Sirius 2011 is a collaborative programme involving Luleå University of Technology together with the Faste Laboratory partners Volvo Aero, Hägglunds Drives AB Bosch Rexroth, AB Sandvik Coromant, Volvo Construction Equipment and several other industrial and academic partners.

Luleå University of Technology, Computer Aided Design and industry partners in collaboration

Sirius, the final-year course for the Mechanical Engineering programme at LTU, prepares students for work in product development. The product development projects of this course are firmly based on close collaboration with industrial manufacturers or on real product development needs identified in other ways. Work is conducted in project groups with the support and guidance of academic advisors from several divisions at Luleå University of Technology as well as industrial advisors. Collaboration benefits both students and industry partners by giving students an opportunity to apply their knowledge when developing optimal solutions to real design problems with a limited time frame and budget. A unique insight into present and future working methods and cooperation in product development is gained.

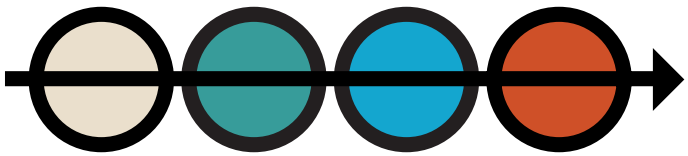
Manufacturing companies gain access to innovative product development performed by well-educated engineers who are unbiased by traditional modes of thinking and problem solving.

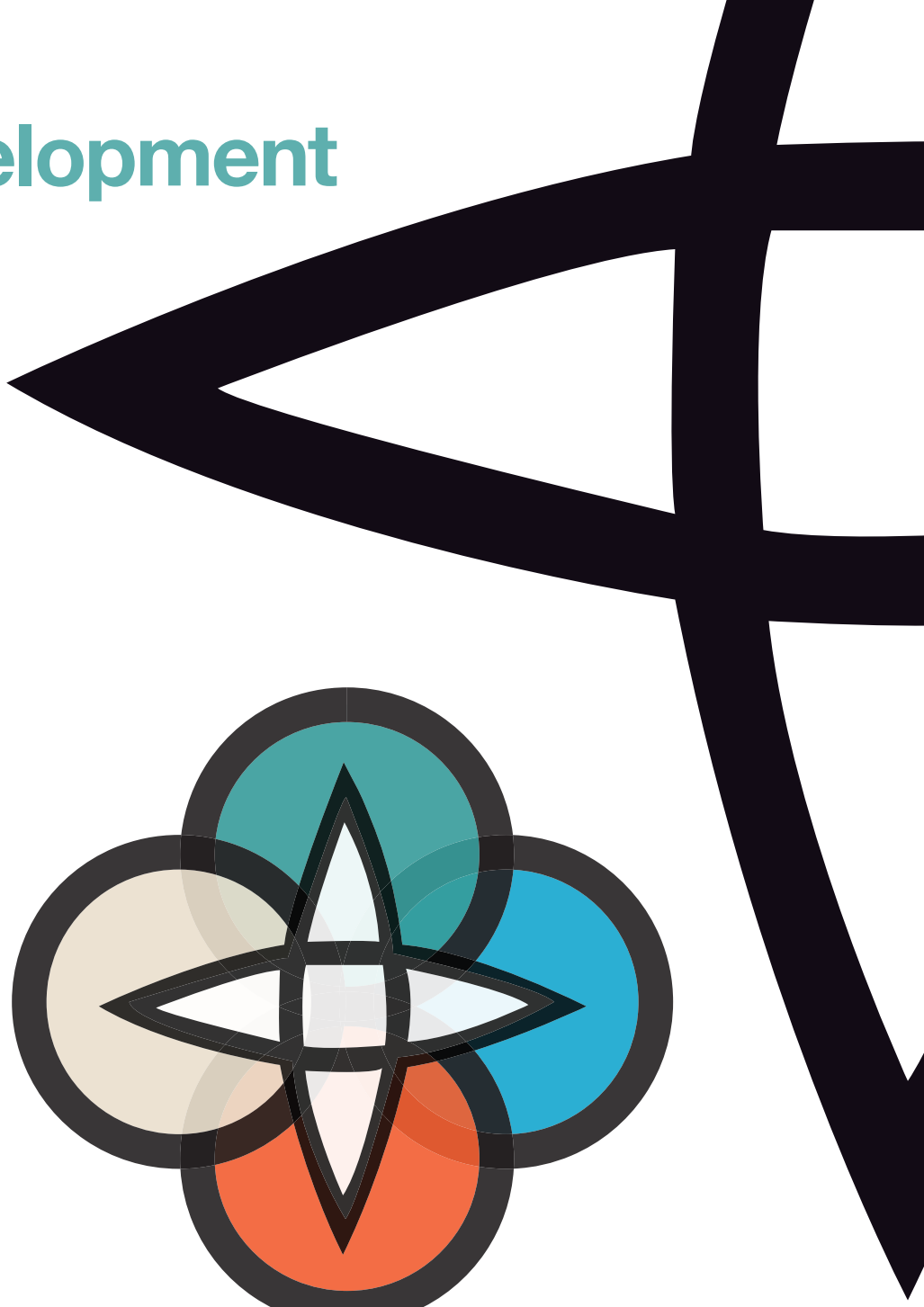
Creative product development

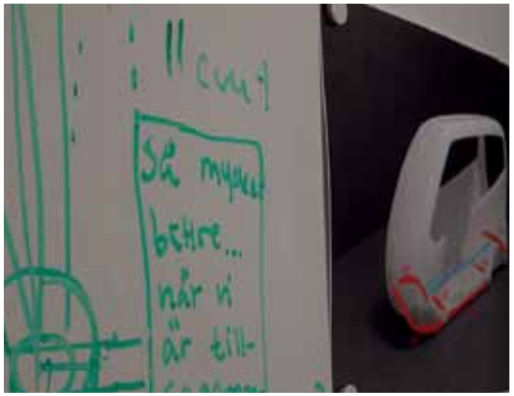
Sirius is a final-year course for students in the Mechanical Engineering MSc degree programme at Luleå University of Technology. Sirius is also open to final-year students from other MSc engineering programmes at the university, thereby ensuring a broad base of knowledge for the course's project groups. During most of the 22.5-credit course, product development projects are conducted in close national and international collaboration with companies and universities. The aim of Sirius is for students to acquire, apply and integrate knowledge considered essential for product developers in modern manufacturing industries.

