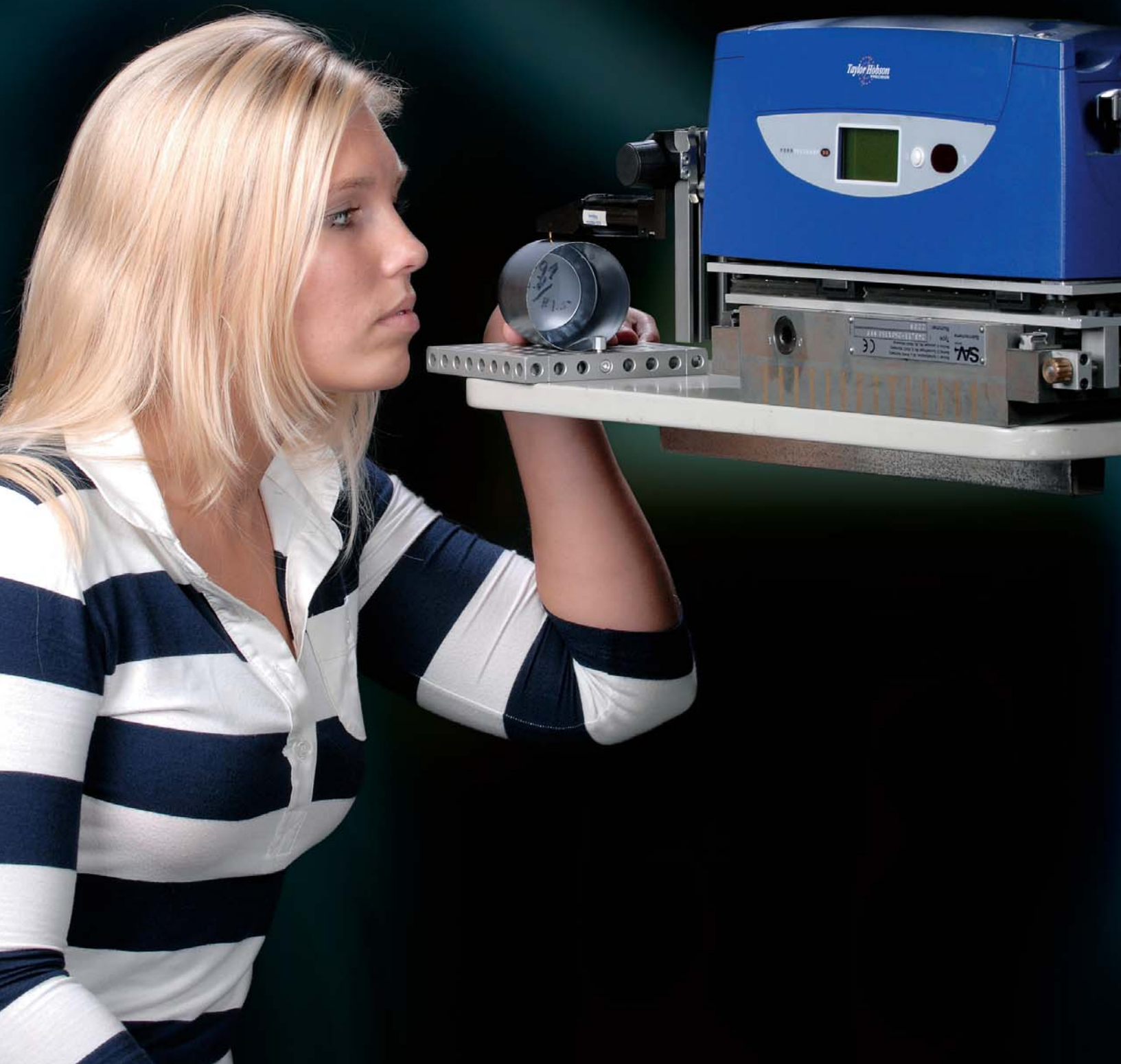


Corus Research, Development & Technology

Continuous innovation

Creating a future in metal



About Corus

Corus is a customer focused, innovative solutions-driven company, which manufactures, processes and distributes metal products as well as providing design, technology and consultancy services to customers worldwide.

