DIALOGUE #72

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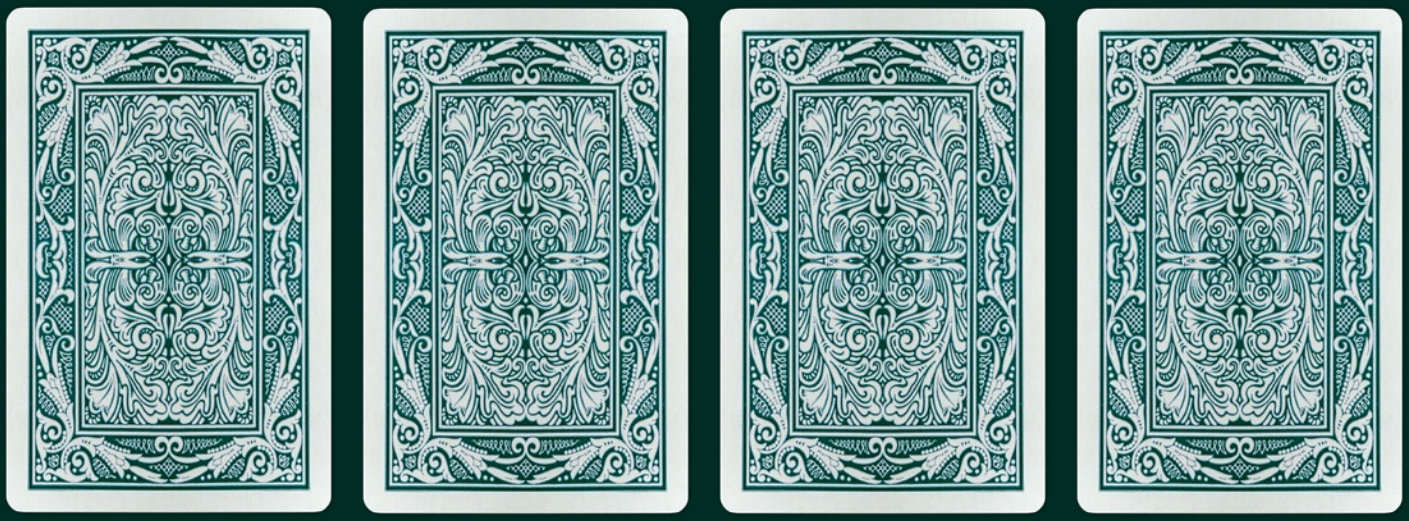
BEAUTIFUL MINDS

WHAT INTELLIGENCE MEANS IN THE DIGITAL AGE

CONTENT



BEAUTIFUL

MINDS

WHAT INTELLIGENCE MEANS IN THE DIGITAL AGE

In a dynamic environment marked by disruption, we can only play an active and shaping role if we are able to do many things quickly, effectively, and in parallel. That cannot be done on autopilot. Instead, we must immerse ourselves in the whirlpool of complexity. To understand interconnections and make decisions, we need to learn intensively, repeatedly adapt to new situations, actively solve problems, and think creatively. For this, we need the will to act and the ability to withstand stress and uncertainty. Above all, however, we need ever greater cognitive performance or, to put it simply, ever greater intelligence.

Ironically, it was not the view of our changing world that prompted both science and business to increasingly engage with human intelligence (HI), but rather the rapid rise of artificial intelligence (AI). On the one hand, in order to understand the internal processes, potentials, and risks of AI, we need a sharper picture of HI and of intelligence itself. On the other hand, the output quality of AI strongly depends on the input quality of HI and on a smart and effective design and governance of the many interfaces between humans and machines.

Human intelligence and collaboration within HI/AI systems are therefore critical bottlenecks that cannot be offset by data volumes or computing power. Put differently: we need approaches to maximize the capacity and effectiveness of both HI and AI and to combine their specific strengths in order to increase the overall cognitive performance of organizations. And finally, there are also parameters beyond pure intelligence that determine whether we arrive at good and sustainable decisions.