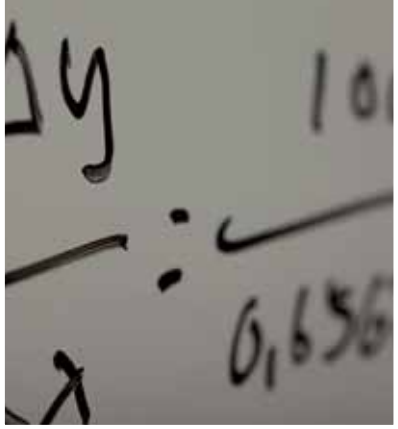
Students gain knowledge in project management, production of creative concepts, mechanical engineering design and computer-aided engineering, as well as command of all stages in the integrated product development chain, from needs analysis to the finished product. Under realistic industrial conditions, they carry out product development in teams, in collaboration with manufacturing companies based on real needs. Experience from Sirius prepares the participants well for teamwork with colleagues from other disciplines.

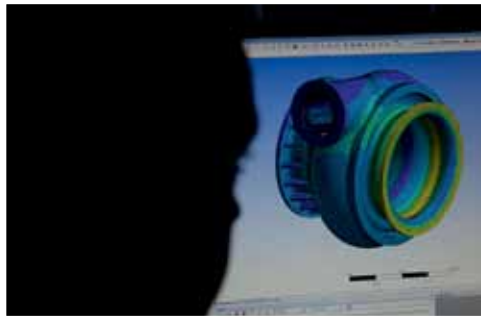
Sirius students engage in a valuable exchange of knowledge and ideas with graduate students and staff from the Faste Laboratory and other departments of Luleå University of Technology. Not only do Sirius students have solid theoretical knowledge, they also have the benefit of valuable experience from work in an integrated environment where methods and ideas from research in Computer Aided Design have been applied.











Needfinding

A user focus has come to dominate company innovation strategies in the past decade. However, in practice, involving users in product development is not as straightforward as it sounds. People cannot always be precise about what their needs are; they might just perceive a situation where satisfactory solutions are lacking. In such situations, it is naturally more difficult to identify these needs. Needs obviously play an important role in innovative or radical product design, since the starting position includes no existing solution.

Thirty years ago, Robert McKim, the head of Stanford University's product design programme, understood that engineers had to be involved during the earliest stages of product development to understand needs. He developed an approach, named Needfinding, that implies the interplay between needs and recognition. Observations, interviews and creative methods are used to identify, analyse, categorise and communicate needs to drive product development in Sirius student projects. The main principles of Needfinding are to first be close to the users and then look for needs, not solutions. This keeps the early phases of product development open to unexpected insights and supports the generation of numerous concept ideas. In turn, this broadens the design space and the opportunities for innovative products. This contradicts a problem-solving approach of product development, where reducing the number of concepts as early as possible is important. Needfinding is part of the Sirius guideline that provides students with capabilities beyond classical engineering design education. The insights into needs provide a solid ground for the activities in concept generation, concept evaluation, detail design and product launch, which are also main parts in the Sirius guideline.

Concept generation

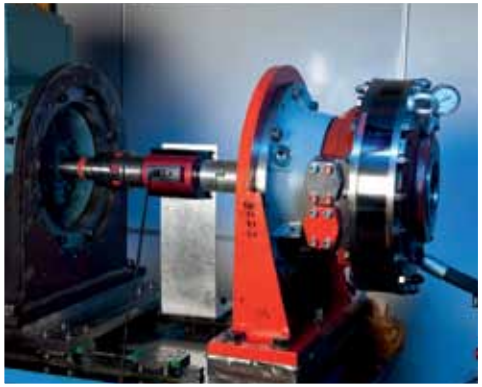
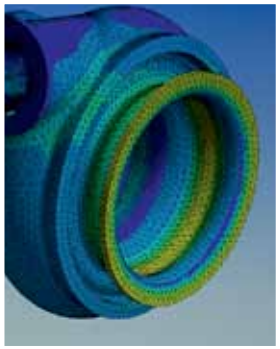
As Needfinding activities unfold, students gradually perceive insights into people's needs and concept ideas. To work the ideas into comprehensible concepts, the use of creative methods is emphasised. The use of creative methods spurs a free mind and openness to new ideas, since judgmental attitudes are not allowed and all ideas are good ideas. The concept generation phase has a focus on quantity, i.e. as many ideas as possible. Examples of creative methods are brainstorming, method 653, brainwriting, bodystorming, and de Bono's six thinking hats. The use of creative tools, e.g. method cards and thinkpak, support thinking outside the box and using all senses to be creative in the concept generation activities.

Concept generation is, in particular, highly iterative. The generation activities occur on different levels throughout the entire product development process as the product matures.

Concept evaluation

Numerous concepts are created during the concept generation phase; approximately 100-150 concepts are not unusual. This plethora of concepts has to be narrowed down into a manageable size during a phase referred to as concept evaluation. Concept evaluation can be seen as activities that highlight some desired qualities in each concept and can be seen as a stage in the design process during which the design space is narrowed down. The aim is to extract a few concepts that best meet the needs in focus and are feasible to be further developed into a product. However, to build upon seemingly crazy ideas from the concept generation, the concepts have to be described more concretely.

A first round of evaluations can be performed, for example, by using creative tools where the focus is on judging the value of the idea. During the later stages, measurable criteria and matrix-based methods, e.g. House of Quality and Pugh's matrix, are used. Small

models or prototypes may be used to test if a concept should be further developed. The idea here is to keep the prototype as simple as possible, since only particular concepts should be tested. Concept generation and concept evaluation are closely related phases and are used to narrow down and open up the design space. The results from the Needfinding activities, i.e. the needs in focus, are used in the evaluation activities to, for instance, judge a user-perceived value of the concept.

