InNovation
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MicroNova
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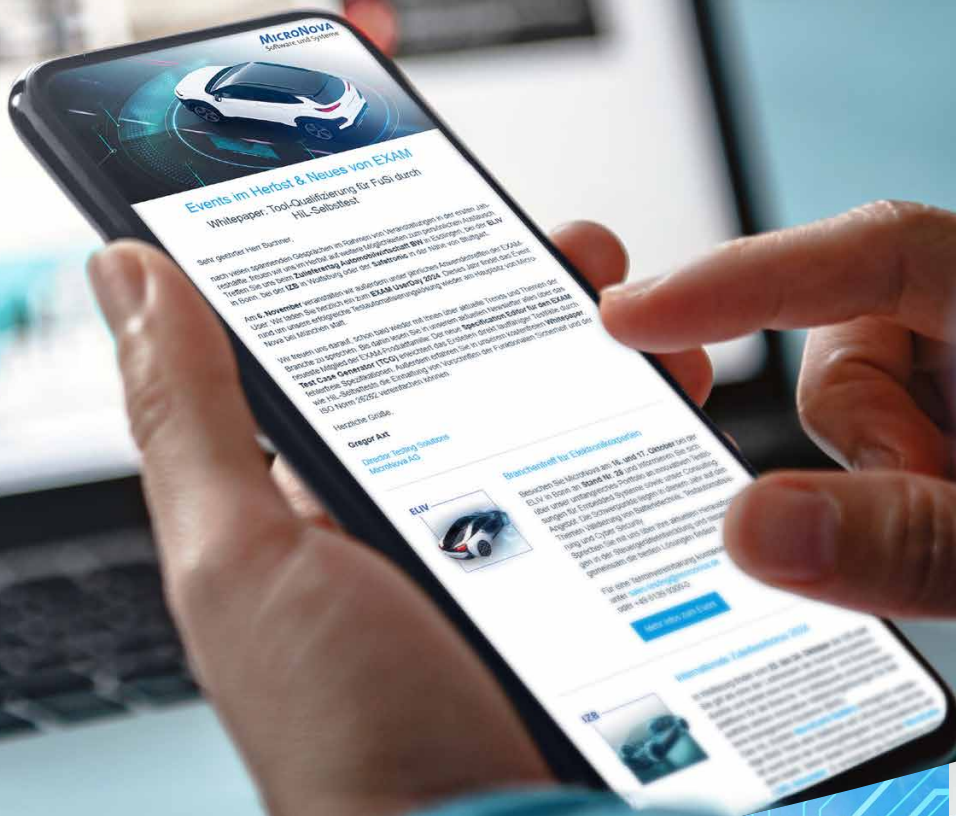
AI in BMS Development
Machine learning methods for
state-of-charge calculation

BMS Validation
Precise and flexible testing with
the NovaCarts product family

Game-Changer Low-Code
Cost-effective and efficient
digitization of business processes

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The Show Must Go On(line)

Dear Reader,

The title gives the game away: the show must go on(line). This is the final issue of our customer magazine InNOVAtion. In future, our editorial team will keep you fully informed using our various digital channels. Our Supervisory Board Chairman, Josef W. Karl, who back then as Managing Director gave the green light for the first issue back in 2002, explains some of the background and motivation in his customary "Voice from the Supervisory Board".

These introductory words have already made it crystal clear that we naturally intend to continue communicating the technology expertise we possess to help you meet the according challenges you face, report on successful customer projects, and provide insights into the MicroNova universe. Hence, it is only logical that this final issue also contains the "regular" content that has shaped the editorial approach of our customer magazine from the outset.

There is an interesting article from the field of consulting that discusses the possibilities offered by AI and machine learning for accurately calculating the state of charge (SoC) and state of health (SoH) of electric vehicles. A further article discusses a shift away from silos and towards an integrated, cross-functional, and cross-domain approach to cyber-security in the automotive sector. We also offer a white paper on the subject of "Methodology of Virtualizing Real ECU Hardware for Software Testing", which you can download.

The consulting articles are firmly rooted in the automotive environment, and we have more to report for this industry – including our hardware-in-the-loop (HiL) simulators for battery management systems. And as a final flourish of inNOVAtion, we outline the considerable potential of EXAM, our solution for the graphical modeling of tests.

Our Enterprise Solutions team has also contributed a number of articles. One of them is an interview with our experts on process digitalization using low-code/no-code solutions. Another article describes the evolution of monday.com from a project management tool to a multi-product suite for smart working. The editorial team has also written a case study on how ManageEngine solutions are used by the municipal administration of Bisingen.

I have already referred to the concluding words of Josef W. Karl in the Voice from the Supervisory Board. And so, it just remains for me to wish you all for the last time in this manner: enjoy the read, stay healthy, and join me in hoping for a peaceful and, prosperous world.

Orazio Ragonesi

AI: Machine Learning Methods for SoC Calculation

ElringKlinger is drawing on MicroNova's AI expertise to further develop its battery management system: An investigation into different approaches for calculating the SoC using machine learning methods.

TEXT: Tobias Haar   PICTURES: © MicroNova

The growing share of electric vehicles on the world market is also increasing the relevance of new technologies for battery management systems (BMS). The ubiquity of battery-powered systems in our daily lives underscores the pressing need for solutions that can manage energy storage systems in a reliable way.

Enhancing battery expertise at ElringKlinger

ElringKlinger AG, headquartered in Dettingen an der Erms in Baden-Württemberg, is one of Germany's leading companies in the field of battery technologies for vehicles. Starting with battery-related components, such as cell contact systems, the company has since moved on to developing complete battery modules and packs. ElringKlinger is expanding its portfolio to include new products and solutions as part of its transformation and evolution from a components supplier to a systems partner. This includes, for example, developing the expertise to specify battery management systems, i.e. electronic control units for motive power batteries.

ElringKlinger chose to partner with software and systems company MicroNova on a project to investigate the use of AI in determining the state variables of battery systems. MicroNova assisted in the project, providing comprehensive consulting services in the field of data modeling using machine learning and artificial intelligence (AI).

The aim of the collaboration between ElringKlinger and MicroNova was to assess various approaches to calculating the state of charge (SoC) and state of health (SoH) of battery cells using machine learning methods. The assessment considered the extent to which such alternative methods of investigation offer advantages over conventional methods. The basis for

this was provided by measurement data from multiple battery cells.

Focus on SoC and SoH

The state of charge refers to the charge level of an electrochemical storage device, i.e. its residual capacity in relation to its maximum capacity. Providing an accurate representation of the charge level is one of the most important aspects of battery management, for example, to enable an estimate of remaining usage time until the next recharge.

The term state of health is usually used to describe the condition of an electrochemical storage device. This parameter can be configured in a number of ways, for example by changing the internal resistance or the capacity of battery cells. The following section looks at the implementation of predicting the SoC in the context of machine learning.

Traditional methods of calculation work with the help of physical models and are ideal for determining the SoC very precisely. In real-life operation, however, this value can fluctuate if readings are inaccurate or the operating conditions assumed by the model differ from reality. Machine learning approaches offer a way to minimize these fluctuations.

Training data

A set of measurement data collected as part of a project funded by the German Federal Ministry for Economic Affairs and Energy was used to train and test the models. The battery parameters relevant for calculating the SoC include, for example, voltage (U), current (I), capacity (Ah), temperature (T) and the sampling rate (t-step). These data can then be used to determine the current SoC value approximatively with the help of data-driven modeling.

To confirm this hypothesis, Micro-Nova's AI experts performed a **principal component analysis (PCA)**, which can be used to assess which variables in a data set show the greatest variances, and thus particularly effectively represent its patterns and structures. The output of this analysis was a ranked list of voltage, temperature, current and sample rate in descending order of importance. Capacity does not feature in the list, as it can be approximated using voltage.

Based on this analysis, MicroNova's consultants collaborated with Elring-Klinger's technical experts to select the features for the models.

The objective for both models is the smallest possible divergence from the actual value, which is determined using error metrics. The metric selected with the help of the consultants (root mean squared error, RMSE) measures the error in absolute percentage points as a deviation from the actual value. The deviation for a precise calculation must not exceed five percentage points over the entire measurement data set in order to avoid significant discrepancies in the predicted SoC values caused by error accumulation over the battery life cycle. This is the only way of ensuring that a machine learning model achieves the accuracy required for in-vehicle use.

