Millions of steps across

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Abstract

With its high-tech prosthetics, Icelandic company Össur would like to enable people to live without limitations. The company manufactures most of the components for the artificial limbs at its own production facilities in Reykjavik. To ensure the quality of the highly complex prosthetics, Össur uses two coordinate measuring machines from ZEISS in production. All measured data is gathered in PiWeb software, which generates analyses and documentation at the push of a button.

KEYWORDS: **measuring machines, prosthetic leg, quality**

Reykjavik, Iceland. 400 people work in the world‘s northernmost capital to remove barriers for patients around the globe. One of them is Lukas Kalemba, a slim, athletic man who lost his left leg at the age of 19. The now 29-year-old German nonetheless moves about without a problem. Although his world was turned upside down in an accident 10 years ago, he now enjoys all that life has to offer. He likes his job, does sports in his free time and he is discovering his new home: Iceland. “My new leg has helped me regain the quality of life that was taken from me back then.”

Fig. 1. *“My new leg helped me to regain a bit of the quality of life that I had lost,” says orthopedic technician Lukas Kalemba, who lost his leg 10 years ago*

High-tech for a self-determined life

Kalemba's left leg is now powered by a mini-computer, inside an aluminum frame with a plastic shell cover. A metal tube connects it to an Össur artificial foot made of two carbon plates bolted together. He wears an Össur silicone liner on what remains of his thigh, which protects his leg and also provides direct contact to the prosthetic via a pin connector. An electric brake inside the artificial knee replaces the lost muscle's weight bearing function. A computer and a fluid that becomes viscous through electrical impulses allows the leg to react automatically to movement: it locks in place and provides support when Kalemba uses it for standing, and adapts to his natural motion when he walks. Kalemba is now also actively helping to advance this technology: at Össur, the manufacturer of his artificial leg, he works in Reykjavik as an orthopedic technician and test person for new developments.

Fig. 2. *A prosthetic leg must be able to bear the weight of the user nearly one million times a year. The Power Knee high-tech prosthetic can replace the muscle activity of people whose legs were amputated above the knee*

Small, light and very strong

Icelandic company Össur is striving to enable "A life without limitations." To fulfill this dream for its customers, the company is relying on three principles: ongoing development, direct contact to people missing limbs such as Lukas Kalemba, and on excellent product quality.

A prosthetic leg has to carry the body close to one million steps every year. For this to be not only safe, but also comfortable, every single component must deliver what the design demands – from the simple aluminum tube and critical components made of titanium up to the electronic elements for complete computer-controlled knee prosthetics. Most of the parts for leg prosthetics are manufactured at the company's headquarters in Reykjavik. "Our parts must be small and light, but very strong and durable at the same time. This, of course, leaves little room for error," explains Ásgeir Páll Gústafsson, CMM specialist at Össur.

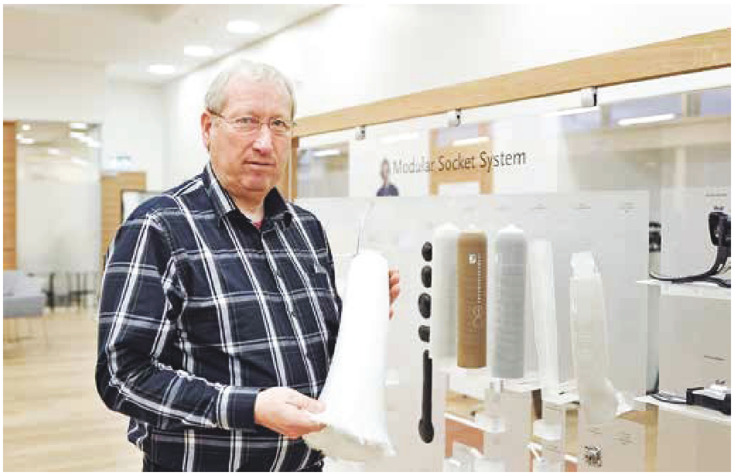

Fig.3. *Guðmundur Jakobsson, Certified Prosthetist/Orthotist at Össur's Icelandic workshop, explains the individual fit of a prosthetic leg*

The Tolerances for some of the computer-controlled knee components are just 10 micrometers. Quality Assurance requires precise measuring tools to ensure compliance. These instruments must also be able to correctly display complex geometries. The artificial knees, for example, feature concave and convex surfaces – something that would be impossible to correctly measure manually. Therefore, two coordinate measuring machines from ZEISS in the measuring lab near production are used for in-process random sampling measurements.