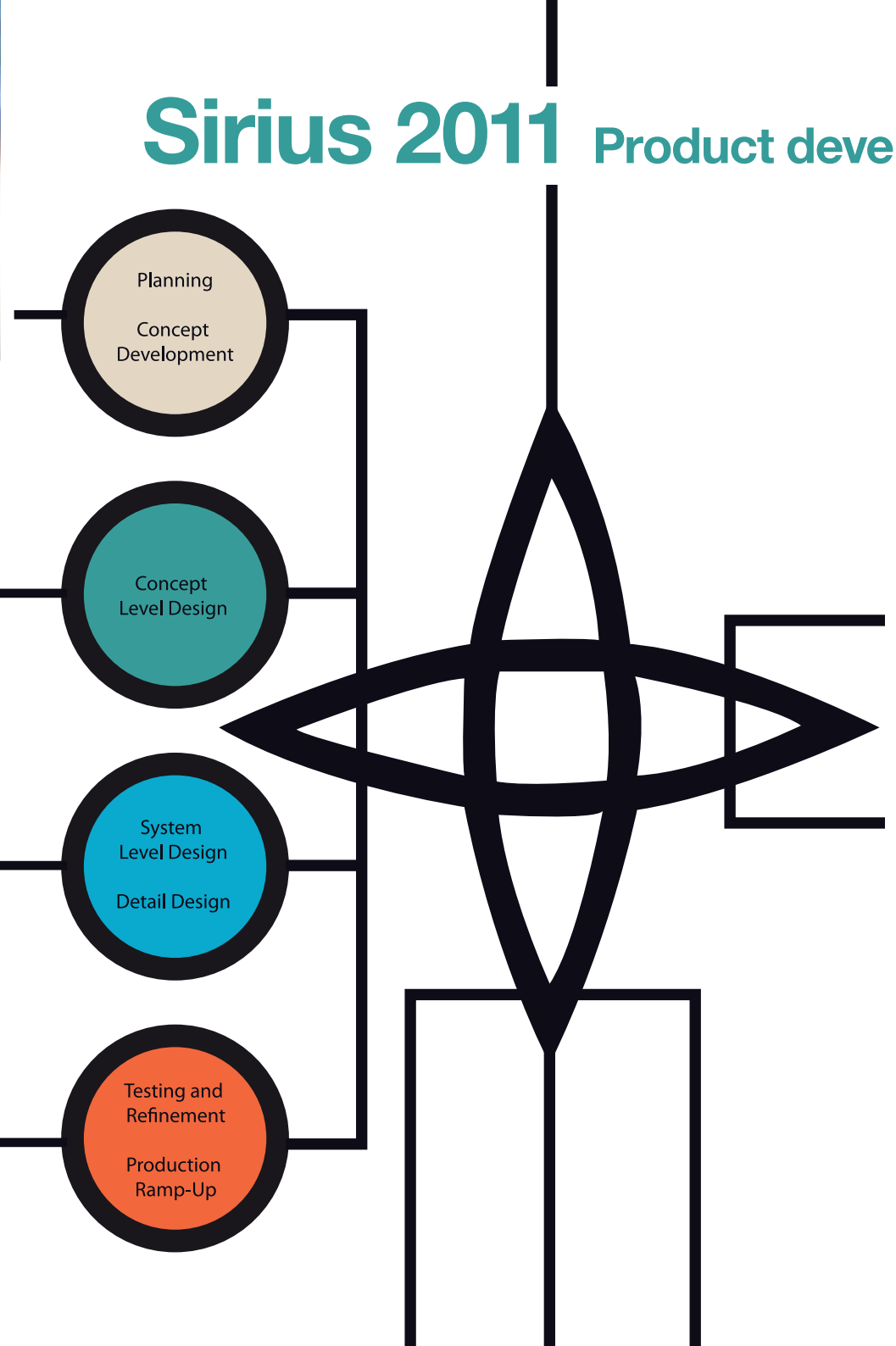
Detail design

After iteratively framing and reframing the concepts in the evaluation phase, a few concepts are chosen for further development. Detail design is a stage where the concepts become more explicit in terms of solutions and functionality. Still, the chosen concepts are at various stages of completion. Therefore, a range of approaches is used. Computer-aided engineering and design tools such as multi-body dynamic analysis and finite element analysis are used, along with engineering design method and methodologies, e.g. case-based reasoning, knowledge-based engineering, simulation-driven design and industrial design approaches. The Sirius course encompasses a diversity of products to be developed; thus, the choice of approach or approaches depends on the focus in the student project.

Product launch

Completing the whole product development process from identifying and understanding needs to product launch is a basic requirement of the Sirius guideline. The Sirius student projects are performed under realistic conditions, in most cases, in collaboration with companies. Therefore, the expectations on the products are high. Several products developed within the Sirius programme are further developed and implemented by the companies. Not only is it important to design a competitive product in terms of design, ergonomics, aesthetics, etc., but it is also important that the students have the opportunity to practice their skills in selling and explaining their ideas. Hence, ideas and concepts are continuously presented to industry partners, teaching staff, or both, throughout the programme. The programme concludes with a public event during which student projects and products are presented. This is a day when many students are pleased to show what they have achieved, and when the Sirius personnel are full of pride for their students.

Sirius 2011 Product development projects



Volvo Aero

The Volvo Aero assignment was to create an inlet manifold for a new high-performance liquid hydrogen (LH2) turbine to be used as part of a rocket. Additionally, the project designed the associated manufacturing plan.

AB Sandvik Coromant

The students have in close collaboration with AB Sandvik Coromant developed a new cutting tool for turning operations. The objective was to design a new interface between the cutting insert and the tool holder.

Volvo Construction Equipment

The project's goal is to develop a new unique and patentable linkage, intended for Volvo's new generation of fuel-efficient and high-productivity wheel loaders. A prototype has been built, and an optimised digital product model has been designed.

Hägglunds Drives AB Bosch Rexroth

Hägglunds Drives develops and manufactures hydraulic drive systems intended for low-speed and high-torque applications. This year's assignment was to investigate how the different losses are affected by motor speed (rpm), specifically splash losses. Also, a concept proposal for technical solutions which can reduce the churning losses for a given speed was developed.

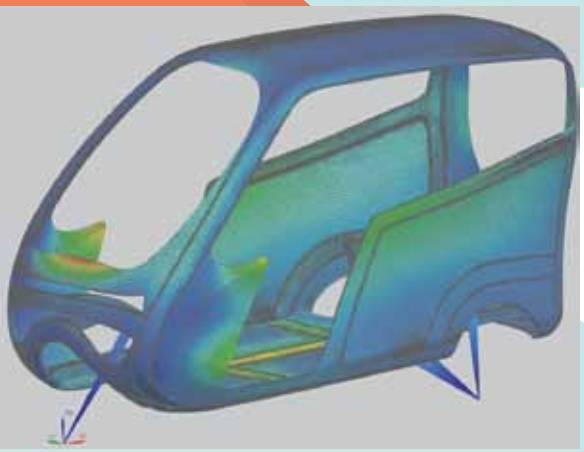
Hybrid Auto-Rickshaw

The aim of the auto-rickshaw project was to develop a concept design of a three-wheel vehicle which would be more environmentally friendly, safer and more ergonomic without increasing the vehicle cost, compared to auto-rickshaws in use in India today. The global motor vehicle industry is moving towards the development of electric and hybrid vehicles, including two and three-wheelers. In collaboration with TVS Motors the Sirius auto-rickshaw project has focused on designing the vehicle platform for a hybrid auto-rickshaw. Results include an optimised CAD model including CFD airflow simulations and structural FEM analysis. Results also include a 1:7 scale model of the vehicle visualising the evaluated interior design and vehicle layout as well as the exterior.

Hybrid Auto-Rickshaw

The global motor vehicle industry is moving towards the development of electric and hybrid vehicles, including two and three-wheelers. In collaboration with TVS Motors the Sirius auto-rickshaw project has focused on designing the vehicle platform for a hybrid auto-rickshaw. Results include an optimised CAD model including CFD airflow simulations and structural FEM analysis. Results also include a 1:7 scale model of the vehicle visualising the evaluated interior design and vehicle layout as well as the exterior.

