

ASAP

2021

ANNUAL REPORT

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Michael Neisen, CEO at the ASAP Group

INTERVIEW

WHAT 2021 MEANT FOR THE ASAP GROUP

How would you summarise 2021 for the ASAP Group?

“Emerging from the crisis stronger – that’s the best way to describe what 2021 meant for the ASAP Group.”

Despite the coronavirus pandemic and all of its negative effects on the market environment in the automotive industry, we managed to bring 2020 to a successful conclusion – with sideways movement in terms of revenues.

In 2021, not only did we return to our former strength, we also enjoyed one of the most successful years in our company’s history. The ASAP Group began to engage with the topic of e-mobility at an early stage, placing a focus on megatrends from the very beginning. This strategic focus on future technologies and our continuous development through investment in productive areas allows us to fulfil our customers’ needs. Despite the challenging circumstances of the past year, we were able to acquire a number of new customers and

further intensify existing customer relationships. Although restrictions on gatherings often removed the opportunity for direct personal contact both internally and externally, it has also been clear that the measures on digital cooperation introduced in 2020 have become fully integrated at ASAP. In the last few months, we have used our experiences in hybrid working to make continuous improvements, thereby ensuring that communication processes and projects ran smoothly. However, the transformed world of work also presents us with new challenges, which we have made a concerted effort to tackle through the ‘Better together’ culture project we launched in 2021.

The ASAP Group coped with the crisis year 2020 comparatively well. Nevertheless, what effects of the coronavirus pandemic remain noticeable and what has changed compared to last year?

Unlike in the previous year, we were affected to an extent by the chip shortage in 2021. This manifested itself, for example, in the fact that prototype vehicles were sometimes unavailable for testing, while some of our customers already reduced their development budgets. Overall, however, after delays to many projects and in many areas in 2020 due to the uncertainty in the market, things got back up to speed again in 2021. Due to the coronavirus pandemic, many aspects of our daily working routine have changed, particularly through digitalisation. New tools, methods and processes have enabled

us to make real progress and improve both our quality and speed. At the same time, the collaboration between locations within our corporate group has improved further still; we now exploit synergies even more effectively, with experts from different locations working together on projects even more than before. However, the rise of digitalisation and mobile working has also brought about a noticeable reduction in personal interaction and close relationships between employees. In many cases, communication, reciprocal coaching and expert conversations filled with creative ideas and approaches have simply fallen by the wayside. It has also proven very difficult to integrate new employees into our company and give them a sense of our corporate culture. Mobile working has also placed greater emphasis on selfdiscipline and responsibility in our employees’ day-to-day work, which has in turn forced us to adapt our leadership style. With this in mind, we have devoted ourselves in recent months to an intensive examination of ASAP’s corporate culture and issues related to hybrid working at ASAP. The resulting culture project, ‘Better together’, will form the basis for preserving our culture and attractiveness as an employer.

In your view, what were the ASAP Group’s highlights in 2021?

I would say that a particular highlight in 2021 was the excellent development of the entire ASAP Group. For one thing, we were

able to strengthen our workforce, and for another thing, we increased our aggregated turnover by over 20%. We recorded the strongest percentage growth in software development and also significantly expanded our capacities in that field. We also enjoyed considerable success in electronics development and, thanks to new projects with our strategic partner ZF Friedrichshafen AG, we also acquired further OEMs and system suppliers as new customers, thereby further diversifying our customer base. Over the last year, we have once again made substantial improvements in terms of quality and capacity, particularly in our strategic focus areas.

“Above all, by investing €12 million in our productive operations, we have further reinforced our market position in the field of e-mobility testing.”

In doing so, we have yet again expanded our locations in Ingolstadt, Wolfsburg and by Lake Constance. This included completion of a new testing hall to upgrade the battery testing facilities in Wolfsburg, plus a project to significantly expand our trialling and testing centre in Ingolstadt with further life cycle simulation systems for inverters. The ‘Better together’ culture project is also a particular highlight of the last year for me, as our company’s culture has always been characterised by our sense of cooperation at ASAP. People are our focus at ASAP and, as a result, so too is open communication

and appreciative cooperation. In the course of this project, we worked across the entire group throughout the year to identify how we could actively promote our company culture and bring it to life in future in the new world of work. The collective will remain a central focus at ASAP in future and help to guide our actions.

Do you have anything new to report on our cooperation with our strategic partner, ZF Friedrichshafen AG?

Over the last year, we have made substantial progress together with ZF Friedrichshafen AG and crystallised the focus areas of our strategic partnership with even greater clarity. In future, we will focus even more closely on the development of e-mobility components and ADAS/AD systems as well as collaboration with the central research and development unit in Friedrichshafen. In 2021, the main focus was on expediting our projects related to the validation of electric drive system components, the integration and validation of new components and functions in fully autonomous shuttles, and collaboration in software development. Overall, since the very start of our strategic partnership, we have continued to intensify our collaboration on the mobility of tomorrow across several ASAP locations. Most notably, our new location by Lake Constance has proven itself a strategically sound decision over the past year. It has enabled us to considerably expand our collaboration. We



also expect to see further positive developments in the coming years and look forward to future-oriented, trusting cooperation.

Where do you think the ASAP Group’s main strengths lie? Or, to put it differently: do you think the ASAP Group is well positioned with its current business model or do you intend to adjust its strategic focus?

“One of our biggest strengths at ASAP is the collective – every single person who drives the company forward with their passion and enthusiasm.”

We are dynamic and decisive, well connected across the entire corporate group, and our focus is always on our customers and the quality of our services. In addition, our strategic focus on future-oriented technologies in the automotive industry, which we have followed consistently for many years, is ideally suited to the mobility transformation and therefore also to our customers’ needs. Development services in new technological areas are a clear focus of our business model. We will continue our consistent exploitation of synergy effects between our various service areas and thus offer our customers a



high level of consistency and universality as well as a distinct overall understanding of all our services.

“As a result, even the rising complexity of technologies in vehicles presents less of a challenge and instead stands to benefit the continued development of the ASAP Group.”

In light of the ASAP Group's strong position in relation to future technologies, we currently see no reason to alter our strategic focus. In the course of our newly launched strategic project entitled 'Speed up', we will once again develop our strategically important service segments over the coming year, thereby further accentuating the ASAP Group's future direction.

Are you able to give us an idea of what is to come over the next few years?

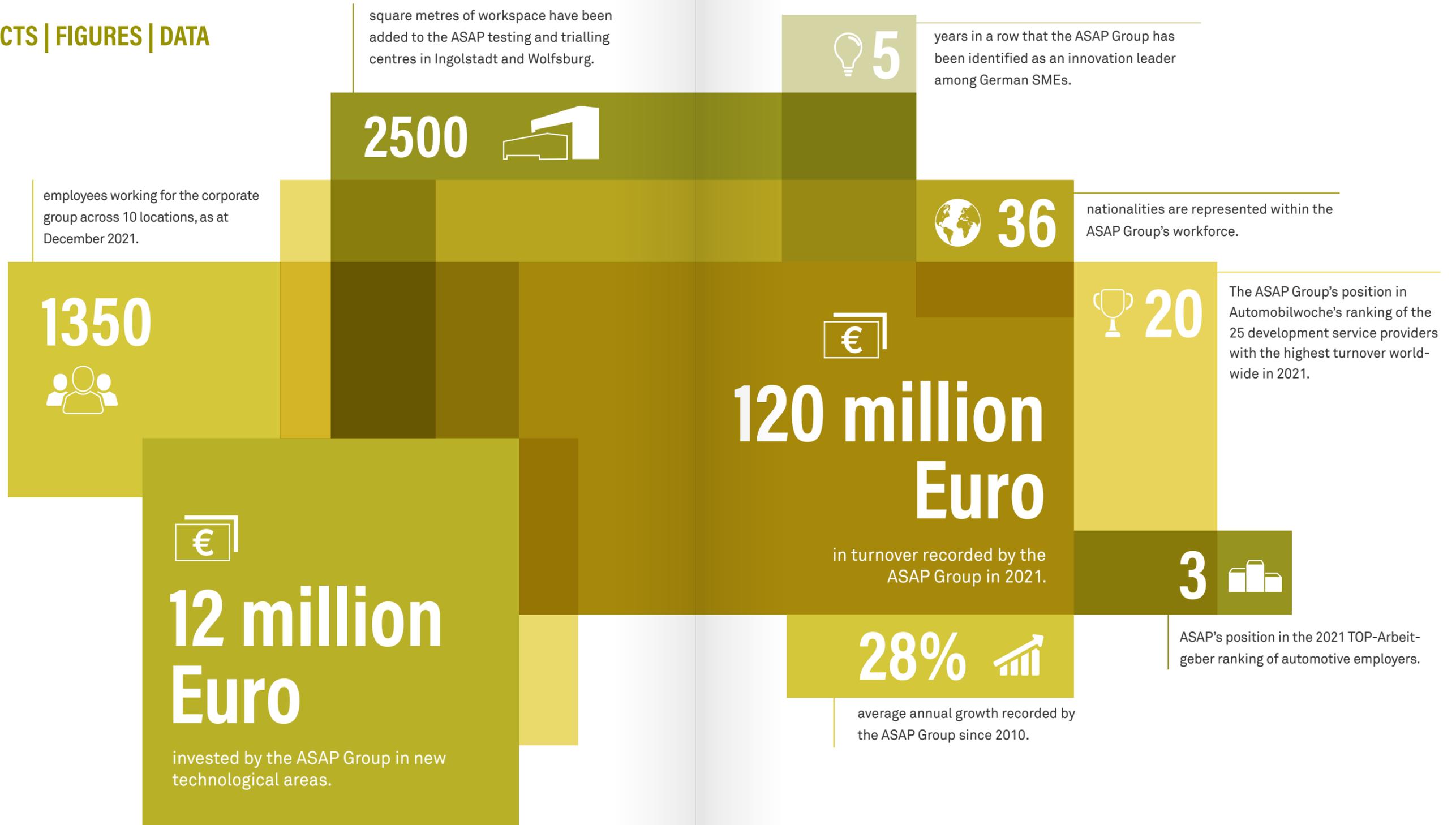
Looking to the next few years, our 'Speed up – ASAP 2025' strategy and implementation of the measures it contains will continue to promote the corporate group's development. This means that we will continue the systematic expansion – and continuous development – of our competencies and capacities in ASAP Group's strategic service segments. The qualitative and quantitative upgrading of our resources will happen both organically and through targeted measures. One thing that will play an important role in this is setting up further ASAP locations, not only in Germany but also internationally. Another is increased cooperation with partners in best cost locations as a means of countering growing cost pressure in the automotive industry and the increasing scarcity of skilled labour in one fell swoop. In addition, we will also make ongoing expansion of our cooperation with our strategic partner ZF Friedrichshafen AG a particular focus in future. Increasingly intensifying the networking of our services throughout the corporate group will be another central topic in the years ahead. This will enable us to keep optimising the consistency and universality of our services and exploit synergies. We will also pay special attention to our attractiveness as an employer and the topic of new work. Given that actively embracing the ASAP company culture

is fundamentally important for this, we will start in 2022 by devoting our attention to the measures developed in the 'Better together' project and their implementation.

“In regard to the future development of the ASAP Group in the years ahead, I am convinced that we will be able to maintain the momentum from 2021 and continue our positive development.”

2021

FACTS | FIGURES | DATA





INTERVIEW

THE ASAP GROUP'S MANAGEMENT REFLECTS AND LOOKS AHEAD

An interview with the members of the ASAP Group's management team, covering the challenges, events and highlights of the

business year 2021 as well as the developments and issues that await us in the years ahead.



Gürsel Sen

Gürsel Sen, Managing Director of ASAP Technical Service GmbH:

The 2021 business year was an unexpectedly good year for ASAP Technical Service GmbH. Due to the prolonged coronavirus pandemic and its negative impacts, we had expected to suffer financial losses – but instead, we ended up significantly exceeding our targets in the first half of 2021. The second half of the year was somewhat weaker on account of the

chip crisis. This was caused by production downtime in the automotive industry, which had a direct impact on our production-related services. Having said that, we were able to weather these phases without having to switch anyone to short-time work, as we were able to temporarily assign employees to support projects at other ASAP locations. ASAP's Brussels location also continued to grow steadily in 2021 – we established a rapidly scalable team of experts specialising

in all aspects of production, situated close to our customers. Overall, we were able to secure numerous new orders and ended the 2021 business year with solid figures.

Looking at the many challenges in our market environment, I consider the excellent results achieved by the entire ASAP Group to be a particular highlight of the past year. Despite the tough conditions, we were able to record strong growth. This shows that with ASAP's strategic direction and our continuous investment in future-oriented technologies, we have set the course for sustainable growth in good time. For me, another key positive is our increased work on projects for customers in the Bremen region; we are currently considering expanding our premises in the region by adding a new site. Our corporate culture at ASAP is another highlight for me. I think it says a lot about the high priority we assign to ASAP's corporate culture that, even in difficult times, we not only hold fast to our culture but also prioritise efforts to develop and adapt it to the new world of work, making it a focus in a year like 2021. In the course of our newly introduced culture project, we have been able to enhance our corporate culture at ASAP with very positive results.

Change will be the watchword in the years ahead – and I am certain that ASAP is ideally prepared to handle it. We must face up to the challenges brought about by the transformation of mobility in general and, in particular, by the electrification of the car. At ASAP Technical Service GmbH, we must

continue expanding our service portfolio and collaborations with customers in the field of quality assurance for electronic components. Ongoing employee training and investments in suitable testing equipment are absolutely fundamental to this. In addition, I believe that the current shortage of skilled workers – and therefore our efforts to rapidly grow our workforce – represents a significant challenge. Nevertheless, I look to the years ahead with great optimism and expect to see growing demand, and therefore solid growth, for ASAP Technical Service GmbH.

Robert Werner, Managing Director of ASAP Engineering GmbH Ingolstadt and ASAP Electronics GmbH:

The 2021 business year was very successful for ASAP Electronics GmbH at our Munich location. We were able to overcome the onset of the pandemic and the crisis year of 2020 with high capacity utilisation and without switching anyone to short-time work. Many projects gained momentum again in 2021, which made it possible for us to record decent growth at our Munich location. Proportionally speaking, we saw the strongest growth in electronic development – predominantly in the field of test methodology and design, but also in relation to test automation, SIL modelling and areas related to processes, methods and tools (PMT). We faced some challenges in a major project involving series production support for central vehicle infrastructure, but we managed to turn things around in the middle of the



Robert Werner

year and the initial results are already clear to see. In addition, we have made significant progress at our Ingolstadt location, both in relation to wire harness development and in terms of the project situation. We showed considerable improvement, especially in the second half of the year. For instance, we started a collaboration with a systems supplier in the field of platform development, including for electric vehicles, and

received an exclusive contract from another systems supplier. By contrast, the situation is somewhat more challenging in relation to vehicle construction. Following postponements for several project launches, we were forced to switch to short-time work at the start of 2021. However, as the year progressed, we were able to balance this out by gaining new customers so that, by August, the situation had returned to normal.

In addition to our strong development, a particularly highlight of 2021 for me was our Munich location taking its first steps in the field of e-mobility. We took on our first projects in series production support for HV components (charging/on-board power supply) and received further large-volume enquiries regarding the development of future vehicle generations. At this point, I'd like to stress the importance of the collaboration with our strategic partner, ZF Friedrichshafen AG. We successfully initiated our first joint project in the field of transmission control units. Beyond that, we also implemented a major project for ZF in the field of driver assistance systems, which involved generating and automating test cases as well as overall system validation for an Asian OEM.

At ASAP Electronics GmbH in Munich, we move into 2022 with a very positive order situation and, overall, I can provide a thoroughly hopeful outlook for the years ahead. We will continue to vigorously pursue our Vision 2025 for our Munich location – which involves further developing the site, focusing on services related to electrics and electronics, and expanding our capacities in the field of e-mobility. It is already clear that we will need to broaden our expertise and develop additional competences in the year ahead, with the areas of electronics development and e-mobility playing a central role in that. Given the numerous enquiries from major clients, the outlook for wire harness development at our Ingolstadt site

is also very positive. In the field of vehicle construction, I think there is a good opportunity to intensify our collaboration with our strategic partner, ZF Friedrichshafen AG, with regard to fully autonomous shuttles. All in all, I am convinced that thanks to their strong position in relation to future-oriented technologies in the automotive industry, ASAP Electronics GmbH's Munich location, and the ASAP Group as a whole, are well prepared for the years ahead and will continue to show positive development.”

Christian Schweiger, Managing Director of ASAP Electronics GmbH Ingolstadt and ASAP Engineering GmbH Ingolstadt:

For us, the 2021 business year can be divided into two very different halves, with the first half severely impaired by budget freezes and delays to project launches due to the coronavirus pandemic. As a result, utilisation of our testing and trialling centre at our Sachsenheim site fell below expectations. The situation then improved in the second half of the year, and we were able to significantly increase our customer diversification in all areas once again. Rising, long-term order volumes were accompanied by the recruitment of many new employees. New recruitment approaches enabled us to attract considerable interest and achieve an excellent growth curve. For example, we hosted the first 'ASAP dev.TALK' event – a combination of a BarCamp and a conference on topics related to software development

– and took part in a presentation format in which we could pitch our projects and vacancies. The year 2021 showed very clearly that our customers are focused on software development and electronics development services, as we received a disproportionately high volume of enquiries in these areas. Our Engineering Service and Communication Service, which were particularly hard hit by budget shifts and reductions last year, managed to turn things round and achieve a positive result. The current situation meant

that there were project postponements in our collaboration with our strategic partner ZF Friedrichshafen AG – yet, we still recorded stable growth in this regard, too. For example, there are new starting points for the collaboration, with our Test Systems division as the supplier of test benches.

As a result, a particular highlight of 2021 for me was developing our expertise and capacity in the field of software development – and we are working flat out to conti-

nue expanding our capacities. I also regard the Process Automation Kit (PAK), as a product of our own, as a major success. Our individually scalable automation solution is being used successfully by a major OEM customer, resulting in considerable time and cost savings in the series development of control unit software. I would also rate our development in the field of e-mobility as very positive, evidenced in particular by our investment in upgrading our test bench infrastructure for trialling power electronics and inverters. This includes creating space at our Ingolstadt location for new life cycle simulation systems, which our Test Systems team has developed and produced inhouse.

Looking to the years ahead, I consider the most significant challenge to be overcoming the rising cost pressure in the automotive sector while simultaneously dealing with the limited availability of skilled workers. Overall, however, the ASAP Group is in an excellent position for the future. We concentrated our services on future-oriented technologies in the automotive industry early on and continuously strive to make our service spectrum more consistent and universal. For many of our competitors, the need to shift to future-oriented topics (i.e. software-defined vehicles) is the subject of much discussion and presents enormous challenges. By contrast, ASAP started to address these megatrends several years ago. Customer feedback and our company's development

and success show that we were right to do so. For this reason, I believe that ASAP is on course for further success in the years ahead. I am convinced that we will continue to expand – especially in the fields of software and electronics development.”