From this arises a range of questions we must address: what is the relationship between intelligence and factors such as intuition and empathy? What does it mean for business models and competitive strategies when AI is unlimited but available at marginal cost? How must we shape the interplay between biological and artificial intelligence in industrial environments? How do we define responsibility and decision-making in a process- and automation-driven world? Are there fundamental limits to the scalability of AI, and should there be ethical boundaries as well? How can we best prepare organizations for a transformation that is accelerating further and further? How can we foster creativity and non-linear thinking, which only humans are capable of?

It would be presumptuous to believe that these questions can be answered conclusively. But it would be irresponsible to hope that we can avoid them. In this issue of DIALOGUE, we want to examine the phenomenon of intelligence from as many different perspectives as possible – and we have found some inspiring sources of inspiration.

Wishing you an inspiring read!

SEBASTIAN DIERS
Managing Director of the DACH region
EFESO Management Consultants

“WE MUST PROMOTE CRITICAL FACULTIES AS THE VERY ESSENCE OF INTELLIGENCE AND AUTONOMY”

PROF. SABINE PFEIFFER

In your academic work, you analyze the effects of social change and digital transformation in the world of work. Are we prepared for the complexity and uncertainties that characterize this working world today?

We are indeed dealing with a world that is becoming more complex and faces major challenges. The ability to recognize patterns and build models is therefore becoming more important in many areas. And that applies not only to traditional academic professions but also just as much to trade and caregiving. I don't believe we are fundamentally overwhelmed by this. Human beings are not flight animals. Evolutionary, we are quite good at building models spontaneously and based on experience in complex and information-poor situations, and at remaining capable of action.

The cognitive abilities we need for this go far beyond mathematical skills or spatial reasoning, things usually associated with intelligence. They are deeply tied to the real world and its conditions. Intuition, in particular, arises from direct engagement with things, from grappling with complexity in practice. Unfortunately, our school system is still far removed from the concrete tasks of everyday life.

AI provides us with cognitive assistants that support us especially in complex, hard-to-analyze situations. How does this development influence our autonomy and capacity to act?

There are several aspects to this. The more assistants and tools I use, the more I need a well-developed intuition that tells me, if in doubt: "What the AI offers me may be based on our company-specific data and may sound plausible, but somehow I still don't trust the result." Then I remain capable of making decisions and taking action, even when the situation is unclear.

This gut feeling, as I said, arises from practical experience and critical engagement with reality. It cannot be replaced by grand narratives or AI-generated storylines. That said, I do not yet see the often-projected leaps in productivity, this has much to do with the fundamental limitations of technology. Unless we develop a new generation of AI that relies less on probabilistic methods, the generated results will need to be checked thoroughly, at least when dealing with critical and complex issues.
And to assess plausibility, deep knowledge is still required. Speaking from my university practice: one will still need to read and understand the papers themselves.

What can we do to foster the abilities indispensable for sovereign action in the age of AI in business and society?

I believe the decisive question is how we develop people into critical observers, into those who question and are willing to endure critique and divergent perspectives. Not only about AI or its individual fields of application, but also in relation to all issues that require justification and must not be blindly accepted. We need to think more about how to cultivate critical faculties as perhaps the very essence of intelligence and autonomy, and how to preserve them.

How much responsibility lies with decision-makers in business and politics, and how well are they living up to it?

In our empirical work, we see that while a strategic vision is painted, there is little willingness to engage with the "nitty-gritty" of day-to-day work or with possible delays and revisions. When criticism or suggestions for change are raised by those tasked with actual implementation or affected

by the consequences, there is a strong reflex to say: "You can't come here with the wrong mindset, asking the wrong questions, and ruining the mood."

There is a powerful narrative at play: don't hesitate, keep up the pace, roll out technologies as quickly as possible or else we'll fall behind in the competition. And this applies even when the pace overwhelms us, when in fact we need time to adapt, to understand risks, to invent ways of breaking down complexity, and to embed them into processes. We are heading toward a layering of risks, and one can only hope it somehow turns out well.

In one of your current research projects, you are also studying the collaboration between traditional engineers and software experts. What are the key insights from this research?

