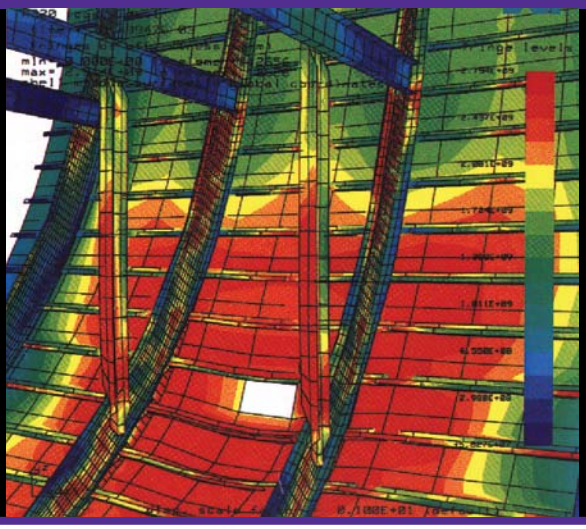
Success Story

QinetiQ



Internal blast loading on an airframe showing onset of failure.

"As a business, QinetiQ's strategy is to be the most effective part of our customers' value chain, and the capability of the Altix enables us to do that."

– Ian Cullis, QinetiQ

The Need for Speed at QinetiQ

To out-compete, out-compute

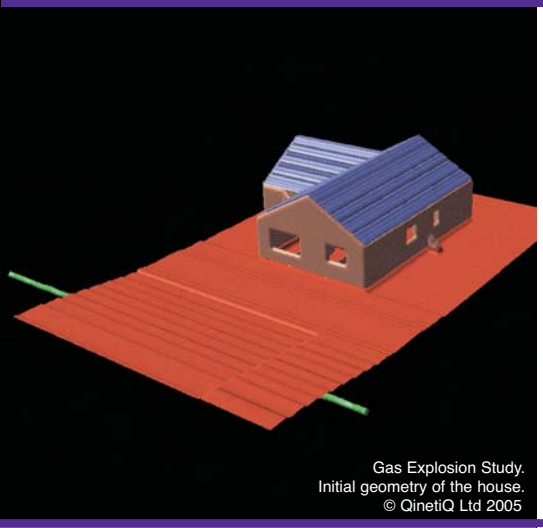
QinetiQ is a leading international defense and security technology company. A leader in the creation, application, and exploitation of defense and security technology, QinetiQ's key focus is to add value to customers' programs through the application of technology solutions.

In mid-2005, one of QinetiQ's business groups purchased a 64-processor SGI® Altix® system—the latest in a long line of supercomputers that spans back almost 30 years, and includes an ICL 1906, Cray 1S, Cray XMP, two Cray SV1s, and a 16-processor Silicon Graphics® Origin®.

"One of the projects we're focusing on is understanding how explosives interact with materials, and what happens, for example, when a projectile hits a target at very high velocities in excess of 10km/second," explains Ian Cullis, technical consultant—modelling, Lethal Mechanisms Business Group. "The physics describing these processes is non-linear, so although you can write the equations down you can't solve them. And because they're non-linear you can't use intuition to come up with a solution either. So in the late 1970s we invested in a computer code designed to solve these types of equations, and we've been refining it ever since.

"If you're interested in a projectile impacting a target, you need to split that space into cells, and solve Newton's laws of motion in relation to the conservation of mass, momentum, and energy for each cell. You then repeat this process to move the problem forward in time, so you can predict what's going to happen.

"Clearly, what limits anybody's ability to solve this type of problem is the size and speed of the computer used—hence why we've tended to acquire technology as it becomes available. Since investing in the Altix, for example, we've already seen an eight-fold increase in speed compared to what we had with the Origin."



Gas Explosion Study.
Initial geometry of the house.

"By using modelling to predict the outcomes of experiments, and then using the experiments to validate and further refine its code, QinetiQ can accurately predict the results of a range of scenarios being investigated for its customers."

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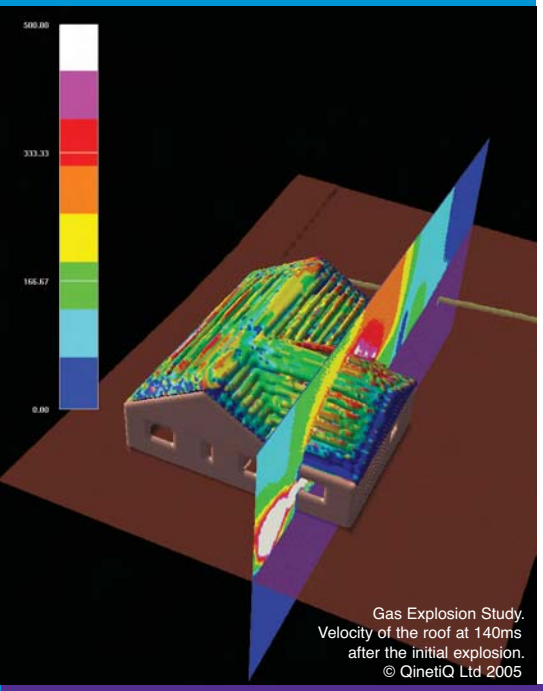

Gas Explosion Study.
Velocity of the roof at 140ms after the initial explosion.

By using modelling to predict the outcomes of experiments, and then using the experiments to validate and further refine its code, QinetiQ can accurately predict the results of a range of scenarios being investigated for its customers—avoiding the need for many of the experiments that would otherwise be required to test these; increasing development speed; and saving time and money.

