Royal DSM N.V. creates innovative products and services in Life Sciences and Materials Sciences that contribute to the quality of life. DSM’s products and services are used globally in a wide range of markets and applications, supporting a healthier, more sustainable and more enjoyable way of life. End markets include human and animal nutrition and health, personal care, pharmaceuticals, automotive, coatings and paint, electrical and electronics, life protection and housing. DSM has annual net sales of EUR 9.3 billion and employs some 23,500 people worldwide (2008 figures). The company is headquartered in the Netherlands, with locations on five continents. DSM is listed on Euronext Amsterdam. More information: www.dsm.com

DSM – the Life Sciences and Materials Sciences Company

DSM has a strong science base, with cutting-edge technological competences in many different fields. R&D and technology play a key role in the realization of the company’s innovation strategy. DSM’s R&D activities, which have a global spread, involve more than 2,000 people and an annual expenditure amounting to over 4% of net sales (in 2008: € 394 million).

DSM manufactures a broad spectrum of high added value products such as vitamins, enzymes, pharmaceutical ingredients, engineering plastics and resins. These are produced from a variety of feedstocks – both fossil based and, increasingly, renewable – through chemical synthesis, fermentation and polymerization. Large-volume DSM products, such as vitamin E and caprolactam, are produced in dedicated large scale continuously operated facilities while others are produced batchwise in multi-product plants. The performance of our products often depends not only on their molecular composition but also on their physical morphology and structure, making formulation and compounding essential process steps. DSM relies on excellent process technology to be able to face the global competition successfully while reducing its ecological footprint ever further. To this end, we carefully maintain and purposely develop enabling and basic competences in this area. These include applied thermodynamics, reactor engineering, separation technology, particle technology, process modeling and process control.

DSM’s process technologists work in three main areas: R&D, Design & Engineering and Manufacturing.
Working at the interface between research and application

An interview with corporate scientist Peter Jansens

DSM cannot survive without process technology. This applies to all of its activities, both in materials sciences and in life sciences. DSM has good reason to designate process technology as one of the six core competence areas in which the company wants to excel. As a corporate scientist, Peter Jansens is responsible for maintaining this level of excellence. He makes sure that new skills are developed in process technology and that know-how and best practices are shared. Peter coordinates the corporate research program on process technology and directs ACES (Advanced Chemical Engineering Solutions), DSM’s process and product technology center which serves all the business groups.

Range of options

Naturally, process engineers do not just work within R&D. There are in fact three areas within DSM in which process engineers are employed:

• In Research & Development, where process engineers develop and scale-up new processes or improve existing processes, for example through the introduction of new technologies, optimization of operating conditions, intensification of equipment and smarter formulation of products.

• In Design & Engineering, where process engineers design and evaluate a process on the basis of the ideas generated within R&D, initially in conceptual form and subsequently in greater detail.

• In Manufacturing, where process engineers are responsible for running the production plants and solving operational problems. These process engineers also provide input for the development of new processes, based on the practical experience they have gained.

Teamwork

Within R&D, process engineers form part of a multidisciplinary team. DSM increasingly strives to involve process engineers as early as possible in the development of a new production process. Peter explains: “We prefer to work with multidisciplinary teams from the earliest stage of development. For example, if a chemist is considering a process route which involves a number of different solvents to synthesize a new product, a process engineer may point out that reaction and separation involving one solvent is preferable for economic or practical reasons, even if the yield from the reaction stage then turns out to be slightly lower. At such an early stage, it is still relatively simple to adjust the reaction. At later stages, adjustments become progressively more expensive.”

Passion

Peter has always been passionate about process technology. “I particularly like working at the interface between research and application. In my previous job at Delft University of Technology [in the Netherlands, ed.], my research concentrated on pioneering process concepts for the longer term, but I never lost sight of the application aspect. Here at DSM, I’m geared more towards the short and medium term, but everything I do is still based on solid science.” He joined DSM in 2008. Before that, he was a professor at Delft University of Technology in the field of separation technology and scientific director at the Delft Centre for Sustainable Industrial Processes. Delft is also the city where Peter studied chemical engineering and obtained his doctorate. After gaining his doctorate he worked at Shell International Chemicals for a number of years, first as a scientist and later as a process designer and assistant plant manager. Peter: “I find all three aspects of the field interesting and challenging. What I like about research is that you are involved in innovation, and particularly that you’re able to help solve problems that are important to society.” DSM has always placed great emphasis on innovation and sustainability. The company has

continued on page 4

Karla Danen

Scientist at Advanced Chemical Engineering Solutions (ACES) in Geleen (Netherlands)