Focus on machine learning methods: random forest v. long short-term memory

After extensive literature and data analysis, two machine learning methods were selected that have the potential to predict battery state variables by identifying the interaction of several battery parameters.

MicroNova's consultants identified random forest and long short-term memory as the most promising approaches for such models.

The value of random forests (RF) for this project lies in their ability to produce accurate results with limited data and minimal adjustments to the hyperparameters. Additionally, training an RF model is less time-consuming and less costly than training a neural network, which requires significantly more training data and hyperparameter optimization. Random forests are therefore ideally suited for this application.

The drawback of the RF approach is the inability to extrapolate from baseline values. Due to its internal structure of decision trees, random forests can only calculate output values they have already seen during the learning process. The training data therefore need to account for all possible acceptable values of the battery parameters and SoC baseline values. This ensures that the RF model can calculate an SoC value for the entire range of data in a real-world operation.

Another challenge in applying this type of model to the available measurement data is its inability to capture time dependencies when calculating output values. An additional feature to the existing measured variables in the data set was therefore generated for the random forest model in order to represent the SoC value of the previous time step. This allows the random forest to factor in the time component in its calculations.

The second approach is based on a recurrent neural network called **long short-term memory (LSTM)**. The idea behind this type of neural network is to implement a function that allows the time context of successive data to be stored. This means that the neural network can remember previous inputs up to a certain point and use them to generate a prediction for the current input.

The main area of application for these special neural networks is in the modeling of time series data. This makes the LSTM very well suited for calculating the SoC, as it can recognize changes in multiple battery parameters over time, potentially allowing it to calculate very precise SoC values. A disadvantage of this methodology is its high sensitivity to model parameters and the resulting increased effort required to create the network structure and to fine-tune the model.

As with the random forest model, the LSTM also directly maps battery parameters to the SoC. The difference to the RF approach is that all inputs can be viewed in relation to time. Unlike the random forest model, this approach looks at all battery parameters over a predefined time window in order to calculate the actual SoC value.

Hyperparameter optimization

It is necessary to optimize the hyperparameters of a model in order to adapt it to a given set of data. This process is called **hyperparameter tuning**. The term hyperparameter refers to the higher-level parameters of a model that remain unchanged during the learning process. They describe, for example, the maximum depth of the random forest model or the number of neurons in a neural network. While the model is actually learning, the variable model parameters such as weights and biases in a neural network are then adapted to the data set with the help of optimization methods.

Different approaches were used for random forests and LSTM. A brute force strategy (grid search) and a random-based strategy (random search) were implemented in order to optimize the random forest hyperparameters. After testing a number of random combinations of hyperparameters, the best candidates were selected to test all possible combinations in the proximity of these individual hyperparameters. To accomplish this, MicroNova's experts trained the RF model on a portion of the measurement data and tested it with the test data set. The mean deviation between the calculated and actual SoC value was then determined and the best combination of hyperparameters was selected based on this. It can be considered an approximated local optimum. This strategy greatly depends on the number of parameters that need to be optimized. Optimization was performed in this way because the random forest approach has relatively few hyperparameters compared to the LSTM and does not tend to respond very sensitively to changes in them.

Bayesian optimization was used to adapt the **hyperparameters of the LSTM** to the data set. This approach can be used to determine the global optimum of a target function whose evaluation would otherwise incur high costs due to the enormous computing capacities required. An approximation can significantly reduce these costs. This involves creating a so-called surrogate model of the target function, which is easier to evaluate than the original function. This can then be used to select the potentially best combination of hyperparameters to improve the overall outcome of the model – in this case, the deviation of the model prediction for the SoC value from the actual value. Thanks to this

ElringKlinger – Partner to the automotive industry

As an independent and globally positioned supplier, the ElringKlinger Group is a powerful and reliable partner to the automotive industry. Be it car or commercial vehicle, with combustion engine, hybrid technology or as an all-electric vehicle – the company offers innovative product solutions for all types of drive systems, thus contributing to sustainable mobility. Lightweight design concepts reduce vehicle weight, which in turn reduces fuel consumption and CO_2 emissions in internal combustion engines and increases the range for alternative drive systems. ElringKlinger positioned itself early on as a specialist in electromobility with pioneering battery and fuel cell technology. The company is continuously developing its sealing technology for a wide range of applications. Its shielding systems ensure optimum temperature and acoustic management throughout the vehicle.

Dynamic precision parts from ElringKlinger can be used with all drive types. Engineering services, tooling technology and products made of high-performance plastics – also for sectors outside the automotive industry – round off our portfolio. In total, around 9,500 employees work for the ElringKlinger Group at over 40 locations worldwide.

optimization strategy, it was possible to model the LSTM model in a timely and cost-effective way. This approach proves more effective than a brute force strategy because it is sensitive to changes in the hyperparameters.

Evaluating the three models

A total of three models were evaluated: two random forest models and one LSTM model. One of the RF models and the LSTM model include the above features without the SoC value from the previous measurement step; the second RF model includes all the features. This division of the RF models is required if there is no baseline SoC value for calculating the present value. It must be calculated using the RF model without time dependency.

ElringKlinger set an average error value of 5% as the reference value for the accuracy of the AI approaches tested. A reference data set not included in the training data was used to validate the models. The mean validation data error values for the first and second RF approach were 3.4 % and 0.5 % respectively. The mean deviation in the LSTM approach was 3.3 %.

Evaluation result

On the basis of the models that had been trained and validated, Micro-Nova's consultants ultimately recommended random forest as a model for calculating the SoC. However, it can only be combined with the control unit via a cloud infrastructure owing to its size.

In the final assessment, the LSTM model was given a qualified recommendation, as its small size potentially allows it to be integrated into a BMS control unit. However, there is room for improvement in terms of the accuracy of its calculations, which could be accomplished, for example, by using filter mechanisms for the model's input and output values.

Advantages of AI models over conventional methods

The AI approaches examined can respond to changes in cell chemistry with acceptable error rates using the measurement data, thereby coming close to the accuracy of physical models. Data-driven AI approaches are therefore able to respond dynamically to changes in operating parameters, particularly when it comes to live operations in the vehicle. This is an advantage over physical models, whose calculations are based on assumptions about the operating parameters and are therefore less flexible in responding to any changes. A further advantage of data-driven solutions is that the models can be easily expanded to include more learning data.

The project was thus brought to a successful conclusion and the customers' requirements were fully met. ElringKlinger is now able to use the developed data pipeline to train additional models with measurement data and to optimize existing models with additional data. ■
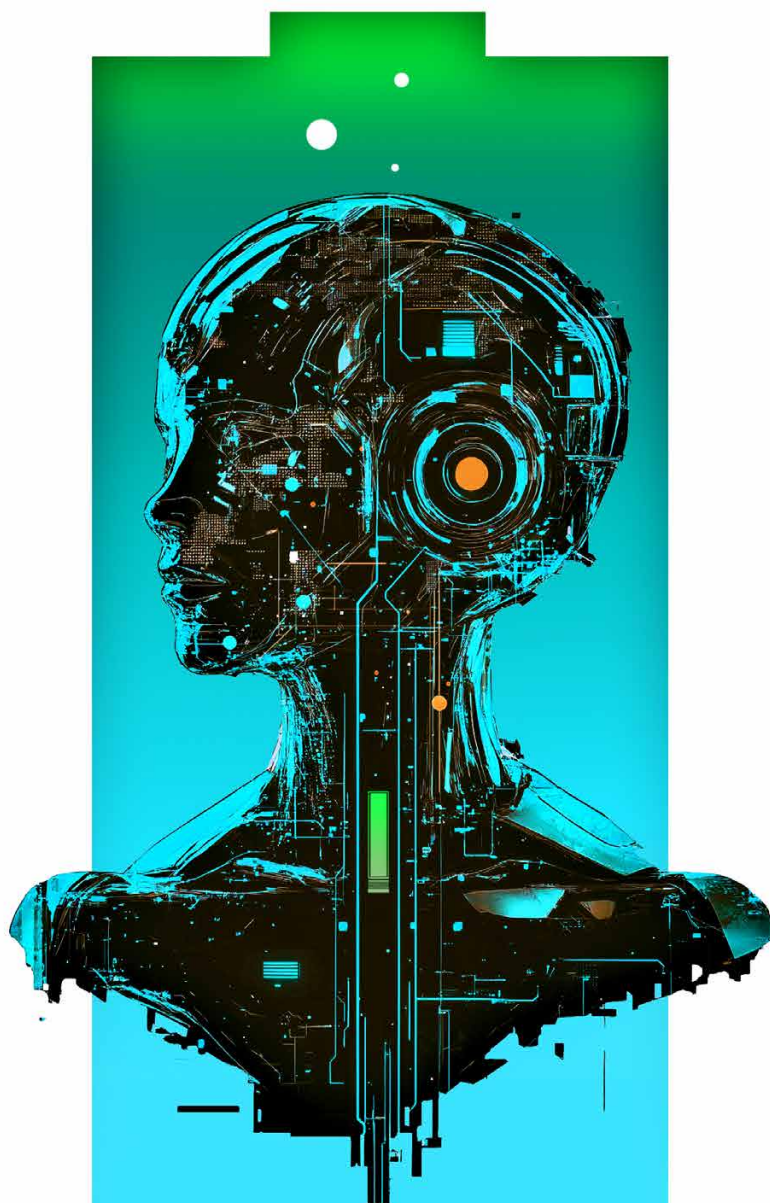
Organizational Silos