I would highlight one aspect in particular that will occupy us for a long time: IT comes from a logic where iterative corrections are almost always possible. That is why one can often work according to the principle of "good enough is okay." In classical engineering, that is not okay, because then the car won't drive, or the bridge will collapse. Classical engineering is designed to engage with materiality. In the end, what engineers calculate, plan, and construct is a product that has tangible effects in our physical world. There are safety criteria, sometimes even matters of life and death, and at the very least, enormous economic consequences if a large production plant does not run because of a miscalculation. Their work always has very concrete, sometimes irreversible consequences. That is why we have developed such a comprehensive system of testing and certification.

We must engage much more intensively with this discrepancy on all levels, precisely because physical things are becoming increasingly permeated by software, and IT is becoming the foundation of nearly all processes in our society. The long-running debate about whether IT should learn from engineering how to build truly sustainable, reliable products has therefore become even more relevant today. Because IT is highly vulnerable to cyberattacks, it is often "buggy," it can be indirectly compromised, for example, if the power grid fails. We are thus creating risk potential for which we currently have no answers. Even worse, we are not seriously looking for answers.

PROF. SABINE PFEIFFER

Professor of Labor & Organizational Sociology, Member of the Board
Bavarian Research Institute for Digital Transformation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“ONLY BY ACKNOWLEDGING REALITY WE CAN ARRIVE AT SOLUTIONS THAT ACTUALLY WORK IN REALITY”

NICO LANGE

We are often surprised by the seemingly irrational actions of other actors. Is this due to a lack of analytical ability, or rather a lack of willingness to analyze and understand different logics of action?

I can point to three reasons I have observed for decades. The first is that one needs deep contextual expertise to be able to comprehend other systems of thought. You must have lived in the country, speak the language, read certain books, and seen certain films in order to understand expressions and references. This is lacking in politics as well as in business. How many people do you know, for example, who speak Mandarin and have lived in China? And how many people talk about China?

The second problem is our economic notion of rationality. And although we know fully well that this image of Homo Oeconomicus does not apply either to ourselves or to others, we stubbornly cling to it and try to impose this model onto the world.

And the third, and possibly most decisive, factor is that as an aging, affluent society we are indeed deeply afraid of change, and therefore approach the world with wishful thinking. Because if we truly acknowledged what is going on, we would have to act, and bear the consequences of our actions. We face a problem with European security. Putin is waging a war to fundamentally alter the order in Europe. Yet every day I meet people who say: "We just need to finally talk to Putin. China will secure peace, Trump will secure peace, the Pope will secure peace." The real question is whether we ourselves are willing to defend the order in Europe. That is the question Putin has put on the table, and we are not even attempting to hear it.

Are we lacking rigor and self-discipline in our thinking?

Yes, reaching clear analysis and conclusions about what should or should not be done is also a matter of self-discipline. Essentially, it is Karl Popper's principle: I must repeatedly carry out sober, informed analysis and force myself to test and correct my hypotheses, become aware of my wishful thinking, and ultimately question myself.

Many in positions of responsibility in politics and business conduct an analysis only once and then approach the world again and again with the same hypothesis. And to connect back to the first question, objective analysis is often ideologically distorted. But if one does not acknowledge reality, one cannot arrive at solutions that work in reality. We see this right now in our major debates, be it labor and energy costs, or the resilience of our society. There is a strong wish to somehow get by without major change - even though deep down we know this cannot work.

In organizations, there is a tendency to delegate decisions to systems and processes. Is that a problem today, when the framework conditions are losing stability?

The process is important for decision-making. But the process is not more important than the decision itself. And I see in large bureaucracies, including large corporations, an obsessive focus on optimizing and adhering to processes. I find this dangerous, because on the one hand it is no guarantee of a good outcome. And on the other hand, uncomfortable issues that may lead to conflict cannot be resolved through systems and processes. If it is only possible to make a decision when no one feels bad about it, then you move forward only millimeters, if at all. Today, we do not have that time. The changes ahead of us require that we make rapid and decisive decisions, even when there is no broad consensus or when resistance must be overcome.

This is where individuals make the difference, those who trust their own clear analysis, accept the corresponding consequences, and translate them into decisions.

Our leadership teams have built their careers under largely stable framework conditions. Do we have enough inner strength and determination to deal with the current complexity and dynamics?