Thomas Martens, Managing Director of ASAP Engineering GmbH Wolfsburg:

Following an extremely demanding business year in 2020 as a result of the coronavirus pandemic, we started 2021 with cautious expectations at the Wolfsburg site. Although capacity utilisation recovered significantly in the second half of the year, from a business perspective 2021 proved to be even more challenging than the year before. In addition to the prolonged nature of the pandemic, one particular reason for this was the chip shortage, which was accompanied by delays to project start dates and budget constraints from our clients, and had a severe impact on us. However, we used this phase to press ahead with customer diversification, positioned ourselves in new areas and further expanded our service portfolio. As a result, we acquired a number of new projects, including in the fields of electronics development, wire harness development and construction. We also established a new Software Development team at the Wolfsburg site. Initial projects are already successfully under way and our new employees are collaborating closely with software development specialists at other ASAP locations. Collaboration with our

Christian Schweiger





Thomas Martens

strategic partner ZF Friedrichshafen AG on testing and integrating new components and functions in fully autonomous shuttles has also progressed positively. Despite the challenging conditions, we have also been able to celebrate some exceptional successes this year. In particular, these include positioning ASAP Engineering GmbH Wolfsburg very effectively in the field of e-mobility. We offer our customers services that are

consistent and universal, and thereby deliver considerable added value. Most notably, these services focus on the commissioning and predevelopment of e-vehicles, high-voltage charging, and testing battery cells and modules. On a related note, the completion of the new testing hall at our testing and trialling centre is another highlight of 2021. By expanding our trial spaces and testing facilities, we have once again expanded our

development and testing services in the field of e-mobility. All in all, we gained a great deal of stability in 2021, which means that ASAP Engineering GmbH Wolfsburg starts the new year stronger, working at full capacity and with a good project landscape. I am convinced that, with the strategic focus of the ASAP Group as a whole, we will enjoy further strong growth in future-focused technologies for the automotive industry in the coming years and, in doing so, continuously expand our service spectrum. At our Wolfsburg location, I see particular potential in the field of e-mobility – focusing on the areas of batteries and charging/infrastructure – along with software development and mobile services. Above all, battery cell testing and the related upgrades to our test system infrastructure will remain key focuses in 2022.

Martin Ott, Managing Director of ASAP Engineering GmbH Weissach and ASAP Engineering GmbH Lake Constance :

“The summary of the 2021 business year is thoroughly positive. The start of the year was dominated in particular by the founding of ASAP Engineering GmbH Lake Constance on 1 January 2021, which served as a clear sign of our intention to continue intensifying our strategic partnership with ZF Friedrichshafen AG. With the new company, we set ourselves the target of doubling already healthy growth – and managed to surpass even that. Our team in Friedrichshafen grew

significantly as new projects were acquired. It is particularly pleasing that the team has become a close-knit unit following a series of team-building measures. We also significantly improved our results again at ASAP Engineering GmbH Weissach in 2021, primarily thanks to structural optimisations and attractive new projects. At the start of the second half of the year, this site returned to a state of constant productivity following a challenging year in 2020, with the areas of software development, electronics development and CAD engineering leading the way with a number of large-volume orders. Our Wire Harness Development team also made excellent progress, with initial extensions already announced for projects started in 2021.

With this in mind, a particular highlight of the year for me was the outstanding progress and excellent results both companies achieved. ASAP Engineering GmbH Lake Constance in particular was well above target. One positive aspect to note in this context is the fact that we were able to generate a lot of new project enquiries thanks to direct internal recommendations from our customers. This has enabled us to substantially grow our trusting collaboration with our strategic partner ZF Friedrichshafen AG over the past year. This kind of sustainable growth – securing new orders thanks to impressive performance in past and ongoing projects – is an outstanding success and demonstrates that, through the high con-

sistency and universality of our services and our many years of experience working with future-oriented technologies in the automotive industry, we offer our customers outstanding added value and support as a partner in the development process.

I believe that rising cost pressures in the automotive industry and the growing shortage of skilled workers will be the most significant challenges in the coming years. This is why, at our Lake Constance site, we have launched a pilot project to widen our

search for talent internationally and focus on language learning and education. In addition, it is important to reconcile ASAP's corporate culture with the changes in the world of work. The sense of community that shapes our work at ASAP should obviously remain central in the future. In the ASAP 'Better together' culture project, multisite teams made up of employees from various hierarchical levels developed a number of ideas and measures that will be introduced gradually in 2022.

Martin Ott



The year ahead will also be very eventful for our Lake Constance site. For example, we will move into our new offices in Friedrichshafen itself at the start of the year, significantly expanding the space available to us. This should offer our employees optimal conditions for office working and also allow them to network and connect better with one another. In addition, we have set ourselves ambitious goals for significant growth in 2022. We want to continue the growth at our Weissach location, especially in relation to electronics development and software development. Collaboration between sites, particularly in these areas, will also continue to intensify at ASAP. All in all, I expect to see very positive development at both locations in the next few years."

Volker Schier, Managing Director of ASAP Engineering GmbH Rhine-Main :

Following a very challenging 2020 for ASAP Engineering GmbH Rhine-Main – in which we were severely impacted by budget reductions and postponements to project start dates from our customers – the demanding 2021 business year ended up being very successful for us. At the very start of the year, we received major new orders that ensured we were able to work at almost 100% of capacity for the entire year. Our services were barely impacted by the chip shortage and in the first half of the year in particular, our teams were supplemented with a number of new

recruits. Our test drive team, for example, more than doubled. Among other things, we received contracts for large test drive projects, which involved collecting data for the development of driver assistance systems across the whole of Europe. Test drive projects have continuously increased in complexity in recent years. Given the additional requirements in measurement technology, implementation now involves far greater volumes of data than in the past and requires a far higher number of routes. We have gained expertise in this field over many years and support our customers as a development partner.

A particularly positive point to underscore in 2021 was the continued stable growth of ASAP Engineering GmbH Rhine-Main. We successfully acquired new projects, worked to full capacity most of the time and as a result, showed growth. Growing our Electronics Development team was another key milestone. Our location will place its focus in this area on trials of driver assistance systems on testing grounds. We will continuously expand our services related to ADAS and NCAP tests, and we regard cooperation with suppliers to the automotive industry as an excellent opportunity for further development.

Following the successful completion of a handful of projects at the end of 2021, one of the challenges in 2022 will be to continue working to a high level of capacity.



Volker Schier

Overall, however, I look to the years ahead with positivity; I am convinced that we have considerable potential for further growth at ASAP Engineering GmbH Rhine-Main. Working with all other ASAP locations, we will continue to expand and develop the cooperation with our strategic partner ZF Friedrichshafen AG. The fields of driver assistance systems and electronics development have a substantial role to play –

we can provide support with our services in close proximity to our customers. In addition, we are currently planning to set up a Software Development team at our Rhine-Main location. The goal is to establish a central team capable of providing crosslocation project support throughout the entire ASAP Group, which will allow us to further intensify the use of synergies within our corporate group.

Robert Morgner, CFO of the ASAP Group:

In the 2021 business year, we managed – despite the many challenges in our market environment – to continue the growth of the ASAP Group. At around €120 million, we recorded the highest aggregate turnover in our company's history and have grown much more robustly than was the case for the industry on average. I believe it is our strategic focus on future-oriented technologies in the automotive industry that underpins these positive developments and ensures, through our service portfolio, that we are part of the automotive transformation. With our services in the areas of electronics development, e-mobility, software development and testing, we are actively driving forward future-oriented topics and supporting our customers on this journey. Another positive, in my opinion, is our decision to press ahead in 2021 with the digitalisation measures introduced at the start of the coronavirus pandemic, which has made our processes overall even faster, more digital and more streamlined. I'd also like to take this opportunity to draw attention to the many awards we received over the year, naming us as a top employer.

A particular highlight of the last year for me would be the remarkable innovative power shown by the entire ASAP Group. Even in a challenging year such as 2021, we once again increased investment in our production areas to €12 million in total. For instan-

ce, we invested in a product of our own, the Process Automation Kit (PAK), as well as our development and testing capacities in the field of e-mobility. In addition, we once again secured the TOP 100 award as an innovation leader among German SMEs and also received innovation funding from the Federal Ministry of Education and Research (BMBF) for three of our projects. Another major success for us in the 2021 business year was the strong growth of the ASAP Group. We successfully increased our aggregate turnover by 20%, with exceptionally strong growth in our strategically important areas of software development and electronics development. Furthermore, we were able to recruit a lot of new employees for the ASAP Group, once again demonstrating how attractive we are as an employer.

Since I still regard the scarcity of skilled labour as a significant challenge, being such an attractive employer and using innovative recruiting measures will be very important in the coming years. Our strategic partnerships – such as the partnership between the ASAP Group and fka GmbH – will also become ever more important in ensuring we can rapidly scale up project teams. From an economic perspective, we will also increasingly need to integrate partners from best-cost locations. I expect that a further challenge in the years ahead will lie in handling the transformed world of work, a development given added impetus by the onset of the coronavirus pandemic. In this context, it is important to



Robert Morgner

retain a balance between new ways of working and flexible work structures on the one hand, and preserving and refining our ASAP company culture and our employees' identification with ASAP on the other. All in all, though, I believe the corporate group is very

well prepared for the future and in a position to continue achieving solid growth. We have the right strategic focus, we have the right spirit – and our aboveaverage market growth is confirmation of that.”

HIGHLIGHTS 2021



← 100m

48
mph

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AR HUD VALIDATION

ADAPTING AN ADAS TESTING APPROACH FOR INFOTAINMENT VALIDATION

AR head-up displays (HUD) play a pioneering role in two respects. Not only do they provide comprehensible and realistic real-time displays in the driver's field of vision, in doing so they also build trust in drive-assistance systems (ADAS). This helps to pave the way for autonomous driving. However, similar to the development of highly automated ADAS, the countless situations and parameter combinations that an AR HUD will face makes it impossible to specify

all test cases for validation. Consequently, conventional testing approaches alone will not be sufficient. The ASAP Group, a development partner to the automotive industry, therefore uses scenario-based testing – a method with its origins in the field of ADAS. ASAP has adapted this approach for infotainment and, by combining it with keyword-driven testing, delivers time and cost savings while simultaneously performing comprehensive validation.

The HUD shows vehicle and traffic information, warnings and navigation information, projected onto the windscreen. Providing important information directly in the driver's field of vision helps to make driving significantly safer and more convenient. When combined with augmented reality (AR) to form AR HUD, this effect is reinforced. Displaying virtual information directly in the driving situation ahead of the vehicle creates an augmented reality, as these virtual directions and actual, real-world occurrences merge to create an overall image. Forward-looking, precise displays allow drivers to grasp situations more quickly. In addition, AR HUD makes a vital contribution to communicating ADAS responses – such as lane corrections by the active lane assist system – in a way that is clearly understandable, thus ensuring that drivers do not feel uncertain or uneasy. As a result, AR HUD creates trust in the ADAS, thus helping to lay the foundation of acceptance that future autonomous driving solutions will need. Ultimately, this technology will require consumer acceptance in order to be successful, yet acceptance in Germany currently remains under 50%. [1] Now that the legal framework has been established for autonomous driving in Germany from 2022 [2], this vision for the future is one step closer to becoming reality. For AR HUD to live up to its pioneering role, proper validation of its perfect functioning is vital. The ASAP Group has a service spectrum that includes all aspects of (AR) HUD development and provides validation services for

its clients, applying scenario-based and keyword-driven testing in the process.

High-performance control units present new challenges

The need for new validation approaches also stems from fact that many OEMs plan to build vehicle architectures around central high-performance control units in future. This necessitates new processes and new ways of working. While functions have thus far been distributed between numerous control units within a vehicle, future generations of vehicles will only feature three to five centralised high-performance control units responsible for logic and function. Each will be combined with simpler control devices for component regulation and control. The first models using this centralised approach are already in series production. In the example of AR HUD, this means that the majority of logic in past HUD control units is instead mapped out in a single software module (AR Creator), which is in turn part of a high-performance control unit. The AR HUD control unit itself only contains basic functionalities, such as displaying the video stream generated by AR Creator. This changes development and validation processes at a fundamental level. As the high-performance control unit is responsible for the AR Creator as well as the logic and function of many other components, there are far more interfaces to take into account, along with 10 to 12 times as much stored source code.

The numerous interdependencies between the individual functions make it vital to obtain an overall understanding of the connections – beyond knowledge simply of the components within a specific domain – and also increase the need for coordination. While validation was once downstream from development, the use of central high-performance control units means that testing is now conducted in parallel with development. This makes it possible to identify errors at an earlier stage in development but also increases the complexity of validation. Testing always uses an iterative development model at the end of each sprint using, which allows for dynamic adjustments to the features being tested. However, this means that validation needs to be significantly faster and more flexible. In addition, the degree of complexity in how AR HUD itself functions poses entirely new challenges for validation – which is why ASAP is exploring entirely new avenues.

Sensor data fusion and extrapolation for real-time display

The aim is to project virtual information directly onto the real-world environment in front of the vehicle, so this information must be displayed in real time. Consequently, instead of the simple signal logic previously used in HUD systems, AR HUD requires sensor data fusion and extrapolation of all data. This is because all input data that is relevant for ADAS functions – the input from all ve-

hicle sensors and cameras – is also of vital importance to the AR HUD system. Let's look at an example. Adaptive cruise control (ACC) ensures that a vehicle brakes automatically when necessary due to a given driving situation, such as a car ahead moving at a slower speed. In this case, the AR HUD must display the braking action to the driver as a virtual notice in the real-life driving situation with the slower vehicle ahead in a way that is clear and comprehensible to the driver. The input signals for AR HUD have an extremely high information density. Therefore, it is not possible to provide a complete specification for validation, as there is an infinite number of situations in which static and dynamic objects could be identified and sensor data fusion would have to provide a conclusive overall image. However, some variable parameters can result in accurate recognition of a person, for example, and cause AR Creator to generate and display a corresponding virtual signal for the driver, including: the person's size and speed; the angle between the person and the vehicle; lighting conditions; weather; the road surface and objects such as trees and signs. Evaluating all of these parameters in every conceivable combination is simply impossible. The extrapolation of all data is a further challenge for validation. Extrapolation must take place in real time to provide a meaningful AR HUD that delivers added value for the driver. Due to the signal transit time from cameras and sensors, this data needs to be precalculated so that the AR HUD can make a prediction. If, for exam-



ple, a driver were to turn slightly and the system identified another vehicle ahead that was offset from the vehicle's own course, the AR Creator would have to pre-calculate the route ahead and tailor the virtual signals displayed accordingly. Due to the complex functioning of AR HUD, real-world test drives and conventional testing approaches are unsuitable for time-efficient and cost-efficient validation.

Validating dynamic processes through scenario-based testing

The ASAP Group has therefore adapted scenario-based testing, which has its origins in the field of ADAS, for use in AR HUD validation. By referring to the PEGASUS project, ASAP can conduct effective and efficient testing while simultaneously taking heed of the risks involved. The PEGASUS

research project, pursued by OEMs and numerous other partners from the worlds of business and science, has set itself the aim of establishing “generally accepted quality criteria, tools and methods as well as scenarios and situations for the release of highly automated driving functions” [3] and thus accelerating the realisation of autonomous driving. ASAP looked at the results of the PEGASUS research project while adapting scenario-based testing for AR HUD validation – and thereby reduced the complexity inherent in validation due to the near-infinite number of possible test cases. Unlike requirement-based testing, which ASAP uses in parallel for static spot checks, scenario-based testing makes it possible to validate dynamic processes – such as speed changes and all manner of traffic situations (e.g. exiting a roundabout) with a variable environment (other road users) and wide-ranging environmental conditions (rain, snow, fog, etc.). The ASAP specialists responsible for test design specify both the required scenarios and the test cases. When specifying scenarios, they start by defining all the static and dynamic objects that should be included in part of a scenario, such as an overtaking manoeuvre in an urban environment. The description includes detailed information about all environmental factors, including the parameter spaces for the defined objects. This includes, for example, all possible distances and speeds of a vehicle driving ahead. It describes the basic sequence of action

in a scenario. By contrast, when it comes to specifying test cases, the level of abstraction is far lower. Instead, test drives are set out with specific values for all objects involved in the test case so that (for example) the overtaking manoeuvre described as a scenario can be carried out correctly. Using the defined driving scenarios and test procedures, including the expected results (test cases), ASAP can validate the transmission of data from AR Creator through to the display of information by the AR HUD control unit. This form of validation, which is entirely new to the infotainment field, offers numerous advantages. Scenario-based testing makes the time-efficient and cost-efficient validation of AR HUD possible for the first time – as the rest-bus simulations deployed in conventional testing methods would need signals and values to be specified manually. Given the countless parameters and their infinite combinations, it would simply not be possible to realise a manual rest-bus simulation in an appropriate time frame. Another significant advantage lies in the fact that this approach also enables the validation of correct data extrapolation – which is necessary for AR HUD but is difficult to check. It allows us to precisely define the edge cases and expected values in test cases. This makes it possible, for example, to validate the pre-calculation of a curve and the corresponding display of an appropriate virtual signal by the AR Creator, ensuring that the two aspects are precisely in sync.

