Newsletter

Autumn 2005

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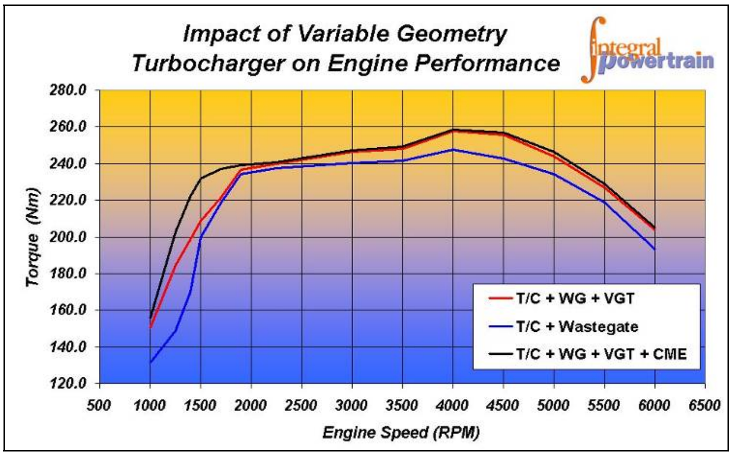
V-G Turbochargers for Gasoline Engines

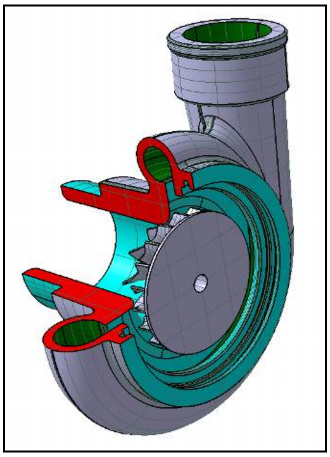
As boosted gasoline engines take increasing market share there is a rich diversity of pressure charging technologies either in production or in advanced development. These include turbochargers, fixed displacement superchargers, multi-stage turbos, combined turbo/supercharging and electrically driven or electrically augmented superchargers such as our own SuperGen system. All of these technologies are trying to balance performance feel, CO_2 and cost.

The gasoline turbocharger sector is currently dominated by fundamentally conventional, fixed-geometry units with incremental improvements such as increased temperature, wheel inertia, twin scroll housings. Given the success of variable geometry in the diesel market, IP investigated the potential for application of similar technology to gasoline engines last year and is now designing a solution for demonstration purposes.

In addition to the thermal challenges, our dynamic simulation shows that the strong interaction of the VGT and gas exchange processes requires new solutions both in the area of engine hardware and the control system. With these in place major benefits are possible in terms of extending the boosted range and improving response and efficiency.

It was also clear that without a genuine systems approach results would be sub-optimal and probably very disappointing. We have therefore added a specialised prototype, low-volume manufacturing and assembly partner to our existing team's (conventional) turbocharger design, EMS strategy and calibration capabilities.





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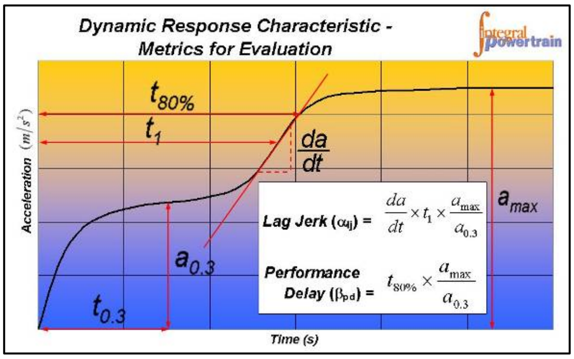
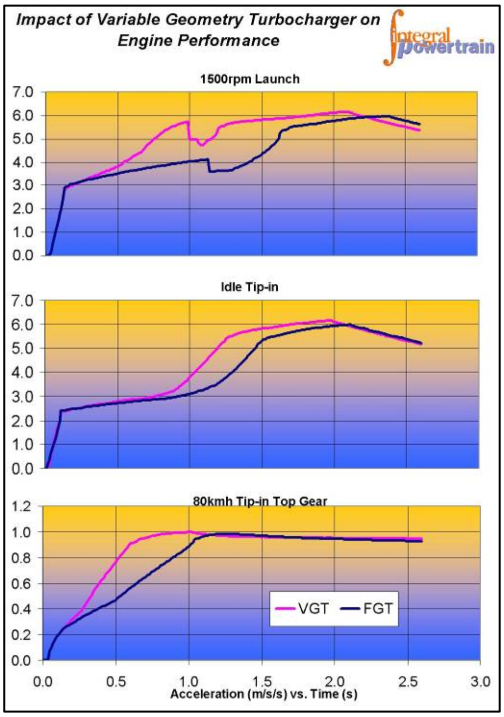
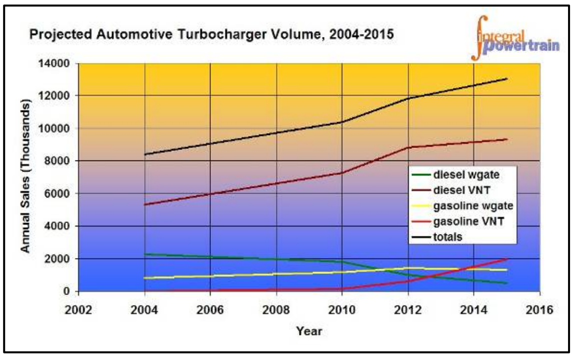
We hope that this comprehensive service will be an enabler for the development and rapid implementation of efficient boosted engines complementary to the objectives of both OEMs and tier 1 suppliers.