Sanjas Hybrid Auto-Rickshaw – We've chosen hybrid, you choose the colour!



The results of an FEM analysis showing displacements in the exterior structure of the auto-rickshaw when loaded with 5000N.

Background

The Sirius Auto-Rickshaw project is just one part of a bigger project stretching over several courses, Master theses and, hopefully, several years. The goal of the overarching project is to develop a new hybrid auto-rickshaw that is safer, more environmentally friendly and better suited to its users. The Sirius Auto-Rickshaw project group is responsible for the development of the vehicle platform.

India has over one billion inhabitants, many of whom do not have the means to own a car of their own. A very common means of transportation for these people is the auto-rickshaw taxi. No one knows exactly how many auto-rickshaws there are in India, but there are 250,000 in Mumbai alone. Most of these use two-stroke engines and are heavily polluting.

In 1998 the auto-rickshaws and buses in Delhi were required to switch to Compressed Natural Gas (CNG) to improve air quality in the city. With this new law, environmental thinking entered the realm of Indian auto-rickshaws. As the number of vehicles in the country is rapidly increasing, their impact on the environment is a growing concern. There have been prior attempts to develop hybrid auto-rickshaws, but they are not yet available on the market.

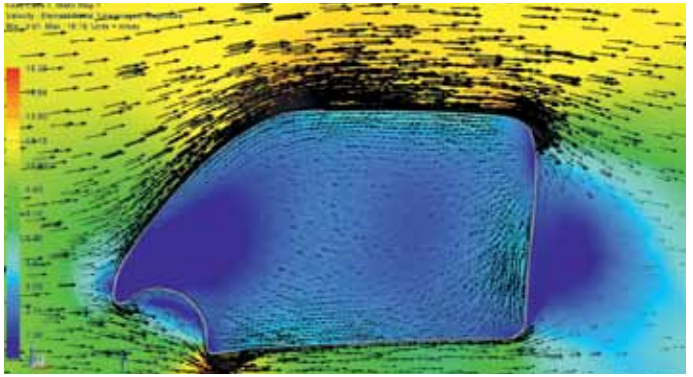
Introduction

The target market's concerns are mainly the price of the product and its fuel consumption and consumers are generally not willing to pay extra for safety features, ergonomics, or environmentally friendly solutions. This leads to the types of auto-rickshaws that can be seen on the streets today; vehicles designed solely to be cheap to produce and that avoid new ideas in favour of what the users recognise and know how to repair. There are many changes that can be made to better fit the system to the user. The goal of this project has therefore been to develop a new vehicle that not only incorporates these features seamlessly but is also designed for a series-hybrid drive train.

Assignment

With the number of vehicles in India rapidly increasing it is becoming more and more important to take the environment into consideration. In order to present a complete and balanced solution to the situation the auto-rickshaw project group has aimed at developing a new vehicle platform that that would fit together with a series-hybrid drive train. A big part of this has been developing the exterior and bearing structure of the auto-rickshaw, starting with simpler, but important, decisions like the seat layout and the packing layout of the drive train and leading to designing a vehicle structure that is suitable

Christoffer Sveder and Daniel Cook evaluating the vehicle's exterior surfaces.



Results from fluid dynamics simulation evaluating the air flow inside the vehicle for one of the entrance solutions.

An early model and sketch of the auto-rickshaw vehicle frame, used for layout design and concept evaluation.

Anders Gustafsson and Hanna Winterquist evaluating the driver environment using a full-scale mock-up.

for press hardening manufacturing techniques.

On the inside of the vehicle the main problem has been fitting the environment to the user; finding out how the users act and combing this with standards to create a more suitable driver environment. Designing low-cost components that will still fit as large part of the user population as possible has been part of this challenge.

Result

An optimised CAD model has been created to give an overview of the entire vehicle as well as to provide means of analysing the design. Results also include a a smaller scale prototype, produced using rapid-prototyping, that visualises suggestions for the vehicle layout and visual design. These model shows that the concept auto-rickshaw puts the driver on the right side of the vehicle and the passengers seated along the sides of the back to enable the use of the entrance placed in the posterior wall. CFD airflow simulations show that this is a viable solutions as long as there is also an option to close the back entrance. The exterior of the concept has been designed to enable the use of press hardening manufacturing techniques and to protect sensitive components, such as lights, in case of collision. Structural FEM analysis has been used to evaluate the bearing structure and exterior.

The packaging of the vehicle's components has been changed much from the commonly used set-up by placing the engine in the front along with a hub motor in the front wheel. This has freed up space in the interior that has been used to improve the layout and ergonomics of the driver environment. This has also made it possible to implement a modular solution that facilitates the use of the vehicle for transport of goods as well as passengers by complete or partial removal of the passenger seats. The result includes concepts of a driver environment suited to the task and it's operators. The seats and instruments have been analysed with comfort assessments and comparisons to the user population.

These results represent the first iteration of the vehicle platform design for the hybrid auto-rickshaw project. They will provide a solid foundation for further development of the hybrid auto-rickshaw.

Back row: Christoffer Sveder, Martin Isaksson, Daniel Cook.
Front row: Jens Johansson (Coach), Hanna Winterquist, Anders Gustafsson.

Hägglunds Drives AB Bosch Rexroth

Varous equipment and motor components from the Hägglunds Drives motor.

Hägglunds Drives AB Bosch Rexroth continuously strives to improve their hydraulic drive systems, reduce losses and increase the overall efficiency. In this project the project group investigated how splash losses are affected by motor speed (rpm) and oil viscosity. In addition, the project group proposed a means of reducing the churning losses associated with the motor.

Experimental setup for the splash loss test rig.

Background

Hägglunds Drives develops and manufactures hydraulic drive systems intended for low-speed and high-torque applications. The hydraulic drive systems are used in a wide range of industries including mining, recycling, pulp and paper, rubber and plastics, offshore, fisheries and building construction. The key part in the hydraulic drive system is the radial piston motor. The Hägglunds radial piston hydraulic motor is known for its high efficiency. As the rotation speed of such a motor increases, its efficiency decreases. Until recently, 90% of Hägglunds hydraulic motors have been used in an operating interval of 0-20rpm, meaning that the decreasing efficiency at higher speed has not been a problem.

Assignment

Looking to the future, Hägglunds Drives is of course interested in expanding their market and offering motors in a wider range of rotation speeds. One step in that direction is to investigate how the different losses are affected by higher rotational speed. Losses in a hydraulic motor can be divided into mechanical, flow, leakage, compression and splash losses. The effects of the first four on total efficiency at higher speed are well known, while the effects of splash loss, probably the dominant loss at higher speeds, are less well known.

