

Tessellations

News And Technical Updates From Tessella

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Defence and technology – into the future

Maintaining a credible and effective defence capability, in the face of a continually evolving threat, requires continual advancement of technology. Building a defence system that will be used for decades to come often means exploiting cutting-edge technology to best effect, plus facilitating 'technology insertion' for future upgrades. However, by its very nature, such technology usually does not come with a track record and therefore inevitably introduces risk.

Exploiting new technologies to achieve advanced capabilities has often proved expensive, with some defence projects being associated with cost overruns and late deliveries. Nevertheless, finding an affordable and effective way forward remains as crucial as ever, given the additional requirements of asymmetric warfare such as counter insurgency and counter terrorism, and the context of severely constrained defence budgets.

Supporting the UK MoD

The UK Ministry of Defence (MoD) is addressing the issue of exploitation of new technology by a series of initiatives designed to foster greater alignment of MoD and industry, and thereby promote efficiency and value for money. The recently published 'Defence Industrial Strategy' seeks to further underpin the collaborative approach by identifying UK Government priorities and technical areas for which sustained on-shore capability is seen as vital to national interest.

In the case of defence research, the founding of Defence Technology Centres and Towers of Excellence enables significant portions of the MoD research portfolio to be coordinated with parallel interests being pursued by industry and academia.

For development and production programmes, the traditional demarcation lines between customer and supplier have been replaced by integrated project teams incorporating both MoD and industry staff. Further, the programmes are run according to the 'SMART' procurement methodology, carefully identifying and tracking the evolving requirements of all the stakeholders and prioritizing these to derive an agreed and cost-effective system definition with risk identified and mitigated. An example of such a programme is the Type 45 Destroyer project.

Developing cutting-edge technology

The Type 45 Destroyer, for which BAE Systems is the prime contractor, will be a key part of the UK Royal Navy's air defences for the first half of the 21st century and will be one of the most advanced warships in the world. The first of class is scheduled to enter service in 2009.



Type 45 Destroyer (© Crown Copyright / MoD)

Designed for the Type 45, the SAMPSON Multi-Function Radar derives and provides vital information for the Principal Anti Air Missile System (PAAMS) – the weapon system forming the main armament – and is therefore crucial to the success of the Type 45 project. SAMPSON can electronically direct and adapt its beam, allowing multiple functions to be carried out simultaneously and thereby enabling the surveillance (long and medium range search, surface search and high angle search) and tracking modes to be combined in a single system. SAMPSON is being designed, developed and delivered by BAE Systems Integrated System Technologies Limited (Insyte).

Key to the function of the SAMPSON radar is an integrated set of automated tracking algorithms.

Working for Insyte, Analyticon is responsible for the design and development of this algorithm set, which processes data derived by the radar to extract information for PAAMS.

The development and integration of these algorithms for this state-of-the-art tracking system requires expertise in radar, tracking, complex system design and detailed mathematical modelling. Exercising and optimizing the algorithms in the context of the complete system is addressed by the use of a sophisticated, intricate, custom-built simulation of both the tracking system and the radar.

At the Insyte facility on the Isle of Wight, the first complete SAMPSON radar has now been installed on a tower representative of a Type 45 foremast, and is currently undergoing testing. Further system tests are scheduled to begin in autumn in the north of England.

The Insyte SAMPSON radar system represents a major technological advance in terms of surveillance and tracking performance, which will help provide the UK Royal Navy with sophisticated air defences for decades to come.

To find out more about:

- **Insyte:** please visit www.baesystems.com/insyte
- **Analyticon:** please visit www.analyticon.co.uk or return the enclosed faxback form

Analyticon
The Right Answer

Tessella
Scientific software solutions

"The SAMPSON Multi Function Radar is a leader in its field and will provide the UK Royal Navy with a capability to challenge the best in the world. This achievement is a culmination of two decades of research and development and was made possible by the innovation and expertise of the Cowes Insyte team and its key partners, including Analyticon, who have made a significant technical contribution."