Karla Danen works as an extraction expert at Advanced Chemical Engineering Solutions (ACES), DSM’s process and product technology center. Karla’s field of expertise is fluid extraction, where she works primarily on projects relating to the production of caprolactam, a raw material for nylon-6. DSM has a dedicated research department for caprolactam, but some problems require highly specific technological knowledge, for example in the field of extractions, and this is when the ACES experts are called in.

Karla works on both short-term and long-term projects. In one long-term project, for example, she is investigating the possibilities for using more environment-friendly solvents. In a recent short-term project, she has also been investigating the capacity of one of the units in the caprolactam manufacturing plant. Using experiments and models, she was able to devise a strategy to increase the capacity of this unit without the need for investment in the plant. “This project has given us a deeper understanding of how the equipment works, so we now know what we need to do in order to increase production,” reports Karla. In short-term projects like this, the results of Karla’s research are usually implemented directly in the plant.

“The nice thing about my job is that I can make a direct contribution to help solve problems in the plant and improve production.”

Along with her day-to-day work, Karla is a project leader in the Dutch Separation Technology Institute (DSTI), a public-private collaboration involved in the development of breakthrough technologies in the process industry. Karla leads the “intensified extraction for bulk processes” project, in which she works with LyondellBasell and the Eindhoven and Delft Universities of Technology in the Netherlands.

Karla has been with ACES since graduating as a chemical engineer from the Eindhoven University of Technology in 2006. Her future plans are to further broaden her experience in a role more closely associated with manufacturing.
David Ruppen
Process Technology Competence Manager at DSM Nutritional Products in Sisseln (Switzerland)

As a competence manager, David Ruppen’s job is to act as a process technology coach and consultant to project leaders, maintain the process technology competence at the required level, develop process technology research programs and stimulate collaborative programs across business unit boundaries.

David’s main drive is to reach a situation where specialists from different disciplines are fully involved in a new project right from the start until implementation. In the past, a new production process was usually designed by chemists, and process engineers were involved at a later stage. According to David, process engineers should be able to provide input from the very beginning. “This will speed up development processes and will result in better solutions, because the chance of things being overlooked will be smaller and costly iterations can be avoided,” he says. It does mean, though, that process technologists will have to learn to make predictions that are ‘quick and dirty’ but adequate and to go for qualitative but concrete statements: “In the beginning there will not be many data to base your calculations on while later, when more details become known, more accurate predictions will be possible.” Before joining DSM in January 2008, David worked for the Swiss life science company Lonza for fifteen years. What was the reason to switch to DSM? “DSM provides many opportunities especially in the scientific field.”

Key focus
Sustainability will be a key focus of DSM’s process technology community over the next few years,” says Peter. “I believe that the development of green products and processes with a small carbon footprint will be the most significant contribution that this generation of process engineers can make. DSM is increasingly moving towards products from renewable raw materials and more energy-efficient manufacturing processes. In developing such products and processes it is important to look at the bigger picture and reduce the overall ecological impact. This means that it does not suffice to make minor adjustments, we also need to come up with radical alternative technologies. In order for a process to be truly sustainable, it needs to be not only environment-friendly but also economically viable. A clear vision of the future and an effective strategy are essential. We should base our efforts not on where we are now, but on where we want to be in ten years’ time.”

Lianne van Oord
Senior Scientist in Performance Materials R&D in Geleen (Netherlands)

Lianne van Oord is leading a project for the development of a new production process for Stanyl® ForTii™, a new polyamide 4T polymer as part of DSM’s long-standing Stanyl® branded plastics. This new material is currently being commercialized. The process that Lianne and her multidisciplinary project team are developing should enable this product to be manufactured at maximum volume and minimum cost. “What I like about R&D is that you get to work on the development of innovative products and build and know how that DSM can use to serve its target markets. By expanding the number of technology options, for example, we give DSM greater flexibility,” she explains. As well as being a project leader, Lianne is also Global Champion for particle technology, which means that it is her responsibility to ensure that the high-level of know-how in this field is maintained within DSM worldwide. Lianne: “Particle technology is important because many products are ultimately delivered in solid form. Particle characteristics translate directly into aspects of product behavior, for example dissolution rate or transportability.” As Global Champion, Lianne puts specialists from the various business units into contact with one another, for example by organizing networking meetings and setting up expert teams. This facilitates knowledge sharing.

