FORCAM
DRIVING PRODUCTIVITY

news

The Next Industrial Revolution
How Smart Factories Create Competitive Advantage

Trouble-shooter Sir John Harvey Jones was a strong believer that mangers must "walk the floor" to fully understand what is happening in their business. This is still true today. There is great insight to be obtained from seeing what is happening at the sharp end of the business, but managers need more than intuition – they need data.

Forcam, pioneers of networking shop-floor operations to achieve machine-to-machine (M2M) integration, can demonstrate productivity gains of up to 30 per cent. This ability to continually monitor and improve performance is the catalyst for greater flexibility in manufacturing leading to economic benefits and reduced cost innovation.

From Mechanisation to Industry 4.0

The three phases of industrialisation have been: mechanisation in the 16th century, electrification in the early 20th century and automation in the second half of the 20th century. The fourth phase of the industrial revolution – Industry 4.0 – calls for the extension of computer networks onto the shop floor to stream manufacturing intelligence direct to the operator and gather production data in real time, with live analysis and role relevant reporting.

Computing technology has up to now been applied around the manufacturing process but not within it. Examples include CNC and PLC controlled machines to give defect free repeatability, CAD/CAM to streamline design and translate this into production, on-machine diagnostics for early warning of failure and enterprise resource planning (ERP) for business-wide management of operations. Despite this, the comprehensive and fully networked application of computing to the monitoring, analysis and management of factory shop floor operations, sometimes called the internet of things – applied to the shop floor, has been a relatively recent development.

Forcam was founded by Franz Gruber who, as an executive with SAP, the ERP specialist, realised that ERP, as a 'top floor' management tool, stopped short of addressing shop floor issues. Capturing data on the shop floor and the real-time analysis of this to detect and remedy deficiencies, was the key to higher workshop efficiency and also enabled the streaming of meaningful real-time data into the ERP system. This is the basis for their computerised manufacturing execution systems (MES), Factory Framework.

Globalisation – the Economic Challenge

Manufacturing technology is now widely diffused and commonplace in developing countries with lower labour costs. This results in relentless pressure to offshore manufacture to lower cost centres once a process becomes mature, mass market and easily replicated. It is impossible to confront this directly. Developed western economies can never match developing economies by wage and cost restraint alone.

Retaining manufacturing therefore critically depends on maintaining technology clusters, with innovation and investment, to deliver new products in plants that have high productivity and a capacity to innovate rapidly and deliver added-value products competitively.

In the UK, low productivity is a persistent problem. Despite being world-class in research in science and technology, the translation of research into new and products is slow with overseas competitors taking up UK scientific innovations more rapidly.

The productivity gap may have been further exaggerated in the recent downturn. Learning from the permanent skill losses caused by shedding labour in previous recessions, companies have often held onto labour in readiness for the upturn in the cycle, depressing UK productivity further.

Cyber Physical Systems – Modelling the Manufacturing Process

Franz Gruber explained, in an interview with an American automobile title, "The key element is the creation of a cyber-physical system. This is a map of the production process in real-time, in a virtual space, like a 'cyber mirror'. This requires an in-memory technology for real-time data acquisition and processing. With this objective data, first of all, wastage is clearly identified and second, you create transparency in factory shop floor operations. You can analyse the production virtually and optimize it in real-time."

There are many practical advantages. Until now production monitoring was a historic process that involves looking back at records of the previous day or week's production to learn and improve. This data may have been machine captured, but in a large part will have been manually recorded and perhaps be incomplete or inaccurate to some degree.

Real-time M2M monitoring means feedback is instantaneous, complete and accurate giving transparency so managers can see where there are problems such as machine outages and downtime, material shortages, quality issues or waste. The immediacy of feedback permits prompt intervention to remedy sub-optimal performance.

This can have huge impact. Consider a modern machine shop, fitted with multiple axis machining centres that can turn, bore, drill, plane, saw and perform multiple operations sequentially. A dozen machines may represent an investment of several million pounds. Return on investment depends on maintaining constant workflow so that the equipment and manpower is fully employed as much as possible.

The operational benefits of Industry 4 are greater than just preventing downtime and minimising waste. Real-time performance information creates an extremely agile and adaptable manufacturing process. Flexible manufacturing, where a particular machine set can produce multiple products and easily and quickly switch from one product to another, becomes an economic reality because information and instructions flow to the shop floor more freely. The smart factory becomes reality.

In the smart factory you can forget previous norms, like standardised volume and batch production. These are superseded because the agility means a batch size of one is now an economic possibility speeding innovation and prototyping. It also becomes feasible to produce individually customised products.

The Smart Factory promotes lean production – maximising ROI, by fuller use of capital assets. The Smart Factory is compatible with just-in-time programmes – delivering what is required, when it is needed – to minimise capital tied up in work-in-progress and the supply chain.

Examples of the Smart Factory

You could think that the main advantages of shop floor networking would accrue in traditional workshops where manual operations predominate. This is true in part, but Smart Factory has been shown to have significant benefits even where there is a high degree of automation. A good example is the automotive industry.