Mr Frank Howe, SAMPSON Integrated Project Team Leader, Insyte

Fusion research – energy for future generations

As the 21st century progresses, global demand for energy is growing significantly. Population growth is increasing the need for energy. Higher living standard expectations worldwide are also fuelling the growth in demand. Coupled with this, there are mounting concerns over the environmental impact of fossil fuels, and the risks of relying on imported energy. New energy sources are clearly required to meet the world's future energy needs. Fusion, the process that powers the Sun, is one such energy source. Fusion energy offers numerous attractive features, including:

- Abundant raw materials: the fuel for a fusion reactor is plentiful in seawater and the Earth's crust
- No greenhouse gas emissions: fusion power will not contribute to global warming
- Fusion is an inherently safe process: there is no risk of a fusion reaction going critical
- There are no long-lived radioactive waste products from a fusion reactor

Recent advances in the science and technology of fusion have dramatically improved the prospect for practical fusion power being achieved during the first half of this century.

Fusion research at UKAEA Culham

Since the 1980s, the Joint European Torus (JET) experiment at Culham in Oxfordshire has been the world's largest fusion device (www.jet.efda.org). JET is operated by the UK Atomic Energy Authority (UKAEA), on behalf of the European Fusion Development Agreement (EFDA), and its major achievements include:

- In 1991: the world's first significant production of controlled fusion power
- In 1997: three new world records set for fusion power production during a three month campaign

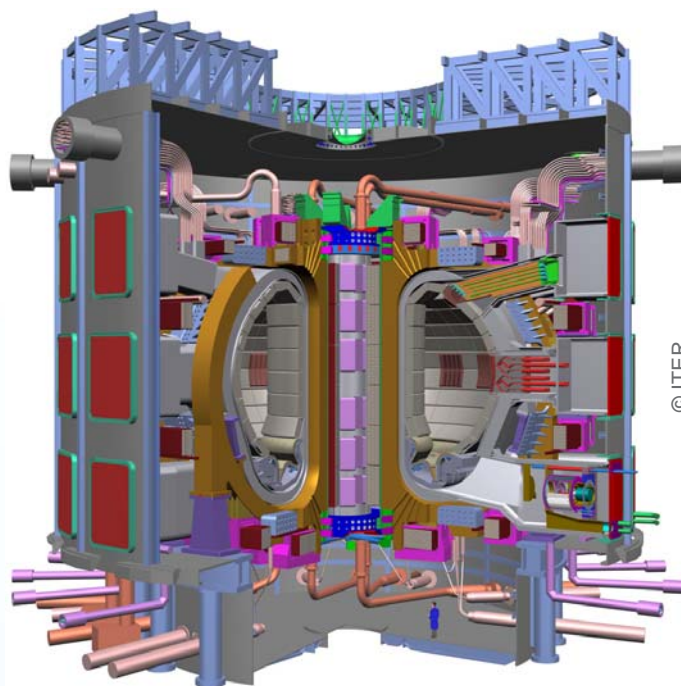
JET's current research is aimed towards investigating the physics and technology requirements for the international fusion device, ITER. UKAEA also carries out the UK's fusion research programme (www.fusion.org.uk), including operating MAST, the Mega Amp Spherical Tokamak. This is an alternative design to devices such as JET and ITER. This research is at an early stage, and MAST will help confirm the potential benefits of this approach.

ITER: the next stage in fusion research

The next step in proving the technical and commercial viability of fusion power is underway, and preparation for the construction of ITER has begun in Cadarache, France. ITER is the world's first attempt at building a power-plant-scale fusion device and represents one of the largest multinational research undertakings ever. Building ITER presents formidable science and engineering challenges. These include developing and working with:

- Large, high performance superconducting magnets
- Materials able to withstand high heat fluxes
- Sophisticated remote handling, instrumentation, heating, control and data systems

There are also major organizational issues. The partners in the project – the ITER Parties – are the European Union, Japan, China, India, the Republic of Korea, the Russian Federation and the United States of America. Complex components will be sourced from each of these partners: integrating these and managing the construction process will be a major challenge. The top management team of ITER has now been named, and the ITER International Organization will be created at the start of 2007. ITER should begin operating in 2016.



ITER opportunities for industry

The complexity of the ITER organization creates challenges for industry. Many components will be procured by one of the ITER partners, and supplied to ITER as 'in-kind' payment towards that partner's ITER funding. Other components will be procured directly by the ITER organization. Many ITER tenders will be for very large components. Few companies will have all of the required skills for such work and so will need to form consortia, bringing in suitable specialist expertise.

