Enhancing industrial productivity
Creating efficient solutions
Gordon France – Ice hockey player and artist – York Harbor, Maine, U.S.
Sports and painting are my great passions – even today at the age of 76. I’ve played ice hockey with my friends ever since I was a kid. I also enjoy traveling with my wife and painting landscapes. But a few years ago, disease nearly put a stop to all that. Intense pain in my knees was making it harder and harder to get around. Then I decided to get knee replacements. The operations gave me back my mobility and put an end to the pain. Now I’m back in the middle of things.
“How can implants be manufactured faster and at lower cost?”

Sabine Fietz – Engineer – Erlangen, Germany

As a Siemens engineer, I look for answers to technological challenges every day. People like Gordon France show me how important it is to continuously work on finding more efficient industrial processes and solutions rather than simply being content with the status quo. The key here is to have a comprehensive overview of all the steps in both product development and the manufacturing process – from the initial implant design to production planning and machine tool configuration (production engineering) to actual manufacturing and services. By using software solutions to link all these steps in an end-to-end process chain, we can enable implant manufacturers to further simplify, considerably accelerate and, last but not least, cut the cost of designing implants. We’re also leveraging this approach to make production processes more efficient in other industries.
Maine, U.S.

Ice hockey is one of the toughest sports around. Next to head wounds, knee injuries are the most common result of unintended collisions on the ice. But seventy-six-year-old Gordon France wouldn’t dream of giving up the sport that’s been his hobby since childhood, even though he’s had two knees replaced: “When I got out of rehab, I headed straight back to the rink, grabbed onto the boards and pulled myself along until I got the hang of it again. Before I knew it, I was whirling around the ice, and my knees were working great.” When not playing ice hockey, the successful artist is continually looking for interesting landscape motifs – preferably in Tuscany or near his summer home in York Harbor on the coast of Maine. That means he does a lot of walking on rough terrain – just as he did before his operations. But today he no longer takes it for granted. “I had severe knee pain for years, and it kept getting worse. The doctors always diagnosed the same thing: the onset of arthritis. So it was only a matter of time before I’d either have to get knee replacements or quit walking altogether.”

Gordon France was aware that there might be complications. He also knew that the implants would probably have to be replaced at some point. But there didn’t seem to be much choice: “I couldn’t hike, I couldn’t skate, and I couldn’t paint any more. Something had to be done.” The operations were a success. About six months after leaving the hospital, Gordon France was once again leading a full life. “I can move like a 25-year-old again. My quality of life has really improved.”

Gordon France is only one example among many. In the U.S., some 720,000 people receive knee implants every year – people who couldn’t continue living their normal lives without the help of artificial joints. And it’s here that our knowhow and expertise in the area of industrial production processes can make an important contribution. As a producer of innovative industry solutions, we’ve developed a solution that will enable implant manufacturers to produce prosthetics faster, more efficiently and more economically. On the pages that follow, Sabine Fietz explains how it all works.
1/2 – Five-time grandfather Gordon France sets a fast pace in the rink. Thanks to two artificial knees, he can still play his favorite sport.
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1 – Knee replacements make it possible for people like Gordon France to live normal, active lives once again.

2 – At our Technology and Application Center in Erlangen, Germany, Sabine Fietz describes how intelligent software solutions from Siemens enable manufacturers to produce implants faster and thus more economically – for the benefit of patients.

Industry solutions for people

Siemens engineer Sabine Fietz has big plans: “One of the megatrends in our society relates to demographic development. People are living longer, which means that there’s a growing need for healthcare products. As the age pyramid for the industrialized countries clearly shows, more and more individuals – like Gordon France – are reaching an age at which their joints are no longer up to the demands placed on them in daily life. Of course, these people still want to continue leading active lives. For many patients, artificial knees are the only way to improve their clinical outcomes and maintain their quality of life. The challenge is to manufacture increasingly individualized products that are also affordable.”