Fast process and product development

New products and new production processes often need to be developed within short timescales, for example due to developments in the market. Lianne van Oord: “At DSM Engineering Plastics, we aim to be the first to enter a specific market, so that we can set the standard and don’t have to fight our way into an existing market.” The time pressure is sometimes further increased by NGO push and OEM requirements well ahead of government regulation.

For example, OEMs are prohibiting the use of flame retardants containing halogen. “Our materials must meet the new requirements. Our new product Stanyl® ForTii™ already does this,” reports Lianne. Business groups such as DSM Pharmaceutical Products, which make special products for specific customers, are also often working under extreme time pressure. Customers want to know quickly whether or not a specific product can be made, and what it would cost.

To develop a production process quickly, it is important to have the right tools to hand. Lianne: “Where standard production processes are involved, you need to have a standard working method for process development, so that you’re not reinventing the wheel each time.” DSM Pharmaceutical Products already uses a standard working method of this type for custom manufacturing. Obviously, it is also important to have capable, experienced engineers in the company who can make a decision on the basis of a few laboratory tests. Lianne: “Such an assessment will reduce the risk and enable you to take measures to mitigate any consequences. To be able to make the assessment, it helps to have experience in the manufacturing area.”

NGO = Non Governmental Organization (e.g. Greenpeace)
OEM = Original Equipment Manufacturer (e.g. Apple, Nokia, Philips)
White biotechnology

DSM designated White Biotechnology as an Emerging Business Area in 2005. DSM White Biotechnology has two spearheads:

• Base chemicals, i.e. relatively simple molecules which can be marketed in large quantities, such as succinic acid.
• Products that can be used in biomass production, such as enzymes which can convert lignocellulose into fermentable sugars, or improved yeasts which can convert sugars more efficiently into ethanol.

Henk Noorman (see below) explains that, from the process technology perspective, white biotechnology presents DSM with entirely new challenges. The biotechnological production of base chemicals, for example, requires huge manufacturing plants with up to ten reactors, each measuring a thousand cubic meters. “Operations of this scale are an entirely new phenomenon, even in the chemical industry. Building such large reactors and ensuring effective mixing represents quite a challenge.”

Another challenge is product purification. A fermentation plant for base chemicals yields aqueous product streams containing relatively high quantities of impurities, but for further processing a high-purity product is needed. “This is really still at the development stage, and further breakthroughs are needed,” says Henk. Furthermore, the variation in the quality of the raw materials and microorganisms used demands even closer monitoring and process control.

According to Henk, process engineers can also play a leading role in assessing the sustainability of new processes. “People often have some idea of the sustainability of a process, but if they have no hard figures to back this up, it is difficult to assess the real value added. This is where we come in; it’s an important part of our work.”

On completion of his doctoral research in 1994, Henk joined DSM and rapidly climbed through the R&D ranks. In his current role as corporate scientist, Henk is DSM’s “scientific conscience” in several bioprocess technology fields, both upstream and downstream. This includes scouting for new technologies outside DSM. If he comes across anything interesting he explores the possibilities for technology spin-ins or partnerships.

Henk combines his role as corporate scientist with that of project leader. One of the projects that he is currently leading is aimed at producing caprolactam in a more sustainable manner. “This combination of roles creates the right dynamism. The role of project leader is very much hands-on, and you have to deliver results. You can’t just lock yourself away in your ivory tower,” he says. His own career shows that R&D people at DSM have very little chance of becoming ivory-tower scientists. Henk has always spent a lot of time in the production plants, making sure that the processes he helped develop were successfully implemented and transferred into manufacturing. Henk: “This is typical of DSM. Scientists at DSM have plenty of opportunities for gaining practical experience, especially because the research departments are located close to the manufacturing plants.”

Henk Noorman

Corporate Scientist bioprocess technology at the DSM Biotechnology Center in Delft (Netherlands)

Henk Noorman specialized in biotechnology as part of his Chemical Engineering studies at university. He explains: “Chemical engineering principles apply equally to biotechnology. If you look at microorganisms from a process technology perspective, you see miniature chemical factories employing biological catalysts.”