A Hägglunds motor is a fully enclosed unit and its interior is filled with oil. The benefit with an oil-filled interior is that it is lubricated and vibration-proof. The drawback is splash losses. During operation, oil is pumped into the connection block. The connection block distributes the oil to the cylinder block and pistons. This cause the pistons to act against the cam ring, producing a torque that makes the cylinder block rotate. When the cylinder block rotates, fluid losses occur due to the surrounding oil in

Team member at work.

the motor casing. These fluid losses are called splash losses.

The task for this project is to study splash losses and how they affect the overall efficiency with increasing rotation speed, and to propose concepts for technical solutions that can reduce the churning losses for a given speed.

Planning

The process of investigating splash losses was divided into three phases. In the first phase, losses were calculated from generic component formulas as well as equations established by engineers at Hägglunds Drives. The second phase included further investigations by tests of a Hägglunds Drives CA70 hydraulic motor with and without oil in the motor case. The third phase was a theoretical analysis of the losses using computational fluid dynamics.

Results

To facilitate analysis, splash losses may be divided into two components: squeeze loss and drag loss. Squeeze loss results from oil being displaced in the contact between the cam roller and the cam ring. Drag loss is caused by the resistance of the cylinder block when rotating in the oil-filled motor housing. The results indicate that, at increasing speed, squeeze loss is the dominating part of the splash loss.

The project has resulted in the development and construction of a test rig capable of measuring splash losses. Furthermore, a CFD-model in Ansys was created, giving a more detailed picture of where the squeeze component occurs and how the motor geometry affects the losses.

Team members working on the test rig

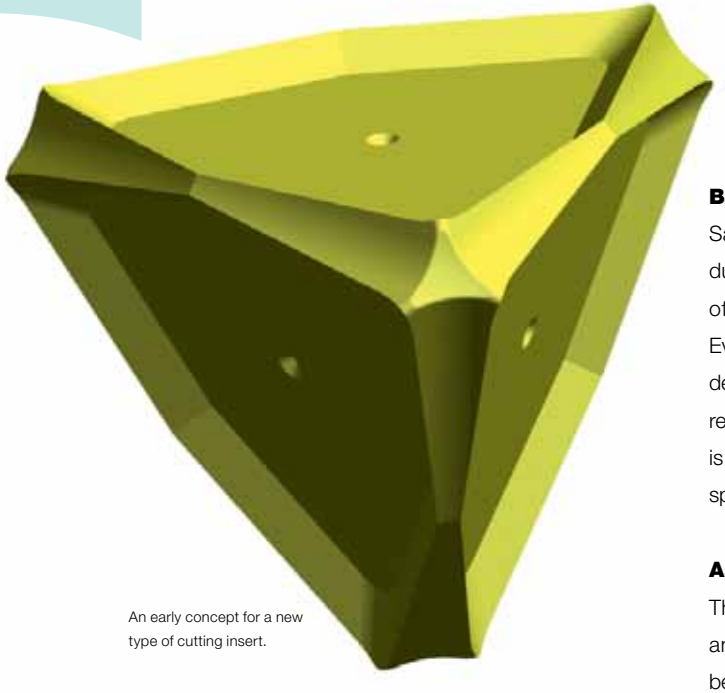
After analysis of the results a number of design improvements that could reduce splash losses were proposed.

Back row: Björn Backe (Coach), Ture Nilsson, Andre Söderlund, Magnus Löfstrand (Coach). Front row: Martin Hambraeus, Gustav Näslund, Stefan Idergard.

Sandvik Coromant

The Sirius students have in close collaboration with AB Sandvik Coromant developed a new cutting tool for turning operations. The objective was to design a new interface between the cutting insert and the tool holder.

One of Sandvik Coromant's existing products.



An early concept for a new type of cutting insert.

Background

Sandvik Coromant is the world's leading producer of tools for metal cutting. Turning is one of the biggest segments for the company. Even though today's turning tools are carefully designed on the basis of decades of experience, research and development, Sandvik Coromant is always looking for new ideas and fresh perspectives.

Assignment

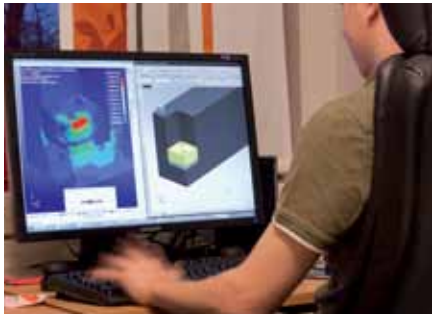
The goal of the project has been to develop an innovative new concept for the interface between the cutting insert and the tool holder, a concept that fulfils today's growing demand for high-pressure cooling.

Method

After gaining a thorough understanding of the task the team started brainstorming ideas while avoiding the constraints of conventional solutions. This was done iteratively as greater knowledge of the problem in hand was gradually acquired. Parallel to this, benchmarking of existing tools was done and interviews with customers were carried out. Around 25 ideas were then narrowed down to six. These six concepts were then evaluated using CAD and FEM, and compared to the technical requirements. The group decided to further develop two of the concepts.

Two turning tool holders on which cutting inserts are mounted.

Daniella Martinsson disassembling a Sandvik Coromant product.



Adam Johansson analysing FEM simulation results.

Back row: Markus Ström, Dennis Edlund, Gustav Gewers.
Front row: Adam Johansson, Petter Kyösti (Coach), Daniella Martinsson, Daniel Ekman.

Result

The two final concepts were both unique and fully designed for manufacturing. The first concept enables the user to fasten the cutting insert more easily than before. It also utilises a new pioneering high-pressure cooling design that optimises the effect of the coolant. The second concept features an innovative cutting insert shape that increases tool life. The team produced two prototypes of each concept in different scales to be able to test the mechanisms and for demonstrative purposes.

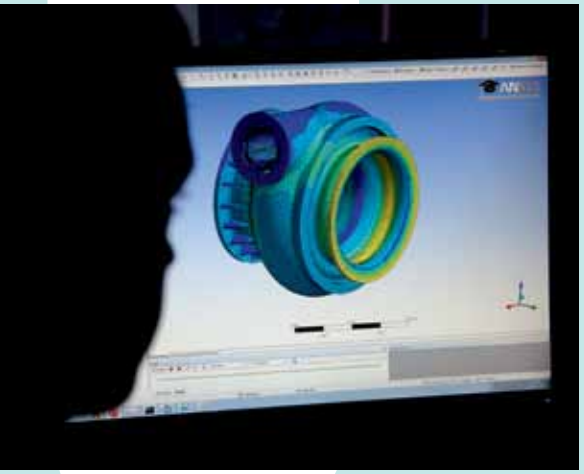
Sandvik Coromant

Sandvik Coromant is a part of the Sandvik AB global industry group, world-leading within each of the business areas Tooling, Mining and Construction and Materials Technology. Sandvik Coromant belongs to the Tooling business area and has achieved a world-leading position by continuously striving for improvement in the development and manufacturing of cutting tools. With headquarters in Sandviken, Sweden, the company, with 8,000 employees, is represented in more than 130 countries world-wide. Sandvik Coromant has long been synonymous with innovation and helping customers to increase productivity and profitability.

