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SECURING THE FUTURE THROUGH DIGITAL TRANSFORMATION

SHAPING THE FUTURE: **DIGITALIZATION AND IT IN MACHINERY AND PLANT ENGINEERING**

The machinery and plant engineering sector is currently undergoing a digital transformation. In light of global crises, supply chain challenges, and mounting pressure to innovate, success now depends not only on product quality but also on the speed and intelligence used to attain it. Digitalization and IT have evolved from mere tools for leveraging efficiency to essential investments in future viability.

Companies investing in digital technologies and modern IT infrastructures are today laying the groundwork for lasting competitiveness, increased innovative strength, and economic success.

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DIGITALIZATION IN MECHANICAL ENGINEERING – EMPHASIZING KEY TECHNOLOGIES

Instead of broad buzzwords such as "Industry 4.0" and "IoT," the emphasis is placed on specific, actionable technologies that are already providing tangible results. Digital technologies derive their value not from the lab, but from practical application. Mechanical engineering gains particular advantages when specific use cases with measurable return on investment are implemented, ranging from real-time data utilization to the digital simulation of complete systems.

Overview of relevant technologies in innovative applications:

1 **Cloud computing & edge computing:**
Flexible, scalable IT resources empower real-time, data-driven decision-making both on a central and distributed basis.

2 **Artificial intelligence & machine learning:**
Automated analysis of large volumes of data optimizes processes, quality, and maintenance.

3 **Digital twinning:**
Virtual representations of machines and systems for simulation, optimization, and error prevention.

4 **ERP & MES systems:**
Data flows seamlessly from order to delivery.

5 **Transparency and automation:**
The basis for safeguarding margins, ensuring process and cost transparency, and enabling automation

6 **Product Lifecycle Management (PLM) systems:**
Holistic management of the product lifecycle – from the initial idea to the actual service.

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POTENTIAL FOR LOWERING PRODUCT COSTS

REDUCING TIME-TO-MARKET

Market-oriented solutions for customers are prioritized above all else for product development in mechanical engineering. The primary challenge facing the German mechanical engineering industry is achieving an optimal balance between cost and benefit, monitoring value creation, and maintaining the ability to offer competitive prices. Speed is crucial in every process and ultimately determines who secures market share.

1 Digital product development:

Innovative products today are no longer created sequentially but instead developed in parallel, in processes in which they undergo digital planning, simulation, and testing. Digital product development serves as both a catalyst for accelerated innovation and a means to reduce costs. The key lies in how consistently organizations embed these technologies and methods into their development workflows. Some examples of digital product development include:

- **Simulation & digital prototypes:** Digital models take the place of physical prototypes, reducing development costs and accelerating test scenarios.
- **Collaborative platforms (e.g. cloud-based PLM systems):** These streamline coordination, enhance transparency, and enable parallel work across multiple locations.
- **AI-assisted variant design:** This technology automates the creation of design variants, enabling efficient customization of products.

2 Agile development methods:

Iterative processes enable faster adaptation to customer needs. It is crucial to recognize that the effectiveness of this approach relies largely on the willingness and ability of the teams to embrace this new method. If this is unsuccessful, external support can facilitate and moderate the change process to ensure that "agility" becomes a reality rather than just a buzzword.

3 Virtual commissioning:

Testing and optimizing machine functions before physical production begins is an important step. The final stage of a project often harbors considerable economic risks and reduces the company's profit margins. Expenses associated with transportation, on-site commissioning, and securing acceptance remain a black box until the end, making them difficult to estimate and plan for. Virtual processes make this phase of the project more manageable and greatly lower the risk of substantial additional costs.

4 Modularization & variant management:

Reducing complexity and lowering development costs is crucial. The concept of modularization presented here, which has long been common practice in places such as China, has not yet become established in German mechanical engineering. The benefits are clear, even if it requires moving away from some aspects of traditional German engineering. The explanation is straightforward: customers today are no longer willing to pay extra for this additional exclusivity.