How to avoid safety and security issues

TEXT: Andy Gudera, Ashley Lobo   PICTURE: © tippapatt / Stock.Adobe.com

The traditional development model of the automotive industry, which is characterized by a strong division of labor, is currently facing complex challenges in the areas of safety and cybersecurity. Is this type of product development still the most suitable set-up for such requirements?

The development of advanced vehicle elements such as hardware, software, network, safety, and security is becoming more and more demanding. The growing focus on software in vehicle development has been accompanied by organizational changes: From an ECU-centric approach that combined hardware, software, utility and system functions, function-centric organizational structures have been created over the past 10-15 years.

Could the approach of splitting development into isolated departments, each focussing on a single function or component, potentially lead to significant risks, particularly in the area of safety and cyber security?

This article examines the impact of single-function thinking and departmental isolation in automotive development, particularly when considering the information security, safety and cyber security implications of modern vehicles.

The Challenge of Single-Function Focus

Automotive development often starts with a clear goal: deliver a new functionality, including the associated sub-functions, that improves the driving experience. The easiest way to explain this is with a practical example:

Imagine developing an innovative parking assistance system that helps drivers navigate tight spaces by controlling steering, accelerating and braking. Incidentally, the actuators of all driver assistance systems can be summarized in these three basic functions.

The function owner is responsible for developing the functionality, a role that was invented in the automotive industry and has since become established in other sectors as well. This role is responsible for the proper functioning of the system, possibly focusing exclusively on the parking assistance feature and optimizing it for different scenarios. However, can this single-function focus create blind spots?

The acceleration functions are virtually "shared" by various separately developed functions, such as adaptive cruise control or motorway assistant. Steering and braking interventions can also be used as stabilization functions. We are therefore dealing with multiple use of the actuators. Overlapping interventions could thus lead to problematic situations in terms of driving safety.

Admittedly, such an example is more or less obvious and is already taken into account in the safety processes of the intended functionality. Nevertheless, it can be used as an explanatory aid.

A similar situation arises with seemingly simple features like climate control. On its own, climate control is harmless. But when combined with other systems – such as window controls, door locks, and headlamps – it could be manipulated to create hazardous conditions for the driver.

An air conditioning system switched off by a third party and windows that cannot be opened can – depending on the outside conditions – cause the windows to mist up quickly and thus reduce visibility. If this happens at night and the headlights are also switched off by a third party, the risk of an accident is very high for the vehicle occupants.

As the function owner only deals with the scope of an air conditioning system during development, scenarios such as those described are not really noticeable and are not as obvious as in the safety example above.

This is where the risks of thinking and acting in silos or departments become evident. In a complete vehicle, functions do not exist in isolation. They are part of a larger, interconnected system where the interaction between components can cause vulnerabilities.

The Cybersecurity Blind Spot

In the world of consumer electronics, the risk of hacking is well-known, and developers are quite vigilant in protecting against it. However, there is a worrying level of complacency in automotive design, as evidenced by regular media reports of vehicle hacking.

It seems, developers often assume that vehicles, being physical machines, are less susceptible to cyber threats than digital devices like smartphones and computers. This relaxed – and outdated – attitude can be dangerous. The more unaware developers are, the more likely they are to overlook potential vulnerabilities that could be exploited by attackers.

Hackers could exploit a seemingly harmless function – such as the combination of air conditioning and window regulator control – to create critical driving situations through unauthorized access.

Information security, while often linked to cybersecurity, carries its own unique set of challenges, particularly in the automotive industry. It involves safeguarding the vast amounts of data generated and processed by modern vehicles.

This data includes everything from GPS coordinates to driver behavior. Unfortunately, many automotive developers focus primarily on physical security and overlook the risks associated with data breaches or unauthorized access to sensitive information. Hackers who gain access to personal data stored in a vehicle's systems could exploit it in numerous ways, including identity theft, location tracking, or unauthorized access to user accounts.

Given the increasingly connected nature of modern vehicles, where features like infotainment systems and in-car Wi-Fi interact with external networks, safeguarding this data is crucial. Neglecting information security can lead to severe consequences, both for consumers' privacy and the company's reputation, especially as regulations become stricter.

This underscores the importance of considering cybersecurity from the very beginning of the development process, rather than treating it as an afterthought and, much more importantly, to demand specialist support from cybersecurity engineers.

Overcoming Silos in Automotive Development: A Barrier to Safety

The organizational structure of automotive development often mirrors the compartmentalized approach to functions. Teams are divided by specialization: hardware, software, operating systems, network, diagnostics, safety, and security. While this division of labor allows for focused expertise and faster development cycles, it also fosters a siloed mentality. Each team becomes deeply engrossed in its own piece of the puzzle, with less consideration for how their work interacts with other components. The focus is shifting more towards processes rather than applied technology.

For example, a function owner may – and this is a recurring observation – have a limited understanding of the hardware or software that supports their function. This lack of cross-disciplinary knowledge leads to one-dimensional thinking, where the broader implications of their work are not fully understood or considered. When

„Only a holistic approach can help identify potential vulnerabilities that might otherwise go unnoticed. By involving cybersecurity experts early in the development process and technical solution finding, teams can ensure that security is built into the system from the ground up, rather than being retrofitted after the fact. Only then can we truly speak of security by design."

– Ashley Lobo,
Consultant,
MicroNova

teams work in self-induced isolation, the synchronization between them becomes a significant challenge. The boundaries between departments become barriers to holistic thinking, which is crucial for ensuring the safety and security of the final product, including information security.

The extent to which agile development also leaves its mark would need to be analyzed further. It remains to be seen whether the heterogeneous teams required by Scrum and other agile methods will actually be put together in the current situation of a shortage of skilled labor and development spread across different companies.

Considering a More Connected Approach

To mitigate these risks, companies should foster a culture of cross-functional collaboration. This means breaking down the silos that separate departments and encouraging teams to work together from the earliest stages of development.

Of course, this also means a flattening of the hierarchy and the elimination or regrouping of various positions. This is certainly a challenge, as humans are creatures of habit and have long internalized the familiar structures.

Considerations for cybersecurity – and here the functional and technical aspects are even more important than the procedural ones – must be integrated into every phase of the development lifecycle, from initial design to final testing and validation.

Developers should be enabled and encouraged to think beyond their immediate responsibilities and con-

sider the broader system in which their functions operate. In addition to training in applied cybersecurity, functional safety and information security, this also requires regular contact and even driving safety training for software developers. Saving on these measures now can cost companies significantly more later on.

Only a holistic approach can help identify potential vulnerabilities that might otherwise go unnoticed. By involving cybersecurity experts early in the development process and technical solution finding, teams can ensure that security is built into the system from the ground up, rather than being retrofitted after the fact. Only then we can truly speak of security by design.

Conclusion: Rethinking Development Practices

The automotive industry is at a crossroads. As vehicles become more complex and interconnected, the traditional approach of developing functions in isolation is in our eyes no longer sufficient. Single-function thinking and departmental silos can create significant cybersecurity risks that undermine the safety and reliability of modern vehicles.

In order to meet these challenges, automotive companies need to adopt a more integrated approach to development and be more communicative. Cross-functional collaboration, early consideration of cybersecurity, and a holistic view of vehicle systems are essential to creating safe, secure, and resilient vehicles. While there is no one-size-fits-all solution, raising awareness of these issues is the first step toward a safer automotive future. ◾

About us

At MicroNova, we understand that navigating the complexities of development requires more than just processual know-how. In fact, it requires a holistic approach that considers every facet of your project. We help you to see the big picture, from the function to the underlying necessary technology, required processes and documentation. So we support you ensuring that all functions are developed with cybersecurity in mind and that they integrate seamlessly across the vehicle.