Volvo Aero

In cooperation with the world's leading manufacturers of aero components, Volvo Aero develops and produces components for aircraft, rocket and gas turbine engines. With a business philosophy based on close cooperation with aerospace partners, the company has chosen to specialize in order to be truly competitive in each field of operation.

The aim of this years Volvo Aero project was to create an inlet manifold for the new Volvo Aero high-performance liquid hydrogen (LH2) turbine.



Team member Joel Lindström working on post-processing simulation results

A CAD model of the developed inlet manifold.

Introduction

Volvo Aero has been a part of the European space programme since the 1970s and has been responsible for the design and manufacture of nozzles and turbines for rocket engines for the European rocket Ariane. Volvo has made parts for the earlier Ariane 4 and the Ariane 5 (now in service), and is involved in the development of rocket engine parts for the coming Ariane 6. In cooperation with the world's leading aero companies, Volvo Aero develops and produces components for commercial aero, military aero and rocket engines with high technology content. Volvo Aero offers an extensive range of services including maintenance, repair and overhaul of aero engines and industrial gas turbines, sales of spare parts for aero engines and aircraft as well as sales and leasing of complete engines and aircraft.

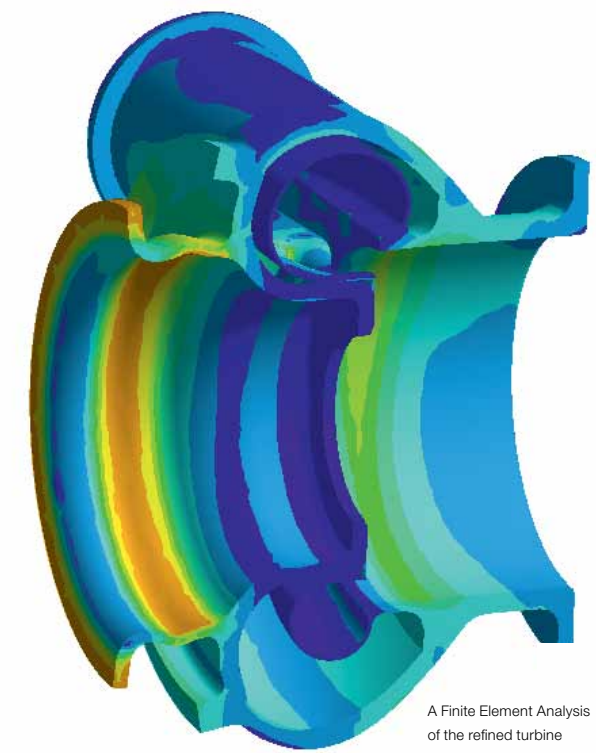
Background

Currently, Volvo Aero is taking part in the design of a new first-stage rocket engine intended for the Ariane 6 rocket. The engine is of a new type and has approximately twice the thrust as the old engine. Volvo Aero is developing the nozzle and two turbines for the new rocket.

Assignment

As a part of Volvo Aero's current design work on the new high-performance liquid hydrogen (LH2) turbine, the aim of this assignment has been to create an inlet manifold for the turbine based on specifications given by Volvo Aero. This included challenges such as imense thermal gradients, high pressures and a large mass flow. In addition to the design a manufacturing plan was to be proposed.

The current version: A Vulcain 2 turbine



A Finite Element Analysis of the refined turbine manifold.

VOLVO AERO

Volvo Aero develops and produces components for commercial aero, military aero and rocket engines with high technology content, in cooperation with the world's leading aero companies. Service and maintenance is an important part of our operation. Volvo Aero offers an extensive range of services, including maintenance, repair and overhaul of aero engines and industrial gas turbines, sales of spare parts for aero engines and aircraft as well as sales and leasing of complete engines and aircraft.

Results

The developed concepts were digitalised to solid models and, through the use of advanced simulation methods such as CFD in Fluent and FEM with ANSYS Mechanical, the concepts were evaluated in terms of best performance. This involved pressure losses, thermal influences and worst-case pressure loading scenarios. Evaluations were conducted in collaboration with Volvo Aero through web conference meetings. The production possibilities were evaluated with regard to the available manufacturing capabilities of Volvo Aero and its suppliers.

The project resulted in a simulated digital model that fulfils the design criteria for future prototypes at Volvo Aero. A full-scale model of the product was manufactured using rapid prototyping to visualise the final design and the assembly sequence. In addition the team developed a manufacturing method for the production of the product.

Back row: Petrus Gedda, Tim Lindsköld, Henrik Lindström, Anders Nordberg.
Front row: Erik Metsävainio, Michael Lundin (Coach), Håkan Lideskog (Coach), Joel Lindström.

Volvo Construction Equipment

Volvo CE produces the world's most capable wheel loaders. Maintaining this position requires continuous R&D to ensure that machines are equipped with cutting-edge technologies that make them competitive on the world market.

This year's Volvo CE team developed an innovative linkage for the next-generation wheel loaders.

Current version of L120 at work.

Background

Volvo Construction Equipment's wheel loaders are one of the most successful and recognized loaders on the market, giving Volvo high sales volume and wide customer recognition. Now the patent on Volvo's well-known Torque Parallel linkage has expired. The Sirius project's goal is to develop a unique new and patentable linkage which is intended for use in Volvo's new generation of fuel-efficient, high-productivity wheel loaders.

Assignment

Early in the process the project team learned that Volvo wheel loaders are regarded by customers as premium machines (within the segment) and that the old linkage is very popular among customers. Volvo's linkage, Torque Parallel, is an all-round linkage and is good at handling different attachments; therefore, the new linkage must be similar, but better. The team recognized the main points to improve to enable:

- equivalent or better visibility for the operator
- higher breakout torque and lifting force

The targeted wheel loader is the L120. The machine is widely used and suits many different applications. Improving the above stated criteria for the L120 would increase the productivity and

Current version of L120 at work.

Using a model wheel loader to demonstrate desired functionality while making an associated CAD model. Jesper Berglund in front, Fredrik Hedman in the background.

overall efficiency of the machine. The machine would remain nimble and easily manageable but have the load capacity of larger machines. In future this could lead to a reduction in the number of models needed in the Volvo line-up and, thereby, more cost-efficient production.

Results

Working with the product development process described earlier, the group succeeded in building a prototype out of steel and an optimized digital product described in the project report. The final concept gives the wheel loader higher breakout torque and lift forces. It also contributes to better visibility for the operator. The final concept also greatly improves productivity and efficiency.

Volvo CE – More Care. Built in.