Fig. 4. *Each component of a prosthetic must meet the design requirements exactly. The measuring machines must also correctly display complex geometries*

Avoiding "Error 45"

"When all production machines are running, we measure at least 17 different parts every hour," says Gústafsson. The machine operator starts the measurements at the push of a button. Measuring technician Gústafsson and his colleague prepare the required measurement programs and clamping devices so that their colleagues can position their workpieces properly on the coordinate measuring machine without any difficulties and select the corresponding measuring program. The sensor then automatically scans the workpiece and determines the defined form and location data. Measurements with manual measuring equipment, on the other hand, are being gradually eliminated at Össur: “The main problem with manual measurements is something that we call Error 45, or an operator error,” says Gústafsson, adding that “they also take up time that could be better used elsewhere.” Therefore, Össur now only manually measures the most simple parts.

Fig. 5. *At Össur headquarter in Reykjavik Örn IngviJónsson, Director of Management & Operations, and Quality Manager Ásgeir Páll Gústafsson work for “a life without limitations”*

10 years ago this was a lot different. Before buying its first coordinate measuring machine in 2004, Össur was not even able to measure the geometrically complex parts. The elaborate knee components with curved surfaces, for example, were purchased from an outside source. The company has grown quite significantly since then. In addition to additional lathe and milling machines, the new equipment included a ZEISS CONTURA coordinate measuring machine that is still in use. Soon there will hardly be any parts whose details cannot be measured on the coordinate measuring machine. Therefore, company management decided to invest in a second measuring machine. “We considered another ZEISS machine because we were so satisfied with the ZEISS CALYPSO measuring software,” explains Gústafsson, who values easy, intuitive operation. Össur decided on the ZEISS O-INSPECT multisensor measuring machine to also cover its optical measuring needs. However, Gústafsson has rarely used this option because the contact sensor has proven so accurate that Össur is still able to measure workpieces with very tiny geometries by contact.

Benefitting from the amount of data

Be it contact, optical or manual, Össur diligently documents all measuring results. After all, as a manufacturer of medical products, the company must ensure the traceability of its measurement data in accordance with ISO 13485. Up until about six months ago, Gústafsson and his colleagues entered this data in Excel sheets: “At some point in time, we came to the conclusion that we not only want to document this enormous amount of data, but also use it.”

For this reason, Össur introduced ZEISS PiWeb software to analyze, assess and graphically display quality and process data in real time. Measurement data from the coordinate measuring machines is automatically forwarded to the software. Even results from the remaining manual measurements are entered into the central system by machine operators. Consequently, trends in data sequences can bequickly recognized and visualized. This enables staff members to quickly draw conclusions about machining processes – much faster than in the past. Gústafsson provides a good example: before the introduction of PiWeb, an engineer wrote her thesis at Össur. Her task: using all the measurement data, find and analyze the 10 workpieces at Össur that have the highest defect rate. This took three months because she had to review and analyze every volume product. “With PiWeb, this is only matter of minutes, “says Gústafsson.

The results obtained this way for production data also improve the quality of the company‘s products. This quality helps people such as Lukas Kalemba master their everyday activities on two legs. “Just because you lose a leg, doesn‘t mean you have to stop living,” says Gústafsson. Sitting in a glass meeting room at Össur, he points to a few people walking by: “Out there is one of the super users, who test our products for everyday activities: Helgi Sveinsson, world champion javelin thrower.”

References

[1] Innovation – The Magazine from Carl Zeiss Industrielle Messtechnik GmbH. Issue 17, 5/2014, p. 36 - 41.