In the UK, UKAEA's Fusion and Industry team, headed by Dan Mistry, is committed to helping UK companies to bid for work in fusion. Dan and his team co-ordinated the UK presence at an 'ITER Opportunities for Industry' conference in Barcelona in 2005, and recently hosted a similar event at Culham. (Tessella participated in both events.).

To help companies find partners for fusion tenders, UKAEA have a database of potential fusion suppliers (visit www.fusion-industry.org.uk). A similar database for ITER suppliers is hosted by EFDA (www.efda.org/eidi). Tessella is registered with both of these, to facilitate participation in consortia bidding for major fusion tenders.

Tessella has been supporting fusion research at JET since the early 1980s. Building on this experience, Tessella is currently working with UKAEA to define the requirements for a Neutronics Management System for ITER, and is looking forward to supporting the next generation of fusion research. To find out more about Tessella's experience supporting fusion research please complete the enclosed order form or email info@tessella.com



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For further information and free Technical Supplements please complete the enclosed form or email info@tessella.com

Managing IT project portfolios – the tools of the trade

Nominet runs the domain name registry for the .uk domain, providing an essential part of the Internet infrastructure. With automated systems to handle registration requests and queries received electronically from the companies that offer domain registration services to the general public, Nominet's day-to-day business relies on innovative technology to meet their business needs. The challenges that Nominet's IT Director Jay Daley faces, in providing high-technology core services to the business, require him to employ a variety of management techniques.

Use of a technology partner

Nominet has used Tessella's expertise on a variety of business-critical projects, including the development of high-availability systems with significant performance requirements.

Because .uk domains are registered on a first-come, first-served basis the turnaround of a request has to be very quick, and updates to registrations must become available to query systems as early as possible. The primary means for checking the availability of a domain name is to look up the current owner information through the WHOIS system that Nominet, like other domain registries around the world, operates for its own domain. However, Nominet has to strike a balance between providing public access for look-ups, of who owns particular domain names, and preventing people from raiding the entire database. Previous large-scale thefts of data from domain registries have resulted in scams targeting the individual domain owners, such as issuing bogus renewal invoices for the domains. To prevent large-scale harvesting of records, requests on WHOIS are throttled per user.

An innovation Nominet has introduced to allow large-scale queries from trusted users is the *Domain Availability Checker* (DAC), available to subscribers to check the availability of domain names, without returning the detailed information on current registration that WHOIS must provide. The DAC serves around 23 million requests a day, each needing a response in milliseconds. Rather than relying on returning less information to allow higher throughput, the DAC uses a system of per-user virtual tokens to throttle to a pre-agreed level the average requests per hour and per day from each user. (See <http://blog.nominet.org.uk/tech/algorithms>)

Tessella has worked on each of these high-throughput systems. Being able to call on expertise from a trusted technology partner has enabled Nominet to both fulfil specific skills requirements and supplement their in-house development teams where necessary.



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Invest in own research

A number of Nominet's high-throughput systems involve a large amount of machine-to-machine communication, using XML as the document exchange medium. Usually software developers would write their own code to read XML data into their own application's structures, but XML accelerator tools are available to buy that can do it more quickly. Nominet invested time writing and optimizing their own XML parsing, to use as a benchmark for evaluating commercial accelerators. This quantifiably demonstrated far better performance in some of the tools, providing the business justification for buying an effective one.

Nominet has also carried out work on algorithms for detecting abuse of the main WHOIS database. This has resulted in a robust detection system and the ability to take or threaten legal action where attempts are made to steal the contents of the database.

Strategic funding of open-source projects

Many core systems depend implicitly on open-source projects. For instance, the BIND DNS Server is used on the vast majority of name serving machines on the Internet to allow computers to determine the addresses of other machines. Nominet has provided support for smaller open-source projects, either through direct financial help or by contributing developer time. While this has been a cost-effective way of gaining features in systems used by Nominet's team, the strategic benefit is also significant. By helping ensure that these open-source projects gain widespread and continued success, Nominet benefits from the tools it uses today being still in use and supported for their application's lifetime. It also helps avoid lock-in to a particular commercial vendor.

Involvement in standards-setting bodies

Taking part in the early development of standards, affecting the technology and communications of the business domain in which it operates, gives Nominet the opportunity to contribute its staff's expert knowledge, and to help shape future agendas.

The challenges faced by Jay Daley in meeting the company's technological needs are similar to those faced by other IT directors across all sectors. Although Nominet is run as a not-for-profit company, his task is to meet strategic aims through internal resourcing and bringing outside expertise to bear, in a business where technical solutions can make a difference between being able to operate effectively or not at all.

