INTERVIEW WITH DR BERND-DIETMAR BECKER, CHIEF TECHNOLOGY STRATEGIST AND EVANGELIST, FARO

Bringing Reality into the Information Space

FARO is known as a trusted source of high-precision 3D measurement, imaging and visualisation technology. In the surveying and mapping field, the company is particularly well known for its laser scanning solutions. On behalf of '*GIM International',* Wim van Wegen recently met with Dr Bernd-Dietmar Becker, chief technology strategist and head of FARO Labs (the company's research and innovation department), to discuss what we can expect from laser scanning and its role as key reality capturing technology in the years ahead.

You recently announced that you have divided your business into six vertical sales and product management business units. What is the strategy behind this?

We want to be closer to our customers and our industries, and we want to be more solution-oriented. This means we want to start with the customer problem, understand it completely and then deliver a solution that solves that customer problem. The end markets are described in the verticals, i.e. Factory Metrology, Product Design, Construction BIM-CIM, Public Safety Forensics and 3D Solutions. One good example is our market-leading laser scanner; it will work in all of these markets. However, the software often has to be specific, which is why we acquired two software companies in the Public Safety Forensic space: ARAS 360 and CAD Zone. We have now created specific software systems which use the same hardware (laser scanners) but deliver specific features and solutions relevant to the specific needs of a crime scene investigator or crash reconstructionist. We acquired another company, Kubit, which is focused on the construction space. Thanks to its diverse plug-ins to Autodesk products, we now have much better access to the Autodesk universe and customers like architects. So we derive the needs for the hardware products from the verticals and, if possible, we create one product – like the laser scanner – which is good for many verticals. We also create new products, like the handheld laser scanner, which will respond to a particular vertical's specific needs, e.g. forensics or product design, based on our analysis of that vertical's profile and potential market success.

In addition to the laser scanning itself, it's also important to process, visualise and store the data. Which solutions do you offer for those aspects?

In terms of processing, we have a pretty audacious strategic goal of being in and out of a site 10 times faster than today, so instead of taking two weeks we want to take just one day. We're moving in this direction stepwise. As a first step, how can our customer capture 3D data faster? We believe the indoor mobile mapping system is the right solution. There are already some solutions with handheld systems, but we think the quality is sub-standard and they are not that cheap either. So we are working on a faster capturing solution. Secondly, processing is becoming much faster. FARO Labs has developed the FARO Scan Localiser which constantly performs 2D mapping based on a SLAM algorithm during the scanning project. The Scan Localizer knows where the scan has been taken as well as the orientation. Then the laser scan data is 'stitched together' automatically as the scanner moves forward. You can immediately see if you've forgotten something, which happens often – a washroom or a storage room, for example. You can immediately check the map to make sure you really have every scan registered. With our automatic post-processing software you can still optimise the accuracy, but you'll also immediately see the 2D map and all the scans which are registered in the box. We are working to simplify the software for specific industries such as architecture, construction or forensics with the new FARO Scene, task-oriented software. Many people don't want the complexity of the whole platform, they just want to get results – and fast!

In terms of data storage, way back in 2003 we did a huge project for BMW in Leipzig which involved 3,500 scans to capture the whole plant. We actually managed to send all that data via the internet to Slovakia to get it modelled into MicroStation. So, yes, data is a topic to some extent, but today as storage is becoming so much cheaper and the internet much faster it is less and less of a problem. Of course we're also creating more data – we have now HDR colour and 165 megapixels colour per scan – but at some point of data density it is good enough and it will stop. Take Apple's retina display; personally, as a human being, I don't need more pixels on my display now, I don't need four times retina. So the user's need defines the limit. Therefore I don't see that the data volume will continue rising forever. At the same time, the general bandwidth and the general need for high-volume data is increasing so the solution will overtake the problem. Lastly, we launched our WebShare Cloud system many years ago to bring the data to the cloud, as an Amazon web service. So you can store all the data in the cloud and then access it via the internet. We can now achieve much higher-quality visualisations in the cloud and ultimately everyone will work in the cloud only; there will be no local processing anymore. This means you have the full power and the parallel processing of the cloud, which also is inexpensive. Whether you run one computer for 10,000 seconds or 10,000 computers for one second, the cost is roughly the same. But if you can put things in parallel, which is possible here in many ways, you achieve much faster processing and the storage is pretty cheap too.

