The Sensors & Instrumentation Knowledge Transfer Network

Philip Cooper, Director, Sensors & Instrumentation KTN
National Physical Laboratory, Hampton Road, Teddington, TW11 0LW England
phil.cooper@sensorsktn.com

Abstract The Sensors & Instrumentation KTN has established itself as the UK’s national network in sensors and instrumentation, developing a community of over 2,250 member organisations. This paper describes the background to Knowledge Transfer Networks (KTNs) and the changes that are happening to KTNs at a national level, before describing the market size, activities and successes of the Sensors & Instrumentation KTN. The paper concludes by describing the merger between the Sensors & Instrumentation KTN and four other KTNs to create a new KTN, with a working title of the Electronics, Sensors and Photonics KTN.

1. Introduction

Knowledge Transfer Networks are managed by the Technology Strategy Board and are designed to stimulate innovation in the UK economy through higher levels of research and development and knowledge transfer. The Sensors & Instrumentation KTN has worked successfully with a large community of organisations since it was started in November 2005. This paper describes the background to KTNs, the focus, work and successes of the Sensors & Instrumentation KTN, and the forthcoming merger between the Sensors & Instrumentation KTN and four other KTNs, to create a single KTN covering the Technology Strategy Board’s Electronics, Photonics and Electrical Systems Key Technology Area strategy.

2. Background to KTNs

Knowledge Transfer Networks (KTNs) have a national remit and are broadly focused on either technologies or markets. Twenty five KTNs are currently supported by the Technology Strategy Board, the body responsible for KTNs. Following a review carried out by the Technology Strategy Board last year, a new portfolio of 14 (see summary in Annex A) is being created by merging some KTNs and creating two more.

The review of KTNs by the TSB highlighted the importance business users attached to the Knowledge Exchange role. The following key activities were highly valued:

- Access to relevant information on technologies & markets (95%)
- Information on funding opportunities (84%)
- New academic & business relationships (75-81%)
- Access to skilled people (69%)
- Influencing public sector policy (70%)

KTNs facilitate the rapid transfer of relevant high quality information on technologies, markets, funding and partnering opportunities, promoting knowledge exchange as a contact sport. They promote two-way communication, informing members of new technologies, markets, funding opportunities, and marriage-broking and, in addition, acting as the Technology Strategy Board’s ‘eyes and ears’ in their community.

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The Sensors & Instrumentation KTN (SIKTN) is led by the National Physical Laboratory (NPL). The KTN was born out of the Intersect Faraday Partnership and the KTN formally started in November 2005.

The KTN is generally described as technology oriented. However, it has focused on the whole supply chain to ensure that innovation in sensors and instrumentation is driven through to benefits for the many end user or market sectors that are underpinned by the technology. To achieve this level of coordination across market sectors means cooperation with market sector specialists is necessary. From the outset, therefore, the KTN has positioned itself as a network of networks.

The supply chain, by which sensors and instrumentation add value to the economy, is shown in Annex B and in a simplified form as Figure 1.

![Figure 1: The Sensors and Instrumentation Supply Chain](image)

In essence, sensors are in most cases a component level input to sub-systems, which may be integrated to form instruments that perform the economically or socially vital sensing, measurement, diagnosis or monitoring tasks required by the end users in various market sectors. Underpinning this value chain is a set of fundamental capabilities also required at the various stages.

The KTN covers all sensors technologies, the majority of relevant sub-systems and all of instrumentation. It also has specific expertise and links in certain end user markets which allows us to understand their needs sufficiently to serve them. The next section looks at the sensors and instrumentation market.

