From shop-floor to top floor

Comment by Dan Rossek, Automation Marketing Manager

The list of reasons why manufacturers should integrate individual line and equipment control systems into high-level enterprise management software is growing. And as the case becomes more compelling, the technological 'wizardry' to make it happen is not only solid fact (rather than science fiction) – it is faster, simpler and more 'intelligent' than ever.

As every line manager knows, the trend for manufacturers to monitor operational efficiency in order to optimise profit has been rumbling onwards ever more loudly. More companies aim to measure Overall Equipment Effectiveness (OEE) in order to identify bottlenecks and weaknesses in the production process. But these calculations can only be arrived at, once sufficient data is being collected from the entire operation and reliably stored.

Increasing regulatory and customer pressure

At the same time, certain sectors such as pharmaceuticals, food and automotive are feeling increasing regulatory and customer pressure to log process-critical data in ever finer detail and in ways which are fully traceable. This means not only that the days of 'pen and paper' data collection are long gone, but that some of the slower ways of electronically logging information are giving way to much faster, real-time collection and processing.

For example, the Food & Drug Administration's (FDA's) CFR21 part 11 directive for the pharmaceuticals sector is now well-established, and foresees the collection and storage of production data without the possibility of human intervention. The EU's Good Manufacturing Practice directive lays down similar standards regarding reliable and secure records.

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Marketing Manager

Even in non-critical applications, ad hoc data collection systems are susceptible to omissions and errors. At the same time, the retrieval of data from traditional modes of storage is often, at best, unreliable.

Take the example of optical character recognition (OCR) or verification (OCV) in a pharmaceutical application. A modern vision system such as Omron's FH is capable of processing a product every 30ms or so. But this capability is matched by an expectation that the system will compare inspected data with externally-stored reference data, securely log it and allow instant access, if required. This poses problems for a traditional PLC-based collection method, where data is stored to temporary areas such as internal memory or a removable media card. Typically, this data is 'dumped' periodically to – or extracted by – an external storage location such as a network server or database, often using a SCADA (supervisory control and data acquisition) package as the 'middle-man'. In doing this, any real-time element is lost, along with the ability to query or instantly retrieve historically-stored data.

So if traditional SCADA middleware is falling short, what is the solution? The answer lies in a combination of much faster communications (we are talking sub-millisecond speeds) and local control systems which allow this direct, two-way dialogue with enterprise-level relational databases to take place.

Industry 4.0

There has been much written in the press about 'Industry 4.0', a futuristic, completely-connected industrial world, where all components are not only 'aware' of each other but can communicate in real time. Well, that future is already - slowly - becoming a reality.

Ethernet-based networks such as EtherCAT allow every part of an automation system, from sensors to robots, to exchange information at speeds that were undreamt of in the past. This gives the controller instant access to every detail of production information. Once this controller is also connected to the enterprise-level - Enterprise Resource Planning (ERP), Manufacturing Resource Planning (MRP) or Manufacturing Execution Systems (MES), for example – we can start to see the 'Industry 4.0' vision being realised. Ultimately, this means integrating the manufacturer's own customers and business partners into the production process, not just locally but globally.

This is not something dreamt up by the marketing departments of automation component manufacturers. At the recent Processing and Packaging Machinery Association (PPMA) Show in Birmingham, Prof Duncan McFarlane of Cambridge University spoke about this very topic. He highlighted how 'localised intelligence' and 'customerisation' of manufacturing processes allows the customer to directly shape and dynamically change execution aspects of the order. Although this is a philosophy which has gained most traction in high-value engineering seen in the automotive sector for example, it is an approach which all integrated businesses and supply chains could learn from. Prof McFarlane pointed out that this philosophy requires greater intelligence to be embedded within the product. Notably how the product itself is directly linked to information and rules governing the way it is intended to be made, stored or transported, thus enabling the product to support or influence these operations.

To make this vision a reality, the controller hardware must be able to connect directly with the same networks as the databases which form the backbone of each enterprise-level system. As we have seen, up to now, additional hardware modules or SCADA middleware have been the enabler for this, but have also introduced bottlenecks into the process, losing the real-time aspect of data exchange. Inserting this intermediate level into communications also introduces an element of risk, with requirements for maintenance, system updates and constant vulnerability to viruses.