Our personalized training and coaching on-the-job are designed to meet your specific needs, ensuring that your team gains the skills and insights necessary to succeed. They ensure applicability in your project to your product and maximise learning.

We meet you at eye level, taking the time to fully understand your challenges and work alongside you as sparring partners for new ideas. Additionally, we protect you from the overwhelming burden of compliance by streamlining the integration of the required cybersecurity standards, ensuring that your project stays on track without being bogged down by regulatory overload.

Whitepaper

Methodology of ECU virtualization
of real hardware for software tests

TEXT: Dr.-Ing. Jonathan Lehr   PICTURE: © Shuo / Stock.Adobe.com

The digital transformation enables the use of new methods for the development of embedded systems in the automotive industry and related sectors such as the aviation industry and plant engineering. The use of digital twins increases precision and flexibility in the development of electronic control units (ECUs).

This virtualization of ECUs has become an indispensable technology for meeting increasing safety and security requirements. The digital twin of an ECU makes it possible to bring the software development to a high level of maturity even before it is integrated into a real control unit.

The white paper shows how a virtual ECU (vECU) Level 4 improves the development of real control units through a greater depth of testing and at the same time enables earlier validation of the software. This is because the virtualization of a system allows access to intrinsic software parameters during runtime on a virtual hardware-in-the-loop (HiL) simulator. The simulation of error scenarios on a virtual test bench enables test engineers to identify software errors that would otherwise only have a negative impact on the functionality of the ECU at the end of the development process. This relates to the topic of functional safety in terms of ECU functionality and cybersecurity.

By implementing a vECU in a virtual HiL simulator, the test coverage regarding the safety and security aspects of a control unit can be drastically increased. The virtualization method presented here opens up new possibilities for more efficient software testing.

The free white paper on the methodology of virtualizing control units can be downloaded here:
https://www.micronova.de/en/consulting/news-events/infomaterial-downloads/whitepaper-methodology-vecu.html

Award-winning Validation Solutions for BMS

The requirements for reliable and efficient battery management systems (BMS) are constantly growing in the fields of electromobility and energy storage. MicroNova's hardware-in-the-loop (HiL) system NovaCarts Battery is one of the most powerful and advanced platforms for performing comprehensive tests and validations of BMS functionalities for all battery types. These also include solid-state and starter batteries. The solution offers highly accurate cell simulation and supports developers in creating features such as state-of-charge (SoC) and state-of-health (SoH) controls.

Safe battery operation also requires continuous monitoring of the cell voltage and temperature of the individual battery cells. Cell module controllers (CMCs) are responsible for performing this task. The NovaCarts CMC Simulator is therefore the perfect extension, as it can be used to simulate several such modules and is suitable for both test bench and desktop applications. The NovaCarts Battery Cell Emulation Board completes the solution. It is the only board worldwide to simulate the state of a battery in real time and deterministically at every stage – with microsecond resolution for electrical

simulations that even enable electrochemical impedance spectroscopy (EIS) for ECUs.

NovaCarts Battery – Precise Cell Simulation for Modern BMS Applications

The NovaCarts Battery HiL system is an extremely flexible platform that offers extensive testing options for BMS. Its modular design allows a wide range of battery types, including solid-state cells and starter batteries, to be realistically simulated and adapted to future technologies. A special feature is the FPGA-based (field-programmable gate array) cell simulation, which enables extremely fast computing and response times. This makes it possible to simulate voltage dips and current surges extremely accurately – a critical factor in developing and validating modern BMS algorithms.

The system is particularly future-proof and flexible, as new functions can easily be added via firmware updates without the need for costly hardware modifications. Another highlight is the modular architecture of the NovaCarts Battery System, which enables a high degree of scalability and

convenient adaptation to a range of test requirements, whether for low-voltage, high-voltage, or power-based batteries. NovaCarts Battery provides support for the development of new BMS functions, such as impedance spectroscopy as well as precise state of charge (SoC) and state of health (SoH) analysis.

NovaCarts CMC Simulator – High-Performance Cell Module Controller (CMC) Emulation

Lithium-ion batteries require constant monitoring of their cell voltage and temperature; this is handled by cell module controllers (CMCs). These CMCs capture the state values of each battery cell in real time and forward them to the BMS. The NovaCarts CMC Simulator can be used to simulate a wide range of these monitoring modules in a very flexible way, making it possible to carry out BMS tests at a very early stage of development without the need for actual CMC hardware to be present.

The FPGA-based NovaCarts CMC Simulator provides highly accurate and fast emulation of multiple battery

monitors and can be deployed in both HiL systems and desktop applications. This flexibility enables CMC components from different manufacturers to be tested in combination with a BMS – without significant conversion times or added costs. A further advantage is the simple integration of real CMC components, which can significantly reduce test bench costs.

NovaCarts Battery Cell Emulation Board – Electrochemical Impedance Spectroscopy (EIS) for Future Generations of BMS

The NovaCarts Battery Cell Emulation Board (NC-BEB1001) sets new standards in battery cell simulation. The board emulates the electrical behavior of lithium-ion and fuel cells with extremely high precision and dynamics, making it the ideal platform for developing the next generation of BMS and new types of battery.

One special feature is the integrated EIS function, which works at a frequency of up to 10 kHz, enabling the precise analysis of electrochemical processes within the battery and contribu-

ting significantly to the development of new BMS functions. In addition, the board allows for microsecond-accurate battery state simulation over the entire life cycle. Since the emulation board can be customized to meet new requirements through firmware updates, it is well placed to handle future developments.

Conclusion: Ideal Testing Solutions for Future-Proof BMS Development

The NovaCarts Battery HiL system, the CMC Simulator and the Battery Cell Emulation Board make this product family one of the most comprehensive and innovative solutions for BMS testing available on the market. Developers benefit from the extreme precision and flexibility of the systems, which can be easily adapted to new requirements and also make it possible to validate new generations of batteries such as solid-state cells and fuel cells. These test solutions are therefore crucial to the cost-effective development of safe, durable, and future-oriented battery technologies. ■

Award: "Products to Watch"

Micro Nova was honored with a special award for its test solutions at the International Suppliers Fair (IZB) in Wolfsburg, where the company was an exhibitor. The industry magazine Automobilwoche selected the 'Products to Watch' for the first time this year, honoring the 25 most promising products. We are delighted that our BMS test solutions are among these top innovations and have been named a 'Product to Watch by Automobilwoche'.

EXAM

Automated Test Processes for

Efficient ECU Development

TEXT: Editorial Staff   PICTURE: © ParabolStudio / Shutterstock.com

In the world of vehicle development, the number and complexity of tests required to validate electronic control components (ECUs) is steadily on the rise – at the same time, budgets are shrinking and development cycles are becoming ever shorter. Technologies such as autonomous driving or the connected car require an enormous amount of test cases on account of the multitude of scenarios that need to be tested. This results in complex processes, huge amounts of data, and a constant stream of new challenges for test departments and suppliers. One solution to this is to automate and standardize test processes while using X-in-the-loop (XiL) resources from any location.

EXAM: The Test Automation Solution

Standardized test processes, reusable test cases, comprehensive testing: the test automation tool EXAM (short for EXtended Automation Method) is a solution designed for the graphical development of test cases. In addition

to hardware-in-the-loop (HiL) simulation and test bench automation, it can also be used in industrial automation, embedded development, and software-in-the-loop (SiL) simulation.

Drawing on decades of experience in the field of test automation, Micro-Nova has developed a solution to optimize and accelerate the testing process. This means that HiL resources are used to their full potential, and automation relieves the burden on employees while keeping costs as low as possible.

As a comprehensive methodology based on the unified modeling language (UML), EXAM creates a platform-independent language to represent test situations. By using this solution, companies can create standardized test processes, ensure test cases can be reused, and perform tests in conjunction with partners or suppliers across departmental and company boundaries. The ease of use means no professional programming knowledge is required to graphically model test sequences.

Easy Start, Better Test Process

EXAM supports users in dividing up tasks in the testing process, making it easy to integrate into their existing testing environment. It is based on the three perspectives of Modeler, Testrunner, and Reportmanager.