Many of your customers are in the construction sector, where building information systems are gaining in importance. Which opportunities does this open up for laser scanner vendors?

Many opportunities! As you know we bring reality into the information space, and the more IT systems someone has the better that is for us, since they need somebody who is delivering content. I relate the CAD system to the time of Rembrandt, when paintings were done by hand. But nowadays we have photo cameras, which means we can create realistic data very easily, quickly and reliably. The CAD system will only be used for new designs; people will scan what they have and model what they want to do in the future – the stuff that they don't have. BIM alone won't be enough; BIM needs a huge point-cloud entry point. And that's actually gradually happening: we're connecting to the Autodesk tools, via our team in Dresden for example. The automotive industry is also using MicroStation, which has a point cloud entry point. It is also embedded into Siemens NX – the Siemens simulation system Plant Simulation and Process Simulate. The scanned points are actually the most real and thus reliable data – they are the 'photograph', if you like. Any subsequent changes are deviations. Ideally, the BIM systems should be able to take in point clouds directly. That's a great thing for the laser scanning industry, and especially for the service providers, since people who create content are needed. Everything is about productivity: about becoming much cheaper and faster, that's the reality. Only the new designs need a Picasso or Rembrandt mindset!

What's the geographical distribution of your global consumer base? In which application domains are FARO scanners mainly used at present and in which areas would you like to become more active in the near future?

Our distribution worldwide is roughly equal across EMEA, the Americas and Asia. Asia has been picking up really well. Regarding the application domains, architecture and construction – our BIM-CIM vertical – is our biggest laser scanning industry accounting for roughly 50%. Forensics is about 25% and growing very fast. The rest is product scanning: shipbuilding, car manufacturing, aerospace, etc. By using the best tools and combining them, we have opened up a new market – product design – which strategically is very interesting. It's a cross-over between our traditional metrology side and our laser scanning side. This vertical covers all kinds of products: cars, ships, scooters, plastics, whatever. It's kind of an overlap between the scan arm used in metrology systems – which is super-accurate but for smaller products – and the larger stuff you can cover with our laser scanners.

FARO laser scanners are also used on mobile mapping systems, using vans and cars as platforms. How do you see the market of mobile laser scanning systems evolving over the coming years?

Mobile mapping is already a productive concept; it's 20 to 50 times faster than stationary scanning. If you want to scan roads and long-distance projects or large objects, then it's a very good option. Of course the accuracy is not as great as in stationary scanning, but if you're scanning many kilometres of roads then there's physically no alternative. Mobile mapping is very logical, yet its success in terms of units sold is still rather small. That's often because the systems are very expensive. Siteco – a FARO partner – is now offering a very good solution which provides a relatively good value-to-cost ratio, but that's still not enough. The costly components are the IMUs, and the professional IMU systems are still too expensive. The question is: do we really need them? There will be technologies such as camera-based stabilisation in the future. Today, even some military drones have been developed which only have a camera. So I think the price will come down further as we research lower-cost inertial systems. The future is a backpack fitted with a scanner – but for lower cost than shown today. When I'm on vacation I can go for a walk, visit a beautiful church or whatever, and then when I get back to the hotel I have captured it all, without even really being aware of the fact that I was scanning. We can compare that to the Kinect system that broke the price barrier at the bottom end of the 3D capturing system market. Now you have a lot of applications which have been developed for consumers but also semi-professionals, and you can do quite a bit with it. There will still be extremely professional products, which make sense for highly accurate solutions, but then there will also be 'take along, walk around and capture' systems.

Staying on the topic of mobile mapping systems, you've already mentioned backpack laser scanners, but there are also handhelds and even laser scanners mounted on unmanned aerial vehicles (UAVs or 'drones'). How is FARO anticipating developments in the drone market?