Franz Gruber again, "Audi is a lighthouse example for me. The car manufacturer has demonstrated that the combination of Industry 4.0 technology and the optimal use of manufacturing organizational principles, made it possible for their press shops to reach increased productivity goals of 20 percent, within 12 months. Even in the highly automated component production areas, productivity increased by ten percent, in the first year."

Another example from the automotive component industry is the supplier MSR Technologies, which manufactures many various parts for large automotive companies, including parts of the turbocharger for automotive leader BorgWarner. For this project, the manager was able to increase shop floor productivity in the targeted area by 25 percent. The project also provided an extremely short ROI due to the production process achieving a ten percent decrease in energy consumption.

In the UK, Weir Minerals, who make heavy duty pumping equipment for mining and the oil and gas industries, had a similar experience with a trial at their Todmorden factory. Following the installation of factory shop floor machine networking they registered productivity gains of 12 per cent in the first six months. Further improvements have been on-going to such an extent that the company extended the application from the machine shop to the foundry and is planning a roll out throughout the division, including overseas plants.

Applicability to Plants of all Sizes

New technology is often seen as the preserve of large companies and the cost of implementation a barrier to entry to smaller operators. Experience suggests otherwise. Systems can have a relatively short pay back due to better use of capital assets, waste reduction, reduced re-work, reduced capital tied-up in work-in-progress as well as improved production schedules. This both improves the ROI and, in cases where assets were previously considered fully employed, can reduce immediate pressures for capital expenditure to increase capacity.

Small machine shops can use the system to gain competitive advantage. Larger organisations may use the system both in their own operations and to integrate supply chain partners so that capacity information and orders can flow through the system and synchronise component and material orders.

Multi-national companies can also apply these systems across borders to benchmark plants and make best practice the norm. Franz Gruber explained, “One of the major design goals for the latest software version can be expressed as the 1-10-5-4 concept – that is, one central planning department, ten plants, in five countries, communicating in four languages. A major auto component supplier is currently implementing such a system that will eventually encompass 1200 machines in nine plants spread over the Americas, Europe and Asia.”

Driving Change and Innovation

Aerospace, automotive and rail are industries that are dominated by prime manufacturers, but supported by a supply infrastructure comprising hundreds of smaller companies supplying materials, sub-systems and components. In this hierarchy, company-to-company communication is relayed bi-directionally through several tiers of supply. It is a slow, sequential and iterative process. This is an impediment to research, technical innovation and production so development programmes are inevitably long, slow and costly.

Now apply the Smart Factory. When the whole supply chain is networked and communicating in both directions the system becomes more responsive, more agile, better able to adapt, innovate and respond to end user demands. In this environment development cycle times and costs fall, productivity improves, and the whole industry benefits from efficiencies at every level.

Conclusion

Terry Scuoler, chief executive of the Engineering Employers Federation (EEF) summarised the opportunity and threat to UK manufacturing perfectly at their recent London conference. "The fourth industrial revolution will change the global face of manufacturing beyond recognition. The UK must take a leading role if we are to realise our ambitions for a healthy, balanced and growing economy.

"The next decade will bring great and rapid change and the early-adopting nations will maximise the opportunities presented by new technologies and thrive as a result. There will inevitably be winners and losers, which is why we should take note when manufacturers say there is a real danger of the UK being left behind."

Writer Profile

Franz Eduard Gruber

Franz is a graduate industrial engineer and the chairman and president of Forcam, a company he founded in 2001. Previous experience is with ERP specialist SAP, where he worked on special projects with the CEO and with IBM Germany where he specialised in computer aided manufacturing (CIM).

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High res images and this text is also available to download from the web at
www.ainsmag.co.uk/fo255/5388fo1a-eef-conference.htm

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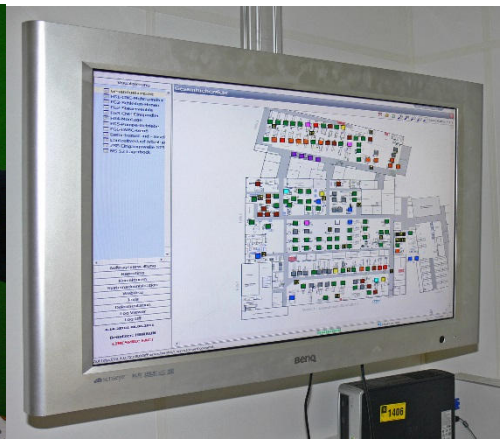
Picture Captions

Picture of machine tool and Audi press

Modern machine tools and items such as presses in automotive plants require high levels of utilisation to ensure satisfactory return on investment. Smart Factory provides the real time information to deal with problems such as outages, but also opportunities to exploit gaps in the schedule and for more flexible systems of manufacturing. (file: 5388fo1h-audi-press.jpg)

Pictures of two different screens

Technicians, supervisors and plant managers have differing information needs. Smart Factory presents relevant information to each role in an understandable and actionable format. (files: 5388fo2h-msr1.jpg and 5388fo3h-msr2.jpg)



Picture of complex equipment

Even highly automated manufacturing operations can benefit from the real-time gathering, analysis and reporting of production data. (file: 5388fo4h-msr3.jpg)