Keyword-driven testing for automatic test case generation

Although scenario-based testing makes it considerably easier to carry out testing, the vast number of different scenarios increases the complexity of test automation. The solution is to use test automation to depict thousands of test cases in such a way that the test themselves can be fully automated. To do this, the descriptions of test cases and driving scenarios must be automatically implemented in the corresponding tools. In AR HUD validation, the toolchain comprises around 12 different tools in addition to the AR HUD control unit and the high-performance control unit that includes the AR Creator. Test automation is tasked with bringing together the entire toolchain and ensuring that all tools engage with one another automatically and without interruption. At the start of a test run, for instance, the test automation automatically starts all connected tools or controls a single tool to conduct an automated cross-check of the target image and the image actually displayed at the right point in time. In order to implement test cases more swiftly and reduce the complexity of test automation, ASAP combines scenario-based testing with keyword-driven testing for use in AR HUD validation. In this form of test-case description, which is certified in accordance with ISO 29119-5, individual test steps are stored in a database in both human-readable and machine-readable formats. This means that ASAP

starts by writing a corresponding script for each defined test step – the so-called key-words – so that it can be carried out automatically. A test might be a command to control a certain tool. Once defined as final, all keywords (test steps) can be deployed universally and parametrised in the database. If, for example, a line displayed by the AR HUD to depict the ACC feature should be a particular colour, this information can be input and stored. This creates reusable test steps that only need to be parametrised with different input values. The process of inputting test steps to create a test case is also automated. The result? Partial automation of test automation, which delivers immense time savings due to the enormous volume of test cases required for AR HUD validation. A further benefit of keyword-driven testing is that, if changes are required, the corresponding keyword only needs to be amended once in the central database, with any amendments then automatically taken forward in all future test cases. Further significant advantages also lie in the fact that test steps are stored in human-readable and machine-readable formats in the database. On the one hand, real test drives can be reproduced using the documented data and repeated virtually any number of times until the desired result of validation is achieved or the scenario has been checked to ensure consistent quality. On the other hand, virtual test drives can also be reviewed in real-world test drives, as test cases are available not only as scripts but also in

human-readable format for the test driver. By adopting this new approach – a combination of scenario-based and keyword-driven testing – ASAP thus reduces the complexity and effort involved in test preparation and execution, ultimately ensuring time-saving, cost-effective and comprehensive validation of AR HUDs. ASAP is currently developing a corresponding test bench to further optimi-

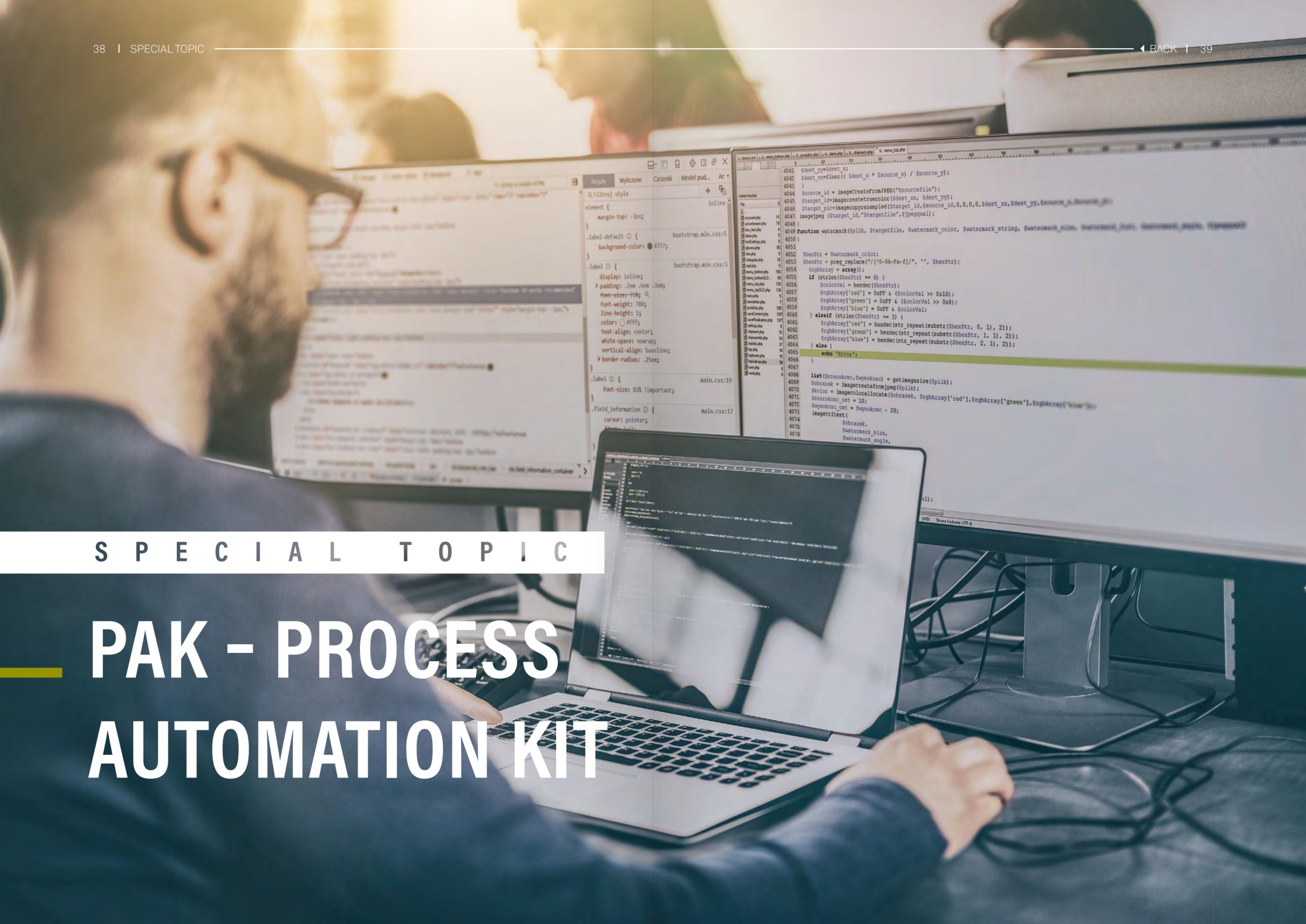
se the process. Its modular structure will ensure that all interfaces are easily accessible and all hardware versions and prototypes can be swapped in and out without difficulty. This system will enable us to implement all test drives more efficiently in future – and, once it receives approval, AR HUD can lead the way to the future of autonomous driving.

Reference:

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SPECIAL TOPIC

PAK – PROCESS AUTOMATION KIT



PROCESSES – METHODS – TOOLS: RETHINKING DEVOPS

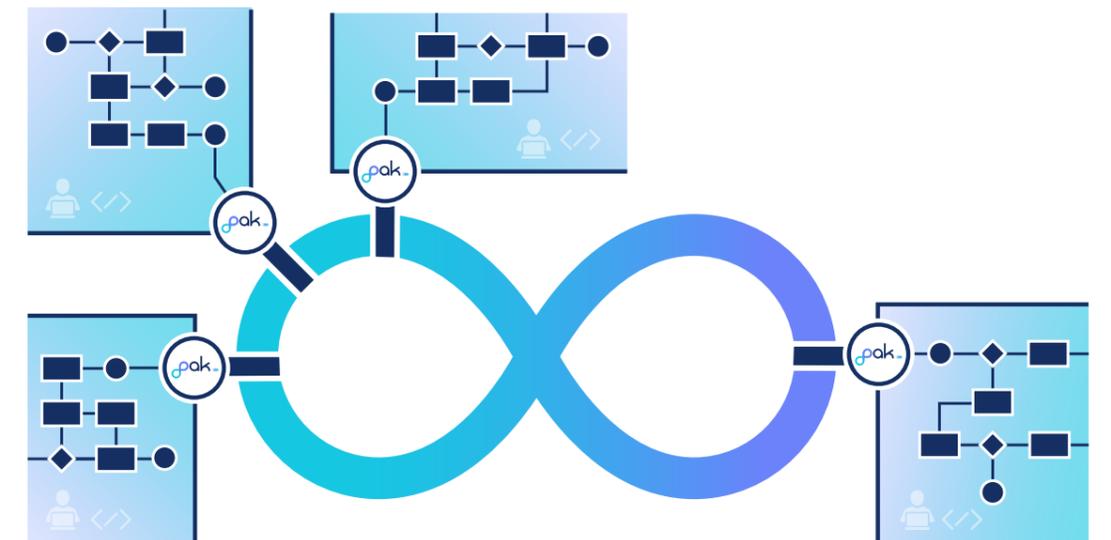
INDIVIDUALLY SCALABLE SOLUTION WITH MODULAR SYSTEM MAKES IT POSSIBLE TO MAP AND AUTOMATE PROCESSES, METHODS AND TOOLS AT THE DEVELOPER LEVEL

Uniform and comprehensible processes, methods and tools (PMT) – for many, this is both a vision and a basic requirement for meeting the challenges of automotive software development and successfully bringing the latest platform architectures to series maturity. Although fully homogeneous PMT remains something of an illusion, OEMs and suppliers have long been working to create universal process landscapes and are banking on automation solutions and agile working. The most decisive factor, however, has thus far gone widely unnoticed by automation solutions in the DevOps pipeline: people. In the development of so-called ‘software-defined cars’, processes and methods not only need to be automated, they must also be observed and embraced by everyone involved. With this in mind, the ASAP Group has developed the Process Automation Kit (PAK)

– a framework for individual, scalable and reusable automations and a useful addition to common DevOps practices. The PAK demonstrably reduces the complexity, time and cost of development while improving developer acceptance and quality. The PAK incorporates 11 years’ experience of PMT development in the series development of ECU software at an OEM. ASAP redeveloped the PAK based on this expertise, creating a solution that targets the point at which other comparable solutions stop: it focuses on the people in the DevOps pipeline. The modular system concept makes it possible to define and automate development steps for specific developer roles and reuse these later for other processes. The PAK guides developers through their work, reducing the burden on them and thus creating more time for creative, value-adding work and improving employee satisfaction.

The future will vastly increase the importance of the electronics and software used in vehicles [1]. Forecasts suggest that, by as soon as 2025, the proportion of the costs for these components in vehicles will increase by 19 per cent in comparison to the other components [1]. While the time to market for new software continues to fall, including through over-the-air updates, the software itself is simultaneously becoming increasingly complex. Automotive manufacturers and suppliers must comply with established and new standards and requirements set down in the Automotive SPICE, ISO 26262 and UNECE-WP.29 standards while also using agile approaches to break

complex projects down into manageable steps. If companies are to successfully overcome these challenges, they must fundamentally review their PMT structure. It is important to create consistent and harmonious processes, methods and tools, support the creative work of everyone involved in the process and, at the same time, create an efficient system.



Automating development steps in specific developer roles throughout the DevOps pipeline

“COMPANIES NEED TO FUNDAMENTALLY REVISE THEIR PMT STRUCTURE”

AN INTERVIEW ON PROCESSES, METHODS AND TOOLS (PMT) WITH SEBASTIAN HEINEMANN, HEAD OF SOFTWARE ENGINEERING AT ASAP

A consistent PMT landscape – nice to have or essential?

Sebastian Heinemann: “Consistent and comprehensible processes, methods and tools (PMT) is wishful thinking for many operational developers, process owners, quality assurance officers, development budget holders, project supervisors and managers. At the same time, it is a basic requirement for overcoming the challenges of automotive software development and successfully bringing the latest platform architectures to series production. This is because, on the one hand, complexity is continuously increasing, while on the other hand, the time-to-market for new software is becoming shorter due to over-the-air updates. Plus, automotive manufacturers and suppliers must comply with established and new standards and requirements set down in the Automotive SPICE, ISO 26262 and UNECE-WP.29 standards while also using agile approaches to break complex projects down into manageable steps. If companies are to successfully overcome all of these challenges, they must fundamentally review their PMT structure. It is important to create consistent and harmonious processes, methods and tools,

support the creative work of everyone involved in the process and, at the same time, create an efficient system.”

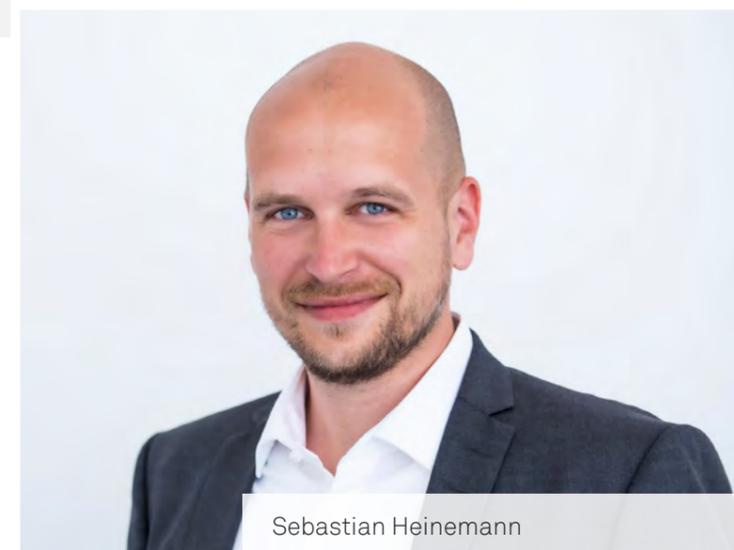
Are there further challenges regarding PMT?

Sebastian Heinemann: “In addition to new process and quality standards I’ve mentioned and the need to release software at increasingly short intervals, there is another aspect that means we need to dissolve the predominantly heterogeneous, disconnected, control unit-specific PMT structures used to date: In future, vehicle architectures at many OEMs will be based on central high-performance control units. This means that future generations of vehicles will only feature three to five centralised high-performance control units responsible for logic and function, whereas functions to date have been distributed between numerous control units within a vehicle. The central high-performance control units will then be combined with more simple control units to regulate and control components. The first models following this centralised approach are already in series production. At the organisation level, that is to say in relation to cross-domain PMT responsibility, this

means that fundamental process-related and technological decisions are taken for all domains. On the one hand, this involves implementing comprehensive, binding specifications from development and validation process and quality standards such as A-SPICE, ISO 26262, UNECE WP.29, ISO 29119 and ISTQB, as well as for homologation purposes. On the other hand, technological and cross-cutting decisions on tools need to be taken in the areas of lifecycle management, source code management and cloud systems.”

What makes the process of implementing consistent cross-domain solutions so complex?

Sebastian Heinemann: „In addition to the points I’ve mentioned, different domains need to use individual methods and tools for their projects. Let’s take the field of drive system and chassis functions, for example. These systems are often equipped with functions that often relate to control technology and can be implemented most efficiently through model-based systems engineering (MBSE), code generation and with a conventional MIL-SIL-HIL approach in validation. On the other side, there’s ADAS/AD systems, where we encounter challenges partly based in control technology and partly in algorithms – such as longitudinal control, sensor-data fusion, object classification and the use of arti-



Sebastian Heinemann

cial intelligence. Functions are implemented in objectoriented languages such as C++. Validating this type of software often requires scenario-based testing in complex co-simulation environments. We also have infotainment systems, which are implemented with Java and other languages. The challenges in this field lie in UX development, graphical systems, complex state machines and entirely individual validation methods, sometimes using image processing. Finally, there are also connectivity systems that compute the functions and data in the vehicle, in the cloud and on mobile devices. These systems entail entirely different challenges in software implementation and end-to-end validation. Creating uniform cross-domain solutions for this while also supporting individual domains with their specific challenges and technologies really is a monumental task.“

What does this mean for your vision of a consistent PMT structure?

Sebastian Heinemann: “In summary, it means that the various domains and their

widely varying technologies present entirely different challenges for implementation and validation methodologies and, therefore, the methods and tools used. So, we need to take a differentiated view of the requirements of the most homogeneous, detailed and applicable PMT possible. It is not possible to implement these requirements in this way, at least for the implementation and

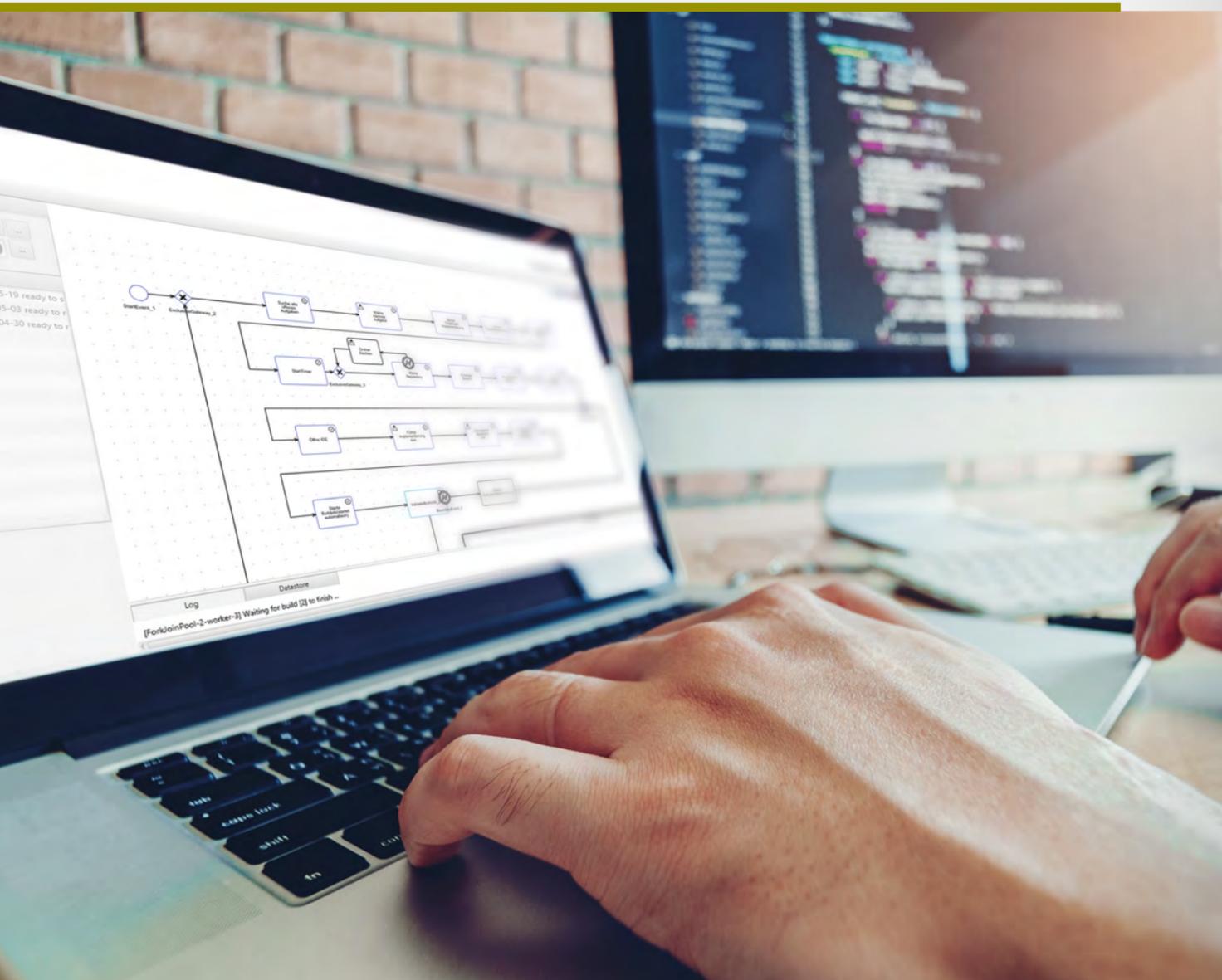
software validation level (in the context of A-SPICE: SWE.3 to SWE.6 inclusive). A fully homogeneous PMT landscape will remain something of an illusion in the future, as the detailed technological challenges involved in the development and validation of future drive, ADAS/AD, connectivity and infotainment systems are simply too great.”

Solution approach based on consistent use of DevOps

DevOps – a portmanteau of ‘development’ and ‘operations’ – follows the approach of creating an organisational culture based on cooperation and self-responsibility [2] and originated in IT and software-based technology firms. Today, DevOps is mainly regarded only as a method and toolset for implementing high levels of automation in development processes in order to accelerate the development and operation of software-based products or make them more performant. DevOps approaches have now become established in the automotive industry and are seen as potential enablers of the future development of ‘software-defined cars’. The skilful use of tools and agile cooperation models enable development to proceed more swiftly while also reducing error rates in the development and operation of new software products [3]. The individual development steps (plan, code, build, test, release, deploy, operate and monitor) dovetail seamlessly and form the phases of the DevOps pipeline. Embedding them in an infrastructure made up of continuous integration, continuous testing, continuous delivery and monitoring also delivers speed and scalability. If a developer makes changes to a code, not only are these changes continuously brought together in the current software status, they can also be executed and tested automatically. The developer therefore receives prompt feedback and,

if necessary, can make further changes to the code and restart the consistent process throughout the DevOps pipeline. Through its agile mindset as a collection of cultural components and suitable processes and tools, DevOps provide a framework for this new form of collaboration. Nevertheless, despite all this automation, the human factor remains decisive because, to achieve the desired results, everyone involved must follow new processes and embrace the DevOps culture. At the same time, A-SPICE, ISO 26262 and other standards, in combination with domain-specific requirements, create a complex framework.

The major challenge therefore lies in conveying to all operational developers – in their specific roles as requirements engineers, architects, function/software developers, integrators and testers – what their duties are and what is expected of them. This results in long, specific induction phases and operational tasks that sometimes serve only to satisfy process requirements or the time-consuming use of a specific tool chain. The original DevOps concept of encouraging employees to cooperate and thus promoting their creativity and value-adding activities often faded into the background. This is why the ASAP Group, a development partner to the automotive industry, has developed the Process Automation Kit (PAK) – the automation solution that targets the point at which other solutions stop: the developer level. The PAK makes it possible to map complex PMT



in an organisation and a specific project at the developer level, automate it wherever possible and focus on the people in the DevOps pipeline. The PAK is a suitable solution for any DevOps-based organisation – and organisations looking to implement DevOps – as a useful addition to their own automation pipeline.

