

Executive Summary

In June 2002, the UK Advisory Group on Nanotechnology Applications published its report 'New Dimensions for Manufacturing: A UK Strategy for Nanotechnology'. In the preface to this report, the Chairman of the Advisory Group stated 'that in order to keep pace with competitor nations we need to recast the scale and nature of our nanotechnology activities. We need to raise awareness in industry of the enormous potential impact that nanotechnology could have and ensure that investment and action by Government, industry and researchers is fully aligned to maximise the benefit for the UK'.

This strategy should not be developed or refined in isolation from, or ignorance of, international activity and trends. Global nanotechnology activity and investment is growing rapidly. Recent DTI sponsored Missions to the US and Germany have surveyed nanotechnology activity in those countries. As the most mature economy in a rapidly developing Asian region, Japan recognises a pressing need to move up the value chain, and arguably leads attempts in the region to do so. The Japanese Government has named life sciences, information and communications, environment and nanotechnology as its strategic priorities for the next 5 years. And significantly, it increasingly expresses the view *that the convergence of biotechnology, information and communications technology, cognitive science and nanotechnology* provides the route to achieve that objective.

This DTI International Technology Service sponsored Nanobiotechnology Mission took place to Japan in the period July 15-19, 2002. It especially reviews Japanese nanotechnology activity directed at enabling the *convergence of biotechnology, information and communications technology*. It focussed on biomolecular engineering, surface functionalisation and micro/nano-fabrication technologies which lie at the convergence of biology, chemistry, physics and engineering. These can be directed at harnessing the potential of genomic information through devices and systems providing real-time predictive, point-of-care and personalised health care, and find additional applications in tissue engineering, pharmaceutical screening, environmental, food and process monitoring, forensics and defence. The UK delegation represented a breadth of perspectives, across sectors (defence, diagnostics, pharmaceuticals, agrochemical), size (multinationals to university spin-offs), and background (academic, former large corporate, large corporate).

This report details industry activity disclosed to the Mission at NTT Basic Research Laboratories, Olympus Optical Company, Toshiba Corporation, Shimadzu Corporation and Matsushita Electric Industrial Company. In addition, reports on research and strategy in the public sector, derived from discussions with high-profile individuals, namely Professor's Kawai (Osaka University), Baba (Tokushima University), and Namba (Osaka University in collaboration with Matsushita) and members of the National Institute of Advanced Industrial Science and Technology (AIST, Osaka campus) are provided. Brief details, derived from secondary sources, of activities by Canon, Fujirebio, Fujitsu, Hitachi, Hosokawa Micron, Toray Industries, NEC, relevant SME's and other University and public-sector Research Institutes are appended for completeness.

The Mission concluded that technology convergence is indeed recognised to be an opportunity in Japan, but little evidence emerged of a serious attempt to quantify market opportunities and provide commercial focus for R&D activity. At the very least, the scientific teams involved in technology or product development articulated little market awareness. In the clinically related fields of diagnostics and devices there was little evidence of synergistic relationships with the Japanese pharmaceutical sector, or close clinical collaboration to determine end-product value. Little evidence of internationally leading activity in the medical device or therapeutic fields was uncovered, but the Mission was impressed by the clearly evident long-term horizons and commitment of company R&D investment and major strength and activity in both the public and private sector in understanding and harnessing opportunities provided by complex functional biological entities such as biological motors.

The Japanese approach to the protection and exploitation of IP was felt to be out-dated in comparison to that of Japan's major competitors. There was no evidence at any of the organisations visited of active IP management, such as attempts to commercialise or license out non-core IP. The academic and public-sector research institutions visited seemed unaware of the financial cost of maintaining a large and unstructured IP portfolio, a situation encouraged by the fact that a government sponsored organisation meets the patent maintenance costs.

The corporate research groups visited appeared to be directed in their choice of programs solely by scientific interest. There was little evidence of the role or integration of criteria like market awareness, manufacturing cost analysis, regulatory requirements and technology development timescales in directing research strategy. In some cases very unrealistic expectations regarding timescales and the investment needed to progress new technology through medical regulatory requirements was shown. It was notable that the industrial researchers we met did not, by and large, view the academic research base in Japan as a source of new technology, preferring if at all, to consider partnering with research institutions abroad. There was a perception in industry that Japanese public-sector funding for research fulfils the interests of academic scientists, not industry.

It was found that spin-out activity from universities is being actively encouraged by central government. It was less clear that there is a corresponding government-supported programme of any sophistication to aid the process. The culture in universities and public-sector research institutes was found to be changing rapidly (or is at least under great pressure to do so), but it was felt that such organisations still have some way to go to become sophisticated players in identifying, protecting, exploiting and pursuing flexible routes to market for new technologies.

The norm in Japan is to pursue collaboration either in-house or with other Japanese companies, however clear evidence emerged that collaboration practices are changing. International technology partnering and R&D collaboration on the development of new technologies, while still in its infancy, is possible. There is complementarity between Japanese and UK strength and expertise.

As noted in the recent UK Nanotechnology Strategy document, it may indeed be too late for the UK to compete internationally in applications such as semiconductors. However, the strength and health of UK academe and industry in pharmaceuticals and biotechnology, the strong decoupling of Japanese electronics and communications companies from the Japanese pharmaceuticals sector, the greater sophistication of the UK in international IP management, and possibly even our record in entrepreneurship and better understanding of spin-off support needs, all present particular opportunities for Japan-UK collaboration.