Process intensification

Process intensification is a new trend in process technology. It is based on the idea of removing, as far as possible, the obstacles and limitations which slow down a process. Raf Reintjens: “Process intensification is primarily a new way of thinking. Instead of slowing down a fast reaction to adapt it to the limitations of the reactor, we design a reactor that can cope with a very fast reaction. This is not only beneficial for productivity, but also improves intrinsic safety. If you think of the expanding body of knowledge in process technology as an ever-widening circle, process intensification occurs primarily on the outer fringes of this circle, where new technologies are to be found.” These outer fringes may currently hold as many as a hundred new technologies. Raf: “An important part of our work involves making the right choices in terms of what is feasible and meets DSM’s requirements.”

According to Raf, DSM is in a strong position as far as process intensification is concerned. The company’s efforts in this area have delivered significant results. For example, DSM was one of the first companies in the world to use a microreactor for an industrial-scale production process. At DSM Fine Chemicals in the Austrian town of Linz, a 10,000-liter reactor was replaced with a 3-liter microreactor offering the same production capacity, along with a 20 percent improvement in selectivity. The safety of this production process was also further increased because of the reduced hold-up. In the near future, a microreactor will also be used in a second production process in Linz. In combination with another process-intensive technology (centrifugal extraction), productivity will be increased from 10 kg/m³h to 4,000 kg/m³h.

DSM initially used process intensification for pharmaceutical products. Raf: “This is a dynamic world with many different chemistries, where there is much scope for improvement, as many processes are still at the development stage.” In processes for commodity chemicals, this is more complex, as these processes have often been running for many years and have been extensively optimized. However, the ultimate aim is to use process intensification in processes of this type too. “We are already working on this,” explains Raf. “The first steps have already been taken. It may take longer to achieve success here, but the ultimate gains will be all the greater for it.”

Raf Reintjens

Competence Manager Process Intensification, based at DSM Pharmaceutical Products in Geleen (Netherlands)

Raf Reintjens is a process intensification expert and DSM competence manager in this field. “Process intensification is a key driver for innovation and can produce significant process improvements and create new opportunities,” he explains. “My role as competence manager includes acting as a facilitator, ensuring that knowledge is shared in order to accelerate DSM’s development. To increase knowledge, you have to share it.” Newly generated knowledge is valorized in the various business groups, where local experts apply it to specific projects. In his career with DSM, Raf has worked not only in R&D, but also for a number of years in manufacturing. “That was a very useful experience. A company like DSM needs R&D people who understand the language of manufacturing. This is particularly true when new technology is introduced into an existing manufacturing environment.”
Strong focus on people and their personal development

An interview with Robert Claasen, Corporate Director of Manufacturing

Every role in process technology has its own particular appeal, according to Robert Claasen, Corporate Director of Manufacturing at DSM. “One of the nice things about being a plant engineer, for example, is that your work has an immediate impact. If you’re working on projects it takes longer to see results, but then again the impact is bigger.”

Robert explains that apart from the fact that process engineers at DSM have three main work areas to choose from (see interview with Peter Janssen, page 2), they can further develop their career in the following ways:

- Through line management roles. These roles exist mainly in manufacturing. Here, it is important that you enjoy working with people.
- Through project management. This may involve projects within R&D, but also capital investment projects, for example the construction of a new manufacturing plant.
- Through specialization. This is for people who like to specialize in a particular subject area, in which they can progress to the role of corporate scientist.

“In practice, most career paths are of course not so clear-cut,” says Robert. “The important thing is to find out what motivates you. Sometimes you just have to try things out to discover whether they’re right for you.”

The other side

Robert has worked in a number of different roles, particularly in project management and line management in manufacturing.

He has been involved, for example, in various capital investment projects, such as the construction of a new manufacturing plant in Schonebeek (Netherlands). Later, he became the manager of this plant and suddenly found himself on the other side of operations. And this is clearly where he feels at home. He progressed to site manager, a role in which he was responsible for several plants, and later became manufacturing director in charge of six different sites.

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DMC’s plants not only operate in widely different fields, but also employ very different types of processes – not only large-scale, continuous processes, but also multipurpose batch processes.

