The need for a new approach to sensing

Introduction

The reasoning for this article comes from the development of "A brief study of the structure of the sensor supply and demand to meet the needs of the Water/Environment Industry" which is a 66 page report available at www.optocem.net. The work done was part of the objectives of OptoCem.Net which is a part of the Dti's Knowledge Transfer Networks Scheme (KTN). The objective of KTNs is to stimulate collaborative R&D, encouraging commercial exploitation and promote best use in industry; in the case of OptoCem.net the Water/Environment Industry and Oil/Gas Industries.

The objective of the article is to plead for a multi-discipline and multi-level management approach to sensing and monitoring for both process control and environmental control. (Although I would argue that process control and management control is one and the same thing.)

Real world sensing
(Courtesy of Partech Instruments)

The challenge

We all face a considerable challenge in that societal and legislative pressures are already placing considerable demands for data so that environmental and commercial mechanisms can be controlled. This pressure is expected to continue and perhaps intensify. However it is very unlikely that society will be able to afford the required volume and quality of monitoring and sensing to meet the implied needs.

Very few of the users of the data will understand the difference between data and information and will overwhelmingly need information. They will very rarely consider how the information is derived or study the quality of the underlying data.

Until recently the "sensing community" has invented, developed and marketed devices that produce and disseminate data with little regard to the ultimate user's needs and characteristics. There are many forms and types of user; from the plant operator or local regulator's representative through all the levels of management to the policy setting and controlling levels of "big business" and government. Each of these users will have different requirements which range from single parameter monitoring through to the monitoring of catchments or national environmental management.

The needs

A range of considerations arise from the broad spread of uses to which sensor data may be applied:

The plant operator – the use of sensor data may be a minor and infrequent part of his/her activity and training may be inadequate. Job mobility is often high. Calibration and the checking and manipulation of consumables may be neglected.

The local/regional manager – has little interest in the sensor but needs to consider the performance of the plant in the short and possibly medium term. The data needs to be transmitted to either a remote desk or increasingly to a mobile communication point; such as a pc or pda. Some assembly of data, interpretation and assembly into an informative picture is advantageous at this stage.

The Business Sector or Divisional manager – has almost no interest or even awareness of sensors. He/she needs to know the business performance and dynamics, with appropriate benchmarking. Multi-variate data from disparate and widely dispersed sensors must be assembled into an informative picture and transmitted to a number of people on a regular basis.

The Regulator – needs to know that plants are being managed appropriately and that environmental targets are being achieved. This requires the generation of confidence in the regular reports assembled from spatially and temporally sparse underlying data.

The needs could be stated succinctly as more and better quality information at the user(s) working place. This will require:

– More data at lower cost
– Confidence in the data/information
– Comparability of the data/information
– Merging of spatially and temporally sparse data from disparate sources

Note that "better quality" does not necessarily mean better accuracy (to use a familiar but inadequate term – uncertainty is the preferred term but not widely understood yet). Quality may arise from a proper understanding of the data complete with a statement that includes the complete uncertainty chain from sampling, analysing, transmitting the data and the act of processing data into information.

A suggested road map

There has been a reliance on the analysis of samples taken to a central laboratory. Setting aside the doubtful quality of the analysis, demonstrated by the publication of inter laboratory comparisons, the usefulness of such analysis results is questionable on both timeliness and presentation. What is needed is a holistic