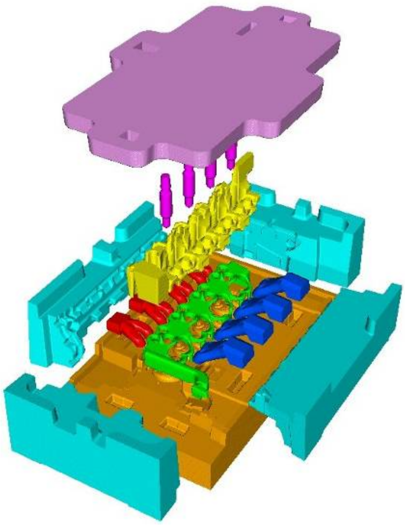


Intrinsys KBE seminar

... industry gathers to review the potential of Knowledge Based Engineering ...

Intrinsys Knowledgeware Seminar to be Repeated in New-Year

Intrinsys, the Aerospace and Automotive PLM focussed sister company to Integral Powertrain, recently hosted a one day seminar on the application of knowledgeware to engineering.



The main aims of the seminar were to showcase the use of knowledge-based tools in CATIA-V5 and to provide an opportunity for the Aerospace and Automotive community to come together and share experience and ideas. The event was well attended with senior representatives from all key customer sectors including F1 Motor-sport, Aerospace manufacturers and Tier-1s and the Automotive OEMs. Several respected journalists from general engineering and CAE publications also attended.

The event was enthusiastically received and it was encouraging to see how, increasingly, companies are backing engineering excellence as a major element of their business strategy towards improving quality and productivity in the face of low-cost overseas competition.

In addition to the presentation sessions we hope those attending found the relaxed atmosphere during breaks and at lunch a good opportunity to network and discuss solutions to current and longer-term future issues in this important emerging area.

– Intrinsys plans to run a similar day in the New Year. Those interested can take a look at this technology at the Intrinsys website: **www.intrinsys.co.uk**

... an interesting concept for completely balancing the piston engine ...

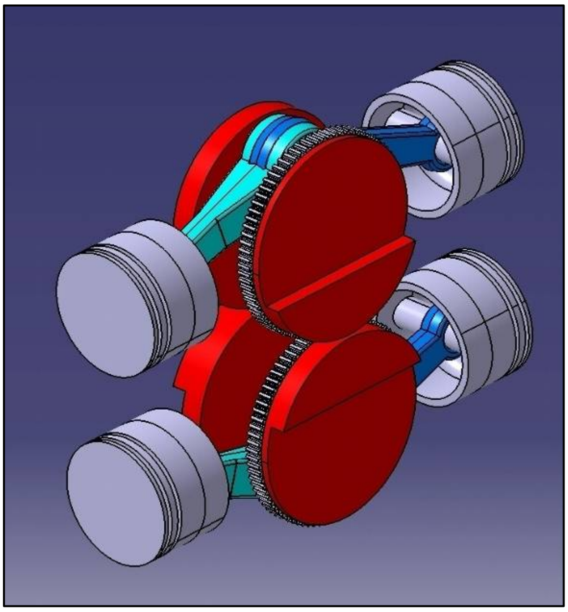
All torque and no re-action? *(Luke Barker)*