Especially in long-established institutions, a career system has developed that is heavily characterized by the diffusion and avoidance of responsibility and by the socialization of decision-making risks. This means that people can also succeed who, although leaders on paper, do not actually lead and lack leadership discipline and willingness to face conflict.

This results in lengthy strategy processes that end without results and without clear statements about which goals should be achieved within which timeframe and with which resources. Dealing with complexity requires intellectual rigor and prioritization. If we are always looking for grand master plans that take everything into account, we never get out of the planning stage. The world will not press the stop button until our grand design is ready. Meanwhile, we are repeatedly confronted with new factors that arise because others simply act, produce results, and move on.

Many critical decision-making processes are not only marked by high complexity and uncertainty but also by great time pressure. How do you see the role of intuition in this context?

As an analyst, when I see a current statement by Vladimir Putin, I immediately have an interpretation. That is indeed intuition. But I only have this intuition because I have been studying Putin for 25 years, speak Russian, know the historical and cultural context, and follow the Russian press. That is why I can explain immediately what is happening, without lengthy analysis. Leaders absolutely need informed intuition, especially the more complexity and dynamics they must process. They cannot simply recite what their apparatus has written for them. They must refine these analyses politically and repeatedly make intuitive decisions. That is precisely what they have the mandate to do.

You have been analyzing and explaining political processes for a quarter of a century. Many current events you described early on as realistic scenarios. How likely is it that analyses reach the decision-making system and have an effect?

One must not expect that everyone will rush into action just because something has been said once. I am convinced, however, that there are many ways to influence decisions, shape debates, and introduce new points. Above all, there is a strong need for clarity. That is why I see it as a meaningful task to interpret complexity in an accessible and plausible way, to make things tangible, to provide clarity and orientation.

NICO LANGE
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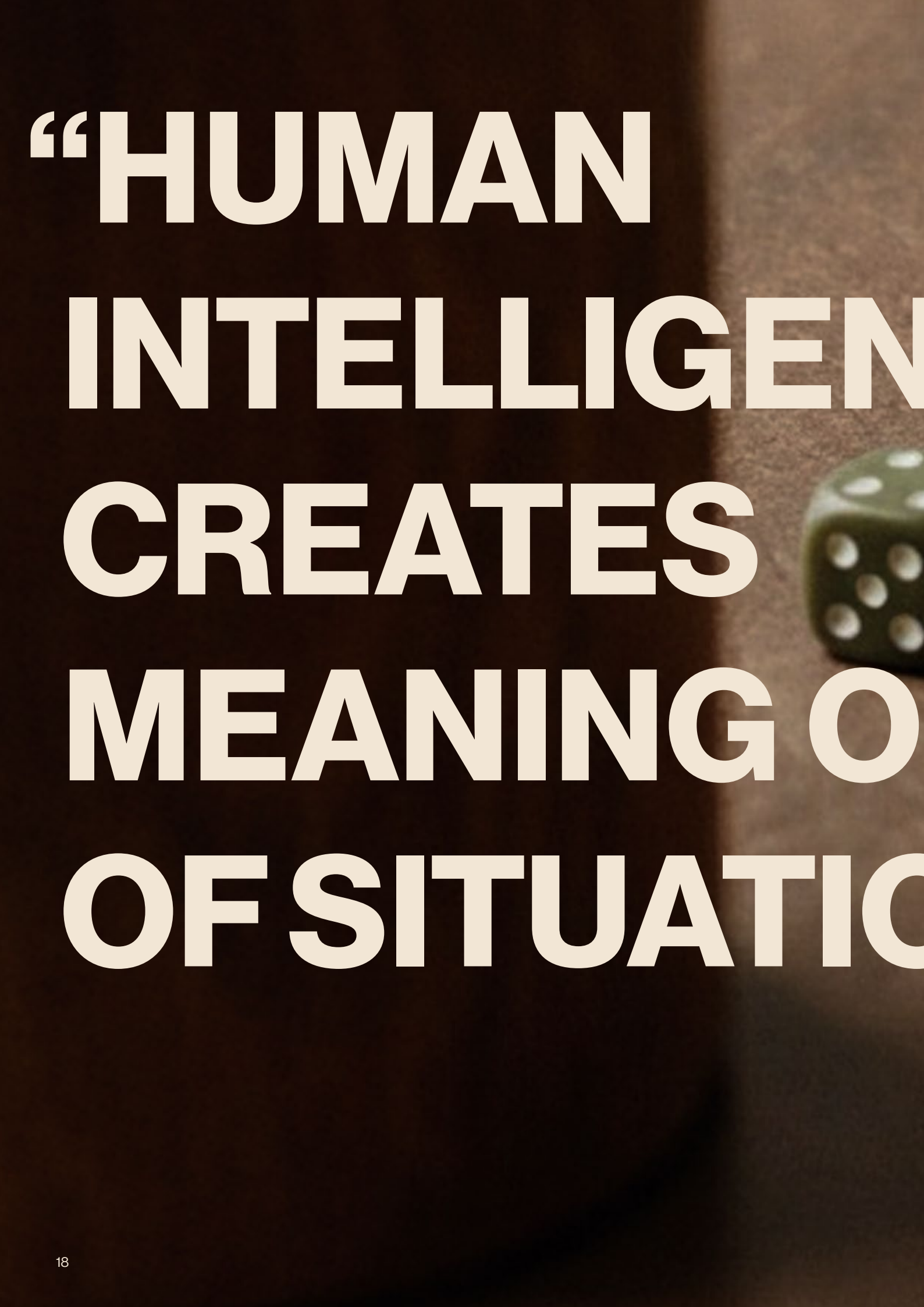
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DR. NIELS SYASSEN

