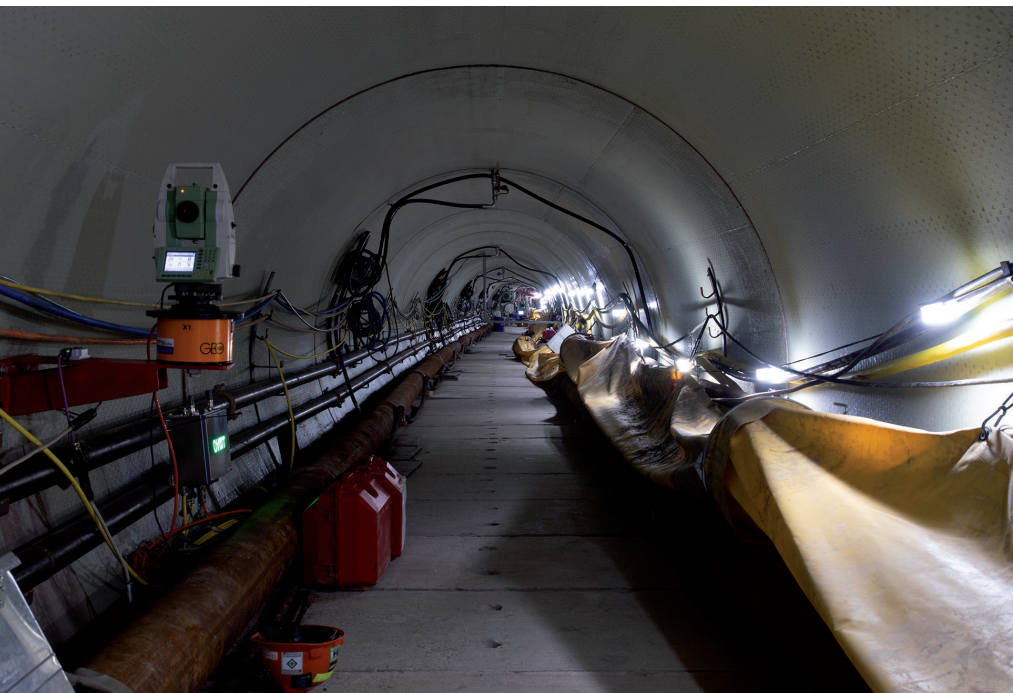


Everything under one roof

With TUnIS Navigation MT, VMT has brought the first and so far the only microtunnelling navigation platform into the market that combines all common navigation technologies in one product. We spoke with Jürgen Göckel, responsible for Business Development Microtunnelling at VMT, about the new system.

Translation of the German article, *Alles unter einem Hut*, which originally appeared in B_I umweltbau Issue 5, October 2020.



B_I umweltbau: Jürgen, the fact that pipe jacks regularly find their way into the target pit of a drive with great precision and millimetre accuracy is nothing new. What was the thinking behind developing a new navigation platform?

Jürgen: Technical reasons were very important. Two systems were predominantly established on the market. On the one hand, there was the U.N.S. platform that Herrenknecht developed to advance the use of gyro technology in microtunnels. On the other, there is the SLS platform which uses a laser total station system that we at

VMT developed in 1994 and have been operating ever since. Basically, these two systems have met industry requirements. They guided the drive from A to B, even when it was difficult and complex. We were able to handle curves and managed long-distance drives.

So far, however, the choice of platform was determined by the corresponding surveying technology – either a gyro or a laser total station system. This severely restricted the flexibility to use the optimal technology in practice factoring in construction site conditions.