Combining international expertise with local service, the Corus brand represents a mark of quality and strength. Working closely with customers, there is a strong commitment to invest in long-term business relations to help develop new products and technologies.

Corus is now part of Tata Steel Group.

Continuous innovation

The key to a sustainable future in metals

Developing the technological knowledge needed for the process of continuous innovation is an exciting task for Corus Research, Development & Technology (RD&T).

Market-oriented metals production has become a knowledge-intensive business. Customers in major markets such as construction, transport, packaging and engineering require high quality materials with properties tailored to their needs at a competitive price.

This demand can only be met by continuously improving processes and products, and by developing new products tailored to customer needs.

In order to support Corus business units in the best possible way, Research, Development & Technology has established a long-term strategic view of key markets and opportunities. In this way Corus RD&T aims at improving the competitive position of the company.

We know that continuous innovation can provide a major competitive edge and we work closely with all our partners, both inside and outside Corus, to create an environment where people and ideas can flourish.

Corus RD&T values its staff highly, and recruits both new graduates and established experts. We offer a good career structure to help people reach their full potential.

Corus RD&T co-operates with universities and research institutes around the world to ensure that we can continue to develop cutting-edge, innovative technologies, now and in the future.



*Dr Brian Smith,
Managing Director of Corus RD&T*

The organisation in a nutshell

Corus RD&T has a matrix structure, with separate management lines for resources (people and equipment) and for research programmes.

Resources

The resources part of RD&T, which actually carries out the research projects, is divided into thirteen departments. Each department is made up of knowledge groups, headed by a knowledge group leader. He or she is responsible for the researchers and technicians in the group and the equipment they use. Each knowledge group has a specific field of expertise.

Project leaders are appointed to take charge of the individual research projects. It is the responsibility of the project leader to pick the right people to work on the projects. They may be researchers and technicians selected from a number of different knowledge groups. Department managers and knowledge group leaders ensure that

RD&T remains well equipped to tackle the problems of the future by encouraging knowledge and expertise development. This includes 'technology watching' and the initiation of new areas of research relevant to Corus.

Programmes

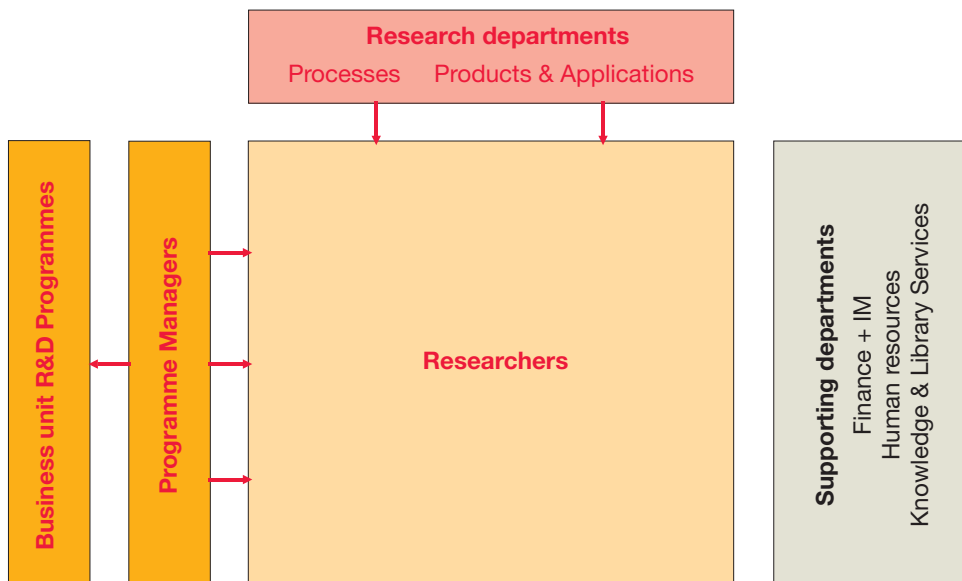
Every Corus business unit is assigned an RD&T programme manager whose role is similar to an account manager. The programme managers oversee the content of the research programme and ensure the smooth running of the relationship between RD&T and the business unit. They are also responsible for setting up and developing technology programmes with each business unit and contributing to technology strategy development.