Test development: The Modeler is used to create the complete test design – from the creation of test procedures in sequence diagrams, the creation and assignment of parameter sets, to the modeling or programming of operations, as well as test compilation.

Managing the test sequence: Individual test cases and test groups are activated or deactivated in the Testrunner. In addition, interfaces can be configured here and the user can define how often a test case or a test group should be executed. It is also where the interface and the corresponding implementation of the test run are assigned to each other. The Testrunner also controls test execution.

Managing test results: Completed test runs are evaluated using the Reportmanager. Core features include managing reports in the results databases and a meaningful presentation of results. Furthermore, results can be easily documented and measurement data clearly visualized.

There are also numerous libraries containing operations used to create test cases. This means connecting EXAM to the corresponding system and test equipment is a simple process.

The EXAM Product Family: Licensed add-ons make EXAM even more versatile.

EXAM Version Control enables model-based versioning of test cases. The versioned elements fall within the model domains introduced in EXAM 4.4, allowing certain operating states of interrelated elements to be frozen. For example, a productive version can be used for tests on the test bench, while another version is being developed simultaneously.

The **Test Cloud Controller (TCC)** automates the global distribution of test jobs to free resources. This lessens the workload on test engineers and improves the utilization of existing HiL systems.

The **Test Case Generator (TCG)** fully automatically creates test cases in EXAM from the test specifications. This substantially reduces costs for maintaining test cases and improves traceability, comparability, and reproducibility.

The **EXAM Jenkins plug-in** for the Jenkins platform integrates the test automation solution into the continuous development workflow (continuous integration, CI) via a REST interface. The REST API plug-in automates test execution in the build environment. This means the results are available more quickly and can be fed back immediately and continuously into the development process.

The **EXAM ALM Synchronizer** enables the automatic transfer of the test specification of the software to be tested between the relevant ALM application and EXAM. After the tests have been performed, the results are fed back directly to provide an up-to-date overview in the ALM tool. This synchronization between the ALM system and EXAM ensures a reliable, efficient, and fully transparent testing process.

The **EXAM ISO 26262 QKit** simplifies the qualification of tool chains in automotive projects. This plug-in for functional safety can be used to create documentation relevant to ISO standard 26262 for the test automation solution. It qualifies this part of the verification chain for the ECU development process of automotive OEMs and suppliers.

You can find more information about EXAM add-ons here: www.micronova.de/exam/produkte.

Freeware with Continuous Development

EXAM is available free of charge for creating and executing tests and reviewing results – unique for a solution of this kind. The tooling is available under freeware license, the core libraries are available as open source. In addition, the licensed extensions listed above complement the test automation solution and make it even more versatile.

AUDI AG, Volkswagen AG and MicroNova have been jointly developing the EXAM test automation solution since 2006. The software has since become the standard for test automation for HiL simulators in the Volkswagen Group. EXAM is continuously being developed in close cooperation with users, so that each new release represents a mature system with tooling and libraries. ■

Interfaces

EXAM provides numerous interfaces to hardware and software components. An up-to-date list of all interfaces is continuously being extended and is available at www.micronova.de/exam/schnittstellen.

EXAM-Services

As an exclusive EXAM distributor, MicroNova is the central point of contact for training, support, or customer-specific modifications of the EXAM tooling. We support companies with an extensive service portfolio in the professional use and seamless operation of the test automation solution and all EXAM add-ons. You can find more information about EXAM Services here: www.micronova.de/exam/services

Game-Changer Low-Code

In this interview, MicroNova digitalization experts Kay Soltau and Oliver Kraus discuss how companies benefit from low-code.

TEXT: Editorial Staff   PICTURES: © VideoFlow / Stock.Adobe.com

Digitalizing Processes Successfully

MicroNova supports companies on their way to establishing effective digital processes:

» Planning, analysis, and process optimization
» Tool selection and implementation
» Process modeling and workflow automation
» Integration into the system environment
» User training and continuous development

InNOVAtion: IT managers and senior executives are under pressure to accelerate processes and reduce costs. What are low-code/no-code platforms and how can these tools help achieve these goals?

Soltau: Low-code/no-code platforms enable users to develop applications and digitally map processes without in-depth programming skills. This is made possible by intuitive user interfaces and a simple drag-and-drop concept for connecting the building blocks of a workflow.

Kraus: It is particularly important for users, such as HR and project managers working outside the IT department, to be able to use the tool without having to undergo extensive training. Anyone can perform the basic tasks, with no programming skills required. Off-the-shelf modules or a little custom code come into play where additional functions are needed. Templates are also available for typical business processes and can be used directly and easily customized. This approach makes companies much less dependent on specialist developers, and more employees can actively participate in the digitalization process.

InNOVAtion: Does this risk creating chaos in the IT environment because too many people are involved?

Kraus: The exact opposite is the case. Shadow IT already exists in the form of individual Excel lists and unofficial workarounds. Companies using a suitable low-code platform have a standardized, centralized system with transparent access and processing rights. What is more, employees in the specialist departments are the ones who know what is really important in the processes. By involving specialists, this valuable knowledge can be incorporated directly into the digitalization of workflows.

„Low-code/no-code platforms enable users to develop applications without in-depth programming skills. The specialist departments are the ones that know what is really important in the processes, and they can apply their knowledge directly to the digitalization of the workflows"

– Oliver Kraus,
Consultant,
MicroNova

InNOVAtion: What type of organization can benefit most from using a low-code/no-code platform? Mid-sized companies with limited resources in particular are often faced with the challenge of effectively driving their digitalization forward while keeping costs low.

Soltau: Mid-sized companies can benefit greatly from this, as they often don't have the resources for large IT teams or external service providers. Low-code/no-code allows them to develop their own applications and drive their digitalization forward, even with more complex applications.

Kraus: Businesses simply become more efficient as a result. One specific example of a use case is the digitalization and automation of approval processes. We used a low-code tool to create a digital process for a mid-sized company that reduced processing time by 40 percent. Almost 50 percent of all applications could be approved or rejected on the same day as a result of the digitalization effort.

InNOVAtion: What typical challenges do you see in companies and what solutions do low-code/no-code platforms offer to address them?

Kraus: Companies often struggle with inefficient processes, long development times, and the associated high IT costs. In many cases, processes have grown with the business, and paper forms and Excel lists are still widely used. This is now outdated and there are much better solutions. Low-code tools can be used to quickly create user-friendly, lean and, above all, effective processes. What is important is for the process itself to be analyzed and, where appropriate, optimized at the same time.

Soltau: Manual processes are not only time-consuming and laborious,

„Digitalization is not a once-and-for-all project, but an ongoing process. Low-code/no-code platforms give companies a powerful tool to make this process a success."

– Kay Soltau,
Consultant,
MicroNova

but also susceptible to error. Automation helps us to achieve noticeable improvements quickly. Manual errors can be minimized and processing times can be drastically reduced for many typical business processes, such as invoice verification.

InNOVAtion: Where do low-code tools reach their limits?

Soltau: Conventional programming methods are still in high demand for very complex applications, such as the development of highly customized and specialized applications. It doesn't happen that often in practice, but the two approaches can also be successfully combined. We like working with low-code platforms that allow the use of SQL queries or JavaScript and SDKs for more complex enhancements. This approach ensures that companies are flexible and prepared for any future eventuality.

InNOVAtion: Another important consideration for businesses is the protection of sensitive data. What security protections are in place on low-code/no-code platforms to safeguard corporate data?

Kraus: The platforms provide extensive security features such as data encryption, access controls and, of course, regular security updates, ensuring that sensitive data is well protected. In addition, many low-code/no-code platforms have built-in security protocols that make sure only authorized users can access certain data.

Soltau: Features such as multi-factor authentication and role-based access controls provide additional layers of security. In addition, security policies can be centrally managed and enforced, minimizing the risk of data leaks and cyberattacks. Most cloud-based solutions store data for European customers securely within the

EU, where EU data protection legislation safeguards businesses.

InNOVAtion: Is it possible to integrate existing systems? Many businesses have existing IT solutions that they would like to continue using.

Soltau: Most definitely. Many companies use Outlook, Teams, Trello, etc. It is generally easy to integrate this existing software, meaning, for example, that items can be generated automatically or people can be notified when tasks are still outstanding.

Kraus: In addition, interfaces – so-called APIs – and connectors permit a

large number of external applications and databases to be integrated. ERP and CRM systems can also be easily incorporated. This in turn boosts the flexibility and scalability of the solutions, enabling companies to optimize their digital processes without having to change their entire IT infrastructure.

