

Tessellations

News And Technical Updates From Tessella

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ExoMars: a world of trade-offs and sensitivities

ExoMars – a European mission to land a scientific rover on Mars to look for signs of life – is currently in development and planned for launch in 2013. Funded and led by the European Space Agency, the mission will consist of a carrier spacecraft (to transfer it to Mars) and a descent module. After reaching the Martian atmosphere, the descent module will require an Entry, Descent and Landing System (EDLS), which will make use of a heatshield, parachutes, thrusters and airbags to bring the lander containing the rover safely to rest on the planet surface.

The current contract for the Phase B1 study phase of ExoMars was awarded to Thales Alenia Space Italia, with the challenging task of consolidating the baseline design for the entire mission. This involves balancing scientific objectives, cost and schedule, risk of mission failure, and political factors such as the effective use of the industrial partners distributed around Europe.

To support this work, analysis and trade-offs of the available launch, transfer and EDLS options are being performed by Deimos Space S.L. (based in Madrid). Analyticon (now a branch of Tessella) is part of their team, with responsibility for analysis of the descent and landing phases.

As the ExoMars project has progressed, many different options have been discussed: launch rockets (with limits on the total mass that can be launched), arrival trajectories at Mars, landing sites and altitudes, and parachute/airbag technologies. Within this rapidly changing landscape, the project team needs to explore questions such as:

- What range of designs is feasible?
- Which landing sites are reachable?
- How large do the parachutes, airbags and thrusters need to be?
- How would a larger rover affect the capability to land safely?
- Which descent module release strategies are compatible with the landing accuracy requirements?

In many complex projects, eventual success depends on getting an early understanding of the trade-offs and sensitivities involved. There is a need to assess rapidly different design or development options, and find a balance between conflicting requirements.

In a project like ExoMars, where the constraints are both challenging and likely to change, such 'system-level trade-offs' are vital – gaining insight into the crucial parameters and helping to find the optimum solution at each stage.

For ExoMars, taking a numerical approach to mapping out the 'landscape' of available design options has supported the international community in deciding on the best way forward for the mission.

Deimos and Analyticon have developed tools to make numerical assessments of these questions in a way which allows rapid assessment of a wide range of options and, crucially, rapid re-assessment in changing circumstances. A technique developed by Deimos calculates the 'reachability' of each part of the Martian surface and shows it in the form of a map, taking into account the required landing accuracy, capability of the heatshield and so forth. This allows, for any given mission baseline, a clear view of the capability to meet the requirements and the amount of margin.



The ExoMars rover will be ESA's field biologist on Mars (Image: ESA)

At Analyticon, a 'parametric analysis' approach calculates the required size and mass of the parachute, thruster and airbag systems for any given set of input parameters. For example, the effect of a heavier rover can be assessed immediately, or the optimum balance of parachute size against thrusters can be investigated. With bigger parachutes and more thruster fuel the descent module can slow down more quickly, which may be safer, but at the cost of more EDLS mass – which means less mass for other items like the scientific instruments.

With the help of such analyses, ESA has been able to agree with the participating states the mission baseline on June 11, 2007. ESA is now focused on refining the design of the so-called 'Enhanced Baseline' which provides a maximum science return to the European scientific community while maintaining the goal of demonstrating important technologies for future exploration missions to Mars. ESA is now preparing for the transition from the study phase to the implementation phase which should start in early 2008. With Analyticon also responsible for detailed simulation of the descent, and involved in the design of the parachutes themselves, this exciting mission will continue to offer many opportunities in the future!

Design trade-offs in your business?

Design trade-offs and sensitivities are common in other industry sectors in which Tessella's clients operate. Sometimes a numerical approach is obvious, as in portfolio planning in the pharmaceutical industry, where risk and potential financial return need to be balanced against other factors such as strategic fit, within overall constraints on development resources. In other cases the criteria are more qualitative, such as in the defence procurement market, where a particular operational requirement could be met by a range of solutions which need to be assessed in terms of their cost, combat effectiveness, expected reliability in the target environment, and flexibility of application to other requirements. Working with partners and suppliers who understand your constraints and objectives, and have the technical expertise to explore them, is key to gaining the insight you need to support design decisions.