What does "Sensor Intelligence," the slogan of SICK AG, stand for?

This slogan contains two perspectives. On the offering side, "Sensor Intelligence" means that we provide intelligent sensor solutions that not only generate data but also refine that data into information and deliver actionable impulses. On the corporate side, this self-conception is part of our DNA. It has always been SICK's goal to use technology to realize ideas with profound meaning. For example, the safety light curtain, an invention of our founder Erwin Sick, was already presented in 1951 at the "German Inventors and Innovations Fair." This marked the beginning of a new era in industrial safety.

The current market situation is characterized by increased dynamism and complexity. Where do you see the reasons for this increase?

Dynamism arises both on the customer side and in the supply chain. Due to the globally unstable political and economic situation, previous planning approaches are reaching their limits. Another factor is artificial intelligence, which is developing at a speed at least twice as fast as previous technology cycles. These trends result in enormous structural challenges for the entire market, which is why all areas at SICK are called upon to develop approaches to cope with this dynamic complexity.

Does this development require a fundamentally new management philosophy?

In my view, the solution does not lie in "either-or." Traditional management methods have worked very well in a stable environment. Now we must deal with increased dynamism and develop suitable leadership approaches.
In stable environments, it is about repeatability, clear methods that deliver reliable results, and continuous optimization. High dynamism, on the other hand, requires a transformational leadership approach. One must first define a broad direction and set a vision. Then it is essential to bring the right people together in the company to drive topics forward with new models of thinking, approaches, and technologies. This requires an iterative approach, feedback loops, and freedom to establish a rhythm that is faster

than the pace of change. In other words, in both thinking and action, we need a "both-and." That is why we place great emphasis on ensuring that our leaders learn to master both modes.

How do you assess the potential of AI in areas such as strategy development and innovation?

For well-defined, rule-based problem settings such as chess, a deterministic two-person game with a finite state space, or the strategically more complex game of Go, which is characterized by extremely high combinatorics and long planning horizons, both descriptive and generative AI models show outstanding performance. These systems can be trained efficiently through supervised learning, reinforcement learning, or self-play methods, like image and pattern recognition, where clearly structured input data and target variables are available.

We see this, for example, in our camera sensors, which very successfully use AI. For strategy, however, the picture is more differentiated. AI quickly delivers structured information and helps to create an overview, which is very valuable given today's environmental dynamics. But then it requires humans to abstract, draw consistent logical conclusions, relate them to their own strengths, and derive a set of decisions. This requires knowledge and experience, intuition, creativity, and sometimes instinct, all things that are the result of years of development.