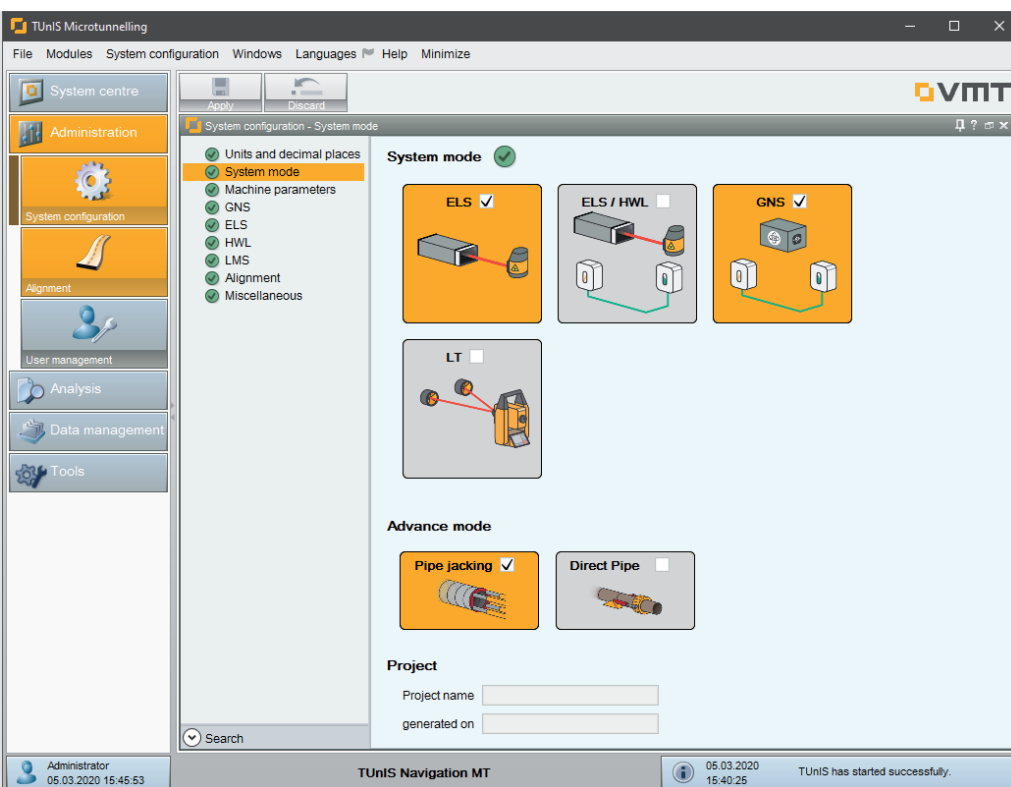
In addition, the technological basis of these

system platforms is now becoming outdated. The programming environment is no longer supported and cannot be further developed. Against this background, the decision was made. We are now taking the big step and developing a completely new platform in which all established navigation technologies are brought together. We did not reinvent the basic ideas of how to navigate a microtunnel, but we have managed to get everything from the simple laser target system for straight drives with small diameters to the gyro for curved alignments to the laser total station for long-distance drives under one roof. That gives users a completely new level of flexibility.

Q: If you start with a fundamental new development, you also have the opportunity to think very freely about what the system should be able to do in the end. What was in your specifications?

Jürgen: The first premise was to at least retain the functionality of the previous solutions. In addition, there were a number of ideas and suggestions for improvement from those in our company who work with the systems in the real world on construction sites. Ultimately, of course, the suggestions and feedback we have received from our customers in recent years played a major role. We have put together our package from this.

One of our goals was to improve system



The new system brings all common navigation technologies together in one platform.

reliability and we wanted to increase the accuracy of the representation of the advance progress for those involved on the construction site. With microtunnel navigation, we always measure while the tunnel is moving. That means there are always small errors in the calibration. These errors add up over time. That is why control measurements are made at certain intervals to adjust the system again. We have worked on using the new platform to provide more precise information about the position of the machine between the control measurements and thus to make the advance more transparent. Ultimately, in addition to failure safety, it is a matter of keeping the number of control measurements necessary as low as possible without going outside the project's specified alignment tolerances. This reduces downtime and therefore saves both time and money.

Q: From your point of view, what are the highlights that you have been able to implement from your specifications into the finished product?

Jürgen: Let me distinguish between the relatively universal and easy-to-use gyro and the laser total station system, which is more suitable for experts because it requires a little more support and know-how on the part of the user.