“Multipurpose batch processes represent a completely different way of working, in a market with far greater dynamics and much more customer-specific requirements. At DSM, you have the opportunity to gain experience with both process types,” says Robert.

Many aspects

Robert’s responsibilities as Corporate Director of Manufacturing include determining the most suitable locations for new manufacturing plants, identifying ways to improve sustainability and process control aspects, and putting good leadership into practice.

He also manages DSM’s Global Manufacturing Competence Center (GMCC). In the same way that Peter Janssen is responsible for process technology competences within R&D, Robert is responsible for competences within manufacturing. In this role, his objective is to make DSM a truly operationally excellent company. GMCC staff visit the various DSM manufacturing plants to give advice, for example on process management, process safety or advanced manufacturing (see page 11). “What I like about this job is that it offers such tremendous variety,” says Robert.

continued on page 10

Aukje Doornbos

Plant process engineer at DSM Fibre Intermediates in Geleen (Netherlands)

As a plant process engineer, Aukje Doornbos has a hectic job. She is employed in the acrylonitrile and diamondbutane plants belonging to DSM Fibre Intermediates. “I spend a lot of time solving major or minor problems in the factory, or adjusting specific components, so every day is a surprise.” It is this hectic nature of the work that Aukje finds so appealing. “I’m the kind of person who is focused on action and results. In this job, you can see results quickly. This is life in the fast lane. You often have to make decisions on the basis of very little information,” she explains. Aukje also works on long-term projects, for example dealing with safety, the environment or capacity expansion: “Two years ago, we wanted to expand our capacity by 10%. This had far-reaching consequences. In some plant units, we had to examine every line and pump to see if they could handle such an increase in capacity. Ultimately, we managed to increase capacity by even more than 10%. For projects of this type, Aukje works closely with other parts of the organization. R&D, for example, provides ideas to help solve specific problems, while Sales must tell us what commercial risks we are allowed to take,” she explains.

Aukje started her career at DSM in 2004, after studying Chemical Engineering at Eindhoven University of Technology. She started off in R&D, but soon discovered that manufacturing was much more to her liking. “I guess I spend half of my time in my current job on technical work. The remainder I spend working with people. This job would not suit someone whose main drive is to gain deep scientific insights. Many of the calculations we make here are quick and dirty.”

In 2009 Aukje was voted the Netherlands’ Young Professional of the Year. She particularly impressed the judging panel with her ability to use her close contact with the shop floor in her projects. “I think it was particularly important that, as a woman working in a technical field, I was able to get on so well and so quickly in a man’s world,” explains Aukje.
Energy saving
Sustainability is just as important a consideration in manufacturing as it is in other fields. Robert: “In deciding on the location of a new manufacturing plant, we look, for example, for locations where the environmental impact will be minimal. We investigate how we can reduce emissions and waste through improved process management. We also examine the entire product chain through life cycle analyses.” A special team investigates the potential for energy saving. “For a plant in India, for example, we are assessing whether we can perform a number of operations using solar power instead of steam.”

Focus on people
Robert: “For me, a major reason to work for DSM is the company’s strong focus on people and their personal development. Because of this emphasis on development, it is for example fairly easy to exchange people between different departments. The focus on people at DSM is of course combined with a focus on results, but in a well-balanced way.”

Road to Operational Excellence will consist of three distinct phases
- **Phase 1:** Basics in place
  - Focus on: Manuves
  - Focus on: Continuous Improvement
  - Non-statistical Improvements
- **Phase 2:** Improvement
  - Focus on: Statistical Improvements and Use of Competences
  - Process stability
- **Phase 3:** Operational excellence
  - Focus on: Non-statistical Improvements
  - Continuous Improvement
  - Operational excellence

Operational excellence
An important topic for DSM is Operational Excellence, one of the three pillars of DSM’s Vision 2010 strategy. The ultimate goal of Operational Excellence is to ensure optimum output and efficiency of all processes in the company, not only in the manufacturing plants, but also, for example, in R&D, marketing and sales. For the plants, activities in this field are taking place under the banner of ‘Advanced manufacturing and supply chain’.