InNOVAtion: What trends and developments are you currently witnessing in the low-code/no-code space?

Kraus: The short term will be strongly influenced by artificial intelligence and machine learning. These technologies are being integrated into low-code/no-code platforms to enable

even more powerful and intelligent applications. AI is particularly good at recognizing patterns in data, making it possible, for example, to make predictions about how to optimize business processes. Automated decision-making based on large amounts of data will also play an increasingly important role.

Soltau: We are already seeing the first optimization potential offered by artificial intelligence when working with low-code tools, for example through pre-written e-mails or AI-based workflow builders. These functions are becoming ever more powerful and extensive.

InNOVAtion: Thank you so much for these insights. Is there anything else you would like to tell our readers?

Soltau: Yes, I'd like to emphasize that digitalization is not a once-and-for-all project, but an ongoing process. Low-code/no-code platforms give companies a powerful tool to make this process a success. The most important thing is to be open to new technologies and to take the plunge. Once you have a flexible system in place, you can continue to develop and optimize your processes on an ongoing basis.

InNOVAtion: Thank you very much for the interesting interview! ■
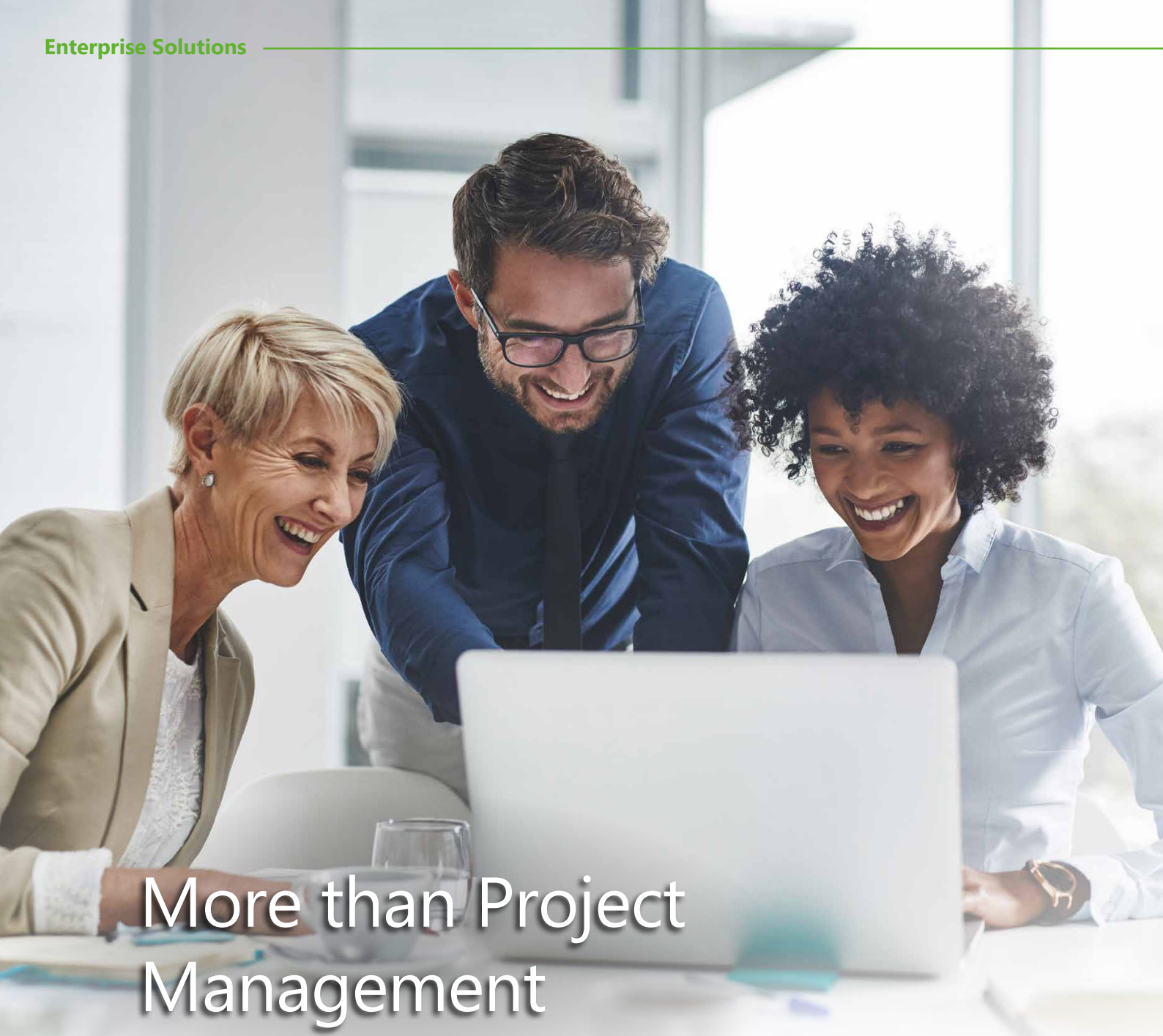
More than Project Management

monday.com Offers Specialized Products for CRM, Product Development & Co.

TEXT: Editorial Staff   PICTURE: © Donson/peopleimages.com / Stock.Adobe.com

monday.com

The monday.com Work OS is a no-code platform that makes it easy for businesses to create work management tools and software applications that are perfectly tailored to their needs. One area of focus is time-saving automation. A wide range of templates, integrated third-party tools, and views for visualizing workflows make users' jobs a whole lot easier. In 2024, monday.com was recognized as a "Market Leader" for the third time in the Gartner® Magic Quadrant™[1] for adaptive project management and reporting. The suite achieved top rankings in the areas of 'Ability to Execute' and 'Completeness of Vision'.

[1] *https://ir.monday.com/news-and-events/news-releases/news-details/2024/monday.com-Named-a-2024-Gartner-Magic-Quadrant-Leader-for-Adaptive-Project-Management-and-Reporting/default.aspx*

monday.com is one of the best-known platforms for optimizing workflows as well as facilitating communication and collaboration within teams. The high degree of customization and flexibility makes the Work OS attractive not only for project managers, but also for use across different industries and departments to streamline processes, automate tasks, and track performance in real time, for example using KPIs. monday.com now offers specialized product solutions to meet the increasingly complex requirements of different departments.

Specialized Features and Workflows for Specific Use Cases

Features and workflows have been developed for the individual products that focus entirely on the specific application in question:

monday work management:
efficient workflows and team collaboration

This centralized software solution helps teams manage workflows efficiently and collaborate in a structured way. monday work management empowers users to manage strategic goals, projects, and daily tasks, optimize resource allocation, and improve team collaboration.

monday CRM:
a customized CRM system for greater success in sales and marketing

monday CRM leverages the power of automation to streamline lead and deal management, provide clear sales pipelines, and manage customer data and activities. To achieve this, monday.com utilizes smart links between teams, allowing other departments – such as legal – to be directly involved in the process. Marketing and sales teams can use monday CRM to work together on both after-sales and customer retention.

monday dev:
use agile workflows to plan, create, and launch new products

With integrated features such as sprints and roadmap planning, it is possible to create agile workflows to bring products or software packages to market faster and to efficiently monitor bug/problem reports. monday dev is ideally suited for product, R&D, and development teams.

WorkCanvas:
developing ideas and working together creatively

WorkCanvas provides a dynamic interface where teams can collaboratively develop ideas, conduct workshops, and visualize workflows in real time, promoting creative collaboration and improving project planning. The platform is fully integrated with other monday.com products and progress is synchronized in real time.

monday WorkForms:
user-defined forms for efficient data collection

WorkForms makes it possible to create custom forms, such as surveys and registration forms, in order to collect, track, and analyze data. There are many ways of sharing forms with external or internal individuals. Boards and workflows are automatically synchronized with the forms, making further processing and evaluation significantly more efficient.

monday service:
effective customer support (beta)

monday service improves the processing of customer inquiries through centralized communication, automation, and transparent goal tracking. It uses a customer portal and integrated knowledge management, among other things, to help teams provide outstanding customer service. The product is complemented by monday.com's AI, which makes processes significantly more transparent and efficient – for example, through automatic ticket categorization.

Dedicated Solutions with a Core Software Platform

The products presented here can be used on their own or in combination across departments. The advantages of a centralized enterprise platform are that synergies can be fully leveraged because processes are integrated seamlessly. For example, after a contract has been successfully concluded in the CRM tool, subsequent task management can be performed in the work management product and easily assigned to the team responsible.