To find out more about Tessella and/or Nominet please complete the enclosed faxback form.



Toby
Project Manager
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Jay Daley
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What's new in Digital Preservation?

Several major new initiatives are underway in the world of Digital Preservation.



The UK National Archives have to preserve rapidly growing volumes of the UK government's digital records, with extra demands resulting from the Freedom of Information Act. As a result, they have launched the Seamless Flow programme, designed to enhance a number of existing systems, and build new systems, to automate manual procedures, including transfer, cataloguing, preservation and delivery of records. The programme is split into a number of separate projects, and the 'Technology Watch' and 'Preservation & Maintenance' projects have been awarded to Tessella.

The British Library are extending their existing Digital Object Management (DOM) Storage System, by adding an ingest facility for eJournals. The solution has been specifically designed to allow extension to the full range of content types that fall within the remit of the DOM Programme (which is building the infrastructure for the UK National Digital Library). Tessella has designed a solution based on our 'Safety Deposit Box' technology.

The Koninklijke Bibliotheek (the National Library of the Netherlands) and the Nationaal Archief of the Netherlands have contracted Tessella to design and develop an open source modular and portable emulator for digital preservation. The aim is to investigate whether emulation can be a practical and cost-effective tool for long-term digital preservation. The project is due for completion in March 2007.

The PLANETS project brings together European National Libraries and Archives, leading research institutions, and technology companies to address the challenge of preserving access to digital cultural and scientific knowledge. This EU funded 4-year project commenced in June 2006 with a meeting of all the organizations involved, including Tessella, and hosted by project coordinator the British Library.

Improving train reliability (OTMRs)

It is now a legal requirement for trains in the UK to be fitted with 'On-Train Monitoring and Recording' devices, to record information such as train speed and the position of the driver's controls. Whilst their primary purpose is to provide detailed information to accident investigators, other very significant benefits can be derived from the information they gather. For example, collected data can be used to monitor fleet performance, patterns of expected behaviour can be built up allowing advanced warning of deteriorations in performance, and then pre-emptive maintenance can be scheduled before failure occurs.

Tessella is helping Northern Rail exploit some of these benefits, and is offering a low risk, three-stage process to other rail operators.

- Pilot stage: looking at existing measurements and verifying that the new approach will yield genuine benefits
- Operational prototype: 'shadowing' current procedures, and checking that using the approach to support maintenance decisions will yield benefits
- Deployment of a fully operational system based on the prototype: supporting maintenance decisions

PK/PD Modelling

An understanding of how a drug is absorbed into the body ('pharmacokinetics' or PK) and how it achieves the target benefit ('pharmacodynamics' or PD) is a critical part of the drug development lifecycle. Building models of these processes allows optimal doses to be selected for clinical trials, while avoiding the risk of toxicity, taking patient variability into account. Given the cost and timescale of drug development, in particular the expense of running clinical trials, such predictive capability is key for pharmaceutical drug development companies.

Our expertise has enabled a number of novel non-linear models to be developed, with associated solution methods, for systems which cannot be described using standard approaches. We have also developed easy-to-use software tools allowing rapid solution of the equations for synthetic populations to assess variability in response. This has provided the capability to perform dose optimization and 'what-if' analyses, which were not possible using the industry standard models and tools. Such a capability can also provide the basis for wider modelling of entire clinical trials, improving the probability of success and optimizing trial size to reduce unnecessary costs.

Tessella – Providing innovative solutions to scientific, technical and engineering problems

Tessella uses its unique blend of scientific, engineering and IT skills to solve the most complex of technical and business problems in a highly cost-effective way.

We have a proven 26-year history of excellence, adding value to demanding public sector and commercial R&D based customers. Tessella now comprises Tessella Support Services plc, Tessella Inc and Analyticon Ltd.

Tessella's services cover software design and development, IT consultancy, infrastructure support and project management. Our enviable reputation for providing high-quality, low-risk, value for money services is backed up by many successful, high-profile projects, plus a high level of repeat business.

Formed in 1994, Analyticon specializes in the design of solutions requiring mathematical modelling, analysis and creative thinking. For each problem we develop a fundamental understanding within the 'big picture' context – so our solutions fit. We focus on the details however intricate – so our solutions work.

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