### 4. The Sensors and Instrumentation Market

#### 4.1. Market size and importance

The importance of the sensing and instrumentation market is hard to overstate (TSB 2009). Jet turbine engines cannot be developed, tested for flight and manufactured without sensors and instrumentation, new drugs cannot be discovered and manufactured without sensors and instrumentation, widespread environmental monitoring is critically dependent upon sensors and instrumentation, communications satellites need a range of sensors to operate. Sensors and instrumentation are underpinning technologies, which whilst important as a sizeable market in their own right, have an enormous multiplier effect in the major markets they enable.

|                | Sensors Market | Instrumentation Market | Underpinned business |
|----------------|----------------|------------------------|----------------------|
| UK             | £3bn           | £7.5bn                 | £120bn               |
| Europe         | £16bn          | £43bn                  | £290bn               |
| World          | £50bn          | £124.5bn               | £1,500bn             |

Figure 2: Sensors and instrumentation market size and underpinned business (SIKTN 2008)
The world sensors market (£50bn) and instrumentation (£124bn) underpin over £1,500bn of products and services. Technical and cost advances combined with regulatory drivers mean that sensors are being used in ever greater numbers. The UK punches significantly above its weight, with a £3bn share of sensors and £7.5bn share of the instrumentation business, despite the fragmented supply chains and foreign ownership of larger companies. This is set within the context of the world sensors market, which is forecast to grow at an annual rate of 7.5% (Frost and Sullivan 2008).

The sector in the UK is dominated by a ‘long tail’ of SMEs that struggle to innovate and gain market share and the sector still suffers from a lack of coherence and therefore recognition of its importance to the UK economy.

4.2. Market segmentation

Sensors and instrumentation covers a broad spectrum of devices ranging in size, value and volume and therefore economic impact. Figure 3 below illustrates this spectrum and helps explain the KTN’s areas of focus. There are both common and unique issues for each of the sub-sectors within this spectrum, thus requiring different approaches to support from the KTN.

At the high volume but low cost end, sensors are already having a huge impact on the economy. For example, an average of >400 sensors are found in every motor vehicle. Many millions of cheap medical diagnostic sensors, e.g. for blood glucose and pregnancy, are sold every year. Trends in microsystems manufacturing, in low power electronics, and in wireless connectivity are opening up new possibilities for the widespread use of sensors. Whilst novel sensing technologies are an important contributor, it is just as important to pay attention to the parallel development of a number of other capabilities in order to deploy sensors in complex systems. These include:

- Miniaturisation; cost-minimisation, performance optimisation, reliable packaging
- Robustness; application in extreme environments; longevity/low or no maintenance
- Self diagnosis; reliability, trustworthiness of sensor data
- Embedded intelligence; transformation of sensor data into application intelligence
- Autonomy; micro-power technologies, radio frequency power transmission
- Sensor communications; robust auto-reconfigurable communication networks
Further up the value curve higher priced instrumentation sells in significantly lower volume than sensors but makes a major contribution in particular in a range of process industries where it enables control and quality assurance. Such sensing and measurement is critical to improved productivity and therefore competitiveness of the UK’s industry.

At the top end of the value chain sits the sub-sector of Advanced Instrumentation. This refers to high value, low volume instrumentation that are generally analytical instruments, scientific instruments or research infrastructures with unit volumes <1,000 / year. Whilst there is a continuum from sensors through to Advanced Instrumentation, this latter sub-sector has some distinct characteristics which make it particularly challenging but vital if the full value of investment in sensors & instrumentation R&D is to be realised. Advanced Instrumentation requires a focused level of attention as this is a largely unrecognised, although very sizeable market driven by government procurement. The low volumes and long timescales but very high values make it attractive to those organisations prepared to deal with the challenges of this sector. In addition, the spin-off benefits of investment here are often less direct but may have major long term impact.

The Sensors & Instrumentation KTN reflects this diverse spectrum of exploitation of sensor technology, representing sensor users, manufacturers and originators.

5. Outcomes and successes of the KTN

The Sensors & Instrumentation KTN has established itself as the national network in sensors and instrumentation, developing a community of 2,253 member organisations (as at March 2009) in a very fragmented supply chain, from sensor researchers and developers, through to sub-systems and instrumentation manufacturers to end-users. The SITKN is a network of networks through which all interested parties (individual organisations and other networks) can access knowledge, partners and support.