Analyticon
The Right Answer

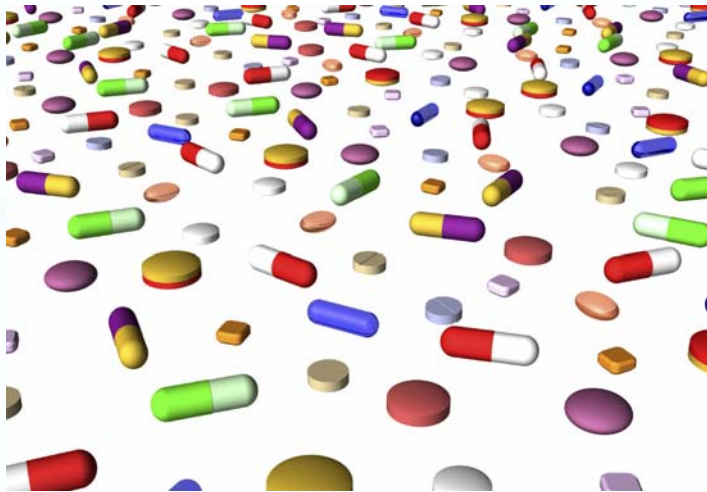
Tessella
Scientific software solutions

DIGITAL ARCHIVING: On the 1st and 2nd of November 2007, the National Library of the Netherlands is holding an international conference highlighting the latest developments in digital preservation tools and the latest trends for long-term archiving. Dr Rob Sharpe (Tessella's Head of Digital Archiving Solutions) is co-presenting a session on the characterization of digital objects. For more information please email info@tessella.com

Critical decisions – an objective approach

For a pharmaceutical company to develop and market just one drug successfully, can cost up to a billion dollars in investment. Companies may have dozens of drugs in development at any one time, but inevitably have limited money and staff. So, they *must* decide how to value their various projects and allocate resources so as to maximize the value of their portfolio.

UCB is a leading global biopharma company dedicated to the research, development and commercialization of innovative pharmaceutical and biotechnology products in the fields of central nervous system disorders, allergy/respiratory diseases, immune and inflammatory disorders and oncology. The company focuses on being the *first* to bring medicines to market for use by specialists treating severe diseases.



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Critical decisions

UCB manages a complex portfolio of R&D projects. To maximize the value of the development portfolio key decisions must frequently be made, including:

- What priority should be given to different projects?
- Should a project be out-licensed to another pharmaceutical company?
- How should resources be allocated in order to maximize the return on investment?

In order to make the right decisions it is necessary to have a clear idea of the risks, costs and potential rewards associated with each project, and to understand these factors in a whole-portfolio context.

Analyzing the portfolio

Working closely with staff at UCB, Tessella has developed software tools to support all aspects of the development portfolio analysis process.

A standard format has been defined for project data. This, together with guidelines for users providing such data, helps UCB's project teams prepare data on a consistent basis across the whole portfolio. The tools also assist with the quantification of risk, and help project teams visualize how risks are spread across the different phases of development.

The portfolio management tools rapidly calculate measures of project and portfolio value. A graphical user interface enables the user to select quickly which projects, potential portfolios and strategies are to be considered.

Once an analysis is selected, the resulting calculations are underpinned by sophisticated mathematical methods to ensure that the value of each potential portfolio is accurately assessed. This takes into account the possibility of project failure at each phase and the dependencies between separate branches of development.

Many of the costs, risks and rewards used to estimate project value will not be fully known. The tools allow the level of uncertainty on these inputs to be specified and then rigorously calculate the resulting uncertainty on outputs of interest. This information can be used to provide confidence levels on a measure of project or portfolio value such as risk-adjusted Net Present Value (NPV) or net profit. Alternatively, sensitivity analyses can be used to show where uncertainty in the inputs is causing the greatest uncertainty in the output values. Effort can then be focused on obtaining more information in those areas which have the greatest impact on investment decisions.

The portfolio management tools produce a large number of graphical outputs designed to allow decision-makers to assimilate data easily. The data that underlies these graphs is not lost; it can be automatically exported to Excel should further analyses be required.

By using their new tools to support a number of development portfolio reviews, UCB staff have been able to identify ways in which the process of collecting data, performing analyses and presenting results to senior management can be made as streamlined as possible. Tessella has responded to these findings by enhancing the tools to further automate the analysis process.

Objective decision making

Tessella's portfolio management tools have been successfully used to support a number of development portfolio reviews.