Intensive collaboration

People working in the various research areas (Processes, Products or Applications) collaborate closely together in focused projects. Departments supporting project work include Knowledge & Library Services, whose experts provide background information and assist in knowledge exchange and preservation.

Successful product development requires knowledge about process parameters and the product performance for a given application, as well as insight into needs of specific markets and society in general. For example, in the automotive area, knowledge about properties of various steel grades is used to predict product performance such as crashworthiness of a car.

Corus Research, Development & Technology





Research expertise

Process research

The work done in this area helps Corus business units improve the quality of the steel making process and steel products, so improving efficiency and reducing overall production cost.

Process research also makes a valuable contribution towards a more sustainable society by making the most efficient use of raw materials. It minimises energy consumption in process stages such as ironmaking and in the casting of steel into slabs, billets and blooms, and the

rolling of these sections into metal strip and other products, such as rods, sections and rails.

Other work that helps the environment, while at the same time reducing costs, includes the improvement of refractory linings in blast furnaces and steel converters, and the development of new processes that reduce the number of production steps.

Process modelling and simulation (both physical and mathematical) is an

important tool in process research, and there are also extensive facilities for testing both at a laboratory and a pilot plant scale.

Pilot experimental facilities include pilot plants for cokemaking, sintering and pelletising, an electric arc furnace, secondary steelmaking and casting facilities, and equipment for testing and characterisation of materials at high temperatures.



Bridget Stewart

“The best part of my job is the tremendous variety,” says **Bridget Stewart**, a researcher in the Steelmaking and Continuous Casting Department. “As well as doing research in the lab, I get to spend at least three days a month on a steel plant organising trials and audits to improve performance. This may involve a large team from our department going out to the plant in shifts round the clock to try and solve a problem. It can be very intensive and exciting work.”

Bridget feels that her PhD in materials chemistry from Aberdeen University prepared her well for a career in RD&T because it trained her to think in terms of longer in-depth projects as well as opening doors to a broader experience in research at an early stage. Joining the company as a production and technical trainee in 1997, she completed two six-month placements before moving over into her chosen field – an area that allows her to put her research on oxides to good use in a steel plant. Bridget is responsible for looking after mould powder development and scale control, both processes critical for good surface quality of steel.

“As president of the Chemistry Society at university, I learnt a lot about organisation and people management – skills that are crucial for my current role. Because the projects are long term, you have to be very self motivated.” People management skills have helped Bridget build up a good relationship with fellow researchers and workers on the plant

whose help is crucial to the success of her projects. In addition she organises work experience for summer students and trips for staff to go to visit other steel plants to find new ideas for casting steel.

"I also feel very lucky to have the opportunity to work alongside researchers in other countries." As coordinator of several three-year projects sponsored by the European Commission, Bridget maintains close links with other steel companies, research institutes and universities in Europe and was recently invited to act as PhD examiner at the prestigious Royal University of Technology in Stockholm. She also travels abroad for training courses and to present her work at conferences. So far, she has visited South Africa, Canada, Sweden, Italy, the Netherlands, Germany, Luxembourg, Spain, France and Belgium.



Peter Hoppestejn

"I have always been interested in environmental issues," says **Peter Hoppestejn**, a knowledge group leader in the Rolling Metal Strip department. His job involves supervising a group of researchers who are investigating reducing energy consumption in the steel making process – and therefore CO₂ emissions in the atmosphere. Part of their job involves identifying technologies which could be most beneficial.

It was during Peter's days at Delft University working as a research assistant that he realised his interest in applied research. He went on to study a doctorate there, helped partly by experts from Corus.

In 1999 he joined the company as an energy and combustion technologist.

"The Netherlands has one of the best records of reducing energy consumption and Corus has signed an agreement with the Dutch government to try and maintain this position," says Hoppestejn. Peter and his team are using the research they have compiled to help reduce energy consumption at Corus steel works around Europe. Part of this process involves drawing up performance benchmarks based on a best practice steel plant, and developing an energy efficiency plan. This brings Peter into contact with colleagues at Corus business units across Europe. "People take our work very seriously," he says. "Every three months I am expected to report back to Corus business units and the management team in the Netherlands. Once a year I present to the government. It is a big responsibility."