A central software package breaks down silo thinking within companies and facilitates the exchange of information and data. At the same time, companies can save time and money with a clear tool infrastructure, since contract management, user training, and support are all provided by a single reliable partner who is very familiar with the organization's vision and requirements. ■

Patch Management in Public Administration

Endpoint Central Reduces Workload through Automation

TEXT: Editorial Staff   PICTURES: © Bisingen Municipal Administration

Bisingen Municipal Administration

» Industry: Public administration
» Employees: Approx. 150
» Headquarters: Bisingen in Baden-Württemberg

The municipality of Bisingen is located in the Zollernalb district of Baden-Württemberg and is home to almost 10,000 people. The municipal administration of Bisingen employs around 150 people who support the 19-member municipal council in its work. Even though the municipality of Bisingen is small, the municipal administration is a public authority and is therefore classified as critical infrastructure that is particularly at risk from cyberattacks.

A huge workload for one administrator

The facilities and people supported by Bisingen's include the town hall with around 30 employees and the municipal council, a school complex with three schools and their respective administrations and building management systems, six kindergartens, a library, the water supply including the elevated reservoir, a sewage treatment plant, the municipal public works department, and several facility managers. The IT equipment used in these different areas reflects their diversity. The workload for Dominik Kegler, who is currently the only person responsible for all IT-related issues in the municipality – from equipment procurement to user service and maintenance – is correspondingly high.

With limited financial resources, patches for the various devices were rolled out either manually or via Windows Server Update Services (WSUS) until 2017. However, this did not allow the deployment of third-party patches. It was also not possible to manage remote sites from a central location. In addition to Microsoft solutions, the council also used Linux operating systems and third-party software products. At the same time, the number of mobile devices continued to grow, with smartphones and tablet PCs increasingly being used alongside laptops and mobile phones. Without an effective endpoint and patch management tool, it became increasingly difficult to efficiently manage this wide range of devices, operating systems, and software.

then assessed whether his positive experiences in the private sector could be transferred to the public sector. "As an IT administrator, I have to say that it doesn't matter what is what is implemented. What is important is that a solution is actually implemented," the IT specialist notes. "And Endpoint Central simply offers an unbeatable cost-performance ratio that a municipality of our size can also afford."

Although a municipal administration may have fewer employees than a district authority, which also has to run a vehicle registration office, for example, the variety and complexity of the tasks remain virtually identical. "The other vendors were simply too expensive for our purposes. That's why we're glad we found such a high-quality solution in Endpoint Central, which also saves the municipality a lot of money," says Dominik Kegler.

ManageEngine Endpoint Central

Once the decision has been made in favor of Endpoint Central, the implementation was quick and straightforward. A short test phase in the 'old' test environment was used to determine the exact software requirements and to purchase new hardware. It only took a few days until all systems were installed and fully operational. The necessary client software was also rolled out to the endpoints. The focus then shifted to fine-tuning the patch management.

"Patch management in Endpoint Central offers a wide range of features, and the number of products covered is huge," adds Dominik Kegler. "A major benefit that I really appreciate is the fully automated yet thoroughly tested installation process." This involves rolling out new patches to a reference group first. If a user reports problems or a patch fails within a certain period,

„The patch management in Endpoint Central offers a wide range of features, and the number of products covered is huge. A major benefit that I really appreciate is the fully automated yet thoroughly tested installation process."

– Dominik Kegler
IT / Administration, Bisingen Municipal Administration

the IT administrator can still intervene in the automated process and prevent the patch from being deployed to the remaining systems. However, if the test rollout goes smoothly, all other computers are also updated. In a final step, Endpoint Central generates a report that provides an overview of all the endpoints that have received the patch automatically and without external intervention. "A fine thing," adds the IT manager.

All of the mobile devices used by the municipal administration are now managed using the mobile device management functions of Endpoint Central – and that applies to devices from all vendors. Dominik Kegler has divided business smartphones and tablets into different groups and defined different standards for each. For example, he

When Dominik Kegler, who as Head of IT / Administration reports directly to the mayor, moved from the private to the public sector, he chose to focus on two key issues right from the start: centralization and IT security with a particular focus on patch management. It was the latter in particular that he hoped would make his job easier. "Good solutions and automation are vital to being able to handle the workload involved in providing support on your own," reports the IT specialist.

In his search for such a tool, the IT manager took a closer look at a number of vendors and their solutions. They included the endpoint management solution Endpoint Central from ManageEngine (formerly Desktop Central), which Dominik Kegler was familiar with from previous roles. He

can easily and efficiently assign the appropriate permissions and configurations to the devices of town councilors, facility managers, the public works department, kindergartens, and all BYOD devices. The use of Samsung KNOX provides additional device protection. For example, when a device needs to be repaired, it is temporarily shut down and the data is temporarily taken offline. The kiosk mode is also extremely helpful for the IT specialist, as it provides council members with the appropriate apps for their smartphones.

The standardizations introduced by Dominik Kegler also help to simplify the IT manager's daily work. This includes, for example, the software portal provided with Endpoint Central, which allows the various sites to download and install software themselves – without the need for administrator support.

Less tiresome hassle, greater security, and more time

Another benefit of Endpoint Central for the municipal administration is the secure connection of its remote sites using a forward server located in the DMZ. For example, it allows kindergartens to log in over the Internet and communicate securely with the internal server. This provides an extra layer of security, especially since public institutions in particular must be careful not to allow access to their infrastructure via the Internet.

In addition, Endpoint Central's Endpoint Security add-on provides a number of additional tools to help the municipality protect its devices even more effectively. For example, the vulnerability management feature warns about zero-day security vulnerabilities. The device control feature is some-

thing that is highly valued by critical infrastructure entities and is also used by Bisingen's municipal administration. It is used to encrypt and release the USB sticks procured exclusively by the IT department. If an employee finds the encryption annoying and tries to remove it, the USB flash drive will be automatically disabled on the municipality's endpoints. Dominik Kegler will also be informed and will then ask the employee to return the USB stick for re-encryption. Device Control is also used to prevent users from charging third-party smartphones on municipality-owned computers for security reasons.

The IT manager also finds it reassuring that Endpoint Security allows him to check his own work and that it notifies him if he has missed something or perhaps ticked the wrong box. For example, some experts consider the "Ctrl+Alt+Del" keyboard shortcut to be a security vulnerability, and Endpoint Central will alert users if they try to use it anyway.

Dominik Kegler finds the administration tools that come as standard with Endpoint Central very helpful and makes extensive use of them. They include Wake on LAN, system tools, remote shutdown and remote control as well as general announcements, which the IT administrator particularly likes. If he needs to tell his colleagues something, such as that a system is unavailable, he can reach everyone quickly and easily.

The remote control function is also used regularly in Bisingen. It allows the IT manager to access employees' computers simply and easily to provide remote support. The required agent is already installed on the computers, and the firewall rules are already set. This saves the municipal administration the trouble of purchasing yet another remote support product.

The Bisingen municipal administration also uses the extensive range of reports that are already included in Endpoint Central and which can be configured to suit its requirements. For example, user-defined data can be masked out in the reports so that it is not displayed in plain text – a major advantage in terms of GDPR compliance. However, Dominik Kegler uses the report on passwords, which are changed all the time, particularly often. It allows him to check the report rather than having to dig through the AD to find a particular password.

Conclusion

Since its implementation, the Bisingen municipal administration has made systematic use of all the features in Endpoint Central to automate all tasks wherever possible. This is the only way Dominik Kegler can manage the workload of administrating the wide range of devices and equipment by himself.

Patch management in particular is an absolute must for IT administrators, regardless of the size of the organization. "No matter how small or large: if I only had five computers, they would still need to be patched. And ManageEngine even offers a free version that can be used on up to 25 endpoints."

Dominik Kegler has already used the time saved through automation to implement Site24x7 from ManageEngine, for example. This allows him to easily check the performance and availability of websites, web-based applications, and servers.