This challenge applies particularly to implants, many of which have only a limited lifespan and must be replaced after a certain time. Artificial knees, for example, are subject to heavy loads and generally do not last longer than ten to 15 years. The quest to provide the best possible prosthetic for each patient is spawning a continually increasing number of different implant sizes and shapes. Aware of this situation, Sabine Fietz and her colleagues are leveraging Siemens’ strengths to create solutions for implant manufacturers. “At Siemens, we not only have decades of experience in industrial production. We’re also one of Europe’s largest software providers. Our innovative software solutions enable all process steps – from a product’s development to its manufacture – to be simulated, tested and integrated in a virtual environment. What’s the advantage? Our customers can test and optimize all steps in the product development and manufacturing process in the virtual domain before a single machine tool or production facility goes into operation. They can see what impact a change in the planned product design has on all further production steps, whether the production facility is running smoothly, and where the manufacturing processes can be made even more productive, efficient and flexible.” Only when everything is working perfectly in the on-screen simulation does the real production process begin.

Siemens is also leveraging this expertise in its solution for the industrial production of implants, thus supporting prosthetics manufacturers worldwide. As Sabine Fietz knows from many discussions with customers, manufacturers find themselves facing more and more new challenges: “Due to the steadily increasing number of patients in need of artificial joints, the demand for different implant sizes and shapes is also growing.” In order to manufacture variously sized batches of prosthetics economically and thus as cost-neutrally as possible, companies are looking for ways to optimize their existing processes. What’s needed are manufacturing solutions that offer greater flexibility and efficiency while maintaining high standards of quality and current levels of production reliability. “That’s exactly what our solution does,” says Sabine Fietz. “By linking virtual and real processes, we enable the efficient use of manufacturing facilities even for small-batch production.” Efficiency means one thing above all: speed. Whether rapidly implementing specifications in the form of digital prototypes, quickly developing computer-numerically-controlled (CNC) programs, swiftly setting up or retooling machines for different batch sizes or, last but not least, accelerating machine-tool performance – Siemens’ solution makes it all possible while also ensuring that quality requirements are met. “By implementing this approach, we’re reducing the cost, effort and time needed to manufacture implants and laying the foundation for more affordable and thus more widely available implantation processes.” That’s what Sabine Fietz finds most rewarding: “Our solution is helping patients regain their quality of life. And ultimately, that’s what counts.”
720,000

In the U.S., some 720,000 people receive knee implants every year.
Innovative industry solution
from a single source

The production of implants is a prime example of how Siemens’ solutions are helping enhance industrial productivity. We consistently deploy integrated technologies for the benefit of our customers. Our wide-ranging portfolio – coupled with solid, internationally proven vertical-market expertise and a strong customer focus – enables us to deliver the right products and solutions for every application.

With our comprehensive offerings for automation technology, industrial controls, drive technology, industry software and services, we supply and support customers worldwide along the entire value chain – from product design to production planning and engineering to actual production and services.

Siemens is driving the future of industry.

Product design

In the chemicals, pharmaceuticals, food and beverages, car and machine tool industries, intensive global competition, increasing product variety and new technologies have radically shortened innovation cycles for products of all kinds. Industry software can markedly reduce development times and slash costs. To virtually develop, test and optimize their products, companies worldwide are relying on product lifecycle management (PLM) software from Siemens.

Production planning

Industry software makes it possible to completely simulate and optimize production by developing whole factories and individual machines on screen. This approach saves time, conserves resources and cuts energy costs while increasing plant profitability. The key to success lies in the integration of our PLM software into our automation systems, which cuts time-to-market by up to 50% while enhancing quality.
Enhancing industrial productivity
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Increased automation has revolutionized industry in recent years, and the trend is continuing. Our Totally Integrated Automation (TIA) platform enables companies to optimize their automation solutions – no matter what industry they’re in. The productivity and efficiency of entire factories can be improved even further with the help of efficient motors, gears and converters. The use of innovative and perfectly tailored drive technology alone can yield energy savings of up to 70%. Maximum production performance and response are also ensured by our Manufacturing Execution System (MES). Thanks to intelligent data linking, companies can influence production processes transparently and in real time.

Effective maintenance plays a vital role in industry by increasing plant availability. But service doesn’t end here. From planning and installation to operation and modernization, we support industrial customers with product-, system- and application-related services throughout entire plant lifecycles in order to reduce downtime and conserve resources. Based on decades of vertical-market and process expertise, our rigorous customer focus is enabling us to enhance industrial productivity and efficiency while cutting overall production costs.

As the use of hardware and software increases, it is becoming more challenging – but also more important – to ensure that individual systems communicate and cooperate seamlessly. Our Totally Integrated Automation Portal (TIA Portal) is an engineering revolution that enables integrated, uniform access to all automation tasks while optimizing workflows and reducing engineering costs by as much as 30%.
“As researchers, we always have to think ahead.”