"Thirty years ago, before the advent of computer modelling, an R&D program required around 1,000 experiments at an average cost of approximately $53,000," continues Ian Cullis. "For a similar system we'd now do 100 experiments and the rest would all be modelling—so the cost savings are phenomenal. We've also done a lot of work on characterising materials, and developing state-of-the-art algorithms to describe how they behave (particularly dynamically), to enable us to do 'what if' studies such as 'suppose I had a material with the following properties, what could I do with it?'

"Through this we've become involved in a wide range of defense and non-defense projects, such as oil well perforators and explosive welding. Our largest simulation on the Origin involved modelling a gas explosion. It took 19 days to get a solution, whereas if we repeated that on the Altix it would take just two-and-a-half days. So for the sorts of problems we're being asked to tackle, that's the impact the new machine is having.

"One of the benefits of computer modelling—particularly in a defense environment—is that if an emergency situation arises, we can respond very quickly by assessing the potential threats, their possible danger, how we can protect our forces better, and how we can improve our systems to defeat the opposition.

"Another important area is where a system is already in service, and needs to be upgraded or used in a different environment. We can then use modeling to optimize the system within its existing design envelope, or investigate what will happen if it's used in a particular way. Then there's the issue of operational analysis and planning, how different types of systems will perform, and how we can combine our high level modelling into the more simplified codes and algorithms that these analyses typically use."

"A key driver for QinetiQ is that for the services we're providing, high performance computing is an essential tool," agrees QinetiQ's head of business improvement, CIO group, Dr. Amjad Farooq. "If we don't have enough processing power or there's a certain type of service that we cannot provide, we may not be able to take up

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> *Head of Business Improvement, CIO Group, QinetiQ*

certain new business opportunities, because we may not be able to meet customers' timescales.

"Our customers demand flexibility, quick responses, and in many cases have a choice—so we need to respond to that. Our strategy is to see how we can bring people together, and purchase technology that increases the capacity that our people can jointly use. We've been looking to forge a partnership with a supplier who has and will continue to have the right sort of technology; is very flexible, responsive, and can help us to win business by supplying us with the computing we need. We invited a number of parties to do this, SGI won, and we now have a very good relationship. SGI was the right choice, and a good supplier to partner with.

"What we're looking at with the SGI Altix is to offer a computing service on our corporate network, so that if a particular group has an immediate need for a large amount of processing power, it can take over the entire node, run it and get the required results.

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"Something we've found is that if our scientists know they don't have the necessary computing power, they can sometimes limit their ambitions. Typically they'll limit what they do according to what is available or what they can afford to buy within the agreed customer budget—which can sometimes be less than they could be achieving. So what we're saying now is that if you have a great idea and need some more computing power, it's available. If you come up with something customers want, then let's unlock that. Don't compromise because you have a small machine and can't do things. Think corporately, because there are other facilities you can access.

"We want to add to what we have, and grow that to give us the scale and flexibility we're looking for. SGI is now inside our strategy, and helping us to develop that strategy. We don't have to withhold information about our budgets, because our pricing structure is already agreed, and so we can tell SGI how much money we have, and they will deliver absolutely the best capability and the best value for money they can.

"Looking to the future, one of the things QinetiQ is also doing to knit all this together is to pilot the use of 50 desktop PCs to do grid computing. We'll also link these with the Altix in a way that makes it transparent to anyone who needs to use its computing power, where their job is actually being executed."

Security Technology Development at QinetiQ

"QinetiQ is actually very well positioned to explore many of the issues around grid computing," concludes Ian Cullis. "If you think about a lot of organizations that invest in IT solutions, this often ends up with an overspend because they can't test what they're going to do before they do it. But if you've got the sort of network that QinetiQ has, we can go to a customer and say this is the solution we're proposing and we can actually develop and test it on 9,000 grid machines. At one end we've got desktop PCs, at the other we've got the Altix. We've got systems that can grow and there's the opportunity to explore different architectures—so the whole thing really is exciting and incredibly challenging.

"With regard to Linux®, we've always been at the forefront of operating systems and compilers, simply because of the size of our code. We've had very few issues moving from the Origin to Altix, and those that we had were resolved very quickly by talking to SGI. Everybody looks at issues like these as a problem, but they're not, because they're giving you an understanding that you can hopefully share with someone else if they have something similar.

"As a business, QinetiQ's strategy is to be the most effective part of our customers' value chain, and the capability of the Altix enables us to do that. And the real potential I see for Altix is that it gives QinetiQ the potential to become a real player in high performance computing—not because the company culture says we should be, but because our people and our customers say we have to be."

> "Altix gives QinetiQ the potential to become a real player in HPC—not because the company culture says we should be, but because our people and our customers say we have to be."
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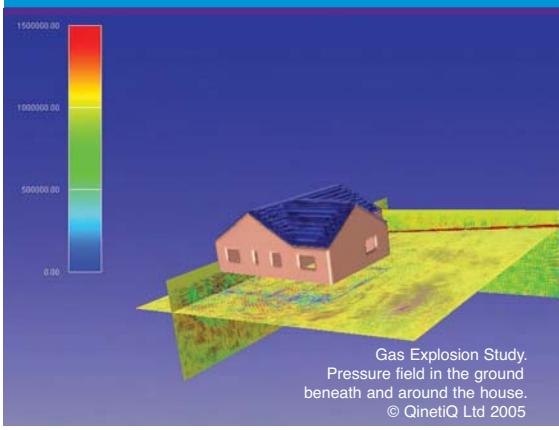
> *– Ian Cullis, QinetiQ*



Gas Explosion Study.
Pressure field in the ground beneath and around the house.
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