The ability to analyze data using these tools means that decision-makers at UCB quickly understand how a change (or potential change) in one of their projects will impact the whole portfolio.

Because all projects are valued in a consistent manner and the effect of uncertain information is clearly shown, decision-makers can have confidence in the results of the analysis. The tools allow an objective approach to decision-making and maximize the value of the UCB development portfolio.

To find out more about UCB please visit www.ucb-group.com.

To find out more about Tessella's experience of supporting companies in managing their portfolios and more on the future opportunities that lie ahead for this technology please email info@tessella.com or visit: http://www.tessella.com/Services/capabilities/e_decision%20analysis.pdf



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

From black box data to train fleet performance statistics

To enable the effective maintenance of a fleet of trains, whilst continuously improving their reliability, some key goals need to be achieved:

- Performance degradation needs to be identified *before* components fail
- Any faults that have occurred need to be diagnosed accurately
- The behaviour of system components needs to be understood over their full service lifecycle
- And the predicted benefits of any attempted improvements need to be assessed reliably

Close co-operation across the rail industry

For substantial progress to be made in this area, access to a broad spectrum of data is essential. As a result of the privatization of the UK rail industry, largely during the early to mid 1990s, the required data is collected by multiple organizations across the industry. Effective co-operation between rail companies is therefore an essential part of any project that looks to increase the sophistication of fleet maintenance.

Southern (who operate trains in South London and to the South Coast of England) and HSBC Rail (one of the UK's main rolling stock leasing companies) have done just that, joining forces to make a step change in how train operating performance is measured, analyzed and interpreted. Working together, raw operational data is turned into the knowledge required to streamline and maximize the benefits of the maintenance regime.

An innovative system to drive progress

In the rail industry, condition monitoring has been limited to on-train analysis of data, with faults only reported when pre-defined conditions have occurred. HSBC Rail and Southern, recognizing the limitations of this approach, have worked with Tessella to develop the 'Train Automatic Performance Analysis System' (TAPAS). This approaches the problem by analyzing all the data captured in the 'black box' data recorder off the train, enabling behaviour patterns to be constantly re-evaluated and taking train condition monitoring to a new level.

Post incident investigation regulations require all UK trains to be fitted with an On-Train Monitoring and Recording (OTMR) device, the equivalent of an aircraft black box, to log basic operating data. In most cases this data sits unused on the train, downloaded only in the event of an incident. Southern and HSBC Rail recognized that fitting OTMRs provided the route they needed to a fundamental understanding of how their train fleets behaved, and would enable the companies to maximize their performance.

Wireless technology is used to upload OTMR data from in-service trains into TAPAS, a centralized data collection and analysis system. Taking the full dataset off the train allows detailed visibility of evolving trends, enabling early reaction and intervention before an in-service failure occurs. It also provides a view of the train in active service (in all environments), not stationary in a depot having already failed.

The TAPAS 'Engineer's Dashboard' provides a prioritized fleet-wide display of all current issues, with the ability to drill back to the complete original OTMR data set should that be necessary. Centralizing data, collected identically across an entire fleet, in an off-train database, enables a fleet-wide view of performance. A single train can be assessed relative to its peers in the fleet, allowing the monitoring system to move beyond measuring performance relative to fixed parameters.



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Absolute values are insensitive to real-life conditions and can involve many assumptions of uncertain validity. Replacing a fixed performance scale with one that evolves with changing circumstances, makes a monitoring and assessment system more representative of the true operating environment. The TAPAS approach makes the most of limited data sets and allows the monitoring system itself to be monitored for effectiveness.

TAPAS gives Southern and HSBC Rail an unparalleled ability to learn about their fleet, and gain the knowledge needed to maximize the effectiveness of their maintenance regimes. It lets them identify and focus their efforts on the worst performing units in the fleet and allows them to be quantitative, providing numerical evidence to use in conjunction with anecdotal problem reports. Scheduled manual inspections are augmented by continuous in-service TAPAS inspections, which provide the means to assess directly and independently the effectiveness of their preventative maintenance and repairs.

Exploiting knowledge gained

The Train Automatic Performance Analysis System works with the big picture. The knowledge gained allows resources to be concentrated on improving the reliability of the fleet as a whole, rather than improving inherently the reliability of any one train. The breadth of its view is one of TAPAS' greatest strengths. To find out more please email info@tessella.com

In June 2007, TAPAS won a prestigious Railway Industry Innovation Award, in the category of Engineering and Information Technology. The awards, now in their 10th year, recognize the huge amount of innovation taking place in Britain's railways.