MARKUS ZAHN
Director

"Digital twins are becoming the control center for product and process intelligence in mechanical engineering, enabling real-time simulation of machine behavior, facilitating predictive maintenance, and allowing for virtual testing of complete production workflows before any physical components are produced. For companies, this means lower development costs, a reduced number of faults, and faster commissioning. In the future, digital twins will not just be an extension of the real world but a strategic management tool across the entire life cycle."

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IMPROVING QUALITY AND REDUCING WASTE

The erosion of margins in mechanical engineering, combined with various external factors, is increasing the pressure on companies considerably. From placement of the order to receipt of final payment, margins frequently experience a significant double-digit decline, which can be mitigated by implementing a more integrated process landscape. Various tools are available to assist companies in streamlining order processing and achieving greater cost transparency:

- **Inline quality control with AI:** Automated detection of faults in real time.
- **Traceability through digital documentation:** Prevention of delays and additional costs
- **Closed-loop feedback systems:** Continuous product improvement through field data utilization.
- **Digital training & assistance systems:** Reduction of operating errors and faster onboarding.

DR. KRISTIN NAGEL
Director

"Seamless tracking of components and processes is essential for preventing delays during the production or commissioning phase. Inconsistent systems and a lack of paperless manufacturing frequently result in delays. These are always associated with costs that cannot be passed on to the customer, ultimately reducing margins."

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IT AS AN ENABLER OF FUTURE VIABILITY

IT is no longer merely a support function – it is the strategic engine driving business model innovation, resilience, and growth. In machinery and plant engineering, IT is becoming the platform for agility, scalability, and differentiation. This new reality demands a clear technological vision and an integrative approach:

- **Scalable IT infrastructures:** Cloud-native architectures enable rapid responses to market shifts.
- **Cyber security:** Protection against outages and cyber attacks as a prerequisite for digital business models.
- **Data strategy & governance:** Structured data management forms the basis for automation and AI. Those who understand data strategically as a value chain create the basis for innovation.
- **Interoperability & open interfaces:** Future-proof integration of emerging technologies and partners.

WE CREATE SUCCESS

CHALLENGES AND KEY FACTORS FOR SUCCESS

Digitalization is not a sprint but a transformation marathon peppered with stumbling blocks. Technological investments succeed only when accompanied by acceptance, appropriate training, and cultural change. Successful companies therefore approach digitalization comprehensively, considering both its strategic and technological dimensions.

- **Investment costs and ROI:** Digitalization demands upfront investments, but such investments yield clearly measurable benefits.
- **Skilled worker shortage and qualification:** New skills are in demand – ongoing training and reskilling are emerging as key drivers of success, taking the place of pure recruitment (skill shift).
- **Cultural transformation and change management:** Digitalization is not merely an IT project but a holistic transformation process. Digital leadership must be established, with managers serving as key drivers in the change process.
- **Technological complexity:** Selecting and integrating appropriate systems demands strategic planning.
- **Partnerships & ecosystems:** Collaboration with technology partners, startups, and universities as catalysts for innovation.

CONCLUSION AND OUTLOOK

Digital transformation is not an end in itself but a strategic tool for securing competitiveness in mechanical and plant engineering. Companies that invest in modern IT infrastructures, digital processes, and data-driven business models today are laying the groundwork for the future:

- **Cost efficiency through automation and transparency**
- **Faster innovation cycles and reduced time-to-market**
- **Enhanced product quality and increased customer satisfaction**
- **Future-proof business models in a dynamic market environment**

In the years to come, mechanical engineering will increasingly develop in the direction of autonomous, data-driven systems. Intelligent machines, adaptive production processes, and digital services along the entire life cycle are becoming the new standard. Now is the time to lay digital foundations that are adaptable, secure, and scalable.

ATREUS WHITEPAPER

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SUCCESSFULLY IMPLEMENT YOUR DIGITAL TRANSFORMATION PROJECTS WITH ATREUS.

Professional interim management accelerates your digital transformation projects by providing expertise and driving impactful change. Our seasoned interim managers specializing in IT, digital transformation, and mechanical engineering deliver tailored support – whether you need to establish a future-ready IT infrastructure, implement digital product development, or drive change management initiatives.

With Atreus, you can rely on implementation expertise, industry knowledge, and resilient networks – so that your digital transformation does not remain a mere lighthouse project but instead brings lasting success.

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