Volvo CE is a subsidiary of the AB Volvo Group and accounts for about a 20 percent share of the group's sales. Volvo CE is a global manufacturer of construction equipment. The product range currently includes over 150 models of articulated haulers, wheel loaders, excavators, motor graders and many other types of equipment.

Quality, environmental care, and of course, safety are three core values of Volvo CE. These cornerstones are always in focus when new products are developed.

Back row: Jonas Pavasson (Coach), Marcus Björling (Coach), Christoffer Gruv, Gregory Simmons (Coach).
Front row: Jesper Berglund, Otto Jörgensson, Carl-David Andersson, Fredrik Hedman.

The Faste Laboratory

Centre for Functional Product Innovation

In June 2006, Luleå University of Technology and the Division of Computer Aided Design in collaboration with the Division of Fluid Mechanics, the Division of Mechanics of Materials, the Division of Solid Mechanics and the Division of Entrepreneurship were informed that VINNOVA, the Swedish Agency for Innovation Systems, had granted the application to start a Vinn Excellence Centre. The Centre, named The Faste Laboratory, is in memory of Rolf Faste, Stanford University. The centre's goal is to realize Functional Product Innovation through research and education in collaboration with both academia and industry. Currently, The Faste Laboratory is entering its third stage after a thorough and positive review by international experts and will thus continue years six through eight of the planned ten year project. Research and education are concurrent in the Sirius course.

Industrial partners during stage two were:

- AB Sandvik Coromant (SC)
- BAE Systems Hägglunds (BAE)
- Gestamp HardTech AB (GHT)
- Hägglunds Drives AB (HD)
- LKAB (LKAB)
- Volvo Aero (VA)
- Volvo Car Corporation (VCC)
- Volvo Construction Equipment (VCE)

Functional Product Innovation

A perspective of sustainable society forces industrial development into new ways of conducting business. For manufacturing companies, a way forward is to develop physical artefacts to provide functions that can be sold as services. A long-term service contract means that the provider is responsible for delivering these functions throughout the lifecycle of the product. The product provider is responsible for all costs for developing, manufacturing, supporting and continuously upgrading the product. Hence, how to reengineer, reuse and recycle the product becomes important.




The vision of the Faste Laboratory:
is to develop new methods and tools enabling functional products with optimized lifecycle cost and customer value.

Central in this mission are insights into these areas:

• Functional Product Development – contributes to the area of new processes for engineering design. Closely related to the concept of Knowledge Enabled Engineering, i.e. sharing, managing and using knowledge related products and processes throughout the entire lifecycle.

• Distributed Collaborative Engineering – enables design teams to work closely together by means of distance-spanning methods and tools.

• Simulation Driven Design – contributes to bringing several perspectives (e.g. business, engineering and production) into early concept design in product development.

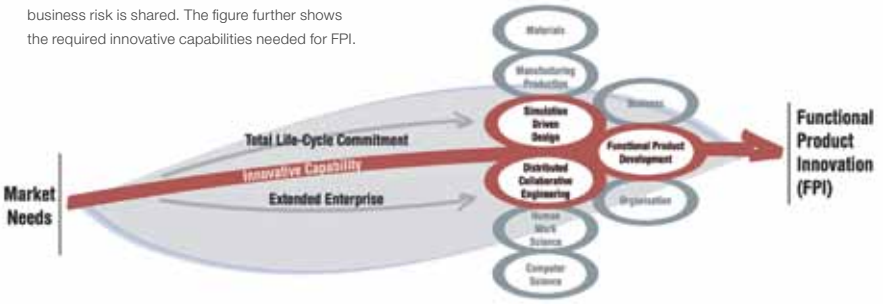
Funded by the Kempe Foundations and the Knut and Alice Wallenberg Foundation, a research studio was designed and built at LTU. This studio will provide unique access to empirical studies, testing and evaluation of new methods and tools in distributed work. The use of the studio will contribute to research within the Faste Laboratory.

"The Faste Laboratory at Luleå University of Technology is one of our strongest research environments. The close collaboration between industry and academia within the centre is crucial in order to achieve state-of-the-art results, to improve industrial best practise and foster sustainable growth."

PHOTO: ATELJÉ GRODAN, LULEÅ

Asc. Prof. Magnus Karlberg, Centre Director, the Faste Laboratory, Luleå University of Technology.

The Figure illustrates how the Faste Laboratory supports the process from market needs to FPI. In order to assume a total lifecycle commitment for a functional product, large company networks, i.e. extended enterprises, are needed where the business risk is shared. The figure further shows the required innovative capabilities needed for FPI.



SSPI:
Scalable search of product lifecycle information

The Scalable Search of Product lifecycle Information project (SSPI) is funded by the Swedish Foundation for Strategic Research, SSF. The project is jointly run by Professor Lennart Karlsson of Computer Aided Design at Luleå University of Technology, LTU and Professor Tore Risch, Uppsala DataBase Laboratory, Uppsala University.

The goal of the SSPI project is to develop software systems for efficient and scalable search of product data and meta-knowledge produced during the entire product lifecycle. In the project, such software systems are based on Data Stream Management Systems (DSMS) and the semantic web model.

http://www.it.uu.se/research/group/udbl/SSPI/

The EU 7th framework programme project SmartVortex

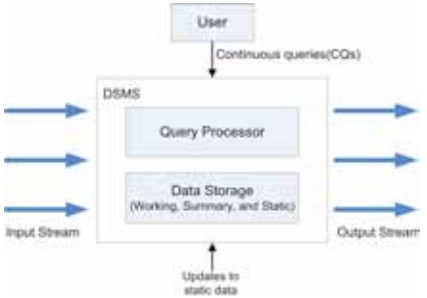
The EU 7th framework project SmartVortex is partly based on the SSPI project and addresses the need for improving collaboration and decision-making by intelligent management and analysis of various types of massive data streams.

The design and production of innovative and highly specialized products encompass a complex lifecycle, starting from an idea through development, manufacture, operation, maintenance and disposal. In each phase of this lifecycle, different streams of tractable product data are generated.

The goal of SMART VORTEX is to provide a technological infrastructure consisting of a comprehensive suite of interoperable tools, services, and methods for intelligent management and analysis of massive data streams to achieve better collaboration and decision-making in large-scale collaborative projects concerning industrial innovation engineering.

SMART VORTEX aims to create a suite of innovative high-impact components.

The SMART VORTEX Suite is an infrastructure containing architecture, methods, tools and services for supporting large-scale collaborative engineering projects by intelligent management and analysis of massive data streams to achieve better collaboration and decision-making.