Value chain for Operational Data
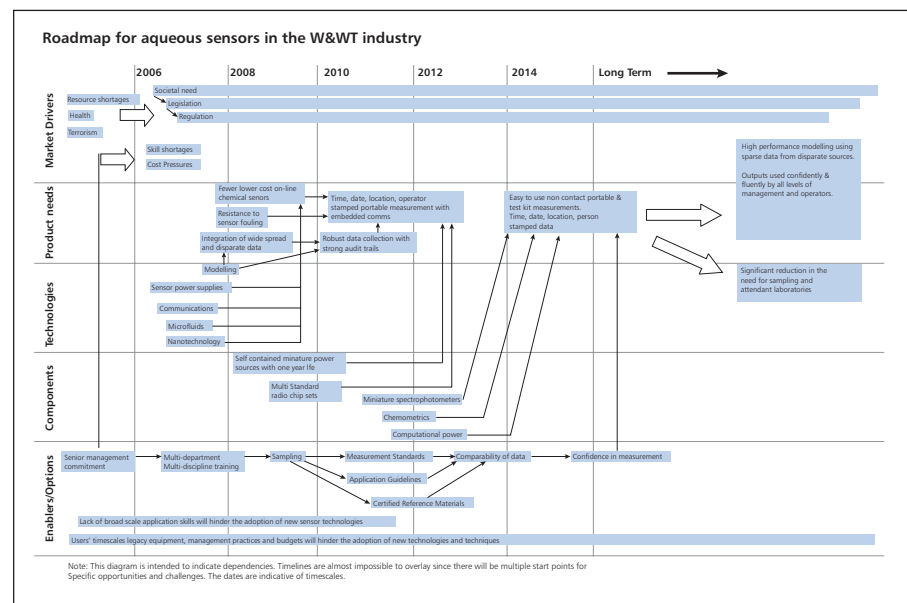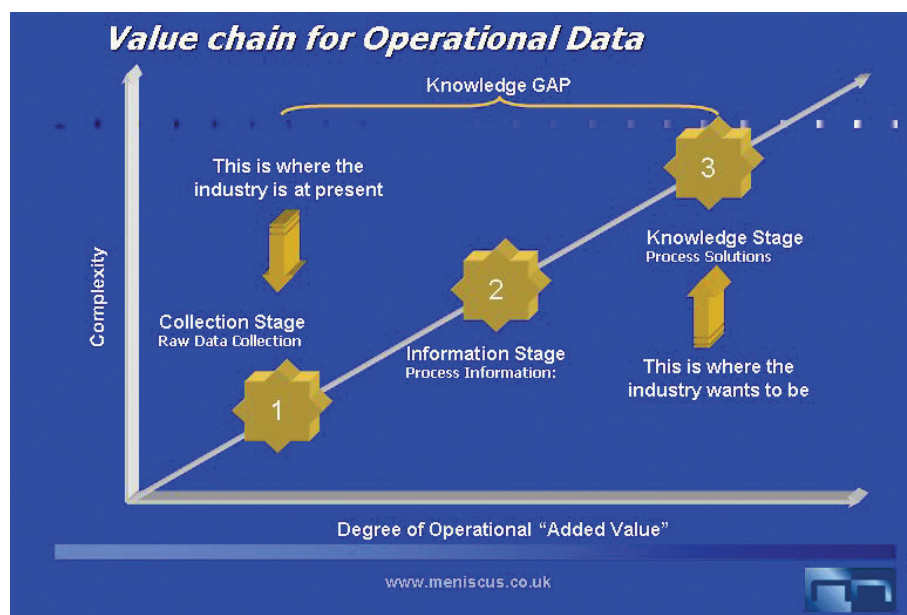
understanding of the need for an appropriate mix of a wide range of data:

• Test kits
• Portable instruments
• On-line instruments
• At-line instruments
• Remote, non-contact measurements
• Samples to a laboratory
• Surrogate measurements
• Indicator measurements

As is well known, the sensing industry is of modest size and highly fragmented and the process and environmental user is highly compartmentalised. Both depend upon other technologies such as various communication tools, data management and modelling tools, high technology component developments etc. Both need to establish a mutual confidence in data and the subsequent information. It was suggested in an UKWIR Report "On-line instrumentation Standards and Practices Ref No. 00/PC/03/1 that there was little confidence in on-line instrumentation.

It is suggested that much more co-operative effort is required and the following roadmap proposes some of the elements of such co-operation.

A paradigm might be the medical industry. Within living memory, the act of collecting some of the personal health data has moved from central highly skilled and costly laboratories through the complete specialist, hospital doctor, GP chain to the patient. The general public can now buy some "sensing methods" as and when they please and other sensing methods are used at different parts of the health hierachy. It is suggested that the key enabling factor was wide spread confidence in the appropriateness of the data and confidence in its quality.

The ability to make a measurement in different circumstances, with different skill sets, is of no use if there is no wide spread confidence in the resulting data. To generate confidence there needs to be audit trails and comparability of data and this requires the co-operation of multiple technologies and multiple management levels in development, manufacture, supply, use and information generation. Supporting Codes of Practice, Methodologies, Standards, Training, etc need to be generated and maintained and there needs to be "cross-discipline, multi-level management and Regulatory co-operation" to understand what is possible and what is really needed.

It is recognised that the above is a non-trivial task but the roadmap suggests a framework for planning and mutually profitable co-operation.

Conclusions

• Do not develop sensors out of context
• Look at other industries/countries before spending significant money
• Avoid compartmentalisation
• Make sure that there is a real need for which finance will be available
• Understand the issues involved in establishing confidence in the data

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