Since 2005 the Sensors & Instrumentation KTN has:

- Organised 118 events, with over 4,400 attendees
- Carried out 747 company visits
- Worked with 651 companies and academics
- Supported 167 funding applications
- Secured £58m of funding for members

The full set of Key Success Measures achieved over this period (to March 2009) are as follows:

| Measure                        | Reporting                                                                 | Nov 05 to March 09 |
|-------------------------------|---------------------------------------------------------------------------|---------------------|
| 1. Market Share               | 1.1 Companies & organisations involved with the KTN.                       | 2253                |
|                               | 1.1.2 Active Members                                                      | 1047                |
|                               | 1.2 Estimated Market size                                                | 2600                |
|                               | 1.3 Growth in active members % (from previous year)                       | 68%                 |
2. Meetings

2.1 No of meetings organised by KTN  
118

3. Interactions

3.1 Project proposals submitted  
167
3.2 Secondments KTPs, CASE  
32
3.3 Overseas Missions & International Partnerships  
11
3.4 Roadmaps & reports published  
27
3.5 Inputs to Govt policy/strategy  
19
3.6 Joint publications & newsletters  
16

4. Finance raised

4.1 Money awarded to KTN members for R&D  
£55,861,742
4.2 Venture capital raised  
£1,990,000

These case studies illustrate the value of the KTN’s activities to two of its members.

5.1. Case study 1 Oxsensis: From early stage to commercialisation

Oxsensis’ extreme environment fibre optic sensors are in demand for the improvements they enable in energy efficiency. A spin-out from the Rutherford Appleton Laboratory, Oxsensis is in a €9m European consortium with members of the Sensors and Instrumentation KTN (SIKTN), including Rolls-Royce and the Universities of Oxford and Cambridge. The mutually beneficial relationship began after Oxsensis met Rolls-Royce at a SIKTN event.

“We’ve done lots of networking through the Sensors & Instrumentation KTN that has been formative to Oxsensis. The events provide an invaluable opportunity to meet customers and understand markets,” CEO David Gahan says. Oxsensis has been profiled in the SIKTN’s popular quarterly publication Sensors News.

Oxsensis has moved from early stage development to full commercialisation and its staff has doubled to 30 in the past two years. It won the IET Innovation Award in 2008 and the small businesses award at the 2007 Carbon Trust/Daily Telegraph Innovation Awards. The company has recently achieved ISO 9001 qualification.

5.2. SIKTN demonstrates industrial demand for interdisciplinary development of nanosensing

The Sensors and Instrumentation KTN has helped to secure £21.6 million funding for a new nanohalth facility at Swansea University. The Centre for NanoHealth (CNH) will support the interdisciplinary development of nano sensing and instrumentation for life sciences. The KTN played a vital role in demonstrating industrial demand for the centre.

“Providing evidence of industry need was a key factor for Welsh Government funding,” says co-director Dr Steven Conlan. “The SIKTN’s input was an online survey from its membership and was incredibly valuable. It verified our market research, and made the case for the centre.”. Responses to the survey came from a broad cross-section of the KTN’s community, details of which were submitted to the funding authorities as part of the CNH business plan.

The KTN has ongoing involvement in CNH. It is currently helping Swansea University to reach the broader sensors and instrumentation community.
6. A new KTN from September 2009

The Sensors & Instrumentation KTN is merging with four existing KTNs as part of the Technology Strategy Board’s reorganisation of KTNs. These are, the Electronics, Photonics, UK Displays & Lighting and Integrated Products Manufacturing KTNs. A new KTN will be created, with the working title of Electronics, Sensors and Photonics KTN. This will be up and running by the middle of 2010.

By removing boundaries between disciplines and forging new links, the new KTN will create a larger community, giving members access to more information, greater opportunities and a wider range of potential partnerships and collaborations. The intention is that the existing sensors and instrumentation community will not lose its focus or its identity and will retain activity such as the successful special interest groups.