An abstract architecture of a Data Stream Management System (DSMS)

Sirius success story, Sandvik Coromant

In the Sirius course, participants work in collaboration with different companies in real development projects covering the entire development process from customer needs to prototyping. The aim of Sirius is for the student to acquire, apply and integrate knowledge that is central for a product developer in a modern manufacturing industry. Students gain knowledge in project management, creative idea production, concept generation, evaluation and presentation as well as in computer-aided design.

Sandvik Coromant has a long history of participation in the course, participation which has benefited both them and the Division of Computer Aided Design. Most Sirius alumni quickly get industrial jobs after graduating, in many cases due to their continued Master thesis work with companies participating in the course.

Many of the currently approximately 400 former Sirius students have good jobs in industry, including five new engineers now employed at Sandvik Coromant, Sandvik Mining and Construction and Sandvik Material Technology. Rebecca Andersson, Tomas Furucrona, Mojgan Mohseni, Per Mattsson and Magnus Persson all took the SIRIUS course in 2008/2009 and worked in a Sandvik Coromant project. After graduating, all chose to work for Sandvik.

In addition, the close collaboration with Computer Aided Design in research projects such as the EU 7th framework programme project SmartVortex and in the SSF-funded research project SSPI* further strengthens Sandvik's collaboration with LTU and Computer Aided Design.

** Scalable search of product lifecycle information, http://www.it.uu.se/research/group/udbl/SSPI/*

Five Sandvik engineers who graduated from the Sirius course in 2009. All are now working for Sandvik Coromant, Sandvik Mining and Construction and Sandvik Material Technology.

From left: Mojgan Mohseni, Product Development Engineer at Sandvik Coromant, Magnus Persson, Product Development Engineer at Sandvik Mining and Construction, Tomas Furucrona, Product Development Engineer at Sandvik Coromant, Per Mattsson, Product Development Engineer at Sandvik Mining and Construction and Rebecca Andersson, Production Planner at Sandvik Material Technology.

Industry and academia in collaboration

Eric Tjernström, MSc
Senior Manager R&D
AB Sandvik Coromant

Sandvik Coromant has a longstanding history of research and development, and shares a long history of collaborative research activities with Luleå University of Technology. For more than a decade, Sandvik Coromant has participated in consecutive Sirius projects and employed about 25 engineers who are graduates of the course. In addition, many Master theses have been completed as a continuation of various Sirius projects. Direct results from the various Sirius projects have been implemented at Sandvik Coromant. These project results, together with the fine engineers graduating from the course, make Sirius a key partner in development and for personnel recruitment.

In addition, close collaboration with Computer Aided Design in research projects such as the EU 7th framework programme project SmartVortex and in the SSF-funded research project SSPI* further strengthens our reliance on LTU and Computer Aided Design.

** Scalable search of product lifecycle information, http://www.it.uu.se/research/group/udbl/SSPI/*

Frank Nagel, MSc
Technical Director
Hägglunds Drives AB Bosch Rexroth

Hägglunds Drives AB has carried out over a century of research and development and has a long history of collaborative research activities with Luleå University of Technology. In addition to valuable research results, that collaboration gained Bengt Liljedahl of Hägglunds Drives AB an honorary doctorate from Luleå University of Technology in 2009.

Hägglunds Drives AB has participated in consecutive Sirius projects since 2004 and employed five engineers who have graduated from the course. Five Master theses have been completed as a continuation of various Sirius projects. Many of the Sirius results and methods have significantly contributed to our engineering methods, while the students were given the chance to understand the customers' requirements and demands for increased performance and productivity. Currently, various tools and methods for project management, used and updated within the Sirius course are being implemented at Hägglunds Drives AB. Thanks to the Sirius projects, we have been able to improve our conceptual development process and products.

The fine results, recruitment possibilities, access to new design methods and new methods for modelling and simulation make the Sirius course stand out as a key partner in research and development for Bosch Rexroth, Hägglunds Drives AB.

Sirius 2011

FOTO: ATELJÉ GRODAN, LULEÅ

Top row, from left: Daniel Ekman, Petter Kyösti (Coach), Jesper Berglund, Stefan Idergard, Erik Metsävainio, Adam Johansson, Otto Jörgensson, Michael Lundin (Coach), Dr. Magnus Löfstrand (Coach).

Second row, from left: Anders Nordberg, Jens Johansson (Coach), Christoffer Sveder, Anders Gustafsson, Björn Backe (Coach), Asc. Prof. Magnus Karlberg, Andrè Söderlund, Carl-David Andersson, Jonas Pavasson (Coach).

Third row, from left: Joel Lindström, Fredrik Hedman, Gustav Gewers, Petrus Gedda, Daniella Martinsson, Markus Ström, Dennis Edlund, Martin Isaksson, Marcus Björling (Coach), Prof. Lennart Karlsson.

Bottom row, from left: Ture Nilsson, Henrik Lindström, Hanna Winterquist, Daniel Cook, Gustav Näslund, Christoffer Gruv, Håkan Lideskog (Coach), Tim Lindsköld, Gregory Simmons (Coach).

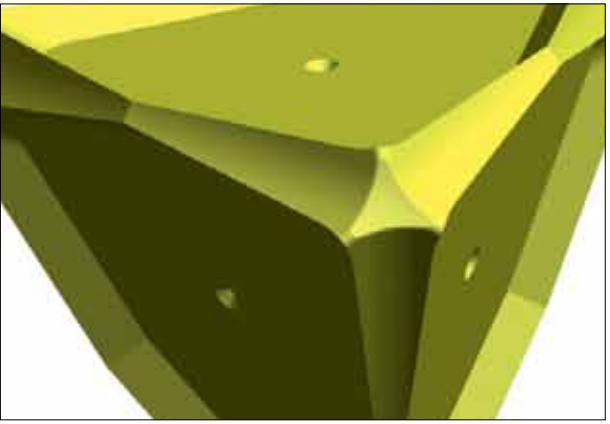
LULEÅ
UNIVERSITY
OF TECHNOLOGY

VISITING-ADDRESS: UNIVERSITY CAMPUS, PORSÖN, LULEÅ
POSTAL ADDRESS: SE-971 87 LULEÅ, SWEDEN
TELEPHONE: +46(0)920-49 10 00. FAX: +46(0)920-996 92
WEBSITE: WWW.LTU.SE/ORG/TVM/AVDELNINGAR/PRODUKT-OCH-PRODUKTIONSUTVECKLING?L=EN

GRAPHIC DESIGN: FORMDABEL, LULEÅ. PHOTOS: ATELJÉ GRODAN, LULEÅ. ILLUSTRATIONS: FORMDABEL & STUDENTS. LTU PRINT: UNIVERSITETSTRYCKERIET, LULEÅ 2011.

SIRIUS

2011



FINAL-YEAR COURSE IN
MECHANICAL ENGINEERING DESIGN
IN THE MECHANICAL ENGINEERING
MSc PROGRAMME AT
LULEÅ UNIVERSITY OF TECHNOLOGY