

Caterpillar Defence Products secures Terrier contract timescales using Flowmaster fluid flow analysis solution

Any place, any time, any environment

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Verification and
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at CDP

In October 2003 Caterpillar Defence Products won a competitive bid for a multimillion-pound contract from the Land Systems business of BAE Systems to provide six powerpacks for the prototype and demonstrator phase of the British Army’s Terrier combat engineer vehicle programme. These powerpacks are based on Caterpillar’s C-18 522 kW engine and Allison’s X300 automatic transmission. To help ensure that the powerpacks will operate reliably and effectively under combat conditions at any time, in any place, in any environment, Caterpillar Defence Products (CDP) is using Flowmaster® fluid flow analysis software to help validate the design of the Terrier powerpacks in operational conditions.

Caterpillar Defence Products

Caterpillar Defence Products (CDP), part of Caterpillar Inc. is responsible for the marketing, sales, project management and logistic support of Caterpillar® and Perkins® diesel engines and transmissions to military and naval customers outside North America. Based in Shrewsbury in the United Kingdom, the company offers power solutions for combat and logistic vehicles, naval propulsion systems and land or ship based electrical power generation systems.

Meeting the challenge of a fixed-price contract...

Craig Wynne is Verification and Validation Engineer at CDP. He says, “Having won the tender, we had to ensure we could deliver the Terrier powerpacks on time and working. Our biggest challenge would be doing this within the constraints of a fixed price contract.” Craig explains, “The powerpacks are more than just engines and gearboxes. They are complex 500 kW power systems that have to perform in a confined space enclosed within the vehicles. It is therefore vitally important to know that they will perform in action. Will they cool at the required maximum ambient condition? Is there enough air for combustion and cooling?” He continues, “We determine this by building and testing a number of



prototypes and pre-production units, modifying the design of the systems and components if necessary, before freezing the design for manufacture.” Craig adds, “If we are to compress our timescales we have to get an up-front indication of the viability of our design. We can’t afford to wait for production vehicles to be made available, so testing is carried out on dynamometers and specially-designed vehicle test rigs. However, such equipment is expensive to make and just as expensive to operate.”

...with Flowmaster fluid flow analysis software

Caterpillar’s solution was to cut time and cost from the proving process by using computer simulation technology. Craig recalls, “Initially we used in-house software from the cooling engineers in our US development centre but found it was too specific to meet all our needs. However, the US had also trialled Flowmaster and suggested we take a look.” Craig continues, “We had a demonstration of Flowmaster and it met all our criteria.” He adds, “As a result, we bought one floating licence of Flowmaster, Fluid Power Steady State. The only other option would have been to go for a CFD (computational fluid dynamics) solution and that would have been more expensive, slower in operation and harder to use.”

One week with Flowmaster saves twelve weeks of testing

Craig gives an example of Flowmaster in action. He says, “I created a Flowmaster schematic network model of the Terrier powerpack populated by its components – engine, transmission, radiators, fuel system, controllers, ambient air supply and so on. Flowmaster then modelled the flow through the system to determine the temperature, pressures and flows.” He says, “It was quite a complicated model and it took me about three or four days to construct followed by a week of testing.” Craig adds, “That’s longer than a manual calculation would have taken but the big saving comes from that point on. I can so easily change the model and re-run it whenever I want. It is very quick too and most simulations run in just a matter of seconds.” He continues, “The Flowmaster model is even more valuable once you have actually confirmed it with hardware because you know then that it is correct.”

Covering the cost several times over

Asked about cost-justification of almost £20,000 of investment, Craig replies, “It wasn’t difficult. We knew that we’d cover the cost if we could avoid building just one extra test rig, though the real cost justification came from the cost and time saved by cutting out some of the physical test stages.”

Eliminating opportunities for error

Looking at the overall benefits of Flowmaster, Craig says, “It helps me to be more efficient in a number of ways. I can get answers for simple models very quickly and can make changes quickly.” He adds, “Even for a simple job, we need to know what will happen if a particular parameter changes.” Citing an example, he says, “I used Flowmaster to model the Terrier exhaust pack pressure. It took just an hour to put the model together and it answered my question instantly. Without Flowmaster it would have taken me ten times longer to validate the answer and would have left lots of opportunity for errors. I would have to set up lots of spreadsheets and carry out numerous manual calculations which I would have to repeat for each change.”

Saving significant amounts of money

According to Craig, a further advantage of Flowmaster is its flexibility. He says, “We handle a wide range of projects, some simple, some complex and Flowmaster copes with them all. And because the models are visual and schematic, I can go back to even a quite complex model after say 6 months see all the data and pick up from where I left off. In the past I’d have had to try to work out where I was from Excel or from piles of paper.” He points out too that, “Flowmaster is enabling us to save significant amounts of money. Terrier powerpacks are quite large and testing them is enormously expensive and time consuming, involving much

forward booking of scarce equipment and resource. The fuel cost alone for a 400 hour test can be over £ 6,000.” There are resource savings, too. Craig says, “We can never get enough physical test time for all the projects we are working on. With Flowmaster, we can complete a testing programme with much less load on our Test Department.”

Excellence in training and support

How easy was it to get results from Flowmaster? In Craig’s opinion, “You do need training to use the software and it was excellent. Of course, you do have to be an engineer. The basic two-day course equips you to hit the ground walking, so to speak, able to create a simple simulation. Then it’s up to you to pick up the pace in your own specific application area or take Flowmaster’s advanced training.” He comments, too, that, “Support is excellent. I can pick up the phone and talk through the issues. The people are extremely helpful and come back to you quickly with the answers.”

Flowmaster: doing exactly what is required

Summing up, Craig says, “I’m really happy with what we have bought. Flowmaster is an engineers’ tool that makes my everyday work a lot easier. It is doing exactly what we wanted and additional uses are now becoming evident. I’m sure we’ll make even more cost savings than we have already.”