Single source of truth for automated process steps

In smaller teams in which developers help themselves and use scripting to create individual automated processes, it is common for continuously growing, unmaintained mini-ecosystems to develop. Over the longer term, this can often cause higher maintenance costs than may be apparent. The PAK can help with this: thanks to its modular system concept, the PAK makes it possible to define and automate development steps for specific developer roles, and then reuse these later for other processes. The PAK makes it possible to offer all teams – up to the organisational level, that is to say in relation to cross-domain PMT – a marketplace for process automation, which can be used and expanded in different areas. This creates a methodology toolbox containing all previously developed process step automations, which require no further creative work from the developers. In this respect, the PAK toolbox serves as a single source of truth. All departments can draw on the toolbox: it stores existing automations that have been

tested and approved as ‘commands’, are always up to date and can be used at any time for new processes. Once developed, these ‘commands’ can be used as often as desired in any future workflow model and deployed in the PAK Editor with a click of the mouse to map and model processes or workflows. New processes can therefore be automated faster and faster over time, which makes it possible to scale the solution. The result? Using a single process language creates universal and consistent process definition and method definition for all teams and projects. In addition, the PAK removes the need for developers to learn process steps off by heart and also offers greater scope for creative development work. The PAK releases developers from process steps that do not add value, guides them through the development process and informs them as soon as they need to provide active input. Ultimately, the PAK allows developers to devote more time to creative work and also improves employee satisfaction.

The PAK thus demonstrably reduces the complexity, time and cost of development while improving quality. In fact, the original solution for fully automated development has already been in use in functional and software development at an OEM for ten years. Over time, ASAP has collected a wealth of experience in productive use of the solution. Based on these requirements and insights, ASAP fundamentally redesigned the PAK, completed with state-of-the-art

technologies from the DevOps landscape. Let’s look at an example that shows the potential time savings through use of the PAK – and therefore the potential to save on development costs. Ten years ago, before any automation had been introduced, the entire field of function and software development at an OEM took around six working days in total to achieve a new stage of integration. This meant the OEM could achieve around 50 stages of integration per year. Today, progress moves at around 1,000 stages of integration a year, with a developer only needing a maximum of 1.5 hours for each stage – as the rest is fully automated. Yet, despite this twenty-fold increase in integration stages per year, the number of developers – and therefore the development costs – have remained stable.

How PAK works, in detail

Before implementing the PAK, it is necessary to conduct an extensive analysis in which ASAP works with the customer to document and define the individual development steps for each specific developer role. This analysis includes all existing and missing processes, all tools used in development and any required tool adapters. As a basic principle, all tools with a programmable interface (API) – whether for source control management, configuration management, testing, development or modelling – can be controlled with a corresponding tool adapter through the PAK. By conducting a detailed analysis, ASAP experts then determine which development steps can be controlled through the PAK to deliver improved quality



FIND OUT MORE

If you want further information, click the following link for [a video explaining](#) how PAK works and the advantages it offers:



Video explaining how PAK works

and automation. This includes all repetitive activities that require no creative input from developers. All remaining development steps not suitable for automation are defined as 'human tasks'. The PAK subsequently informs developers as soon as their active input is required. Initially defining process steps that cannot be automated as a 'human task' until a suitable tool adapter is developed and only later storing them as an automated 'command' in the PAK makes it possible to implement processes gradually with the PAK and flexibly manage and increase the level of automation. This makes it possible to imple-

ment automation of even the most minor process modules immediately and ensures uninterrupted development.

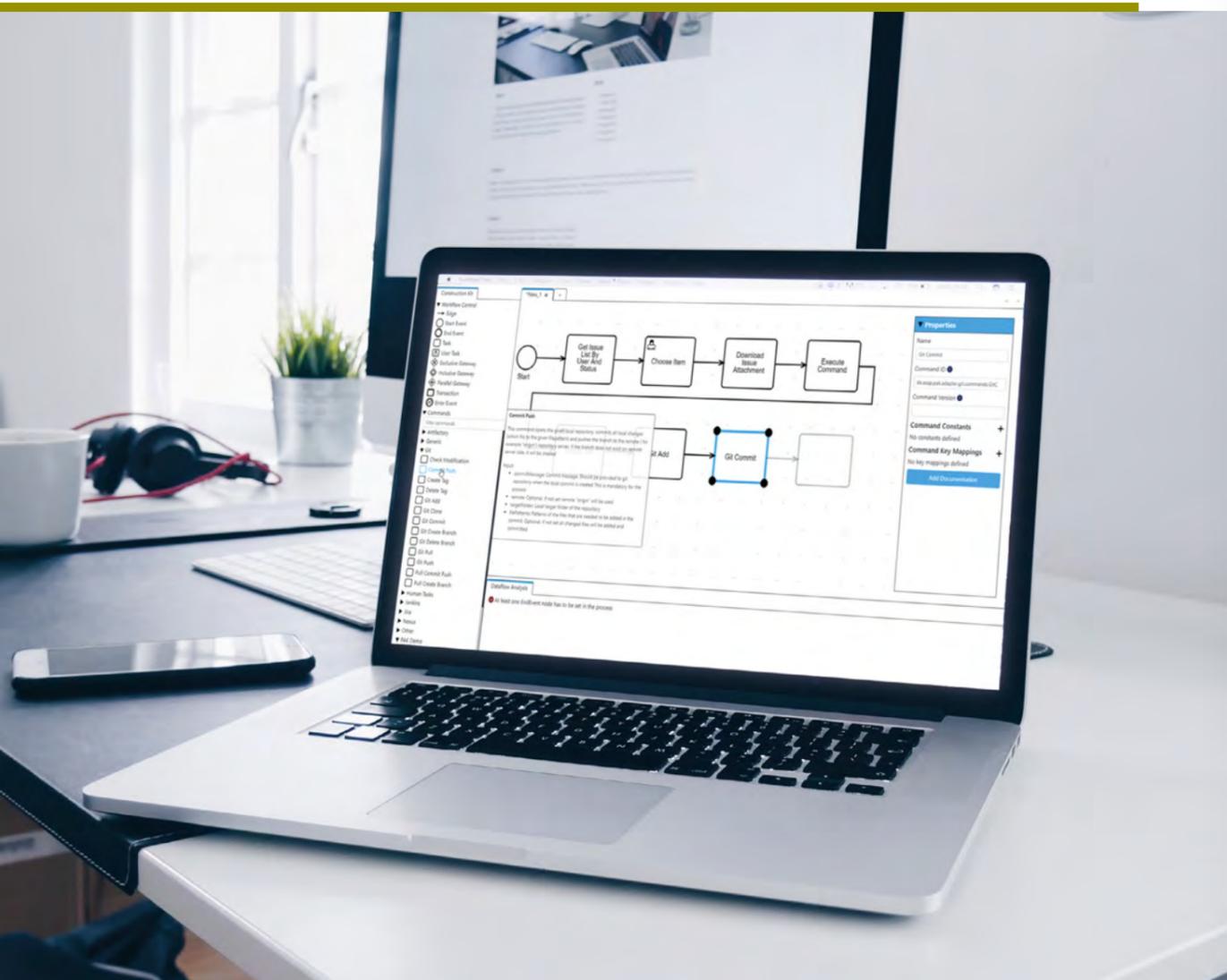
After process analysis, the next stage is workflow modelling in the PAK Editor, which involves structuring and documenting the previously defined development steps. The method toolbox in the PAK Editor makes individual function components such as 'Configure tool', 'Set ticket status' and 'Human task: Set label' available for the entire organisation and reusable for as many processes as desired. 'Human tasks' can be

gradually replaced with newly developed components when it is sensible and cost-effective to implement them. In addition, developers define the characteristics of each individual process step in the PAK Editor – for example, where certain input comes from, where it goes, and how the newly generated output is transmitted. The PAK Editor's data-flow analysis examines data validity and process paths in the process model at all times. This analysis runs automatically in the background and highlights incorrect or incomplete process paths as well as missing input or output details. Workflows are modelled in machine-readable and standardised formats such as BPMN. This makes it possible to draw on existing processes and their documentation and use them for the PAK. The PAK can model and execute parallel workflows and also offers the ability to model dedicated fault paths and trigger compensatory reactions. Complex, lengthy workflows can be interrupted at any time, with their status stored so that they can be continued at a later point.

Numerous advantages for development

In addition to the advantages described above, developers also benefit from the automation solution's multi-lingual character. Unlike most frameworks, which only allow developers to use one programming language, commands in the PAK can be written in Java, Groovy, CMake or Python, or any number of other programming languages.

The automation solution can also be used at the lifecycle level if there is no suitable solution currently in place in the ecosystem. This means that, throughout the value-creation chain of a new function, the PAK can combine all process steps in a multi-user process – functional development, review and testing, software transfer and implementation – to create a consistent, automated process. Using the PAK ensures that individual development steps are not simply skipped or forgotten, meaning that the process owner can depend on adherence to specified quality standards and process conformity at all times. Given that automation also prevents issues such as incorrect document filing and configurations, the PAK also inherently reduces errors. Furthermore, as the aforementioned example of the automation solution's use in function and software development for an OEM makes clear, the PAK makes induction far easier and therefore also saves time in development. The applicability of the PAK at the organisation level – as it facilitates the automation not only of software development processes but of all business processes generally – means that the solution also serves as the basis for process development in accordance with A-SPIICE Level 3, with subsequent tailoring to development projects (A-SPIICE Level 2). The PAK therefore makes it possible to structure all processes, methods and tools in an organisation consistently at the developer level – and unlock far more efficiency potential in future.



PUTTING PAK INTO PRACTICE

USER REPORTS ON THE PROCESS AUTOMATION KIT (PAK)

In our series of articles entitled ‘Putting PAK into practice’, users report their experiences of the benefits of the ASAP Group’s Process Automation Kit (PAK). PAK is a framework for individual, reusable automations and a useful addition to conventional DevOps practices. The automation solution demonstrably reduces the complexity, time and costs of development while improving developer acceptance and quality.

User report from Jürgen Meyer, Head of Software Engineering at ASAP

Jürgen Meyer: “As the ASAP Group’s Head of Software Development, I’m very proud of what we’ve achieved in developing the Process Automation Kit (PAK); I believe it has enormous market potential. The PAK enables us to implement automation at the developer level wherever possible and reasonable – such as for repetitive tasks that do not require any creative development input. Consequently, our developers can concentrate exclusively on creative tasks that add value, with some of the strain of their day-to-day work taken away. In my role as a manager, this represents a decisive advantage, because challenging, exciting tasks – and having enough time to complete them – ultimately results in improved employee satisfaction. This in turn lays the foundations for a positive working atmosphere in the team

and the communality that characterises our work in the ASAP Group. At the same time, it also minimises employee turnover, which gives us a decisive competitive edge, especially given the current shortage of skilled workers. The PAK guides developers through their work – with development steps for specific developer roles defined, automated and later made reusable for other processes – so we’re also able to induct new members of staff more quickly, because they don’t need to learn all the individual process steps for their role by heart. On the one hand, this allows me to scale a team more quickly. On the other, it facilitates interdepartmental and cross-location collaboration because all process steps are seamlessly interconnected, no matter who has been assigned them. The PAK also makes my work easier by automatically assigning tasks to my employees, so neither I nor my project managers have to do that any more. In addition, while assigning tasks to people, the PAK also provides all the documents and tools required for the subsequent developer role, which enables us to collaborate faster and more efficiently. This also minimises any delays caused if anyone involved in the process is absent. As the PAK optimises interdepartmental and cross-location networking while also automatically forwarding feedback and information on new tasks along the tool-chain without delay, our automation solution

is also a decisive factor in the success of decentralised working. Particularly in the coronavirus pandemic, when all ASAP employees – whose roles permit them to do so – are working remotely, PAK ensures that we are still able to collaborate without any issues or delays. At this point, I would like to emphasise that, although the PAK is an important building block for us and a key success factor in our collaboration, it obviously cannot and will not replace direct exchanges between employees or a positive culture of collaboration and teamwork. Thanks to the reporting dashboard in PAK, I always have an up-to-date overview of the status of all of my teams’ projects and receive timely notifications if any action is required. In addition, using the PAK makes it impossible to simply skip or forget individual steps in the development process, which means I can always rely on adherence to specified quality standards and process conformity. This is a decisive advantage for me as a user because, in the automotive industry, our work is heavily influenced by standards (e.g. ISO 26262 on functional safety; Automotive SPICE) that must be strictly observed. In this context, our automation solution acts as a guardrail, ensuring that all standards and requirements are automatically observed. And, if there are changes in the development process, we only need to input them once into the centralised PAK. These changes are then reliably applied for all users of our PAK application, which ensures that everyone adheres to the new framework conditions.

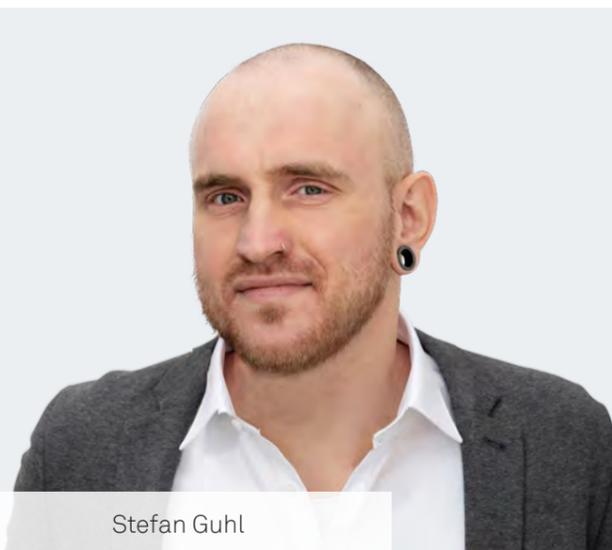


Jürgen Meyer

In the end, all of these factors not only facilitate more efficient collaboration and relieve the strain on employees, they also ensure a consistently high level of quality in development. To my mind, the PAK therefore also contributes to customer satisfaction and represents an important building block in establishing sustainable and long-term business relationships.”

User report from Stefan Guhl, Expert Software Engineering at ASAP

Stefan Guhl: “As one of the software architects, I was heavily involved in the development of our Process Automation Kit (PAK) and know the framework down to the finest details. In fact, the original solution for fully automated development has already been in use in functional and software development at an OEM for ten years. Based on this experience, we redeveloped the PAK from top to bottom using state-of-the-art technology. Our aim was to make the PAK as customisable and user-friendly as possible, creating an automation solution that would put the focus on the developers in the DevOps pipe-



Stefan Guhl

line. With this in mind, we placed particular emphasis not only on functional safety but also on compatibility, modularity and portability. To achieve this, we developed a strong, modular core with a broad, cleverly designed API. This means that our framework can be expanded in line with specific, individual needs and integrated into just about any application. In addition to these modular systems, the PAK enables us to deliver complete implementations, applications and a wide-ranging tool and command kit, which benefits the customer from day one. Just like the core components, users can expand the command kit however they like – and, in another useful feature, they can do so in any programming language they wish. The PAK's modular system concept enables us to define and automate development steps for specific developer roles and reuse them later for other processes. So, by developing the PAK, we have made it possible to model all process steps in a workflow in machine-readable and standardised formats, such as BPMN, and then automate these steps. As a relatively simple graphical specification language, BPMN is also suitable for users

without any expertise in software development. In the PAK BPMN Editor, previously used commands can be easily selected from the kit using drag and drop and moved to the desired point in the model.

Thanks to the automations at the developer level, I no longer have to learn individual process steps by heart and can instead concentrate on the actual development work, which is of course the part I enjoy most. The PAK lightens my workload by taking care of repetitive tasks that do not add value and guiding me through the specific development process for each project. Now, the PAK takes care of data maintenance in all the tools we use to secure the overall process and manual operation of various tools used in development. Even onboarding new staff members is made considerably easier with PAK. They use the defined workflow for their project, which sort of takes them by the hand and guides them through development processes, thus helping them to find their feet faster. As a result, using the PAK ensures that even new staff members adhere to framework conditions because they cannot simply skip or forget individual process steps.

What's more, I can also use the PAK as a framework for the development of heavily process-oriented software because the PAK Editor is capable of mapping out even the most complex processes in an easy-to-understand way. If the process changes,

instead of editing the source code like usual, all I need to do is change the workflow in the BPMN Editor. So, using the PAK, I can reduce the costs and effort involved in development because the task of writing complex codes is replaced with the comparably simple task of setting up the process in the PAK Editor. This simultaneously reduces the testing workload, as the data-flow analysis in the PAK Editor means I can easily check data validity and procedures in the process model at any time. It runs automatically in the background and informs the user of any faulty models or missing or incorrect parameters. We can add commands we've developed to the PAK kit right away, which means we can use them as often as we want in any future workflow models and insert them in the Editor to map and model processes with a click of the mouse. Therefore, we can automate new processes faster and faster as time goes by, which makes our solution scalable as desired and ensures that we can use the PAK the continuously leverage further efficiency potential."

