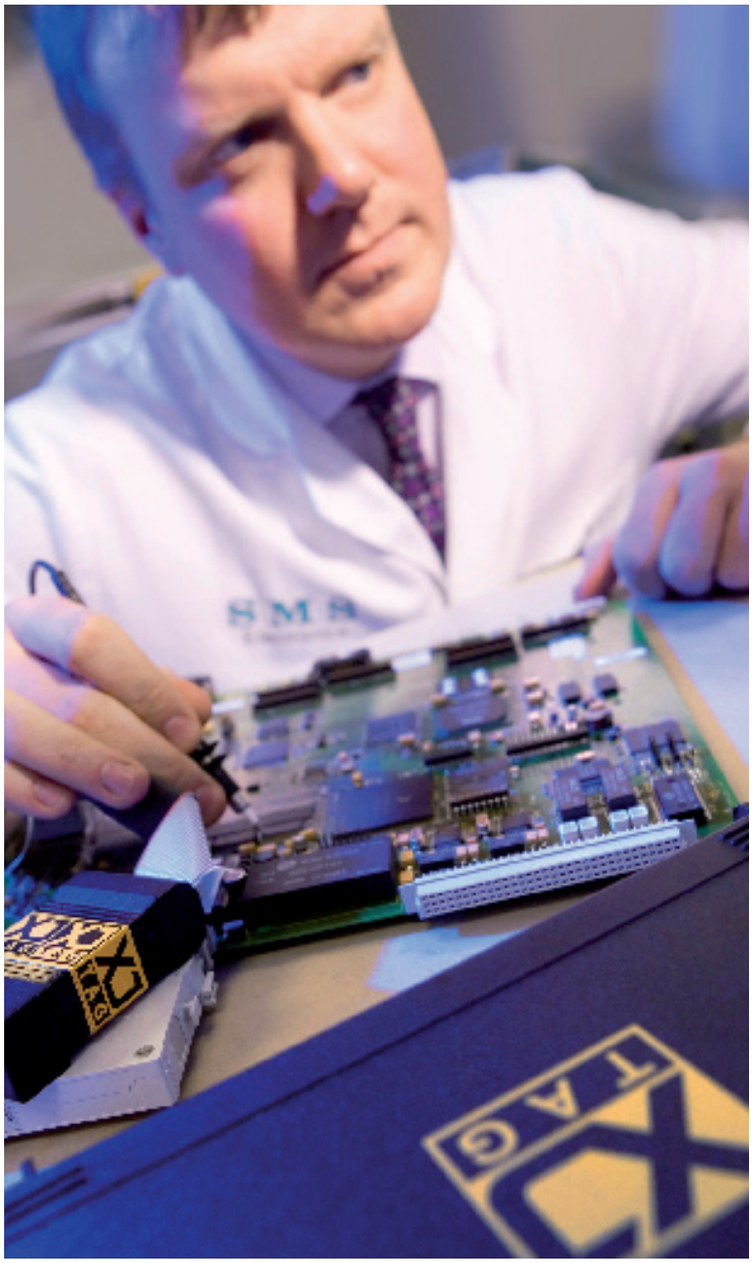
Made in the UK

Manufacturing locally in the UK can enhance both the cost-effectiveness and the quality of the end product and, despite what you may hear, it is a growing trend, says **Chris Hunt** and **Simon Payne**

The view that manufacturing is moving inevitably from Britain to lower-cost services based offshore may be true for mass-market products, but production of high-value, advanced technology products is actually growing in the UK. To continue this success and deliver value at a competitive price, UK-based manufacturers must invest strategically and apply creative techniques at the design, assembly and test engineering stages.

The ability to build products for a wide range of markets and technologies to a high standard - and quickly - is critical to success. While batch sizes may be in the hundreds, rather than the hundreds of thousands, the complex assemblies typically produced demand high placement rates coupled with the ability to place the latest component and package styles.

At electronics manufacturing services (EMS) firm SMS Electronics, for instance, total capacity now exceeds five million placements per day, and the company is able to place any component from 01005 through to 85mm² as well as odd-shaped components up to 125mm long. But the company's latest capital investment, to boost capacity and future-proof its capabilities, has cost over £1m. This level of investment demands appreciable sales revenues to achieve the necessary return.



Chris Merricks, test development engineer at SMS Electronics, using an XJTAG test system.