In the case of the gyro system, I have so far only got the height information from the hose water level that I carried with me. We managed to reduce dependency on the additional hose level. For this, a second calculation method has been implemented in the new platform which allows us to do without the hose water level in many cases. In the case of gravity pipelines with particularly high demands on the accuracy of the gradient, we still have to gather a little practical experience to determine whether

the accuracy is as high as it seems to be at the moment. In any case, the construction site experiences so far are very promising. The laser total station system requires more operator skills but has the advantage that it only needs half as many control measurements. Here we have succeeded in significantly simplifying the control measurements. For example, we no longer need to measure the entire pipe string; instead, a few selected points suffice. That speeds up the process. In addition, we have included an additional calculation that also detects any floating of the pipe string. This was previously not possible with the laser total station system.

A completely new feature for both systems is the so-called correction curve. If deviations are found, this calculation leads the machine operator back to the target line on a gentle curve and prevents adjustments that are too abrupt, as is often found in practice.

We are currently working on a calculation method that compares the gyroscope measurement results with a theoretical machine position, as would be expected based on the steering movements. This way, the machine operator can be informed of any discrepancies at an early stage and react accordingly.

“We managed to reduce dependency on the additional hose level.”

In addition to the software, we have also completely redesigned our hardware platform. The basic aim was to simplify. That means: Less material in the tunnel and more flexibility. The data boxes in the tunnel are almost identical and interchangeable. This makes it easier to handle the components on site and reduces the need to keep spare parts on hand.

Q: As a tunnelling company, how can I integrate TUnIS Navigation into my machine range?

Jürgen: Customers can choose between three variants. On the one hand, you have the option of integrating the system into Herrenknecht systems. That means the Herrenknecht PC in the control container is also used, as is the data line. All you have to do is add the measurement hardware – be it a gyroscope or a laser total station – and you are already integrated into the Herrenknecht system. New tunnelling systems from Herrenknecht already have the basic

version of TUnIS on-board; older systems can be relatively easily retrofitted.

Variant two is a partially integrated solution. The data line from Herrenknecht is used for this. A separate PC and the navigation tool are connected via data boxes at the beginning and end of the line.

Variant three is the stand-alone solution. The system comes to the construction site with its own PC, data line and boxes, and is operated independently of the tunnelling technology. This variant is suitable, for example, if the navigation system is to be used on different tunnelling systems – regardless of the manufacturer.

Q: What costs are we talking about?

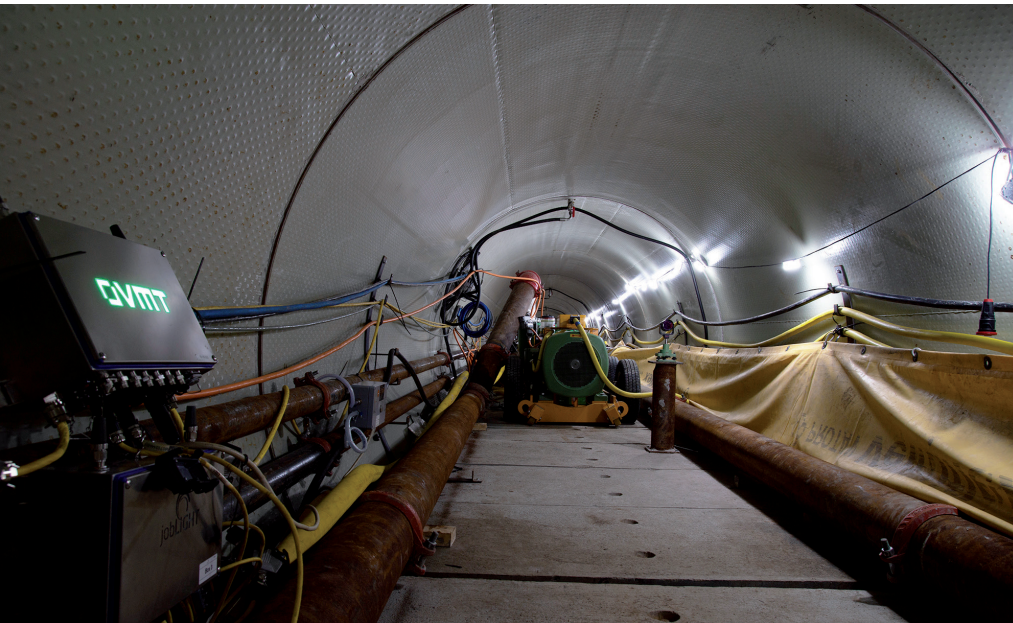
Jürgen: If, for example, I take a stand-alone solution with 500 meters of data cable and a gyro, this costs around €170,000, and with a laser total station it costs €125,000. Any existing gyroscopes or laser total stations are compatible and can be used with the new system. We are now also offering the system via a leasing model, which also enables additional flexibility in terms of financing.