User report from Simon Hettwer, Project Leader Software Engineering at ASAP

Simon Hettwer: „As a project manager in software development at the ASAP Group, our Process Automation Kit (PAK) is a fixed part of my daily work. The automation solution really lightens my workload. In the PAK, we've defined the individual development steps for all specific developer roles

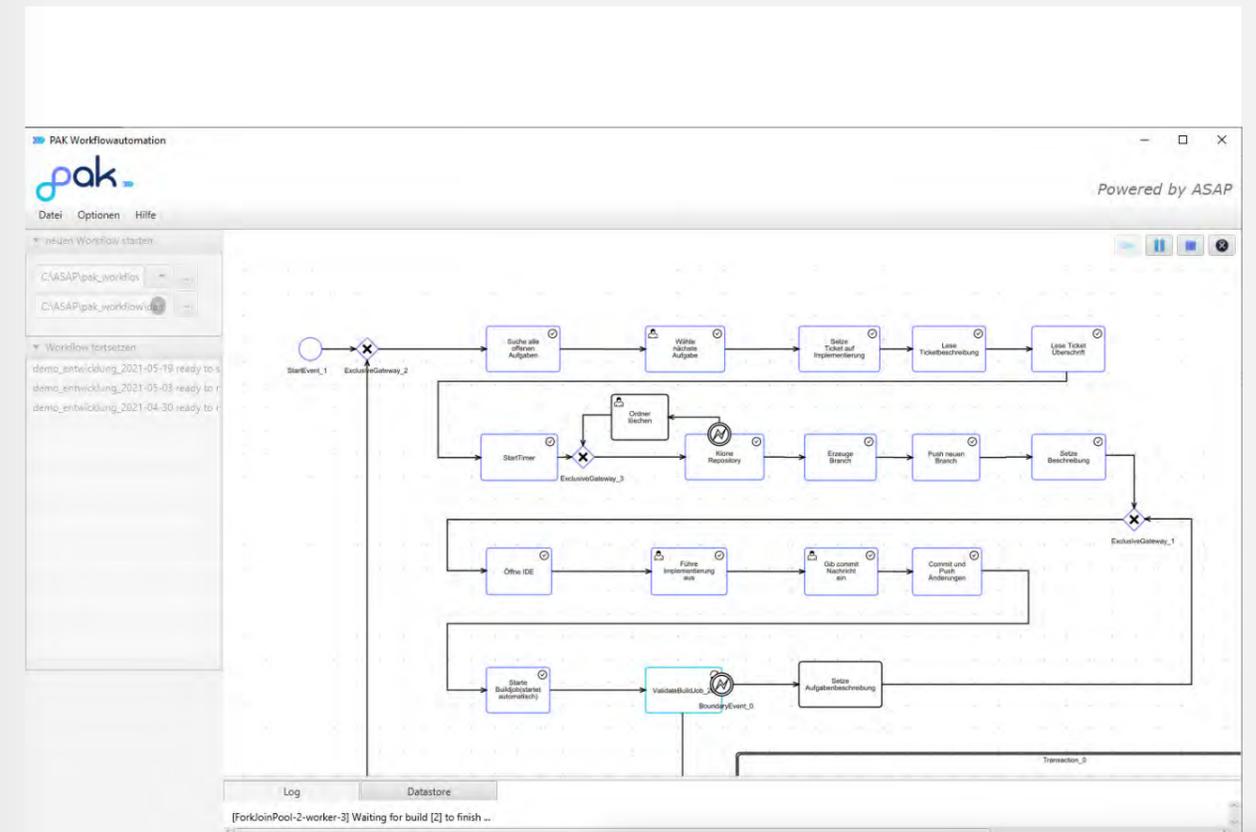
in our team with absolute precision and implemented automation wherever sensible and feasible. Using the PAK has enabled us to unlock considerable efficiency potential and accelerate our processes immensely, particularly in relation to highly repetitive tasks that require no creative input, but also in very complex processes with numerous development steps. The automations at the developer level not only facilitate uninterrupted and clearly structured workflows through-out the entire team, they also free up time so we can concentrate on our creative development work. At the same time, we can always rely on compliance with process conformity and quality standards because the PAK doesn't allow us to simply skip or forget a single step in the development process. The PAK isn't an attempt to somehow replace the project management tools currently in use; instead, it seeks to structure the use of these tools and, ultimately, all processes up to the organisational level in a more efficient, user-friendly way. For example, before we introduced the PAK, one of my duties was to open the same ticket in our project management tool each week. By using the PAK, we have now fully automated this recurrent task, which means I save about five minutes per week. That might not seem like much at first glance, but when you combine it with the time savings achieved through other, similar automations, it adds up to immense time savings over the course of a year. For instance, in projects for customers, the PAK automatically organi-



Simon Hettwer

ses all time events and adds status comments once a task is complete in the project management tool. By removing the need to transfer data manually, the PAK not only ensures flawless data consistency but also delivers enormous time savings in my day-to-day work. Plus, because the PAK automatically synchronises all the tools we use and makes sure we all know what stage everyone in the project is at, it also simplifies the process of drawing up absence contingency plans. For me as a project leader, this means that when someone is absent, I only have to schedule a substitute to cover them in PAK for the requisite amount of time. The PAK provides feedback and information about new tasks along the toolchain without delay – including all the documents and tools required for the subsequent developer role. For one thing, this makes it far less complicated to make arrangements for the substitution plan; for another thing, it allows us to avoid delays in the project. By automatically assigning tasks to team members, the PAK facilitates faster, easier collaboration, including across different departments and different locations. Furthermore, thanks to

the PAK, issuing manual step-by-step instructions for various customer projects with all their various processes and requirements is now a thing of the past, because once workflows have been graphically mapped out once in the PAK Editor, our automation solution implements them automatically once the project gets underway. We have also been able to make significant process improvements with the PAK in relation to software releases, so we can now make new software versions available to our customers much more easily – and, therefore, far more regularly. Today, the PAK automatically issues a release in just a few seconds, whereas I would once have had to allow two hours for each release to start the process manually in various tools. All in all, our processes have become much more stable and faster thanks to the PAK, and the automation solution has also given us more scope to focus on creative development tasks.”



Screenshot of the PAK Editor

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SPECIAL TOPIC

TEST SYSTEMS



LIFECYCLE SIMULATION SYSTEMS FOR INVERTERS

MODULAR STRUCTURE ALLOWS FOR INDIVIDUAL, SUSTAINABLE AND RAPID CONFIGURATION

The ASAP Group has supplemented its product portfolio to include lifecycle simulation systems with a modular basic concept, available immediately. These systems can be configured quickly to meet specific customer requirements and, crucially, are not limited to testing only one end product – such as inverters/power electronics. Additional functions can be added at any time and the individual models can also be added to create new (testing) systems at a later date if required. A multi-stage safety concept and the ASAP Smart Test Execution Platform (STEP), a middleware for test automation, are integrated as standard. STEP unites hardware and software to create a complete system and allows for straightforward commissioning up to 50 per cent faster than conventional systems.

The ASAP Group's testing and trialling centre has used lifecycle simulation systems developed inhouse for many years, with considerable success. The development partner to the automotive industry is making these systems available on the market with immediate effect.

This means customers can now benefit from internally testing concepts which, thanks to their modular structure, offer numerous advantages. Testing systems can be configured individually and further modules for additional functions can be added at any time without significant expense or effort. As a result, the test system's structure remains flexible and can be adapted to individual customer requirements even after completion. The lifecycle simulation systems are therefore not fixed to one end product but can instead be used as a test bench for many different components through the addition of corresponding modules. Customers' own test systems and environmental simulation systems – such as shakers and climatic chambers – can be integrated in the overall system without any issues. These test systems are completed by a multi-stage safety concept in accordance with EN ISO 12100, which safely deactivates the system in an emergency and gives priority to protecting people, components and machinery. In the planning phase, ASAP coordinates closely with each customer to develop concepts for a customised lifecycle simulation system and, if

desired, to integrate the system in existing testing infrastructure, including risk assessment. In the subsequent design phase, experts from ASAP Test Systems define all other details before manufacturing the systems in accordance with all applicable standards. Depending on the design and scope of the test environment, the ASAP experts apply either the Machinery Directive or the Low Voltage Directive and ultimately confirm conformity (with CE marking). "We are currently building twelve further lifecycle simulation systems for inverter testing at the ASAP testing and trialling centre," says Christian Schweiger, Managing Director of ASAP Electronics. "Their modular structure means we are not only able to supply a large number in a short period of time but can also reconfigure them whenever we need to test other end products, such as on-board chargers or DC-DC converters. The ability to combine individually installed modules to create new test systems also makes the overall systems more sustainable in the long-term."

Communication between test automation and test bench

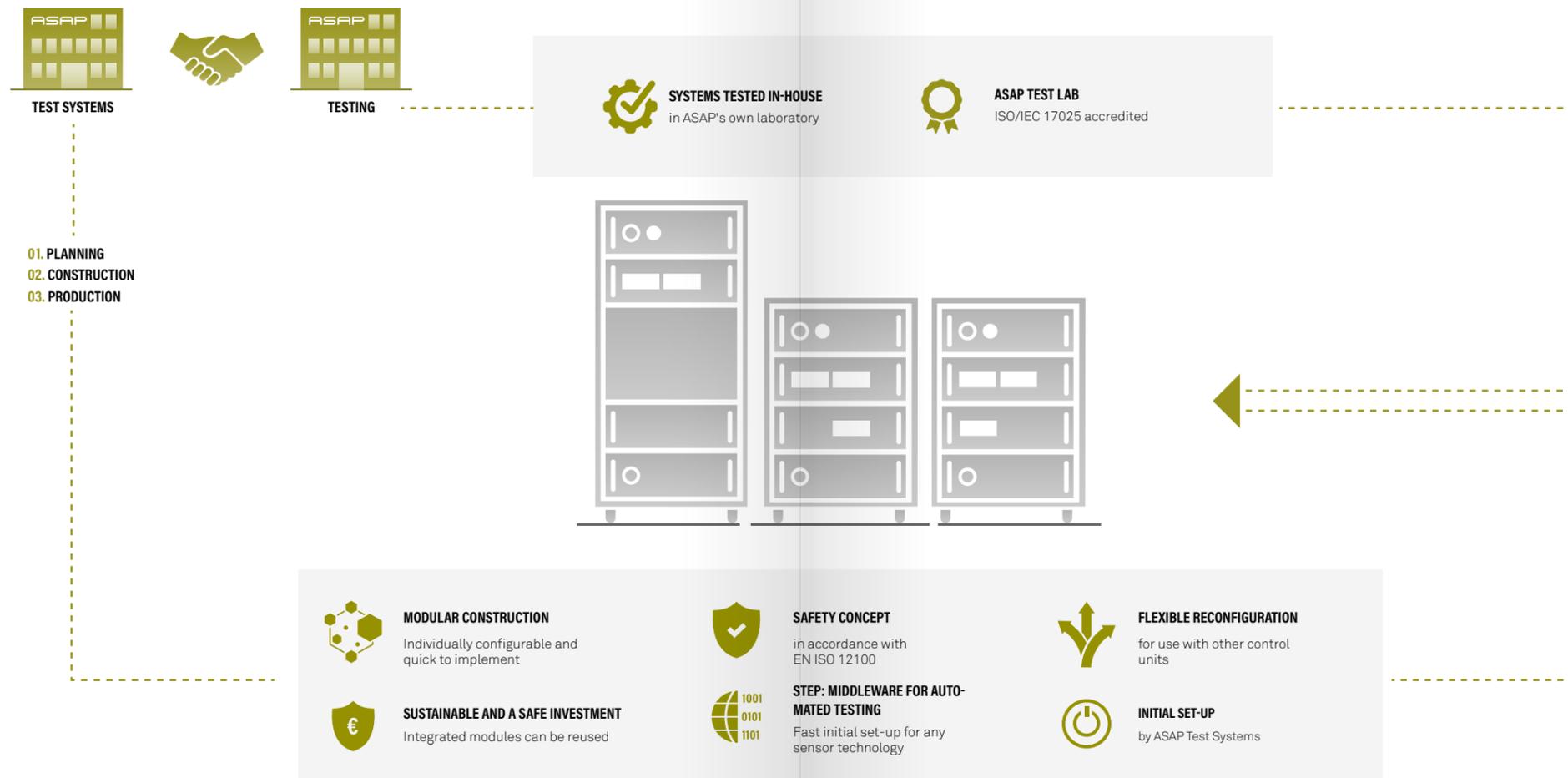
The use of the Smart Test Execution Platform (STEP) in all ASAP lifecycle simulation systems makes it easy to scale up test systems. Any form of sensor technology can be integrated in the system and commissioned quickly and easily with ASAP's STEP software. STEP serves as a middleware between test automation and measurement technology and was specifically

developed by ASAP for testing systems with different measurement and control hardware. The software allows test automation and the testing system to communicate and serves to relay sensor and actuator systems – whatever their source – as an abstracted channel to a single control system. The experts at ASAP Test Systems can support customers by developing the necessary test automation or adjusting existing test processes if required.

Endurance test for components

Following commissioning on the customer's premises, the lifecycle simulation systems are available to test components 24/7. In some tests, the temperature on the test bench can fluctuate between -40°C to 120°C as many as ten times over the course of a day, while such variations would only occur at the corresponding time of day or night or following seasonal fluctuations in real-life test drives. The accelerated, repetitive nature of test bench testing results in a significant component load, not only for the component being tested but for the test bench itself. Durability is essential, as are precise actuator and sensor technologies. Close coordination between ASAP Test Systems and the ASAP testing and trialling centre has yielded a well-engineered testing system. ASAP will continue to implement potential optimisations identified in current and future testing in ongoing product development and thus make improvements available to customers.

SERVICE LIFE SIMULATION SYSTEMS FOR INVERTERS/POWER ELECTRONICS



Lifecycle simulation systems can subject the materials and electronics of vehicle components to particularly high-stress situations. In relation to the development of new vehicles, however, lifecycle simulation systems make it possible to implement tests quickly and yield reliable test results. Looking to current challenges in components and vehicle development – challenges such as short development cycles, constant cost pressures and increasingly complex products – the ability to

conduct efficient testing using ASAP testing systems represents a particular benefit for development activities. At its own testing laboratory, which is certified in accordance with ISO/IEC 17025, ASAP has offered extensive testing services to its customers for many years. Customers can therefore have lifecycle simulation systems planned and produced by ASAP Test Systems entirely in accordance with their specific requirements – but are also very welcome to make use of the services offered

by the ASAP testing and trialling centre. These cover all process steps in component testing, including creating test reports.

All benefits at a glance

The benefits are evident: ASAP is offering a safe, proven testing system that it also uses in its own testing activities. Its modular structure and use of STEP software enables the simple, swift and transparent integration of testing

equipment, measurement technology and control technology, which ensures it is and will remain future-proof. The lifecycle simulation systems feature a highly sustainable design and can be partially or completely reused in new testing activities, which significantly reduces the long-term investment costs. Due to the systems' impressive scalability, ASAP Test Systems can produce even large quantities of them in a short space of time.

ASAP CURRENT LOUPE

SINGLE-CHANNEL AMMETER FOR BIDIRECTIONAL VOLTAGE AND CURRENT MEASUREMENTS FROM $\pm 1\mu\text{A}$ TO $\pm 100\text{A}$

The ASAP Group has brought the latest version of the ASAP current loupe to market: a single-channel DC ammeter for bidirectional measurement of bias current and operating current. The product has already been used successfully for several years at the ASAP trialling and testing centre and by numerous ASAP customers. Now, based on these years of experience using the loupe, ASAP has completely redeveloped it with a new hardware platform, adding a host of new features. Automatic range switching ensures high precision in the respective current range, which stretches from $\pm 1\ \mu\text{A}$ to $\pm 100\ \text{A}$. At the same time, the ASAP current loupe enables users to measure voltages up to $\pm 60\ \text{V DC}$. A rack is now also available, making it possible to use up to eight current loupes simultaneously.

From ± 1 microamperes to ± 100 amperes, the differences between bias current and operating current in control units often vary significantly. With this in mind, the ASAP Group has developed the ASAP current loupe, a non-disruptive measuring instrument with automatic range selection that enables bidirectional voltage and current measurement throughout the entire

range. Voltage measurement takes place in parallel to current measurement at up to $\pm 60\ \text{V DC}$. The loupe is easy to integrate into any testing system, particularly in conjunction with the Smart Test Execution Platform (STEP) middleware used in all ASAP testing systems. It then allows users to measure all vehicle-related component currents – from bias currents to operating currents. The ASAP current loupe can therefore cover the entire measurement range without any extra effort or expense.

The measurement technique in detail

A particularly important part of the new current loupe is the full galvanic isolation in signal processing on the current measurement path. The current is measured in the respective measurement ranges using both shunts and Hall sensors. Automatic four-channel current range switching ensures that no measurement values are missed. Oversampling and a special algorithm digitally process the input parameters and automatically activate the optimal measurement range.

Systemrelevant CAN/CAN-FD and Ethernet communication interfaces connect the



ASAP current loupe to the testing system. All measurement data is automatically provided via the interfaces. Thanks to its compact design, the ASAP current loupe is easy to integrate into existing test set-ups. It is available either on its own or together with a rack (which can hold up to eight current loupes), so that users can test several control units simultaneously on a single test bench. System-relevant settings can be configured using SCPI commands.

The ASAP current loupe complies with all applicable standards and guidelines. For example, the loupe features safeguards against inductive load disconnection. A protective diode has also been integrated to limit output. In addition to its ease of use, the ASAP current loupe also generates cost savings compared to conventional validation procedures in relation to hardware investment and the evaluation and processing of measurement data.

MAINTENANCE CONNECTION
MACHINE NUMER: S/N 212793

LOCATION ZONE 710
BLUEZONE - LANDING GEAR

0.085 INCH
0.075 INCH
0.90 INCH

737 QUANTITY ANALYSIS
DATA SECTION 30-33

CEC 9313

SYSTEM NO	SENSOR NO	LOCATION
1	5848	LEFT
2	7845	RIGHT

MANUALS

Production Capacity: 409/day
Uptime: 99%
Energy State: Active
Pressure: 42/3
Auto Errors: 0

CONNECTED

LOCATION
ONLINE-LAB--359

- BRASS PIVOT HING [M]
- OHM METER [M]
- 12 VOLT TEST BATTERY [M]
- 1.25" PVC ELBOW [M]
- 3.55- ACCFF [M]

MAXData

RULES

- Enable automation using supporting systems
- Support any/all unsafe conditions immediately
- Use eye-protection when working in being down in lab
- Non-necessary items working, long hair and jewelry
- Stay out of safety area, unless you are operating the machines

Alert rules
S/N 212793
0 rules

SPECIAL TOPIC

DIGITALISATION

“AS A SINGLE SOURCE OF TRUTH, MODERN PLM SOLUTIONS ARE THE BACKBONE OF THE DIGITAL TRANSFORMATION IN INDUSTRIAL ENTERPRISES”

COMMENTARY ON DIGITALISATION FROM ANDREE HÜNDLING, HEAD OF ENGINEERING SERVICE AND COMMUNICATION SERVICE AT ASAP; RAFAEL LELUSCHKO, DIGITAL ENGINEERING PROJECT MANAGER AT ASAP; AND PETER SCHRAMM, SENIOR EXPERT IN DIGITAL ENGINEERING AT ASAP

Andree Hündling: “In the first part of our ‘Digitalisation: A Commentary’ series, I examined what we mean by ‘digitalisation’ and what elements form the basis for successful implementation of a digitalisation strategy. By far the most important points were that, in addition to an openness to change and continuous change communication as basic requirements, it is also vital to coordinate and network processes, methods and tools. Transferred to the automotive development environment, this also means that the enormous volumes of data generated in vehicle development must be kept as consistent as possible and held by a single source. Networking all this data requires intelligent solutions. This brings us onto the topic of this article: product lifecycle management (PLM). ASAP has provided services in this field to its customers for many years and my colleague Rafael Leluschko from our Digital Engineering division is one of our experts.”

Rafael Leluschko: “A PLM system is the basic requirement for any successful digitalisation strategy in an industrial firm. Only then is it possible to establish consistent digital processes in product creation and product management. PLM systems create consistency in product management, starting from the initial design through to development, sale and disposal – from the first concept for a product through to the end of its lifecycle. In this way, the PLM system serves as a single source of truth, which keeps all information about a vehicle in one place and ensures it is always up to date.

At present, the automotive industry faces the immense challenge of digitalisation, which affects the entire value-added chain. However, data may well be stored on different systems and databases throughout the entire value-added chain. Let’s look at an example. If an employee in a company’s

development department is working on the 3D designs for a component, their colleagues in production planning will only be able to access these designs at a relatively late stage. They only gain insight into key work stages after a certain delay or continue to work on outdated data due to coordination problems. This often comes down to the fact that the relevant 3D data has to be transferred from one system to another. The use of different systems that do not communicate or provide 100%-accurate data represents a significant source of errors. These errors also cost time – which, due to the increasingly short development cycles in the automotive industry, is in short supply. PLM systems facilitate efficient and error-free inter-departmental and cross-company collaboration from an early stage. Serving as a single source of truth, modern PLM systems make it possible to avoid the negative consequences of data inconsistencies and data silos while also driving forward digitalisation. Deploying a PLM system creates the framework for a network of reliable data throughout the product lifecycle, which then yields the benefit of accelerated process flows and lays the groundwork for digitalisation of these processes. They can be mapped in workflows and thus implemented as virtual collaboration models. PLM systems reduce the complexity, time and costs of development, improve quality and reduce the burden on process users and owners. In this way, PLM also reduces products’ market launch times as it puts in place optimised processes. Companies thereby also create



Andree Hündling

urgently needed process standards that automotive manufacturers have committed to implement.