Research expertise

Products research

Products research focuses on products manufactured by Corus, such as rail or metal strip. Researchers investigate how the properties and behaviour of these products can be best adapted to suit individual market sector needs. For example, the research requirements of a customer using metal strip in the automotive area varies significantly from

the needs of a packaging client. Major fields of expertise include metallurgical research, alloy development, coating technology and the control of surface characteristics. Experimental facilities for products research include simulators for thermo-mechanical treatment and galvanising, pilot rolling mills for steel and aluminium,

pilot coating lines suitable for different coating processes, and equipment for mechanical testing and surface analysis. Corus RD&T also has extensive equipment for characterisation of materials, applying techniques such as optical and electron microscopy and various spectrometric techniques.



Jasper Patel

With an inquisitive mind and an intrigue for pursuing new ideas, a career in RD&T seemed like the perfect choice for **Jasper Patel** when he joined as a researcher in 1990, with a degree in Materials Technology from Coventry University. He puts his career in product development down to “good luck” more than careful planning because he had no idea that he was going to love his field so much. “I get a real buzz from developing technology for the

commercial market,” he says. “Companies always need new products and the driver behind new products is research.”

On the technical front, Jasper’s job as a metallurgist is to investigate and develop steels with improved properties such as higher strength and more impact resistance for structures such as high rise buildings, bridges, oil and gas pipe lines, offshore oil platforms and

agricultural equipment. However, it soon became apparent that he also possessed strong management skills. “My big break came with the merger of British Steel and Hoogovens to form Corus in 1999. I had already been a project leader on a couple of smaller jobs but this presented a far greater challenge.”

Jasper was asked to coordinate all hot rolled strip development activity across

the UK and the Netherlands for transport and construction applications – a huge responsibility involving bringing together key researches in different departments, on different sites and in different countries. “It was a real eye opener. I found myself having to balance two different cultures and having to come up with a strategy that suited everybody. It taught me a lot about managing people.”

More recently, Jasper has given up this role for yet another interesting challenge.

Jasper was asked to lead a “breakthrough technology” project on the development of HSD (TWIP) steels in collaboration with another steel manufacturer, Salzgitter. These steels are the next generation automotive steels combining exceptionally high strength and exceptionally high formability. The technical challenge is immense in that the metallurgy of these steels is being developed, literally, as the project progresses.

In his other job as knowledge group leader, Jasper applies his skills of diplomacy, negotiation and the ability to relate technology to the commercial world. “I always encourage my researchers to look at the broader picture and think of the implications of their work, rather than just focusing purely on technology. The trick is to put yourself in a customer’s shoes and always keep your ideas focused,” he says.



Menno van der Winden (middle)

“Throughout the years that I’ve worked in research, it has always offered me an opportunity to develop new ideas from first concepts all the way to implemented solutions in the plants,” says **Menno van der Winden**, an aluminium metallurgist based in the Netherlands. “This is what attracted me and still is the most challenging and rewarding part of my job.” In 1998 Menno joined Corus after they sponsored his PhD at The University of Sheffield.

His first job with the company was as a project leader developing a simulation machine for the rolling process. Menno went on to coordinate a large European project called VIR[FAB], a massive four-year research project, involving all major companies and institutes in the European aluminium research community. In 2001 he started a

knowledge development project on asymmetric rolling (snake rolling) which resulted in several patents and is now in its final implementation phase for the Aleris rolling mill in Koblenz. In 2003 he became a knowledge group leader and since 2006 has been department manager.

“In my current job I work with the Corus (steel) business units and the aluminium business units that are now part of Aleris Europe. Supplying R&D services to a third party is unusual in our industry. However it does keep us on our toes as, after all, Aleris has one reason only to invest in Corus RD&T and that is the expectation that the results will generate a multiple of the original spending. Delivering against this expectation (that also applies to steel R&D) creates a healthy future for ourselves and for Aleris.”