Nick
Technical Manager
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Andrew Burchell
Fleet Engineer
HSBC Rail



Simon Green
Systems Engineer
Southern

Fission and Fusion

For over two decades **Tessella** has played a key role in supporting the Energy and Chemical sectors, and this has led to our being involved in a number of International Atomic Energy Agency (**IAEA**) activities.

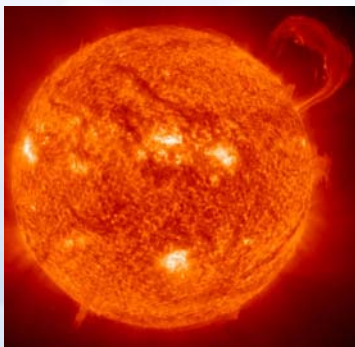
In June 2007, Tessella's Mark Claxton presented a poster at the IAEA International Conference on 'Knowledge Management in Nuclear Facilities' in Vienna. Mark's topic, on the use of Digital Preservation solutions to assist with Knowledge Management, was well received and was seen as a key enabling technology in any Knowledge Management programme. Tessella has also contributed to the IAEA Technical Report 'Long Term Preservation of Information for Decommissioning Projects', which tackles the issues around creating and maintaining living archives for use by the Nuclear Industry. We provided detailed assistance based on our digital preservation work for the National Archives of the UK, US and the Netherlands. The report is due to be published later this year.



Mark >>

<< Richard

In July 2007, Richard Layne, Tessella's Fusion Project Manager, represented both Tessella and the UK Atomic Energy Authority (**UKAEA**) at an IAEA Technical Meeting on Control, Data Acquisition, and Remote Participation for Fusion Research in Inuyama, Japan. Richard presented a poster describing recent work on tools for analyzing videos of fusion experiments, and for web-based remote participation, carried out by the team he leads at **JET** – the Joint European Torus – the world's largest fusion research facility. The conference was an ideal opportunity to discuss how JET experience can be applied to **ITER**, the next generation fusion research device currently being built in Provence, France.



<< Fusion powers the Sun

Courtesy NASA/JPL - Caltech

Sailing the oceans – simulation style

Thales Consulting & Engineering (UK) is an Operational Analysis, Systems Engineering, Business Management and Human Factors consultancy. Part of the Thales Group (a world leader in mission-critical information systems for the Aerospace, Defence and Security markets) it works with the UK Ministry of Defence (MoD), and Government and Commercial sectors, on many projects across a wide range of specialist areas. Thales had a requirement for a system that would be able to simulate the movements of a naval fleet over its lifetime. The system would need to generate a random set of tasks for the fleet to perform and then simulate the fleet's behaviour over a specified time period. The fleet is modelled at the platform (ship) level with each platform having defined equipment fit. The results of each simulation run could then be analyzed and compared with results of alternative fleets to investigate capability surpluses and deficits.

In April 2007, Thales engaged Tessella to develop the model and this exciting work is now underway. The model will enable Thales to investigate what-if scenarios for future possible fleet design that makes the best use of resources and, ultimately, is the most cost-effective for their client. This work is intended to be completed by Autumn 2007.

Measuring and monitoring

JANET(UK), the network operator for JANET, the UK's education and research network, has awarded Tessella the contract to develop a new measurement and monitoring system to replace its highly successful, but ageing, Netsight system. The contract was awarded through the CATALIST framework.



JANET has asked Tessella to re-design and re-develop Netsight, to meet the growing needs and expectations of its user community, and to incorporate recent improvements in monitoring technology.

Adaptive Clinical Trials

Tessella, United BioSource Corporation and Medidata Solutions, are running a series of free educational webinars on Adaptive Clinical Trials, which discuss the critical requirements and functions necessary to make an adaptively designed clinical trial an operational reality. Please visit www.tessella.com/adaptivedesigns.

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 27-year history of excellence, adding value to demanding public sector and commercial R&D based customers.

Tessella comprises Tessella Support Services plc, Tessella Inc, and Analyticon (now a branch of Tessella).

The group's services include software design & development, mathematical modelling & simulation, algorithm development, infrastructure support, project management and consultancy.

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.

For each client 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. Our ultimate aim is that the systems we deliver are used by our clients with great enthusiasm.

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