So, why have consistent, modern PLM systems still not become an industry-wide standard? One of the reasons for this – and a central challenge in the introduction of such systems – is the product in the automotive sector, the ‘vehicle’ itself. On the one hand, it entails a very high degree of individualisation: information on millions of versions with different features, numerous models and corresponding components all needs to be mapped in the PLM. On the other hand, data management also extends to data far beyond company boundaries, as brand mergers, joint ventures, development partners, suppliers, service providers and other external partners involved in the process must also all be integrated. Modern PLM architecture must support all collaborations while also protecting intellectual property wherever necessary. Added to this is the fact that vehicles are continuously becoming ‘smarter’. The result is a product networked with the environment and produced through



Rafael Leluschko

service-oriented business models. Although PLM originated in the mechanical world and is therefore designed to provide information on mechanical hardware, the proportion of electronics and software in vehicles continues to increase. At the moment, these processes can only partially be translated to mechanical development. By far the greatest challenge in the implementation of a PLM therefore lies in combining the mechanical, electronic and software worlds and helping them to communicate. It is worth taking the time to master these challenges as the resulting benefits are immense. Studies on this topic confirm close correlation between the level of PLM maturity and commercial success. In my eyes, modern PLM systems are therefore the backbone of the digital transformation in an industrial enterprise, and one of the most important enabling technologies for digitalisation.”

Andree Hündling: “Our experts from the ASAP Engineering Service and our Software Development division support our customers in developing and implementing digitalisation strategies. Our comprehensive

service portfolio in the topic areas described here include quality-oriented data management, integrated digital engineering, and PLM system integration and customisation. We act as a partner to our customers, from the initial concept idea through to roll-out. For example, we undertake inventories of our customers’ processes, which enables us to conduct GAP analyses to identify the potential that introducing PLM functionalities can unlock. In the next part of this series, we will shine a spotlight on the topic of ‘digital twins’ in this context. The PLM systems discussed in this article are a key precondition for creating a digital twin of an overall product. An established PLM solution complete with digital twins in turn forms the basis for realising a ‘digital factory’ – a topic we will also examine in detail in future articles.”

“DIGITAL TWINS HELP TO MAKE LASTING IMPROVEMENTS TO A COMPANY’S COMPETITIVENESS AND REPRESENT A KEY FACTOR IN DIGITALISATION”

Andree Hündling: “In the second part of our ‘Digitalisation: A Commentary’ series, Rafael Leluschko and I looked at product lifecycle management (PLM) in detail. We also explored the challenges involved in introducing PLM systems and the many benefits they provide. A PLM system acts as a single source of truth for all data and information about a product generated throughout the product’s lifecycle. When enriched with data from other systems (e.g. ERP systems), we often talk about a “digital thread” running through the entire lifecycle. As a central part of digital threads, PLM systems also form the basis for our current focus topic: digital twins. A PLM system is a precondition for creating a digital twin of a complex product, such as a car. It is the only way to centrally manage and virtually reproduce all information about a car throughout the entire product lifecycle.”

Rafael Leluschko: “A digital twin is, in principle, a virtual, computer-assisted model of a process, product or service. Digital twins can be used and provide benefits in a wide range of use cases. In this part of our commentary series, we will focus on the virtual represen-

tation of products, but it is also conceivable that digital twins could be created for entire factories or their processes. In principle, when it comes to the digital twin for a product like a car, we can draw a distinction between hardware and software twins. Hardware twins can depict all information about a vehicle’s components – such as geometries, material properties, weights and surfaces. Meanwhile, vehicle software twins can depict all information regarding how sensors and actuators interact in the vehicle, along with the corresponding functions. At present, this hardware and software information from all lifecycle phases are stored in different systems. In order to facilitate function-oriented development, all information needs to be combined in an intelligent system landscape. We need consistent PLM systems that bring hardware, electronics and software information together in a single location and facilitate communication across all data. In our previous post, we mentioned why it is worthwhile for companies to address and overcome the challenges that arise in implementing PLM systems. The same applies to digital twins: once the foundations are in place, the benefits you stand to reap are immense.



For example, by using digital twins, automotive manufacturers can ensure traceability throughout the entire product lifecycle. Manufacturers have committed to the principle of traceability, i.e. the ability to trace all development steps through to the finished product and beyond. At the same time, traceability has become essential in order to meet the ever-increasing country-specific

legal requirements while also responding to the continuously rising level of product customisation. Not only does ensuring traceability fulfil compliance requirements, it also makes it possible to realise improvements in the manufacturing process and extend the product lifecycle all at once. Once all processes related to establishing complete digital twins have been established, we can track

each vehicle's current state of development and production in real time. Furthermore, digital twins are relocating a growing number of activities into the virtual world. For instance, digital twins make it possible to validate and ultimately optimise components without the need for expensive physical prototypes. Digital twins therefore also help to make lasting improvements to a company's competitiveness and represent a key factor in digitalisation."

Andree Hündling: "At ASAP, for example, we have long used digital twins of functions and components, which enables us to achieve significant time and cost savings in their development and testing. In one project, we created virtual images for all components in an electrical powertrain. In order to test them in line with all kinds of criteria, the digital twins meet various requirements – depicting mechanical, electrical and thermodynamic aspects of the test objects as well as their service life. In that project, we use the digital twins to resolve questions regarding vehicle range and operating state forecasting without conducting real-life test runs. By conducting simulative studies of load and driving profiles, we use the digital twins to carry out virtual testing to identify mechanical and thermal hotspots in vehicles. In addition, we use digital twins in all other phases of e-vehicle development, from design analyses to prototype development to testing. Ultimately, digital twins offer various benefits. For one, they

ensure optimal coordination of individual development phases by ensuring constant data availability. This data in turn facilitates continuous optimisation of the digitally modelled components and functions across all process steps. In addition, digital twins enable us to look into the proverbial crystal ball by conducting virtual tests of new components or functions before initial prototypes or hardware versions exist in the real world. This allows us to gain insight into how components or functions will react in certain situations before they actually occur. We can therefore resolve potential faults and their causes at an early stage in the development process. So, by utilising digital twins, we can significantly reduce the costs and effort involved in prototyping and product optimisation.

At ASAP, our colleagues in modelling and simulation are responsible for setting up digital twins. Our experts from the ASAP Engineering Service and our Software Development division support our customers in developing and implementing digitalisation strategies. Our comprehensive service portfolio include quality-oriented data management, integrated digital engineering, and PLM system integration and customisation. We act as a partner to our customers, from the initial concept idea through to roll-out. In the next part of this series, we will turn our attention to the topic of the 'digital factory', in which the use of digital twins plays a crucial role."

“DIGITAL FACTORIES ARE VITAL IF COMPANIES IN THE INDUSTRY ARE TO KEEP PACE WITH INCREASING DEMANDS”

Andree Hündling: “The third part in our “Thoughts on Digitalisation” series looked at the topic of digital twins. We focused on virtual representations of products and distinguished between hardware and software twins for the vehicle as a product. We also looked at the numerous advantages of using digital twins – such as traceability across a product’s entire lifecycle, for example. In this fourth and, for now, final part in our series of articles, we will go a step further and shine a spotlight on the digital factory, or in other words the virtual representations of entire factories and their associated production facilities. This also brings us back full-circle to PLM systems, which we highlighted as necessary for the consistency, networking and traceability of data at the beginning of the series.”

Rafael Leluschko: “The topic of the digital factory once again highlights the importance of PLM systems. They act as a single source of truth for all data and information about a product generated throughout its lifecycle. When combined with information from other systems, they enable us to create a digital thread that effectively runs through a company. This digital thread is composed of data

from various points along a product’s value chain. This proverbial thread, together with information from the various IT systems, runs ‘virtually’ through the entire production landscape. This kind of digital thread, which is still far from being the norm in companies, also forms the basis for a digital factory. The term ‘digital factory’ refers to a comprehensive network of digital models, tools and methods. These include simulations, three-dimensional visualisations and virtual reality technologies, all woven together using a continuous digital thread. They can be used by each person and every company in the product development process with an extremely high degree of parallelisation. The digital factory can be used everywhere, from the actual planning of production, systems and factories right through to factory operators. There are numerous advantages associated with implementing and using a digital factory. In the future, it will enable us to take a holistic approach to the planning and continuous analysis and optimisation of all processes and resources associated with a factory and the goods produced there. This creates greater transparency, increases efficiency and productivity, and reduces costs, alongside other benefits. Digital tools

such as virtual reality also make it possible to improve communication and avoid errors. We will look at some of the advantages in more detail later. As things currently stand, however, most companies still have many hurdles to overcome before they are able to build a complete digital factory. These challenges include the production systems themselves, which in many cases are still completely unconnected, stand-alone solutions with their own IT systems. What’s more, a networked and integral PLM system by no means incorporates all of a company’s data. Many companies encounter problems with selecting and configuring suitable interfaces for the various IT systems and tools and with defining suitable data formats. Another major challenge is the question of how to factor in and use new technologies, such as modern cloud solutions and networked IIoT (Industrial Internet of Things) technology. If a company can overcome all these challenges, a digital factory with its virtual models can serve as the basis for creating and commissioning a ‘smart factory’. This final stage of upgrading a digital factory is also often referred to as an intelligent factory. By using intelligent components, it would be possible for production to become almost autonomous and carry out a wide range of tasks independently.”

Peter Schramm: “While the challenges involved are very complex, the benefits associated with a comprehensive PLM system and the digital factory more than compensate for the effort involved in implementing



Peter Schramm

them. One immensely important point that has already been mentioned is the consistency of a company’s entire data that comes with making the switch. Changes only have to be stored once centrally in the PLM system and are then immediately available. As a result, you can always rely on the data to be correct and the probability of errors is significantly reduced. In the case of vehicles as a product, which on average consist of about five thousand different components, it is particularly clear how important it is to have reliable, up-to-date data, as expensive errors are likely to occur if this is not the case. The numerous components must be assembled correctly in the technical product sequence and the different variants and derivatives must be constantly monitored by a multitude of different departments. The increasing numbers of variants coupled with ever shorter development cycles make it necessary to accelerate planning processes. Here, too, a digital factory provides a crucial advantage, as it allows processes to be parallelised – something referred to as ‘simultaneous engineering’. Different steps in the development process are no longer



carried out sequentially but in parallel, thanks to the virtual models made available by the digital factory. This saves a considerable amount of time and money in the development phase. The digital models of factories, production facilities and cycles, which are always up to date and are available company-wide, also open up numerous other possibilities for planning. For example, employees can make a virtual visit to a

production plant for planning discussions by using virtual reality (VR) and walk around it together. This facilitates communication and collaboration, whilst also meaning that location is no longer a factor. The virtual models also ensure that training courses can be delivered much more cost-effectively and in a way that is easier to understand. Thanks to VR, companies can also provide training in virtual environments, where digital

information about virtual systems – such as step-by-step assembly instructions – helps those taking part in the training to learn and understand. In addition to VR, augmented reality (AR) can also be used to great effect with digital models. For example, the virtual planning model can be projected onto the actual system when setting up a new production plant, making it quicker to check for conformity. Another major advantage of the digital factory is simulations, which can be used during the planning phase to check the suitability of new production plants for the manufacturing process. The entire process in a factory can be simulated using digital twins of the products to be manufactured as well as virtual models of the production facilities and employees. Not only does this make it possible to detect incorrectly placed logistics shelves and entire workstations that would disrupt the process, but it can also examine workstation ergonomics and the physical demands associated with individual work steps. Limitations in the subsequent production process are consequently avoided right from the planning phase, with workstations reviewed to see if any additional equipment might be necessary. In the case of existing production facilities, simulations can also be used to check, for example, whether the facility is suitable for conversion to produce new vehicle models or fully electric vehicles. There are many more benefits of the digital factory – such as the ability to influence the product by allowing designers to access production data in real time and adapt the product as needed – that

could be mentioned at this point. So, although there is a high initial outlay required in order to implement PLM systems and the digital factory, thanks to the associated potential to optimise processes, structures and resources, it is an investment that pays off – and it has even become unavoidable in order to keep up with increasing requirements in the automotive industry.”

Andree Hündling: “The automotive industry is therefore also at the forefront of efforts to implement the digital factory and has already implemented the tools needed to make data available in many of its processes. The ASAP Group has a broad portfolio of services covering all aspects of these topics to support our customers on their journey towards integrated PLM systems and the digital factory. Our experts from Engineering Service and Software Development help customers to develop and implement a digitalisation strategy. For example, we can set up consistent data management or customise the required systems. We work in close partnership with our customers, from initial conceptual idea to roll-out.”



FUNDING FOR RESEARCH AND INNOVATION

GERMAN FEDERAL MINISTRY OF EDUCATION AND RESEARCH (BMBF) TO FUND ASAP INNOVATION PROJECTS RELATED TO MOBILITY SERVICES, TESTING SYSTEMS AND WIRE HARNESS DEVELOPMENT

Three ASAP Group research and development projects have been given special recognition. For the next three years, the corporate group will receive funding from the German Federal Ministry of Education and Research (BMBF). The BMBF has decided that the projects show a very high degree of innovation and potential value,

and therefore classified them as worthy of funding. The supported projects also demonstrate the multifaceted nature of the ASAP Group's approach, with a service portfolio focused on developing future-focused technologies for the automotive industry. One project slated to receive support is an internal development project

looking at new mobility services. ASAP will also receive funding to develop software aimed at partially automating wire harness development, and another project focused on developing a middleware application to enable test automations and testing systems to communicate with each other.

The ASAP Group has once again lived up to its aspirations as an innovation leader and technology company – several times over. For the next three years, the corporate group will receive government research and innovation funding for three of its ongoing projects. “As a development partner to the automotive industry, we are shaping the mobility of the future,” said Michael Neisen, CEO of the ASAP Group. “In doing so, we explore new avenues, so innovations represent a crucial basis for our business. With this in mind, we are utterly delighted that three of our research and development projects will now receive funding in recognition of their innovative character. Following the TOP 100 award naming us an ‘innovation leader among German SMEs’, which we received this year for the fifth consecutive year, this funding for our projects is further confirmation that daring to take unconventional steps is essential on the path to innovation.”

The projects selected for funding include an internal development project for new mobility services. In this project, ASAP is concentrating on the continuous exchange of data between vehicles and an in-house back-end as well as the modification and use of the collected swarm data to generate

new services for drivers. As part of this project, ASAP has equipped its own vehicle fleet with intelligent sensors. Using methods that draw on artificial intelligence, big data and cloud computing technologies, the collected swarm data provides new insights and points the way toward future mobility solutions that will help to create smart cities.

The corporate group will also receive funding for the development of the ‘ASAP Wire Architect’ (AWA), a software solution to partially automate wire harness development. AWA facilitates the transfer of data and communication between separate development tools, such as EB Cable, LDorado, CATIA, E³.cable and Siemens NX. The software significantly reduces the error rate from human data transmission, because AWA automates data import and export, as well as the reconciliation of design drawings and initiates corresponding changes in the programs. This makes it possible to generate datasets for wire harnesses faster and more efficiently and validate them more effectively.

The third ASAP innovation project awarded funding is the Smart Test Execution Platform (STEP). STEP serves as middleware between test automation and measurement technology and was specifically developed by ASAP for testing systems with different measurement and control hardware. The software allows test automation and the testing system to communicate and serves to relay sensor and actuator systems – whatever their source – as an abstracted channel to a single control system.

ZF AND ASAP - COLLABORATION WITH FOCUS ON E-MOBILITY

AN INTERVIEW WITH THOMAS TREBITSCH, VICE PRESIDENT OF TEST SYSTEMS AND TESTING AT ZF FRIEDRICHSHAFEN AG, AND CHRISTIAN SCHWEIGER, MANAGING DIRECTOR OF ASAP ELECTRONICS GMBH AND ASAP ENGINEERING GMBH INGOLSTADT.

How significant is e-mobility in the strategic partnership between ZF Friedrichshafen AG and the ASAP Group?

Thomas Trebitsch: "E-mobility is certainly one of the core topics in the collaboration between the ASAP Group and ZF Friedrichshafen AG. Especially in comparison with recent decades, the automotive industry is currently undergoing a rapid transition to e-mobility – and this shift has been further accelerated by the corona-virus pandemic. Never in the last 50 years has so much had to change so quickly. The highly dynamic conditions surrounding the topic are very challenging for the entire industry in both technical and organisational terms. In this context, strategic partnerships are an excellent way to pool expertise and apply new

methodological and organisational approaches to find solutions to the various challenges we face. This allows us to exploit the complementary competencies of the ASAP Group and ZF Friedrichshafen AG and combine both companies' capabilities. Not only does this allow us to exchange technological expertise, but we are also able to effectively combine the organisational abilities of two independent partners to the benefit of both companies. So, on the one hand, we have a major corporation in ZF Friedrichshafen AG, which brings a certain degree of structure and stability. On the other hand, we have the ASAP Group which, although it is the significantly smaller partner, can act more swiftly and with greater agility in certain areas. We complement each other very well and combine our organisational abilities to



achieve things that would have been difficult for either company acting alone."

Christian Schweiger: "E-mobility has been one of the dominant trends for many years now – not only in the automotive industry, but also in other areas. Consequently, the topic is considered a priority by the world's leading systems suppliers, and therefore also by ZF Friedrichshafen AG. As a development

partner to the automotive industry, the ASAP Group has engaged intensively with the future-oriented field of e-mobility since the company was founded in 2010 and has prioritised the topic from the outset – for the industry in general and for our corporate group specifically. E-mobility therefore has a very important role to play in our strategic partnership. With this in mind, we're delighted that our collaboration with ZF Friedrichshafen AG



Thomas Trebitsch

on the topic of e-mobility goes far beyond the conventional execution of a project. For example, we have also developed a shared strategic alignment with regard to partnership models and services related to e-mobility, which we continuously review and refine. This means we can ensure that both companies continue to develop as positively as possible in this field. For instance, we're working closely with ZF Test Systems GmbH so that we can offer our customers an even wider range of services in relation to e-mobility testing in future. The field of e-mobility testing is currently shifting away from examining purely physical factors towards higher-ranking functional tests focusing on handling, range and energy savings. We work together to keep an eye on such changes, adapt our services at an early stage to meet our customers' future needs and, in doing so, exploit synergy effects."

Where do you see opportunities and challenges in the future collaboration between ZF Test Systems GmbH and ASAP? Are

there already specific partnership models in the pipeline?

Thomas Trebitsch: "The ASAP Group and ZF Test Systems GmbH have enjoyed a successful collaboration for some years now. Our partnership, which started with supplying our e-mobility test benches to ASAP, has developed far beyond that over the years. We have already identified various areas in which there is potential to further intensify our work together. I believe that one of the most significant opportunities in our collaboration is the fact that we fundamentally complement each other. ZF Test Systems GmbH specialises in high-quality test benches, including the corresponding mechatronics, machine-dynamic design and control systems, while the ASAP Group has particular expertise in relation to validation and simulation. Combining these two areas of expertise means we can offer our customers a wider and even better range of services in relation to e-mobility testing. This in turn provides further potential for significant growth together, as the requirements and demand for validation in the e-mobility sector have increased considerably and will continue to rise in future. Today, the test bench is less a standalone validation platform and is instead increasingly becoming an integrated element in the development process. As soon as the first components are available, they can be validated on the test bench directly – but, at the same time, they also facilitate validation and calibration of the corresponding simulation model

and thereby support the development of the simulation landscape. The transition to e-mobility has given this approach another big push forward, because this method – that is, moving away from testing on roads and test sites towards lab testing – also counteracts the immense time and cost pressures of development. I don't see as many challenges in the future of our collaboration, as we have always enjoyed an open and trusting dialogue with the ASAP Group, and this has allowed us to work very effectively together. The biggest challenge lies more in examining the many ideas we both have, which undoubtedly exceed our capacities, and prioritising the right topics. In addition, it's also important to find the right time and contact points to introduce these topics to our customers. In this respect, we already have specific partnership models in the pipeline, the aim of which is to relocate many of our customers' validation activities from test sites into laboratories. We are planning to supplement the test bench expertise of ZF Test Systems GmbH with the engineering and validation expertise of the ASAP Group. We are set to implement a few of these joint projects in the near future."