Research expertise

Applications research

Applications research is concerned with helping customers to get the most out of Corus products. For example, a car or beverage manufacturer might need support in areas such as optimising design, down gauging of products and helping resolve design and quality issues.

Researchers look at how materials behave when in use in order to optimise downstream production processes, determine the performance of end products and prevent problems such as corrosion.

Developing novel metal-based applications is another interesting area of work, for example making innovative new packaging concepts such as the award winning The Buzz aerosol can that combines metal and polymer.

An important aspect of applications research is responding to the drive for early vendor involvement (EVI). This is aimed at getting involved in the development of new applications by customers, in order to pick up their future requirements at an early stage.

Corus' RD&T facilities for applications research include leading-edge software for modelling and simulation, in particular finite element analysis, and CAD workstations, as well as equipment to test material and component performance such as automated strain and deformation measurement, fatigue testing, compression and bulge testing. There are also facilities for pilot production and product testing.

Adam Bannister



Jenny Venema graduated from the University of Twente in July 2005 and joined Corus as researcher in Forming & Hydroforming Technology in the Automotive Applications department on the same day as her graduation. “My job includes performing research on forming processes to increase the knowledge within Corus, to support customers on the field of forming processes and to be involved in developments of new application of hydroforming technology and tailor rolled blanks,” she explains. Jenny is proud that her work helps customers get the most out of Corus products. “Thanks to one roll forming project, Corus Tubes is now able to make higher specification tubes which meet the needs of the most demanding customers,” she says. “The project included, besides practical tests at Corus Tubes, using advanced computer models to predict the properties of tubes made of high strength steel.” Jenny particularly likes the applicability of the kind of research that she performs. She finds it really important that the research she performs has practical use, and that is really the case in customer support and development of new applications. “Before joining Corus I had no idea how large the IJmuiden site is, and I was also surprised by the professionalism and the expertise of its research organisation. A very positive point of working at Corus is that they encourage professional development and provide good training courses.”

Jenny Venema



After finishing his degree in Metallurgy at Sheffield University, **Adam Bannister** joined Corus because: “I was far more interested in seeing theory put into practice than theoretical research.”

Adam embarked on the two-year graduate training scheme, starting as a researcher in the Engineering Metallurgy department working on fracture and fatigue in the welding of bridges. His work contributed towards the British standards on bridge design.

“Around the same time, the company offered me the chance to learn French. Corus encourages professional development and provided good training courses. I attended team building,

presentation skills, report writing and time management.”

However, it was Adam’s skills in French that enabled him to accept a three-month secondment with the steel research organisation, IRSID, to learn about different approaches to fracture mechanics. “A very exciting time as I was based just outside Paris,” he recalls.

By 1995, Adam had already proved himself as a project leader and went on to successfully lead a three-year 3.5 million Euro European Union project to develop a single unified European method for the safety assessment of steel structures. This involved travelling all around Europe visiting seventeen

different partners including Shell, Exxon and the UK Health & Safety Executive.

Today Adam is increasingly involved with Corus business units on projects such as the safety analysis of gas pipe lines in the North sea and the use of high strength steel sections in the frames of buildings such as the ones being used to rebuild the twin towers in New York. “It is often highly pressurised work, but at the same time it is very exciting. Business units want quick decisions and you really get to learn about the commercial implications of your work. There is a lot of money at stake.”

The importance of joint research

Keeping at the forefront of cutting edge technology requires increasing our knowledge base by working with the best experts in the field.

Working with the best experts means carrying out research in collaboration with universities and institutes worldwide and applying this fundamental knowledge to enhance the work carried out in business units. In Europe alone, Corus collaborates with over twenty other leading institutions, thereby considerably enlarging the scope of its own research efforts. Joint research is also used to fuel new innovations, which invariably leads to more successful projects in the future.

Corus has worked with suppliers and customers for many years and found them to be highly valuable in optimising the performance of production installations. Examples include our research into the use of electromagnetic brakes in continuous casting, which means more efficient production and a higher quality steel, and the development of polymer-coated food cans in various shapes. Partners include the Netherlands Institute for Metals Research (NIMR), the Institute for Microstructural and

Mechanical Process Engineering: The University of Sheffield (IMPETUS), The Welding Institute (TWI) in Cambridge, the Institute of Materials, Minerals and Mining (IOM3) in London, and the Centre de Recherches Métallurgiques (CRM) in Liège, Belgium.