Q: Given the investment costs, what is the economic advantage for the tunnelling company?

Jürgen: The great advantage of TUnIS Navigation MT is its flexibility. Users are prepared for everything that the world of microtunnelling will encounter. Be it small diameters, tight curves or long drives, with the platform I can always access the navigation technology that is optimal for the specific application and the most economical navigation technology for the current tunnelling project.

“The great advantage of TUnIS Navigation MT is its flexibility. Users are prepared for everything that the world of microtunnelling will encounter.”





The data boxes generate a WLAN in the tunnel. This enables unhindered telephone communication or the sending pictures from the tunnel with a smartphone.

We increase efficiency. Our new technology creates a WLAN in the tunnel via the data boxes. That means you can log into the WLAN with your smartphone in the tunnel and communicate uninterrupted out of the tunnel, including sending pictures or video calls. In this way, we can make construction site communication much more efficient.

We use synergies. With the development of TUNIS, the cooperation with the Swiss firm Jackcontrol expanded significantly. For instance, we worked together with Jackcontrol when switching to the new hardware platform, so that both companies are now using the same platform. That means the Jackcontrol system on the construction site can use our technical infrastructure and we can connect our devices directly to the Jackcontrol boxes. This significantly saves hardware and cabling in the tunnel.

With the Atcetera company there is a third partner on board that is active in the field of tunnel lighting and communication. Together, we have developed a luminous data cable that both provides light in the tunnel

and transmits data. This solution also reduces effort and costs. In addition, with Atcetera technology we can expand our selective WLAN into an intelligent WLAN with complete coverage of the entire pipe string. This way, people in the tunnel can be reached from outside at any point or they can communicate with the outside world. This is also an important aspect from a construction site safety point of view.

Incidentally, we deliberately chose open industry standards for the design of the entire system in order to be open and flexible for possible cooperation with other partners.

Q: Do you already have practical experience of specific projects and construction sites?

Jürgen: At the end of last year we tested the gyro system on two construction sites and had very good experiences there. In particular, the alternative height calculation worked very well; better than we imagined. The software for the laser total station system was approved in July and tested on se-

veral construction sites, most recently on a project in Finland, where we were able to evaluate the interaction of hardware and software in an 800 m long tunnel. The WLAN in the tunnel in particular turned out to be a very useful and intensively used feature. All in all, we have had a lot of positive construction site experience and I am very optimistic that we have created a very stable, modern system that offers our customers a lot of added value and the same reliability they are used to from VMT systems.

Q: Have you already received any feedback from the market?

Jürgen: We are currently in the process of rolling out the new system into the market and have contacted many companies and made appointments. Interestingly, we get a lot of positive feedback from Asia and have already received two orders from there. The possibility of leasing the system is very popular with our customers here in Europe and I am very confident that we will succeed in the market with TUNIS Navigation MT because the system contains a lot that offers considerable advantages for the construction process.

We ourselves are absolutely convinced of TUNIS and now use both the TUNIS software and the MT.connect hardware at VMT throughout the company; that means not only in microtunnelling but also in segmental tunnel construction. This indicates that all areas benefit from global experience and from further developments and improvements, also with a view to the robustness of the components. Because they have to work just as reliably and trouble-free under the rough and harsh operating conditions in conventional tunnel construction as well as in microtunnels.