The Directors of the existing KTNs are in the process of consulting members and stakeholders about the future direction of the new KTN. More information will be available on the outcome of this process at the ‘Sensors and their Applications XV’ conference in October 2009.
References

Frost & Sullivan 2008: World sensors and Instruments Report, February.

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Technology Strategy Board 2009. Electronics, Photonics and Electrical Systems Key Technology Area strategy 2008-2011, pg. 43.
Annex A

List of new and current Knowledge Transfer Networks

| New KTN Portfolio (Working titles) | Original KTN Portfolio |
|-----------------------------------|------------------------|
| Materials                         | Materials – comprising 9 Nodes: |
|                                   | a. NCN                  |
|                                   | b. Faraday Advance      |
|                                   | c. Faraday Packaging    |
|                                   | d. TechniTex            |
|                                   | e. Smart.com            |
|                                   | f. Meta4                |
|                                   | g. PIN                  |
|                                   | h. MADE                 |
|                                   | i. PowderMatrix         |
| Biosciences                       | 1. Bioscience for Business |
|                                   | 2. Genesis Faraday      |
|                                   | 3. Food Processing      |
| Electronics, Photonics, Sensors, Electrical Systems | 1. Electronics |
|                                   | 2. Integrated Products Manufacturing |
|                                   | 3. Sensors & Instrumentation |
|                                   | 4. Photonics            |
|                                   | 5. UK Displays and Lighting |
| NanoKTN                           | 1. NanoKTN              |
| ICT                               | 1. Grid Computing Now!  |
|                                   | 2. Cyber Security       |
|                                   | 3. Digital Communications|
|                                   | 4. Location & Timing    |
| Medicines and Healthcare          | 1. BioprocessUK         |
|                                   | 2. Health Technologies  |
| Energy Generation & Supply        | New KTN                 |
|                                   | Including the Fuel Cells part of the Low Carbon & Fuel Cells KTN |
| Transport                         | 1. Aerospace & Defence  |
|                                   | 2. Intelligent Transport Systems |
|                                   | 3. Including the Low Carbon & Fuel Cells KTN |
|                                   | 4. Plus new streams associated with marine, rail and other surface transport sectors |
| Environmental sustainability      | 1. Environmental       |
|                                   | 2. Resource Efficiency  |
| Modern Built Environment          | Modern Built Environment |
| Creative Industries               | Creative Industries (Established ‘08) |
| Financial Services                | New KTN                 |
| Chemistry Innovation              | Chemistry Innovation    |
| Industrial Mathematics            | Industrial Mathematics  |
Annex B

Sensors and Instrumentation Supply Chain

| COMPONENTS | SUB-SYSTEMS | INSTRUMENTS | USERS | OUTCOMES |
|------------|-------------|-------------|-------|----------|
| Sensors:   | Wireless Networks | Analytical | Defence/Security | Profitable Manufacturing |
| - Physical | Autonomous Systems & Robotics | Scientific | Aerospace | Resource Efficiency |
| - Electronic | Vacuum | Test & Measurement | Space | Quality of Life |
| - Photonic | Cryogenics | Metrology | Scientific | Leading Edge Science |
| - Chemical | Imaging | Process | (incl. Research Facilities) | Improved Transport |
| - Biological | Displays | Control | Healthcare | Secure Information Technology |
| Optics/Photonics | Distributed Computing | Embedded Systems | Life Science | |
| | Power Systems | | Built Environment | |
| | | | Environmental | |
| | | | Automotive | |
| | | | Semiconductor | |
| | | | Industrial | |
| | | | Arts & Heritage | |
| | | | Food | |

UNDERPINNING CAPABILITIES:

- Packaging
- Fabrication (incl. MNT)
- Materials
- Design Engineering
- Electronics
- Systems Engineering
- Electrical Engineering
- Software
- Signal Processing/Analysis
- Modelling & Simulation
- Skills/Training
- Measurement Standards
- Certification