In Europe the co-funding of the Research Fund for Coal and Steel (RFCS) is an important tool to bring together experts to form joint RD&T programmes. Within this structure the network of experts is invaluable to the advancement of steelmaking. Corus is also a major player in the European Steel Technology Platform (ESTEP) that aims to take up the challenge of the future for the European steel industry.

RD&T experts participate in European expert groups, national and international standardisation committees and joint research groups in various fields.

In the UK there is a close relationship between Corus and the Engineering Doctorate Centre in Steel Technology based at Swansea University. Corus, in conjunction with the Engineering and Physical Sciences Council (EPSRC), sponsors around 10 students a year on the scheme, which consists of taught modules and a thesis based on a project selected by a Corus business unit. This means that the research is directed at a real business need. The scheme is highly successful and delivers not only high quality research but also a 70% graduate recruitment rate into industry.



New business development

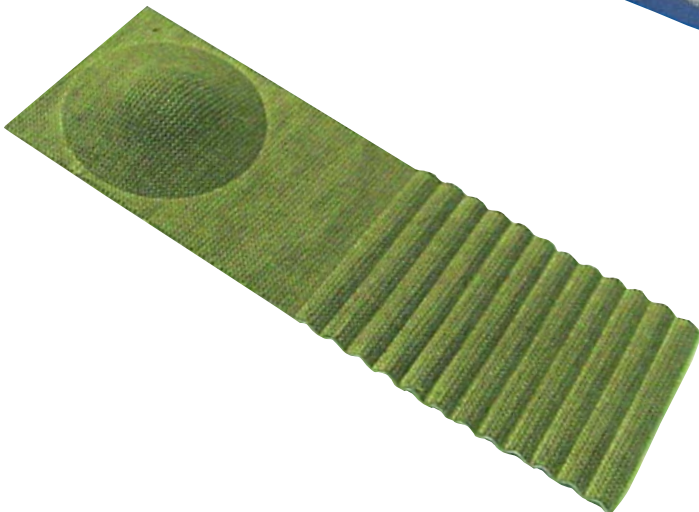
The New Business Development area is different from other areas of RD&T because it identifies and develops good market opportunities for existing technology.

This involves combining technologies to develop a new product, or transferring knowledge to an entirely different area within Corus, or outside the company. This in turn may lead to the successful product launch – the ultimate aim of New Business Development. Working in this field requires a multitude of skills such as assessing the market to see whether the timing is right, whether the product will sell, what Corus competitors are doing and which market to go into first in order to make a profit.

Smartlite™ and TexSteel™ are good examples of the type of work carried out here.

SmartLite™ components (made from thin ductile iron, TDI) are used in many market segments because of their potential in both weight and cost reduction. Even safety critical components such as the safety gripper shown in the picture are produced in TDI.

TexSteel™ products are metal/textile combinations, produced on coil, which combine the stiffness of steel with the soft appeal and feel of textile. Applications vary from building (inner and separation walls) over furniture to automotive and trains/trams/buses.





RD&T's Central Office in IJmuiden:
example of building with steel

Where we are

Corus Research, Development and Technology has its main office on the IJmuiden site of Corus in the Netherlands and operates research centres in the UK and in the Netherlands.

Addresses:

IJmuiden Technology Centre (IJTC)

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Left: STC; right: TTC



Quality certified

Corus RD&T has been awarded various quality certificates. These include ISO9001/2000 certification for its integrated Business Management System that covers all RD&T sites in the United Kingdom and the Netherlands, and ISO14001 certification for its Environmental Management Systems for the Swinden and Teesside Technology Centres in the UK and the IJmuiden Technology Centre in the Netherlands. UKAS accreditation covers various specific tests carried out at RD&T's laboratories in the UK, and ISO17025 certification covers a number of tests in the automotive applications laboratories in the Netherlands.



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