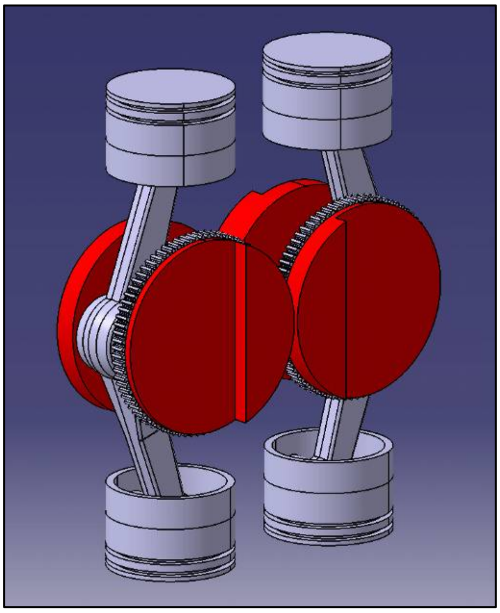
One of our new starter graduates, fascinated by weird and wonderful engine configurations, recently asked me what was the best configuration from a balancing perspective. The stock answer is that I6, V8 and V12 configurations all give perfect balancing of inertia forces and moments. But we all know that even 6 cylinder cars still grumble at low engine speed, so is there a better candidate for "best balanced engine".

When considering the likely refinement characteristics of an engine it is usual to start with the state of balance. Residual out of balance causes displacements at the engine mounts and hence structure borne noise and vibration. For example an I4 engine has a large residual force at twice engine speed and an I6 engine has no residual forces.

But engine mount displacements can also be caused by ***torque reactions*** at the fundamental firing frequency and, to a lesser extent, its harmonics. All conventional automotive engines suffer to some extent from this torque reaction and at low speed it generally dominates any out of balance. Adding more cylinders greatly reduces this effect and clever engine mounting systems can mitigate the effects but there is another way.

In theory the 4-cylinder configuration below gives no out-of-balance force and, if contra-rotating inertias are equal and connected to the transmission via a low stiffness coupling such as a twin mass flywheel, ***no torque reaction harmonics*** due to the cranktrain. Despite the promise of NVH excellence however the configuration has, as far as we are aware, only been used once in a 1930's motorcycle. Perhaps others have been scared off by the gear design! *Interesting link:* http://jeffdean2.home.att.net/brough.htm





... Short report from the annual European automotive technology symposium...

2005 Aachener Kolloquium - Short-report

Despite the fact that we manufacture 3 million engines a year in the UK we still have to go to Aachen, Germany for a first-rate knowledge sharing event!

This years event provided an excellent forum for the advanced Powertrain technology research and development progressing not just in Europe but globally.

The Aachen event is also a valuable indicator of technology trends and for information here is a summary of the number of papers by technology area.

Conventional Gasoline +emissions	Gasoline D.I.	Conventional Diesel +emissions	Advanced Diesel	HCCI Diesel/Gasoline	Transmissions/ Driveline	Turbocharged Gasoline	Supercharged Gasoline	Mild/Micro Hybrid	Full Hybrid	Engine Design	EV	Fuel Cells	Alternative Fuels
11	3	17	2	3	6	5	3	12	2	6	0	1	5

It was a surprise how little electric vehicle and fuel cell technologies featured in this year's proceedings. Is the development of these technologies stalling or are the manufacturers becoming very guarded to protect competitive advantages in their developed technology?

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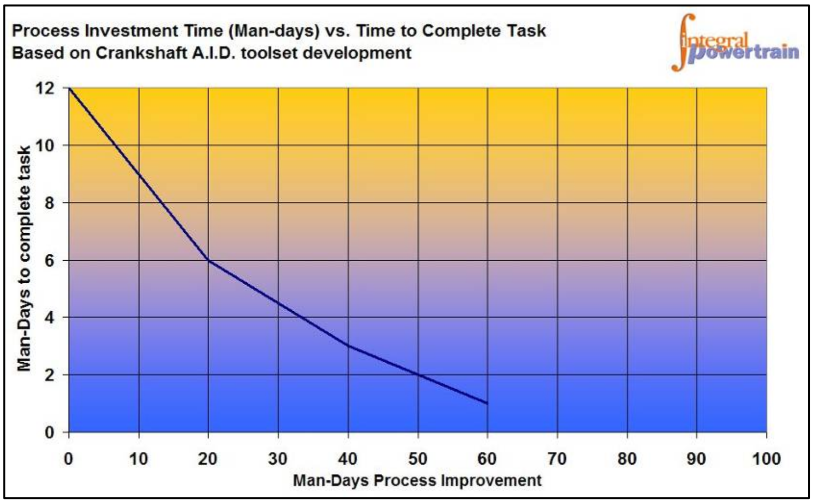
...investigating the economics of improved process development ...