Human intelligence is distinguished by its ability to derive meaningful interpretations from complex and often ambiguous situations; it essentially generates meaning from situations. That is something entirely different from a chess game with deterministic rules or linear consolidation and extrapolation. Unlike humans, AI has neither instinct nor the ability to develop meaningful non-linear courses of action.

Do we need to distinguish fundamentally between AI and the digital economy, or is the development of artificial intelligence simply another evolutionary step?

Digitalization over the past 25 years has focused on transforming processes and creating digital infrastructure, including cloud, IoT, and platforms.

The AI economy builds on these structures with the goal of generating value from data. This influences both technological and societal development and marks the beginning of a new era. That is why we must understand AI technology in its depth and continue to evolve organizationally and culturally, much more than was required during digitalization.

The societal, social, and economic impact of AI cannot yet be fully grasped today. But it is clear that the disruptions will be profound. How should companies prepare for this development, and what must be done to empower people within organizations for the AI era?

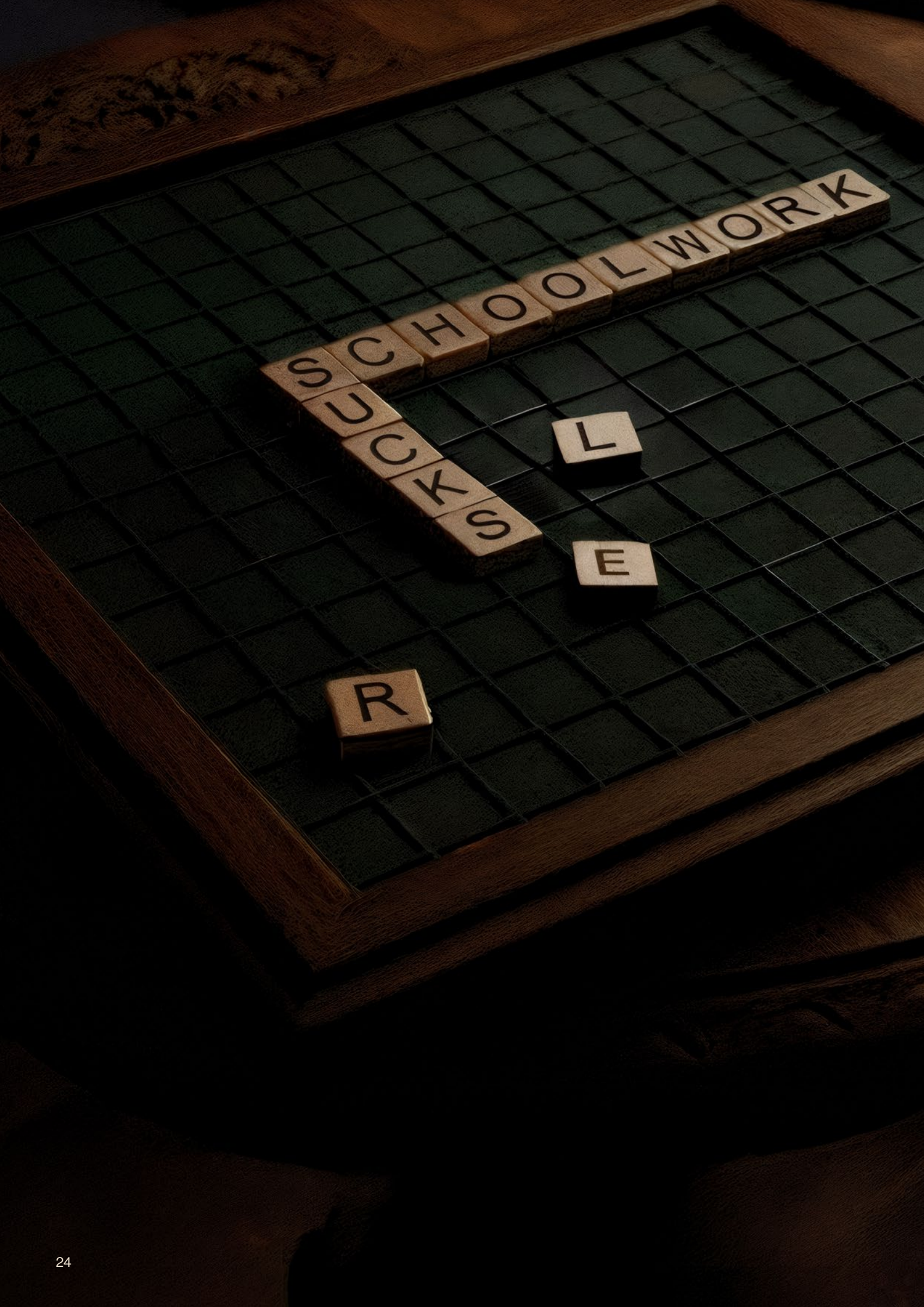
I believe AI can bring more autonomy and relief for everyone if we use it correctly. In our company, there are numerous examples of productive AI applications. For instance, in the automated troubleshooting of production equipment, bottlenecks can be efficiently avoided. AI enables employees to remain capable of action even without deep specialist knowledge or a strong understanding of complex interrelationships and abstract systems. It also provides valuable support to people with physical impairment.
At the same time, we observe that our software engineers can increasingly focus on creative and conceptual tasks, since AI reliably takes over repetitive routine activities. The other side of this development is that the transformation process must be actively accompanied, especially in times when market structures and job profiles are fundamentally changing due to AI. Potential scenarios must be identified early, technological competence systematically built within the company, and decision-making authority redistributed.

