface ensures interoperability between products from different manufacturers which use the same standardized interfaces, commands and synchronization methods. More than 80 different manufacturers now offer SERCOS-enabled products. Rexroth combines this international standard with powerful motion logic integration, intelligent drives and industry-specific application know-how to create scalable drive and control solutions.

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Open architecture

At the field level, which is where communication between individual drives, sensors and controllers takes place, SERCOS III real time functions guarantee the required level of precision. Connectivity to higher level control systems is extremely simple. Companies gain direct access to data at the lowest production level, and every Ethernet-enabled computer can be connected to a SERCOS III port without any additional hardware or software. The computer can link into corporate TCP/IP communications without putting production-level runtime performance at risk. This works because in addition to real time communications, SERCOS III has a channel for non real time information (NRT). The completely transparent integration of real time and non real time data enables users to operate a large mix of devices on the same network. In contrast to other Industrial Ethernet solutions, SERCOS III does not require additional hubs and switches, and it does not use any additional protocols. Connectivity is completely transparent, because Ethernet systems without a SERCOS III ID are automatically allocated to the NRT channel. A 100 Mbit data rate supports data exchange between many devices in parallel without compromising the integrity of real time communications. Transparent integration of real time and non real time data allows companies to completely rethink their systems strategies. SERCOS III brings two worlds together. All nodes speak the same language. Different modules can even share the same cables without compromising integrity and reliability.

Note: this Ethernet series has four parts which address different aspects of the technology. (The publication date publication is shown in parentheses).
The parts that have already been published are available at www.boschrexroth.de/press

Part 1 More flexibility in machine construction through Industrial Ethernet (31.10.2007)
Part 2 Trends and challenges in industrial automation (19.11.2007)
Part 3 Data traffic with high performance and tested reliability (07.12.2007)
Part 4 How companies can master the conversion safely and systematically (14.12.2007)

Bosch Rexroth AG is one of the world's leading specialists in the field of drive and control technologies. Under the brand name of Rexroth the company supplies more than 500,000 customers with tailored solutions for driving, controlling and moving machinery used in industrial and factory automation as

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well as in mobile applications. As The Drive & Control Company, Bosch Rexroth develops, produces and sells components and systems in more than 80 countries. In 2006 Bosch Rexroth AG, part of the Bosch Group, achieved sales of approximately 4.9 billion Euro with more than 29,800 employees.

For more information please visit: www.boschrexroth.com

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