Professor Berend Denkena is head of the Institute of Production Engineering and Machine Tools at Leibniz University in Hanover and one of Germany’s leading specialists in the field of production process and machine tool development.

Professor Denkena, what’s the connection between your institute’s work and Siemens?

Professor Denkena: I’m very familiar with Siemens from my previous work in industry. We cooperate with your company very closely. For example, virtually all the controls and drives used in our machine tools come from Siemens. Our research and teaching focus on production process and machine tool development. In this field, there are many connections to Siemens. In the area of simulation, for example, our work is guided by similar concerns. In the area of machine tool programming, there are interfaces with Siemens’ product lifecycle management software. As researchers, we develop innovative solutions whose implementation may be several years down the road. That is, we think a little ahead.
Siemens has created a standardized process for automating the manufacture of prosthetics. In your opinion, what’s the biggest challenge at this interface with medical engineering?

Professor Denkena: I’d say it’s probably cost. Healthcare solutions have to be affordable. And from a technology point of view, it’s extremely difficult to combine high quality, reliability and low cost when manufacturing only one customized product or a few products of a particular type.

What role do you think the individualized mass production of prosthetics will play in the future? And how would you assess their market potential?

Professor Denkena: Our whole society is aging. What’s more, many people want to remain mobile and active as they grow older. That’s why implants can enhance the quality of life by lasting longer and fitting better. If you can get the cost-benefit ratio right, Siemens’ approach has excellent market potential. But that means the process chain has to be automated from end to end. What are the obstacles here?

Professor Denkena: The problems are usually at the interfaces – from product design, simulation and planning to the operation or programming of the machine tools to the actual production. Siemens maps end-to-end process chains for its products. And in my opinion that’s a key prerequisite for success.

One of your current research projects focuses on the production and implantation of patient-specific prosthetics. What’s your vision?

Professor Denkena: Our vision is to implement production processes directly on site – that is, we want to precisely manufacture components under sterile conditions as close as possible to the operating room – when, for example, an implant has to be replaced or a tumor removed. You only see what the situation really is when an operation is underway. Siemens is on the right track – but our ultimate goal is to manufacture components very quickly right where they’re needed.

How long do you think it will be before that happens?

Professor Denkena: Unfortunately, these things always take longer than they should. That’s been our experience anyway. Regulatory approval always plays a big role in the healthcare field. So, I wouldn’t be surprised if it took at least ten years. I hope it won’t take that long but it’s difficult to make predictions. In any event, I’m convinced that Siemens has made a very important advance since the process you’ve developed may provide many patients with better prosthetics and, thus, enhance their quality of life.
On the road to the Fourth Industrial Revolution

Enhancing industrial productivity
Creating efficient solutions

From Industry 1.0 to Industry 4.0

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It sounds like something out of science fiction: communities of machines organize themselves, supply chains automatically cooperate with one another, and unfinished products send the data needed for their processing to the machines that will turn them into merchandise. These are the developments that will characterize the production environment of tomorrow. Many observers are proclaiming the advent of a fourth industrial revolution: Industry 4.0. The first revolution was triggered by mechanical systems and drives (the power loom and steam engine). The second involved the division of labor and mass production techniques. And the third was ushered in by electronic systems and computer technologies for automating manufacturing processes.

In the world of Industry 4.0, software will network all the steps required for a product’s development, manufacturing and maintenance. Products and machines will communicate with one another and exchange commands. The factories of the future will optimize and control their manufacturing processes largely by themselves, although in accordance with parameters defined by humans – thus increasing industrial productivity. With our unparalleled range of offerings for leading-edge industrial production, we’ll play a key role in shaping this transformation.
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Software is the heart of intelligent factories. It enables products and production cycles to be planned and optimized in the virtual world before the first screw is manufactured. Software will, accordingly, be a key driver of industrial growth in the years ahead. According to researchers, the market for industrial software alone totals €18 billion (2012), with anticipated annual growth of some 8%.

With our outstanding setup – 17,000 software engineers, of whom 8,500 are at our Industry Sector – we’re one of Europe’s largest software companies. A leader in all relevant industrial software segments, we offer a comprehensive software portfolio for the entire value chain – from product development to manufacturing and maintenance – for industries ranging from car making and shipbuilding to aerospace and food production.