"Even if it sounds a bit clichéd, there's no way of getting around ManageEngine Endpoint Central and Site24x7 when you need a centralized overview," says the IT manager, summing up his experience. ∎

Customer benefits:

» Enhanced security with End-
  point Security
» Automation reduces workload
» Excellent price-to-perfor-
  mance ratio
» Many useful tools to assist
  you
» Free version for 25 endpoints
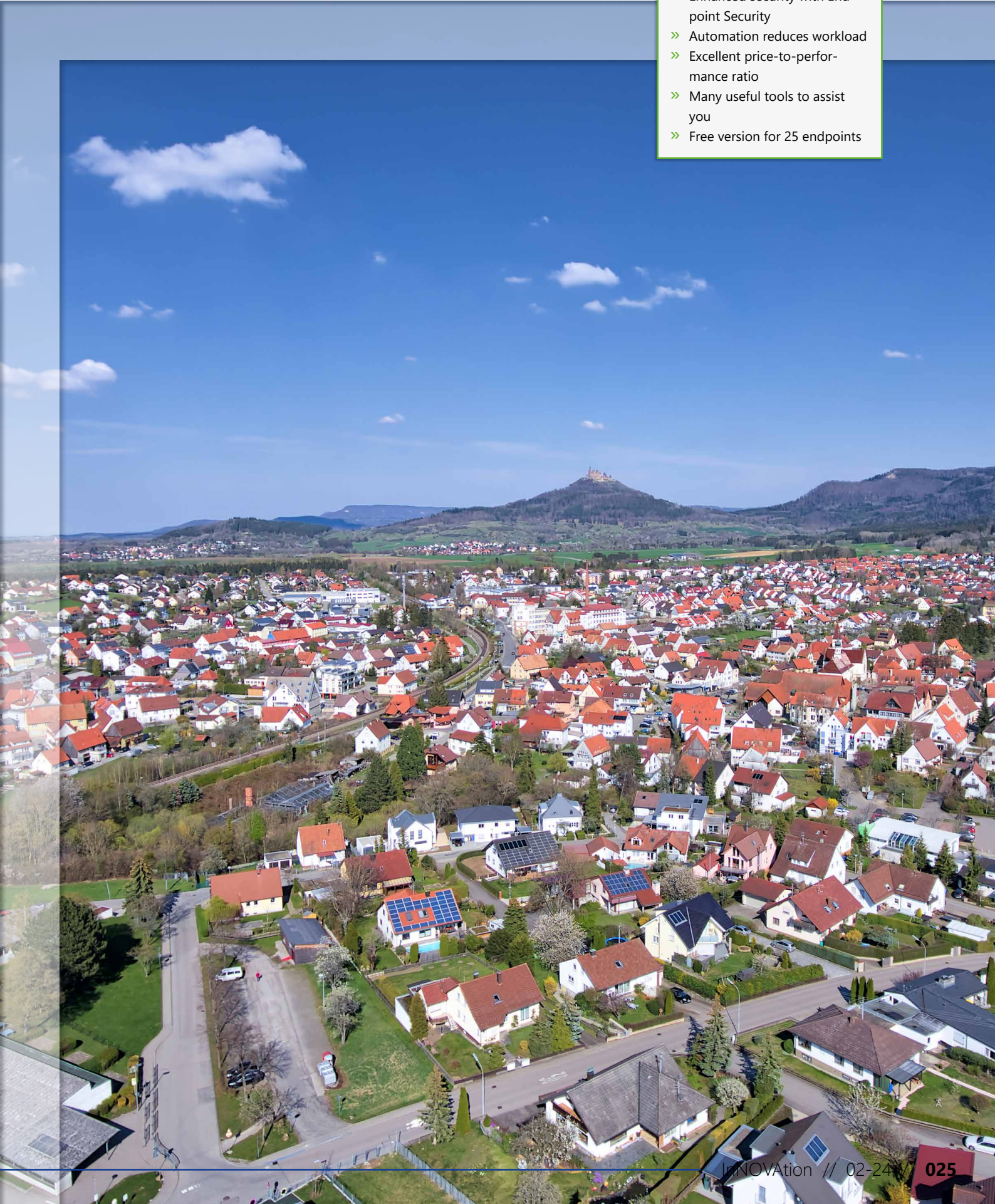
Follow Us!

You are holding the final issue of our customer magazine InNOVAtion in your hands. Let us explain our future communications.

TEXT: Editorial Staff   PICTURE: © IIIerlok_xolms / Shutterstock.com

Whether testing, telecommunications, enterprise IT or digitalization: with InNOVAtion, we have always provided you with comprehensive insights into technical solutions, numerous client reference stories from satisfied customers, and glimpses of the MicroNova universe. We would like to continue sharing all of this with you – by focusing on our digital channels, which have also proven their worth over time: website, newsletters, social media.

Not only can you find information about our products and services on our website at https://www.microno-va.de, but you can also access our latest expert articles and case studies in the "Trends & Topics" section. You can quickly and easily filter the areas that interest you using the article selection feature: https://www.micronova.de/aktu-elles/trends-topics.html.

The ManageEngine offering will continue to be available via its own website at www.manageengine.de, and the team will also operate additional dedicated communication channels.

Newsletter

If you wish to stay up-to-date with our solutions, events, customer projects, and services, you can subscribe to one of MicroNova's dedicated newsletters. Simply check the appropriate box at https://www.micronova.de/newsletter.html.

Social Media

We would also be glad if you followed us and subscribed to MicroNova on social media:

LinkedIn:
Our LinkedIn channel will keep you up to date with the latest news on our solutions, industry events, new publications, and our company: de.linkedin.com/company/micronova.

And Last But Not Least

We look back on over 50 issues, including special editions. Even if the editorial deadlines were occasionally tight, as editors, we have always found it incredibly exciting to explore the various innovative technologies and to work with the authors to present them to you. And in closing, we would like to say: thank you for having been such loyal readers! ∎
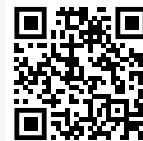
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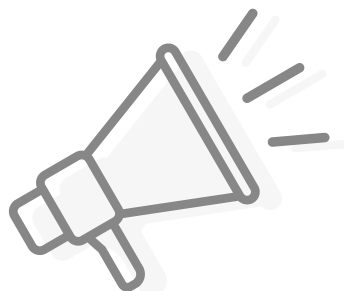
The Final Page

Dear Reader

As you may know, since becoming Chairman of the Supervisory Board, I have had the honor of writing the closing page of our customer magazine InNOVAtion. Now, as MicroNova CEO Orazio Ragonesi has already announced in his editorial, this will be the very last page of InNOVAtion ever.

For me, the communications loop has turned full circle. We launched InNOVAtion in July 2002, while I was still Managing Director of MicroNova electronic GmbH. It was twelve pages long and even then it was already printed on chlorine-free paper. The company was 15 years old at the time, and it would take several more editions until its conversion into a joint-stock company, the appointment of the current management board or the establishing of the current offering portfolio...

InNOVAtion has therefore been our trusted companion and has eventually served as a historical record of our activities. Over the years, the design and editorial content has been continuously developed, just as MicroNova has changed over time, of course. However, the core purpose of our customer magazine, your magazine, has always remained the same: InNOVAtion has communicated the technical expertise of our team, presented customer projects, and repeatedly provided insights into the company as a whole.

And now, you are probably wondering why this is the final act for InNOVAtion. There are a few relatively simple and not particularly spectacular reasons for this. The period between editions is relatively long – especially in comparison to our website and the newsletters from our specialist departments, as well as in view of the short innovation cycles. We also take a critical view of the consumption of resources. And as an innovative company, it would not fit in well with our image to cling to the old out of a mere sense of cherished tradition...

In this respect, InNOVAtion is the hotbed to "more" in faster communication. I have already mentioned the newsletters produced by our departments – please feel free to sign up for any of them that you find interesting if you wish to continue receiving the specialist insights described above. Our activities along the way have been available on the web for quite some time, for example on our website https://www.micronova.de/unternehmen.html or our LinkedIn channel https://de.linkedin.com/company/micronova.

Nevertheless, I share the sense of sadness felt by many authors and members of the editorial team. We have always enjoyed working on InNOVAtion even though every now and then it proved a little stressful in the last few days leading up to dispatch. I also would not like to rule out the possibility of a similar corporate format for MicroNova communications in the future – who knows what will emerge? Who knows what the next trend will be?

These lines would normally have been written by the Ukom leadership and the Management Board. However, Martina Heinze and Orazio Ragonesi "granted" me the final word in the story of InNOVAtion in view of my role as its first "editor-in-chief": **I would like to thank you for your interest and the time you have devoted to reading InNOVAtion – "read you soon".**

With warm regards,
Josef W. Karl

Josef W. Karl
Chairman of the Supervisory
Board of MicroNova