Christian Schweiger: "In the field of e-mobility testing, I believe there is significant potential for ZF Test Systems GmbH and the ASAP Group to achieve further growth together. Accelerated development cycles combined with rising cost pressure in the development phase will see testing migrate from roads and testing sites into laborato-



Christian Schweiger

ries in future. With our testing and trialling centres at ASAP sites in Ingolstadt, Wolfsburg and Sachsenheim, we have the requisite test bench infrastructure, offer services for every step in the component testing process, and can help to develop the necessary test automations. This means we have a precise understanding of the user's side of things as well as many years' expertise in model design, test automation and requirementsbased testing. Looking ahead to the future of our collaboration with our strategic partner, we will be able to combine these abilities with the profound expertise ZF Test Systems GmbH has in mechatronic system design and control technology for test systems – and thereby offer our customers significant added value. I believe the biggest challenges for our collaboration generally lie in the market environment, which is influenced by issues including planning uncertainty brought about by the coronavirus situation and shortages of raw materials, as well as in changing contract award processes. Projects continue to grow in scope and entail



increased responsibility for suppliers and development partners, but also come with greater time and cost pressures. Our focus in 2022 will once again be to examine interfaces in detail and develop a joint market position. Working together with ZF Test Systems GmbH, we will assess the market so that we can collectively tap potential for future growth. For example, one conceivable future partnership model would be for ASAP to oversee the integration of ZF Test Systems GmbH test benches in the customers'

backend, or perhaps provide suitable models. Another scenario for this partnership model would be for ASAP to offer automations for testing and data processing in relation to test systems."

Mr Trebitsch, what do you believe are the benefits of the collaboration with ASAP in relation to e-mobility testing?

Thomas Trebitsch: "As I mentioned at the beginning, our strategic partnership with

the ASAP Group allows us to combine both companies' complementary competencies, which produces enormous advantages for both parties and, ultimately, for our customers, too. For instance, when ZF Test Systems GmbH supplies a test bench, it essentially provides a tool. However, this test bench only becomes a valuable instrument for customers through the simulation models it offers. Through our close collaboration with ASAP, a specialist in validation and simulation, we have direct access to the information we need about how we can further optimise our product. From the user's perspective, ASAP knows exactly where there is room for improvement in terms of test benches' usability and integration as well as which additional functions will deliver added value for end users. This form of collaboration offers benefits for both parties, as ASAP can also continue to further its expertise in relation to validation. The strategic partnership also means we work hand-in-hand on the topics we mentioned previously, which I also consider a major advantage. Experts from both companies often come together for a joint brainstorming session or a short discussion – and the various perspectives from contributors with different core competencies generate a lot of new ideas. Another area that I think offers major benefits for our future collaboration is vehicle integration. The ASAP Group's outstanding expertise in the field of electrics/electronics will come into play, because integrating the electric powertrain into the

vehicle requires knowledge in areas such as control unit integration and restbus simulation. Developing a conventional test bench for vehicle integration therefore represents an ideal area for the ASAP Group and ZF Test Systems GmbH to explore."

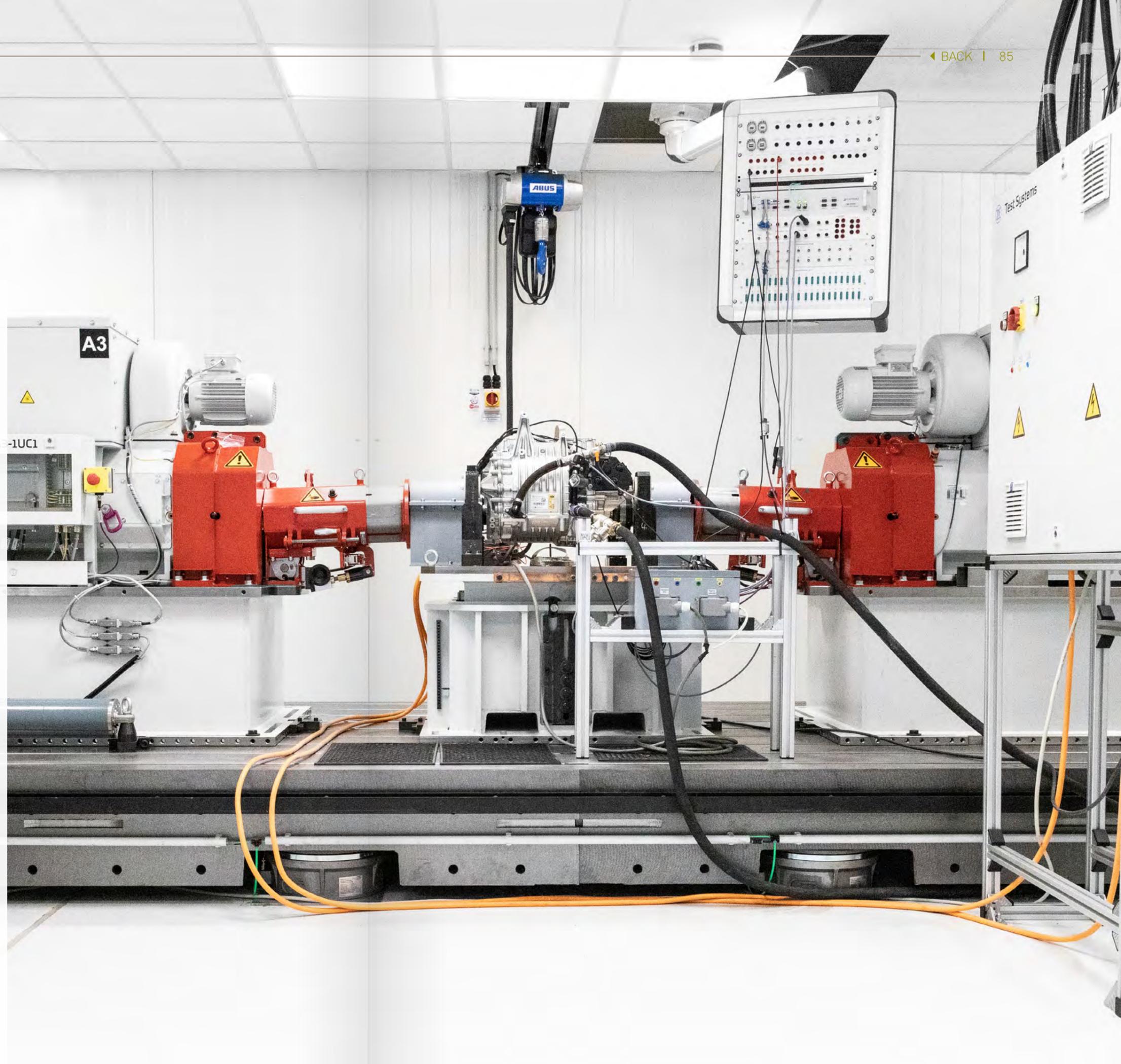
Mr Schweiger, what do you believe are the benefits of the collaboration with ZF Test Systems GmbH in relation to e-mobility testing?

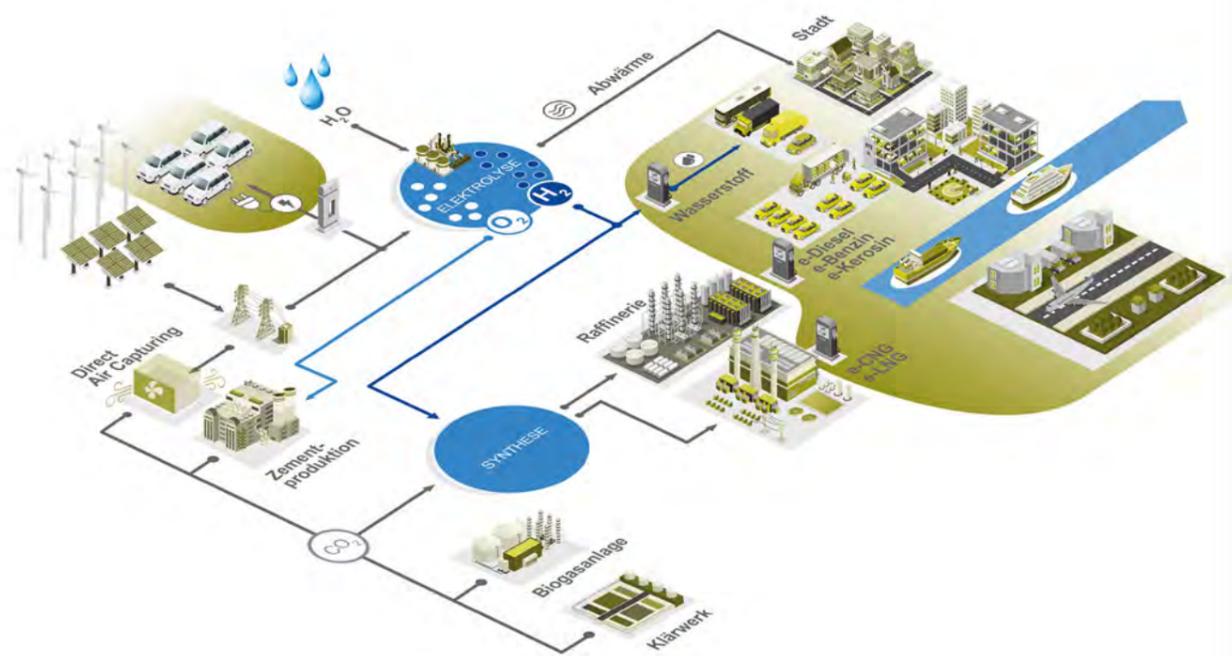
Christian Schweiger: "I believe that a major advantage of our collaboration in relation to e-mobility testing is that our services and focus topics complement each other wonderfully. ZF Test Systems GmbH has its roots in mechanical engineering, while ASAP has developed its test systems from the perspective of validating software functions. Combining our services means that our customers have a wider spectrum of solutions to choose from. For ZF Test Systems GmbH and the ASAP Group, this means exploiting the synergies we create in relation to tooling and development, which enables us to cover all aspects of e-mobility testing – which is what our customers want. Many proposal requests encompass entire test fields and projects continue to grow in scope. By pooling our resources, both in terms of topic areas and capacity, we can respond flexibly to the overall scope of projects. Overall, our collaboration with ZF Test Systems GmbH has enabled us to position our services more broadly and react more swiftly to changing market requirements."

Finally, a more personal question: At the ASAP Group, people are connected by their shared passion for the automobile. What is your personal passion for automobiles?

Thomas Trebitsch: “I’ve worked in the automotive industry for over 30 years and, in that time, I’ve worked on a number of new, fascinating aspects – and yet, the field still manages to capture my imagination every day. My passion for automobiles is a mixture of enthusiasm for the technologies and for the mobility sector in general. I think that the drive, the professionalism and the wide range of topics we encounter here are unique. Beyond that, I’m an avid driver and enjoy spending time in the car, ideally on a mountain road with panoramic views.”

Christian Schweiger: “My interest in a very well-known and successful make of car – including modern classics and newer models – has continued to grow over the years. Cars and their associated technologies have always held considerable allure for me and continue to inspire me, time and again. That goes for high-performance combustion engines and electric cars in equal measure.”





GREEN MOBILITY

SERVICES FOR TECHNOLOGY-NEUTRAL AND SUSTAINABLE MOBILITY

The ASAP Group offers numerous services related to technology-neutral and sustainable mobility. For many years, it has supported its customers with development projects focusing on climate-neutral fuels and other sustainable mobility solutions. Only recently, ASAP successfully completed a project aimed at obtaining certification for a power-to-gas system. Experts from the ASAP Engineering Service assisted our customer in their pursuit of Green Hydrogen certification for the system. The

development partner to the automotive industry stands ready to support companies beyond the automotive industry in future by providing consultancy services in relation to sustainable mobility. ASAP has signed a co-operation agreement with the Institute for Applied Sustainability (inas) to support this effort.

By issuing RED II, the revision of the Renewable Energy Directive, the EU has set out targets for the use of renewable energy by 2030.

While the EU directive has set a goal of raising the share of renewable energy in the transport sector to at least 14%, in early 2021 the German government increased its target to 28%. In order to reach this target, it is counting on biofuels, green hydrogen and an expansion of the EV charging point network, along with other measures and technologies [1]. According to a future scenario put forward in one study, synthetic fuels – so-called eFuels, produced using exclusively renewable energy – could cover over 70% of overall energy requirements for all modes of transport in the EU by 2050 [2]. “As a development partner to the automotive industry, we collaborate intensively with our customers to develop sustainable mobility for future generations,” said Christian Schweiger, Managing Director of ASAP Electronics. “E-mobility is a crucial topic for us – from the very beginning, we have committed to undertaking challenging development projects in this field. At the same time, it is important to approach the mobility of the future with a technology-neutral mindset for the energy transition to be successful. ASAP therefore also supports its customers with an extensive service portfolio in the field of green mobility.”

Green mobility service portfolio

To give an example, ASAP was recently able to bring a project in the field of green mobility to a successful conclusion, thanks to its years of experience and expertise working with related legislation. The ASAP Engineering Service assisted the customer with the development and certification of a

Power-to-X system to produce sustainable and synthetic fuels such as eFuels, eGas and hydrogen. The system has now met all requirements and received Green Hydrogen certification. It produces green hydrogen through electrolysis of water, powered exclusively by electricity generated by renewable energy. In addition to support with certification management and advice on audits in accordance with various standards, the ASAP Engineering Service also offers various other services related to green mobility. These include life cycle assessments and models to calculate the impact on the remaining carbon budget, taking into account specific market requirements such as the electricity mix, vehicle segmentation and annual mileage. Furthermore, in terms of sustainability consultancy, the ASAP Engineering Service undertakes projects that include overseeing and introducing energy management systems, analysing and optimising fleet carbon emissions, providing technical advice on alternative fuels and planning their use.

Cooperation agreement signed with inas

In future, companies outside of the automotive industry will also be able to call on the ASAP Group for consulting services in relation to sustainable mobility solutions. The corporate group recently signed a co-operation agreement with the Institute for Applied Sustainability (inas), thereby further expanding its extensive network of partners in the automotive industry and

the sustainability field. Based in Ingolstadt, the private research institute's main objectives include promoting research, teaching and communication, encouraging people and organisations to change their thinking, and generating enthusiasm around sustainable social and economic models. The institute primarily supports medium-sized companies on the path to sustainability by offering sound, highly practical assistance. "In the ASAP Group, we have found a strong

co-operation partner from the local region with years of experience in the field of green mobility. We are now in a position to systematically apply our expertise in sustainability management and the implementation of sustainability solutions in the field of green mobility. This cooperation opens up numerous opportunities for pioneering projects and potential new solutions," said Dr Michael Tretter, Managing Director at inas.

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NEWS 2021



NEW TEST HALL IN OPERATION AT WOLFSBURG SITE

FURTHER INVESTMENT IN E-MOBILITY AND EXPANSION OF THE BATTERY TESTING FACILITY

The ASAP Group has put a new test hall into operation at its Wolfsburg site, adding around 750 square metres of hall space. The new hall is ASAP's response to the high demand for development and testing services in the e-mobility sector – additional testing capacity has already been brought online with the commissioning of the test hall. The main focus at the new hall is on testing services for battery cells and battery modules. Besides expanding its services surrounding electric vehicle commissioning and

the development of battery systems, ASAP is also upgrading its battery testing facility with a focus on testing for battery cells and modules.

By expanding its testing areas and facilities, the ASAP Group is continuing to upgrade its development and testing services in the e-mobility sector at the company's Wolfsburg site. The development partner to the automotive industry has constructed new vehicle laboratories, workshops and project rooms

covering some 750 square metres. This expansion of the testing and trialling centre has been used in particular to further the focus on safety testing at cell and module level as well as cell characterisation. In building this new test hall, ASAP is also responding to customer demand for commissioning and vehicle update services, which will also be housed in the new hall. "In addition to expanding the battery testing facility and our portfolio of associated services, by investing in the new test hall we are once again demonstrating that ASAP is squarely focused on the mobility solutions of the future," says Thomas Martens, COO at ASAP's Wolfsburg site. "In recent years, we have enjoyed strong growth with our clear focus on cutting-edge technologies such as e-mobility and our emphasis on electronics and software development, as well as testing and commissioning at the Wolfsburg site. Customer interest in our range of services surrounding e-mobility confirms that we are on the right strategic path and points to great potential for the future." This further expansion of the infrastructure sets the stage for continued positive development at the Wolfsburg site. By upgrading the battery testing facility, ASAP has also further improved the consistency and universality of its services, enabling it to offer considerable added value to its customers.

Battery testing facility upgrade

The Group's upgraded battery testing facility allows ASAP to provide testing services for

service life and performance tests at cell and module level as well as transport tests in accordance with UN 38.3 and safety tests conforming to PV 8450. These include thermal testing, overcharging tests and crush tests as well as tests for thermal propagation and internal and external short-circuits. ASAP also provides cell characterisation services for its customers, including cell measurement and analysis. In addition, ASAP creates and evaluates software implementation concepts for battery management systems (BMS), makes measurement-based model adaptations for various cell chemistries and performs model-based optimisation for series production. ASAP experts investigate the differences between various cell chemistries when determining the vehicle's state of charge (SOC), for example, thus ensuring the SOC measurement is optimised. ASAP is also systematically expanding its services in the field of battery development-related simulation, modelling and simulating battery cells and battery systems at a 0-dimensional and 3-dimensional level. The emphasis here is on electrothermal simulation of batteries in conjunction with the battery management system and temperature-controlled peripherals. In addition to constructing and optimising the models, ASAP's work also involves evaluating test data, simulating various test cases and validating models with the help of specific measurement data. This means ASAP can use simulations to check aspects including the limit ranges of different battery systems using simulations.

MORE SPACE FOR ASAP AT ITS INGOLSTADT SITE

NEW TEST HALL PUT INTO OPERATION AT TESTING AND TRIALLING CENTRE

More space for automotive progress: In December 2021, the ASAP Group expanded its premises in Ingolstadt with a new testing and trialling centre. This new centre gives the development partner to the automotive industry an additional 1,500 square metres of hall space. This will enable ASAP to meet the growing demand for testing in the field of e-mobility, with a particular focus on further expanding its test bench infrastructure for inverter testing. The service life simulation systems for inverters/power electronics will be developed and manufactured in-house by ASAP's Test Systems division.

By commissioning a further test hall, the ASAP Group has created space at the Ingolstadt site to further expand its testing services for inverters/power electronics. The first testing systems for this have recently been put into operation in the newly expanded test facility. In recent years, ASAP has continuously upgraded its ISO/ICE 17025-accredited test laboratory in Ingolstadt in terms of service capacity,

consistency and universality in the e-mobility sector. "We see ourselves as a development partner and are in a position to offer our customers considerable added value. This is thanks to our extended range of services," explains Christian Schweiger, COO at ASAP's Ingolstadt site. "On the one hand, our customers require fewer interfaces to coordinate with us effectively. On the other hand, this is a great way for us to reduce development time and costs."