It is crucial to recognize that theoretical discussions and intensive training measures alone are not enough. Without practical testing, the actual potential cannot be identified. Had we not started experimenting early on with ideas and projects, we would no longer be competitive today in key AI areas.

Our approach: experiment, pilot, and scale when successful. To this end, central framework conditions must be established, while knowledge, responsibility, and competence grow decentral within the respective departments. What is needed are committed employees who act as initiators and enablers, to develop concrete use cases, and actively share them within the organization.

One example of this is our internal marketplace, where more than one hundred use cases are now documented, each at different stages of development. This platform creates remarkable momentum and strengthens our teams' confidence that we are actively shaping the AI transformation while remaining capable and sovereign in the process.

DR. NIELS SYASSEN
Executive Board Member Technology & Digitalization
SICK AG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“TODAY IS THE MOST EXCITING TIME FOR COGNITIVE SCIENCES”

PROF. ONUR GÜNTÜRKÜN

It seems that other living beings appear increasingly intelligent the closer we look - today this applies not only to higher mammals but also to birds, or even to trees and fungi. How do you view this development?

This process arises primarily because we are now observing the cognitive abilities of animals much more closely and making fantastic discoveries. But there is also a second, somewhat dangerous factor: the dilution of the concept of intelligence. Many processes that evolved in nature, growth, reproduction, and sexuality have little to do with cognition. Plants, for instance, grow toward the light. That is not a cognitive process. This does not mean that plants cannot also possess some basic form of cognition, but one should only draw that conclusion once all simpler explanations have been excluded. We know, for example, that slime molds perform astonishing feats that appear intelligent. Perhaps they even are. Overall, we live in a very exciting time, with major discoveries of non-human cognition, but also with certain borderline phenomena that should not too quickly be labeled as intelligence.

What are the particularly exciting findings that are currently shaping the field?

It is striking that a person who is very good in one area of thinking is also generally good in most other areas. The proverbial genius musician who is terrible at mathematics is not the norm. There seems to be a kind of general intelligence mechanism that influences the various modules.
These modules may have a life of their own, but they are still strongly affected by the general intelligence of the individual.

We do not yet know whether the cognitive performance of non-human beings is structured around such a general intelligence capacity in the same way. But studies of apes and birds make this appear very likely.

If further research continues in this direction, we may have to assume that many living beings possess some form of central coordination of intelligent actions, which differs in strength between individuals.

At the same time, we know that in contrast to the generalized intelligence that characterizes humans, there are also beings that are highly specialized in certain cognitive abilities. These may involve, for example, spatial orientation or extremely strong long-term memory, depending on their ecological niches.

What do these discoveries mean for our concept of intelligence?