It has been said not only that 'SCADA is dead' but also that 'the PLC is dead'. Some may greet these pronouncements and the much-heralded arrival of 'Industry 4.0' with the same level of scepticism. But in many ways, this is a straightforward example of necessity being the mother of invention: industry's demands are simply outstripping the capabilities of these 'old' technologies.

Accepting PLCs as collectors' items might feel odd to many, given how their performance and programmability has improved over the years. But although the different modules and controllers within a PLC are fully integrated on one level, communication speeds count for little if control is not fully synchronised at any given line's highest operational output.

Thinking beyond the use of SCADA involves a similar shift in mindset and a redefining of the standards of operation. In practical terms, it means that end-user IT departments will have to work more closely with engineering to allow shop-floor equipment to have direct access to enterprise-level systems without the use of middleware.

The solutions allowing real-time data exchange already exist. Omron's NJ501-1_20 machine automation controller CPUs have this level of functionality embedded, thanks to programme-free 'wizard' connections to relational databases including Microsoft SQL, Oracle, MySQL, IBM DB2 and Firebird. Pre-written function blocks then allow data from the machine or process to be mapped, inserted or updated into the database, or a query delivered to select specific data.

It is a paradox that the new generation of machine controller which sidesteps the bottleneck of the PLC (with its issues of synchronised control between CPUs) in fact integrates the various function modules in a way which owes much to the equally discredited technology of soft PLCs. To put this slightly differently, our new machine controllers incorporate the best of the hardware PLC and the soft PLC.

While the hardware PLC uses application-specific integrated circuit (ASIC) technology to operate, with its various CPUs packaged up as a durable unit, the soft PLC uses software to perform the same functions, while being housed on an industrial PC. With the soft PLC, question marks remain over the ruggedness of this PC housing, the reliability of the operating system and reassurance when it comes to ongoing support for a given product.

Sysmac Automation Platform

The latest controllers, such as Omron's Sysmac NJ series, combine the reliability and rugged design of a traditional PLC, but use an open hardware architecture combined with software 'engines' within a single CPU – rather than multiple CPUs – to manage their different functions.

The wider benefits of this approach are neatly illustrated by a recent installation at reprographics specialist Ricoh. Its toner cartridge manufacturing and refilling centre at Telford in the UK is currently migrating towards using a direct link between 'recipes' on a product database and local NJ controllers on the production line. Its cartridge manufacturing has up to now relied on conventional PLCs to ensure that the correct parts are used to assemble each of its wide range of products. The code on each component is scanned and checked. But in the past, this has meant that, when a new item is introduced, new code has to be manually added to each PLC – a laborious and time-consuming business.

At a later date, Ricoh plans to use similar instant communication with an enterprise-level database to scan codes on used toner cartridges sent to its Telford site for recycling. In this case, an NJ controller will allow data, including the number of previous refills, to be checked. This will in turn enable the system to determine whether any given cartridge should be refilled again, while also updating the database.

This degree of intelligent, local querying and decision-making in a real-time manufacturing process was never achievable in the past, and can only be realised using this type of technology.

Other sectors stand to gain, too. In the food industry's complex supply chains, the traceability of its ingredients from multiple sources is more important than ever. In the meat industry, these demands have reached the stage where provenance needs to be traceable back to an individual animal. The amount of detail, the speed of acquisition and retrieval and the security requirements for any data are only going to increase in sensitive product areas such as food and pharmaceuticals.

Concerted pressure is already being applied by regulators and retailers in these sectors, but there are often good internal quality control benefits pointing manufacturers in the same direction. With multiple product variants and flavours increasingly being produced, and often filled on the same line, brand owners need solutions which will quickly and reliably ensure there is a match between product and pack.

This type of option has become a reality, not only for some of the major international automotive manufacturers, but for smaller businesses in the fast moving consumer goods (FMCG) segment, too. It is only a matter of time before even more brand owners come to realise what this new production philosophy can do for them.

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