Applying Economic Models to Process R&D Investments

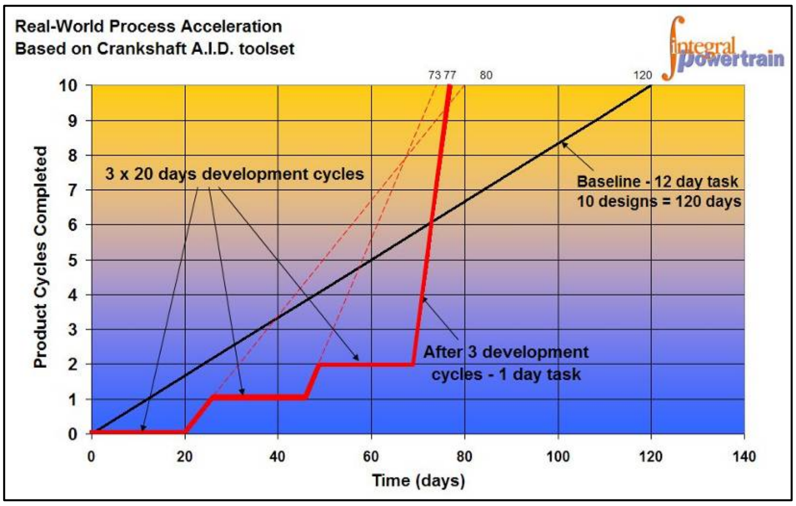
As engineers it is easy to appreciate qualitatively that by investing in process we can create more responsive organisations and improved products. Producing a quantified business case however can be more of a challenge. Even when the opportunity is great it can be difficult to generate the confidence needed to make the required commitment.



In order to help address this issue we have developed a model to forecast benefits, calibrated by our own experience with A.I.D. (Automated Intelligent Design).

The model considers the trade-off between investment and cycle time reduction based on typical improvement trajectories and includes the baked-in improvements for subsequent cycles. As well as evaluating the benefits of automation it can also be used for managing incremental improvements of interfaces between functions and software systems.

Through this investment modelling we've found substantial improvements in speed of delivery and quality can be achieved through investing relatively modest resources, and that through this approach a team applying these strategies can typically slash development times within only a few product cycles. The model can be used to not only determine benefits but also the level of investment beyond which productivity gains are out-weighed by the development cost.



In the case of the crankshaft example shown, the high fraction of repetitive elements within the design cycle (ie. Crank balancing operations, analysis iterations, etc) and the high frequency of usage within our business justified a high level of process acceleration and investment. Although not all tasks can be accelerated to this extent by using A.I.D. methods, most have repetitive or iterative elements in which investment can yield useful benefits.

Finally this analysis demonstrates that achieving a fast break-even point is not the whole story. Most importantly the enhanced speed of delivery remains long after the investment has been made, forming a platform for future process improvements and long term competitiveness.

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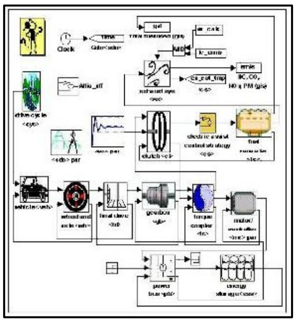
... the case for developing multi-fuels adaptability in future engines ...

Modelling Fuels



Fuel diversity is an evolving issue. Whilst on the one hand the industry is trying to reduce the number of standards governing fuel specification, it seems that energy security and CO_2 reduction requirements will actually widen the differences which already cause concerns.

IP has carried out internal research aimed at an intelligent solution to this problem and is in discussions with various stakeholders to set up a project to take the concept further.

At the heart of our proposal is the development of a more phenomenological model for the fuel within the engine management system. We believe this approach sits well within the architecture of current EMS systems which increasingly mirror Powertrain physical processes.

The initial goal will be to improve speed and robustness with which calibrations for alternative fuels can be produced with the possibility for the EMS to select settings to suit a preferred fuel.

Following satisfactory achievement of these goals, the longer-term objectives will be to develop this technology to deliver cost-effective fuel detection capabilities for production engines using a robust combination of direct and inferred techniques.

New Engineering Centre Opens

IP has now opened its new engineering centre, located near our previous temporary building in Milton Keynes. As well as improving our facilities, the design of the building properly reflects the company's reputation for advanced engineering.

The new offices cover 7000 sq ft gross internal area over 2 floors, with space for up to 60 permanent design staff. There are 2 main engineering offices, two smaller offices, reception, two conference rooms and an 8-place dedicated training facility; all fully air-conditioned.

The new workshop is 4500 sq ft to double height, with the capacity for additional upper level mezzanine space. This additional space provides expansion potential for additional design offices to provide for a further 30 engineering staff.

The workshop facilities are program focussed with several vehicle lifts of up to 4 tonne capacity, an engine build and inspection area, as well as welding, fabrication and machining equipment. A cold test chamber is being commissioned, which can accommodate vehicles (up to light truck), engines or rigs. The cold chamber is capable over achieving below –40°C with an 8 hour pull down time. The facility will allow IP to develop improved control system technologies in the field of cold starting, driveability and cold emission development.

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