An internal consultancy group has been set up specifically for this purpose. The consultants will visit all DSM sites. At every site, a team of four or five consultants will spend around seven months on a full-time basis, analyzing and subsequently implementing opportunities for improvement. Program Manager Remko Bakker explains: “This doesn’t involve major investments, but mainly organizational improvements which enable people to work in a different way.” The consultants try, for example, to help a manufacturing plant to switch more quickly from one product to another and to reduce energy consumption through improved process alignment. Remko: “Obviously, a plant will already be trying to operate as efficiently as possible, but we look at it from the outside and can therefore offer a new perspective.” The very thorough assessments by the consultants include the use of statistical analyses such as Six Sigma. “This allows us to discover possibilities for improvement which would otherwise go undetected. In this way, we can achieve significant progress.”

Since the start of the Advanced Manufacturing program about two years ago, the consultants have already completed five projects, helping DSM to make savings worth tens of millions of Euros.

The consultants will complete the overall program in 2011, but Remko expects DSM to carry on working on this subject beyond that time. “Operational excellence is a development ladder with no beginning or end. DSM will continue to improve its operations on an ongoing basis.”

Remko Bakker
Program Manager Advanced Manufacturing Europe at DSM Corporate Manufacturing in Heerlen (Netherlands)

In his role as program manager Advanced Manufacturing Europe, Remko Bakker is responsible for ongoing consultancy projects in Europe. “The hallmark of our group is that we don’t just draw up a plan, we also spend six months helping to implement it. This is what makes this work all the more fascinating,” he explains. He leads an international team with a diverse composition in which new university graduates work alongside people with as much as fifteen years’ practical experience. “This provides an excellent training ground, especially for new recruits. They are introduced to all aspects of process technology.”

Remko started work at DSM after completing his studies and postgraduate research in applied physics. He began his career as a reactor engineer in R&D, before transferring to manufacturing. He was appointed head of engineering at a production site and later production manager. Remko took up his current role a few years later. “DSM offers many possibilities and opportunities. I’ve taken on a whole range of different roles over the years. The fact that DSM has many different businesses and is becoming increasingly global makes it all the more fascinating.”

continued from page 9

Bernhard Hagemann started his career with DSM at the R&D department of DSM Pharmaceutical Products (DPP) in Linz (Austria). While finalizing his PhD research at the University of Rostock (Germany), he became responsible for the laboratory development of new pharmaceutical products at DPP. This included safety studies, optimization work and quality aspects. Today, Bernhard works in manufacturing as a process expert at DPP’s production site in Linz. Bernhard: “I joined DSM because it is a company where you get to see results from your work. I initially chose an R&D position, to see the development of a new process from the beginning. After two and a half years I decided to switch to manufacturing, to learn more about that field. This job is most fascinating and always challenging. And it is really interesting to work in a multidisciplinary team. In everything we do, safety always comes first. That is what I like most about DSM.”

Together with two colleagues, Bernhard is responsible for the production of maleic anhydride and derivatives such as succinic anhydride and fumaric acid, products that have a very wide range of applications including adhesives, detergents and paints. The site where Bernhard works includes both continuously operated plants and batch plants for customer-driven production runs. Bernhard is responsible for communications with the toll manufacturer and a large part of his work consists of trouble shooting, for example when a separation column is not working properly. He also monitors emission values to make sure these stay within the range allowed by the public authorities. And finally, he is involved in an ongoing drive to further optimize the production processes, for example via Manufacturing Excellence programs. Bernhard: “Suppose the catalyst in one of our processes is leaking and becomes partly inactive. We can solve this problem by just adding some new catalyst material, or by taking out all the catalyst and replacing it by new material. Based on the production capacity, we calculate which option will give the best results.”
DSM is always looking for enthusiastic and ambitious people with an external focus. People who are result oriented and take ownership. People who dare to show entrepreneurship and leadership.

We offer rewarding and challenging jobs in the field of process technology, with lots of opportunities for personal input; an open and pleasant atmosphere; in short... never a dull moment. Terms and conditions of employment as well as fringe benefits are up to market standards. Salary is dependent on your education and experience.

How to get in touch with us?
To find out more about DSM please visit www.dsm.com/careers. Our up to date event calendar and all internship assignments for Master and Pre-master students are published on our corporate website. Of course you can always apply online for a current open position or send an unsolicited application.

Our online application process is followed by a 2 or 3 stage interview process including an online personality questionnaire. Feedback will always be provided on request. During the interview stage you will meet with recruiters, line management and local HR representatives.