As a supplier of automation technology and industry software, we’re one of the few companies to combine the real and virtual worlds of manufacturing under one roof. We’re unsurpassed in this field. And with over 290 manufacturing and production facilities worldwide, we’re also one of the largest users of our own industry software.
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“We all have to think more like visionaries”

Professor Berend Denkena, who holds a doctorate in engineering, is a machining expert. He’s well aware of how important absolute precision is in the field of medical technology, where micrometer exactness is a must. As head of the Institute for Production Engineering and Machine Tools at Leibniz University in Hanover, Germany, Professor Denkena is working on a variety of research and development projects in medical technology and prosthetics.

In his view, Siemens’ solutions for the industrial production of implants are an important advance – one that points the way to the future. As he explains, the key is to integrate the entire process chain from beginning to end: “The problems are usually at the interfaces – from product design, simulation and planning to the operation or programming of the machine tools to the actual production. For its products, Siemens maps end-to-end process chains. And in my opinion that’s a key prerequisite for success.” Sabine Fietz adds: “However, we’re already thinking about ways to continue developing the process. Our goal is to make implant production ever faster, more efficient and cheaper. Why? Because the standard implants used today can’t be adjusted to the bone conditions that physicians discover only after an operation is in progress. As things are now, surgeons either have to remove healthy tissue or fill damaged tissue with cement – in other words, they have to adapt the patient to the implant instead of tailoring the implant to the patient. We’re working on solutions that – building on an end-to-end, almost fully automated process chain – may enable implant manufacturers and their partners to produce prosthetics in the future that are better tailored to individual patient requirements. With rigorously improved procedures, it could even become possible to produce implants in hospitals while operations are taking place.” In Professor Denkena’s opinion, such a solution is quite conceivable. “Implants are currently being manufactured on conventional machine tools. Even when the greatest possible care is taken and the workpiece is sterilized upon completion, contamination may occur. That’s why we have to find a way to operate machine tools under sterile conditions. But this will require a team effort involving a wide range of experts from different fields. And it will take time. Ultimately, the best option would be to manufacture directly on site, but many challenges will have to be mastered before that’s a reality.”

The improvements we’re developing are intended to make procedures less burdensome for patients by fitting the prosthetic to the bone rather than the other way around. Physicians will also benefit since they’ll be able to optimize the implant during surgery, once they’ve seen the joint. “We all have to think more like visionaries,” says Sabine Fietz. “Our solution shows what production processes are going to look like in the future. Modern software solutions are bringing the virtual and real manufacturing worlds closer together, while creating unprecedented momentum and flexibility. For our customers, that means more efficient processes, shorter time-to-market and, last but not least, higher productivity at lower cost.”
“Siemens has made a very important advance that can help provide patients with better implants that last longer, work better and, thus, enhance their quality of life.”
“Once again, I can stand at my easel for hours”
When talking to Gordon France, two topics come up again and again: sports and landscapes. Both are passions of his. “I want my paintings to have visual and emotional appeal for the viewer,” he says. “If I achieve that, I’ve succeeded.” Thanks to his new knee joints, France is once again able to stand at his easel and paint without pain. The implants have also given him the mobility he needs to go out and discover new motifs. Every year, he and his wife travel to Italy, where he hikes through forests, crosses streams and climbs over cliffs and rocks in search of the perfect view. There was a time when the pain in his knees made this impossible and France was forced to gradually withdraw from what had been a very active life.

The turning point came one day when he was playing hockey and intolerable pain forced him to leave the ice after only five minutes. “I couldn’t stand up any more. Right then, I knew I’d have to do something about my knees. The pain was curtailing my quality of life tremendously. I could no longer do the things I loved most.” If he’d known then how well the operations would turn out, he wouldn’t have waited so long. “Everything went perfectly. And it feels as if a new world has opened up to me. I can do everything I did before. I don’t even notice the artificial joints. It’s great.” Gordon France would advise anyone in a similar situation to have the operation as soon as possible. “I have my life back. I have so many ideas for things I want to paint. And I can finally play ice hockey again with my old friends.”

Gordon France | Ice hockey player and artist

“I can do everything with my artificial knees. And the best part is that I don’t even notice them.”
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