Service life simulation systems from ASAP Test Systems

The new test hall provides space for twelve new service life simulation systems for inverters/power electronics, which are developed and manufactured internally by the Test Systems division. Customers can engage ASAP Test Systems to plan and manufacture individual service life simulation systems in line with their own specific requirements. Alternatively, customers can also make use of the services offered at the ASAP testing and trialling centre, which can



take care of all the process steps involved in component testing, including test reports, in ASAP's own laboratory. ASAP's service life simulation systems are safe, proven solutions. The systems' modular structure and use of STEP software enables the simple, swift and transparent integration of testing equipment, measurement technology and control technology, which ensures it is and will remain future-proof. They are desig-

ned to be exceptionally sustainable and, thanks to their modular design principle, can be expanded or adapted easily when the product under test is changed. This reduces the investment costs and saves time when changing products. The concept has been designed with a strong focus on scalability to enable ASAP Test Systems to realise greater quantities of service life simulation systems quickly.

ASAP GROUP AND FKA GMBH AGREE ON COOPERATION

COMPANIES JOIN FORCES TO LEVERAGE SYNERGIES AND POOL EXPERTISE

A strong cooperation for the mobility of tomorrow: Michael Neisen, CEO of the ASAP Group, and Jens Kotte, Managing Director of fka, have signed a cooperation agreement. The focus of the collaboration between development partner to the automotive industry ASAP and fka is forward-looking technologies in the automotive industry – above all e-mobility, ADAS/AD and connectivity. Both companies hope to collaborate on potential research, advance development and series development projects in future and leverage synergies in the process.

The cooperation agreement between the ASAP Group and fka brings together two companies who have always been squarely focused on megatrends in the automotive industry. The two companies hope to intensify their collaboration on potential research, advance development and series development project, thereby advancing their capabilities in their focus areas of

e-mobility, ADAS/AD and connectivity. A key focus is leveraging synergies and pooling expertise to generate maximum benefit, not only for the two companies but also for their customers. By joining forces, ASAP and fka have made their services, technological resources, capacities, test bench infrastructure and networks more consistent and universal.

“With their clear focus on future-oriented technologies in the automotive industry, the ASAP Group and fka complement each other excellently, not only culturally but also in terms of their specialisms,” said Neisen. “By agreeing this cooperation, we are creating a shared basis for the continued growth of both companies and even greater value for other customers. The objectives of our cooperation also include the joint expansion of our testing and sales capacities, and ultimately acquiring new customers together.”

Kotte adds: “The ASAP Group meets all



our requirements for a strong cooperation partner. True to our motto of ‘creating ideas & driving innovations’, we at fka are developing the safe, efficient and inspiring mobility of the future for our customers – and, in cooperation with ASAP, we can enhance our level of performance and expand our spectrum with further specialist expertise. As an automotive expert, ASAP has a due understanding of customer needs and a holistic view of vehicle development, as well as the corresponding network.”

About fka

For 40 years, fka has been internationally known as an innovative engineering service provider for the mobility industry. fka’s 160-strong team is committed to driving the world by developing ideas and creating innovations.

The team around managing director Jens Kotte is inspired by a passion for efficient, safe and fascinating mobility.

FKA AND ASAP – A STRONG TEAM FOCUSED ON THE MOBILITY SOLUTIONS OF TOMORROW

AN INTERVIEW WITH JENS KOTTE, MANAGING DIRECTOR OF FKA GMBH, ON THE COOPERATION BETWEEN FKA GMBH AND THE ASAP GROUP.

Mr Kotte, how did this cooperation come about?

As a research institute, a generator of creative ideas and a driver of innovation, fka is always looking for strong cooperation partners so that we can expand our offering to our customers and further refine our focus. With our methodological expertise and our proximity to RWTH Aachen, our focus is on research and pre-series development. But we always keep series development in mind. This cooperation with ASAP enables us to continue to oversee our methods and ideas in series production with a clear customer focus and the support of a trusted partner. The initial contact between the ASAP Group and fka, which was followed by discussions with the managing directors

on both sides, came about during a specialist round-table discussion on the importance of software development. It quickly became clear that, in addition to the potential to leverage shared synergies, the two companies' corporate philosophies are in tune and the chemistry is right.

What will be your shared areas of focus?

Our goal is to shape the mobility of tomorrow. It needs to be safe, sustainable and inspirational. Key topics include e-mobility, ADAS/AD and connectivity. These topics will also be the focus of our cooperation.

What advantages will the cooperation bring for both partners?

The cooperation makes it possible to leverage synergies and pool our expertise to generate maximum benefit, not only for the two companies but especially for our customers, too. By joining forces, we have made our services, technological resources, capacities, test bench infrastructure and networks more consistent and universal. This allows us to support and delight our customers, from research all the way through to series development.

Looking at both the substance of your work and cultural aspects, where do you see similarities between the two companies?

The megatrends in the automotive industry have always been at the heart of both companies. I think both companies are fascinated by the idea of shaping the mobility of tomorrow. This has also been evident in our discussions in recent months, which were

Jens Kotte





always very constructive, harmonious and conducted in confidence. Reliability, customer focus, agility and interdisciplinarity have been the basis of our success at fka in recent years. I'm convinced that, in the ASAP Group, we have a partner by our side that embodies these values every day, just as we do.

Have you already set shared goals for your cooperation?

We have been actively working together on winning customer projects for some time now. This is something we want to expand further in the new year. We want to turn ideas and innovations into sound, validated solutions

that give our customers a decisive advantage in the various challenges they face. In addition, we hope to continue combining both companies' expertise and synchronise our efforts more precisely. Together with the ASAP Group and our customers, we want to continue driving forward our focus topics of e-mobility, ADAS/AD and connectivity, from the idea to the product.

Are you able to tell us about the projects you'll be collaborating on in the months ahead, or what your next steps together will look like?

We don't want to provide any more detail at this point. We're working hard on various

ideas for the mobility of tomorrow and we're in close contact with each other and with our customers. The cooperation between fka and the ASAP Group opens certain doors that had previously been closed. So, you can look forward to exciting innovations, including cars capable of hearing (i.e. sonic intelligence) and the development of bio-hybrids.

Finally, a personal question: At the ASAP Group, people are connected by their shared passion for the automobile. What passion do you have for automobiles?

Automotive topics have fascinated me ever since my childhood. One of my biggest passions is automated driving. The ability not only

to observe the advances in integrated systems and vehicle intelligence but also to help shape it fills me with excitement. A particularly thrilling topic for me is human-machine interaction, especially in relation to the huge strides forward in the field of ADAS/AD. Even in my current position as managing director, my fascination with development topics at fka has not diminished. Quite the opposite: the incredible innovative power of my colleagues' ideas and their outstanding work in creating safe, sustainable mobility solutions fascinates me anew every single day and fuels my passion without end. I'm lucky to work with my colleagues every day in line with our credo of "creating ideas and driving innovations". I'm grateful for that.

BETTER TOGETHER

COMPANY CULTURE IN TIMES OF HYBRID WORKING

How can we foster a company culture in times of hybrid working? What changes will be necessary in the new world of work? And what can we do to support our employees as they adapt to a new daily work routine? In 2021, ASAP launched its 'Better together' cultural initiative, in which employees from across the corporate group have grappled with these questions and worked together to develop solutions. Ultimately, our collective, our community and our trusting cooperation – elements that form the core of the ASAP spirit – will remain essential elements of ASAP's guiding principles in future, even with hybrid working models in place.

"At ASAP, the collective is our greatest strength; every single employee contributes to our company's development through their passion and enthusiasm," says Michael Neisen, CEO of the ASAP Group. This collective is also at the heart of ASAP's identity and leadership principles, which play a decisive role in shaping ASAP's corporate culture and, as a result, the company's long-term success. The spirit of the ASAP team is characterised by cooperation and a strong sense of community, making these elements crucial for the company's successful development.

However, the world of work has been transformed since the onset of the coronavirus pandemic, becoming increasingly digital. Due to coronavirus restrictions on personal contact and the rise of mobile working, we now spend fewer working days together as a team and instead often work alone. With this in mind, ASAP has launched the 'Better together' cultural initiative to address how the company culture can be adapted to the realities of hybrid working to keep it alive in future. Cooperation and community are now more important than ever before and must be actively fostered and nurtured.

A participative, collaborative road to success

Who better to answer questions about a company's culture and the support its employees need in their new working routine than the people who make up the company? With this in mind, employees across all ASAP locations started compiling their experiences of hybrid working in recent months in a series of workshops. This shed light on perceptions and direct experiences of remote working as well as the opportunities and challenges it entails. The overall response was unanimous: all



respondents had been very pleasantly surprised by how smoothly and swiftly the switch to mobile working had been. Collaborative work on digital platforms continues to be shaped by a sense of trusting cooperation. Nevertheless, remote working means that individual employees are subject to greater requirements with

regard to responsibility and self-discipline, which has also made it necessary for leadership styles to adapt. The workshops also identified further areas of optimization, both for hybrid working models and in relation to bringing the ASAP Group's corporate culture to life in the digital world of work.

The following four topics are the starting point of the ASAP cultural initiative 'Better together':

- › **The legendary ASAP spirit:** How can we preserve and maintain the legendary, tangible ASAP spirit and ensure that employees – and new recruits – identify with the company?
- › **The ASAP office as a home base:** What requirements, duties and needs does an office workplace need to fulfil in future as the home of the ASAP identity?
- › **Employee relations:** How can we facilitate the vital personal contact and relations between managers and employees – despite the balancing act of working from home and in the office?
- › **Leadership responsibility:** How can we give managers greater autonomy and power of self-determination, create transparency and ensure that goals and results are achieved?

Following the workshops, topic managers were appointed to further refine the proposed measures together with different teams

of around ten employees each. The results produced by this participative, collaborative approach are currently undergoing a 100-day stress test, which will run until the end of March 2022. This approach – that is, integrating employees in the process of shaping ASAP's culture and its working environment – was particularly important to company management from the very start of the project. Not only does it improve acceptance of developed measures within the company, this participative and collaborative approach is itself an expression of ASAP's corporate culture of cooperation.

"New work and mobile working means greater latitude – and everyone in the company needs to adopt this mindset with conviction."

"Coordination between employees has worked amazingly well, even digitally."

"I see it as a major opportunity for cross-location working."

"I miss the office as a hub for socialising, networking and exchanging ideas."

A DEVELOPER CONFERENCE FOR ACTIVE PARTICIPATION

ASAP GROUP HOSTS 'DEV.TALK'

In October 2021, the ASAP Group organised the first 'ASAP dev.TALK' under the motto 'I Love Coding'. For one day, everything at the event – which is somewhere between a BarCamp and a conference – centred around software development. Participants were able to use the event to share ideas with ASAP experts and, in addition to gaining exciting insights about programming languages, also learnt about software development at ASAP. Two BarCamps gave attendees the opportunity not only to learn something new but also to actively bring their own knowledge about software development to the discussion.

Two presentation topics and two BarCamp sessions: For one day, everything at the first 'ASAP dev.TALK' centred around topics relating to software development. The digital event format was a combination of BarCamp and conference, with a clear emphasis on enabling everyone attending to actively participate. "Our first 'ASAP dev.TALK' was a great success and we are very happy to have

had such positive feedback," says Sebastian Heinemann, Head of Software Development at ASAP. "The event allowed us to bring together people from a wide range of disciplines, to exchange ideas about software development, and at the same time to share our expertise and enthusiasm in this area with the participants."

The event kicked off with a short keynote speech, followed by two talks from ASAP experts on the programming languages Kotlin and Java. These included practical examples of how ASAP uses them in its day-to-day work. In the afternoon, participants then played an active role in the programme by attending the BarCamps. The participants themselves decided on the two focus topics. While the first BarCamp session focused on the topic of DevOps, the second BarCamp dealt with virtual validation. Stimulating Q&A sessions offered participants deep insights and the opportunity to share experiences and specific developer knowledge.



AWARD-WINNING

ASAP LEADS THE WAY

TOP EMPLOYER

Outstanding working conditions: In 2021, ASAP was once again named one of Germany's 'Top Employers', making it the sixth consecutive year that the company has achieved a stellar ranking. ASAP was ranked 3rd out of 44 in the 'Automotive and Suppliers' category and 36th out of 1,000 in the overall ranking.

LEADING INNOVATION AMONG GERMAN SMES

This year marked the fifth time that ASAP was recognised as one of the innovation leaders among German SMEs. In the independent TOP 100 selection process, ASAP was once again able to demonstrate its innovative strength and particularly impressed the jury in the 'Innovation Success' category. TOP 100 uses a transparent, accountable and scientific approach to identify the most innovative companies among SMEs.

GERMANY'S BEST EMPLOYER

Does the image match reality? Where ASAP is concerned, it certainly does – which is why the Group received the 'Germany's Best Employer' seal of quality this year. In cooperation with WELT, the Cologne-based analysis institute ServiceValue GmbH conducted large nationwide surveys to determine just how attractive German companies are in the eyes of the German public. The ASAP Group was rated 'highly attractive'.

LEADING EMPLOYER

ASAP has once again received the 'Leading Employer' award this year, putting it in the top 1% of German employers for the second year in a row. More than 100,000 companies were considered for this award. The selection process analysed some eight million datasets, making 'Leading Employers' the most comprehensive employer evaluation system of its kind in the world.

MINT MINDED COMPANY

The ASAP Group has been named a 'MINT Minded Company' for the seventh year in succession in recognition of its commitment to promoting young STEM talent. The initiative honours companies that show particular dedication to promoting young STEM talent and specialists.

TOP EMPLOYER FOR IT JOBS

CHIP and data analysis specialist Globis Consulting have joined forces to determine which employers are most attractive to IT specialists. Only the best companies are awarded the title 'TOP Employer for IT Jobs'. ASAP scored exceptionally well in the three test areas of IT applicant handling, transparency for IT applicants and IT employee evaluations, clearly setting itself apart from the competition.

GERMANY'S MOST FAMILY-FRIENDLY EMPLOYER

Outstanding work-life balance at the ASAP Group: The development partner to the automotive industry has this year been named one of Germany's most family-friendly companies for the second time. The winners were selected from over 175,000 companies.



CERTIFIED

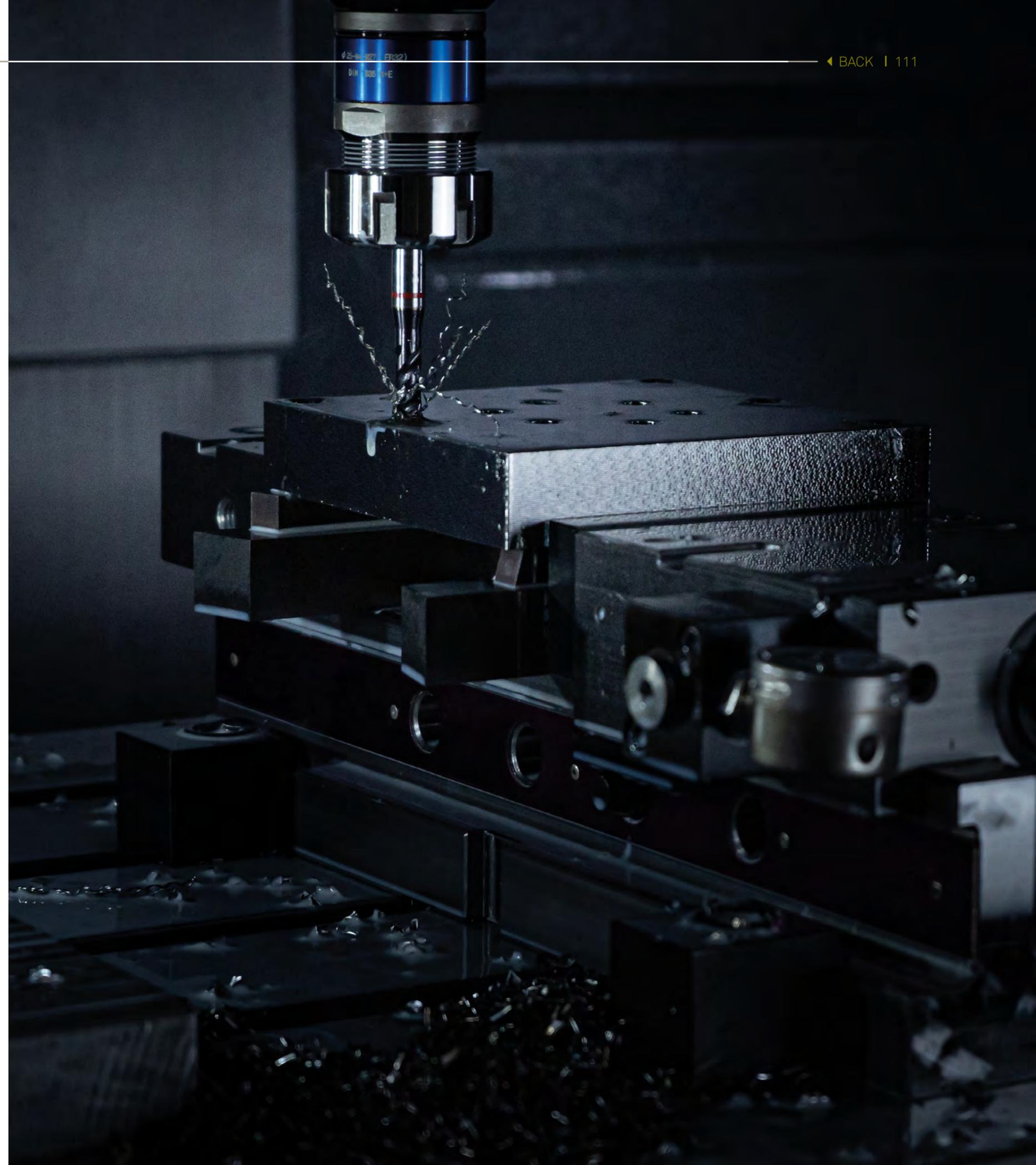
A FOCUS ON QUALITY AND OUR CUSTOMERS

CERTIFIED QUALITY

Quality and customer focus are integral elements of the ASAP philosophy and decisive factors in ASAP's success. Bureau Veritas has certified the corporate group's quality management system in accordance with DIN EN ISO 9001:2015. In addition, as the operator of the central IT and information security systems within the ASAP Group, ASAP Holding GmbH has been certified by DEKRA in accordance with ISO/IEC 27001:2013. ASAP Holding GmbH also adheres to the German Association of the Automotive Industry (VDA ISA) information security catalogue. The certification was issued by DEKRA in accordance with TISAX (Trusted Information Security Assessment Exchange). The TISAX assessment results are published on the ENX portal and can be viewed there.

ACCREDITED TESTING AND TRIALLING CENTRES

The ASAP testing and trialling centres in Ingolstadt and Wolfsburg have been certified by DAkkS, Germany's national accreditation body, as complying with DIN EN ISO/IEC 17025:2005. In addition, the testing and trialling centres have passed audits according to current automotive and industrial standards, including: LV 124; VW 80000 and 80101; DC 10611, 10612 and 10615; GS 95003-x and 95024-x; DIN EN 60 068 2-x and DIN ISO 16750.



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