We already have laser scanners on drones and we've also put a Freestyle in FARO Labs on a drone. This works well, since the Freestyle is developed to move. I am not so thrilled about the future of mounting the traditional FARO laser scanners on a drone, since you need to stabilise it, which today is still expensive, so their time for large-scale application has not come yet. Backpack laser systems are also far too expensive today, we're talking about prices in the range of EUR200,000. Of course they are still in the laboratory phase and the prices must come down over time.

The number of points that can be measured per second is steadily increasing. Where will we be in five years' time?

Actually I don't foresee a dramatic increase in speed, i.e. the point rate – how many points you can capture per second. For example, 20 million points for a short-range scene like a power plant would be perfect, you don't need more; 40 million points is overkill in that context. In a more complex situation 40 million would be ideal, and maybe 200 million would be good for a heritage project. So the question is, how many points do I need and how many scans do I have to make? How many positions do I go through? Then you want to minimise the total capture time. Right now, everyone has got kind of stuck at one million points per second, which I think is good enough. Furthermore, if you increase the point rate you also increase the noise since you have less time to capture photons, so the signal goes down versus noise. There are certainly ways to work on that and it will no doubt improve in the future. And when you take into account the setup time, the start/stop time, moving, registering and so on, then the pure capture time – the point rate – is only a small part of the total time. You can compare it with pixels in cameras. With a chip I can very easily increase the number of pixels if I want to have higher resolution. But then I will need a big enough chip, otherwise I won't have enough light per pixel and there will be too much noise…so I mean, at some point the limit is reached. Overall productivity is more interesting.

Over the past ten to 15 years, a lot of academic research has been conducted to automate the classification of point clouds and to perform 3D modelling semi-automatically. How are these scientific efforts reflected in your products?

They are reflected in the work of FARO Labs and of our Dresden team, the former Kubit team (the former Kubit company, acquired by FARO in 2015), which does the recognition for piping, for walls, for construction and for BIM. They are also reflected through more research in our software team. It is very important because we've calculated that our customers do 10 to the power of 17 points per year. It's really all about retrieving the object information. There are different ways of doing that, e.g. with prismatic objects like pipes or walls, that's what the Dresden team is doing at FARO. We are looking at a solution for factories, construction sites or anywhere you have stand-up parts such as pillars, pipes. So you have a library of known objects and you want to find them in the point cloud so that you can locate them and count them. It's a very important topic, but we're still very much still in the research stage. Nobody in the world has a total solution for this right now.

Which other major developments do you foresee in the coming years that will have a great impact on the laser scanner industry and the geospatial sector as a whole?

For us the top-notch step is ten times more productivity. But other key goals are quality improvement and then the automatic post-processing including object recognition. These are the three major directions for FARO. By the way, in the high-tech industry you never know what will be around the corner! We want to go really fast and adapt quickly to the latest technological opportunities, which is really fun. We need to be very aware of new technological possibilities. The physics are always the same, but when there's a new chip that might enable us to do amazing new things we have to recognise that opportunity immediately. One excellent example is augmented reality, which we're also involved in with our new acquisition MWF (*MWF was acquired at the end of 2016, Ed.).* It enables you to 'go back to reality' and to add all the data and the information you have into that reality; it's especially useful in construction where you can 'see' through the wall to see which pipes are there, it's amazing stuff. This whole development will be an important new force in our industry.

About Dr Bernd-Dietmar Becker

Dr Bernd-Dietmar Becker has been chief technology strategist at FARO Europe since 2012 and he manages the FARO Labs group. He received his PhD in engineering as well as a master's degree in electrical engineering from the University of Stuttgart. He also received an MSc in operations research from Stanford University. He previously worked at the Fraunhofer Institute for Production Automation as a departmental manager and co-founded a factory simulation software company named AESOP GmbH. In 2001 he and his brother founded iQvolution AG, where they invented what today forms the basis of the FARO laser scanner. They sold iQvolution to FARO Technologies in 2005.