It is therefore important for UK manufacturers to plan their investments in technology intelligently. Those that fall behind will quickly cease to deliver leading-edge services and will find future investment increasingly difficult to manage as that leading-edge moves rapidly forward.

Among the most enduring strategic advantages for UK-based manufacturers is the ability to improve efficiency and reduce risks by tightly linking design and manufacturing activities.

For complex and advanced products, effective dialogue is essential to meet functional →p16

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objectives, maintain the project timetable and ensure manufacturability and testability. A focus on design for manufacture (DFM) enhances competitiveness by prioritising automated assembly processes and streamlining the assembly flow by minimising human intervention and assembly time per-unit. The best results are usually obtained by using the expertise of the manufacturing specialist's own engineering staff during the design process.

Test engineering is another important area where manufacturing locally in the UK can enhance both the cost-effectiveness and the quality of the end product. Design for test (DFT) and the use of creative test techniques ensure that complex products can be tested sufficiently within a cycle time comparable to the build time. For this reason, the manufacturer's contribution to the test strategy is valuable.

New approaches are necessary to overcome the challenges of developing tests and fixtures within today's short product lifecycles. Traditional test fixtures such as 'bed of nails' are unable to reach the I/Os of BGA devices and other high-density packages, which threatens to reduce test coverage for leading-edge products.

However, some manufacturers are combining established functional and in-circuit tests with 'soft' test techniques, such as boundary scan, to increase test coverage, reduce the time and cost overheads associated with fixtures, and respond quickly to design changes and product evolution.

Boundary scan or JTAG testing, approved as IEEE1149.1, takes advantage of dedicated test circuitry internal to the IC to exercise on-chip functions, for example by allowing values to be read in and out of internal registers or memory locations. The boundary scan chain has to be laid down on the board to interconnect the test ports of all components featuring boundary scan circuitry, and suitable components must be specified in the bill of materials. Increasing the number of boundary scan components implemented on the board allows a corresponding increase in maximum test coverage.

Processors and FPGAs are among the leading adopters of boundary scan, with many devices offered in compliant versions. Since the technology requires no direct physical access to device I/Os then it can be used to cover test cases that can be difficult or impossible to reach using a bed of nails.

SMS Electronics invested in a boundary scan system from XJTAG which provides its development engineers with graphical tools to visualise all IC interconnects included in the scan chain. Testing of other devices connected to the same nets, but not containing boundary scan circuitry, is also possible. This allows intelligent manipulation of the test sequence to provide increased test coverage.

The most common use of the technology has been debugging processor designs during development, but design engineers are beginning to use the technique more intensively to debug prototypes. This trend is driven by factors such as the test access challenges that prevent attachment of probes to device I/Os, and the increasing complexity of modern assemblies which requires developers to quickly debug designs containing hundreds of ICs and thousands of interconnects.

Boundary scan testing does not rely on the host processor to co-ordinate exchanges with devices on the board, therefore the assembly can be tested even if the faults prevent the processor from starting. Using boundary scan during development allows engineers to predict the time necessary to complete debugging of a design far more accurately than if they are using conventional development test techniques.

A further advantage over traditional techniques is that the tests applied are automatically recorded through the act of writing test scripts to exercise the prototype. Added to this, the XJTAG system allow tests to be written from a device-centric perspective, allowing tests to be re-used with minimal modification after a design change. Upon completion of the prototype stage, the test scripts created actually retain value that can usefully be exploited during the test engineering phase of the project.

In addition, the combination of JTAG-compliant ICs and the associated scan chain linking devices across the board creates an in-built test infrastructure native to each board assembled.

As development engineers implement and use this infrastructure more extensively to test and debug prototypes, the tests created at the prototype stage can then be re-used directly within a high-speed production test strategy, using equipment comparable to the boundary scan tools used by development engineers. SMS Electronics has used this approach to overcome test access challenges and increase test coverage for complex products, within tight timescales.

Compared to offshore assemblers, the test engineering capabilities of UK-based manufacturers allow close co-operation with developers of advanced products using the latest components and assembly techniques.

Intelligent exploitation of this advantage, for example by applying a consistent test methodology and re-using proven tests throughout the product lifecycle, is a prime example of the creative approaches that combine effectively with forward-looking investment in capabilities and capacity.

Production line at SMS Electronics.

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