They have major implications for how we conceptualize the relationship between brain and cognition. The brain structure of mammals is obviously not the conditio sine qua non for higher cognitive performance.
Birds, for example, have followed an evolutionary path separate from mammals for 325 million years and have a completely different, much smaller brain. Yet they demonstrate very high cognitive abilities. Even more fascinating is that the inner mechanisms of these cognitive performances, the inner "machinery," so to speak, are almost identical to those of humans. Living beings that come from entirely different evolutionary lineages apparently converge toward a very similar way of thinking. Over the course of evolution, they develop remarkably similar cognitive machinery.

Can this convergence also be assumed for other aspects, such as empathy?

Empathy is a complex concept that we have not yet sufficiently studied in other living beings. Humans went through their evolutionary process in small groups. In the process, we developed the remarkable ability to cooperate even with people who are not related to us. This was probably a key factor in our evolution. The key factor in the evolution of other species may have been entirely different. Indeed, some animal species react to the suffering of others of their kind without any sign of empathy.
This means the selection conditions that shaped us were not universal, and our capacity for empathy may be more special than in other beings. But in these questions, we are only at the beginning.

In "What Is It Like to Be a Bat?" the philosopher Thomas Nagel pointed out the limits of imagining oneself into another creature. Does the recognition of cognitive convergence rehabilitate anthropomorphism, the tendency to attribute human qualities to other beings?

I do not wish to condemn anthropomorphism because it is in fact an important heuristic tool. Personally, I learn the most when I briefly put myself into the perspective of the being I am observing.
I believe that if the mechanisms of thinking converge, then a very cautious anthropomorphism could be a way to generate initial hypotheses, even though, of course, we can never truly know whether our interpretation is correct.

What does the general similarity of cognitive processes mean for dealing with artificial intelligence?

The question from a cognitive perspective is whether AI is organized in its cognitive processes in the same way as biological intelligence. In humans, we distinguish two types of cognitive processes. The first accounts for the vast majority of our thinking and is purely associative. For instance, we produce much of our language in a way like how ChatGPT does: given one word, the next word is highly probable.

The less frequently used type of thinking is logical reasoning, in which one breaks existing associative connections based on new insights and reorganizes and recombines information. It is like a criminal investigation, where a new piece of evidence suddenly changes the whole picture.
This type of reasoning cannot easily be explained by associative learning processes alone. The exciting question is whether artificial systems, simply by their sheer size, are capable not only of associative but also of reasoning-based thinking processes. According to the current state of research, when rigorously tested, they are not.

If this remains the case, it has interesting implications for both biological and artificial intelligence. A purely associative system, no matter how vast, would in principle not be capable of reasoning-based thought.
The open question then is whether the mechanisms of reasoning in our brains can be built into artificial systems. This is the landscape we are currently navigating. I believe this is the most exciting time ever for cognitive scientists.

Can AI help us better understand the mechanisms of the language of other beings, and is there also cognitive kinship here?

AI gives us tools to decode the communication processes of non-human beings. Here we are making remarkable discoveries, with more and more proto languages in animals being uncovered. Certain structures and cognitive mechanisms of our language can be found in simpler forms, for example, in whale songs or in chimpanzee communication.

Nevertheless, the leap to human communication is more than a quantum leap. Language is a kind of neuro-enhancer that makes our thinking significantly sharper, more efficient, more comprehensive, and more structured. In addition, language is a cultural asset that has, so to speak, horizontal genetics, not limited to vertical transmission from parent to child. This allows linguistic change and knowledge to spread very rapidly across the globe. In this, humans are unique.

PROF. ONUR GÜNTÜRKÜN
Biopsychologist & Cognitive Scientist
Ruhr University Bochum

“IT IS ABOUT THE QUESTION OF WHAT MAKES AN EFFICIENT PROCESS ALSO A GOOD PROCESS”

CORNELIUS SURKAMP

Bosch is a prime example of how a very long tradition does not limit innovative strength. On the contrary, in many technological fields Bosch is among the pioneers and thought leaders. Against this background, how do you view the changes that must be managed in the coming years?

Bosch has reinvented itself several times in its long corporate history. From our capabilities and experience, from intelligence, and from the traditions embedded in our culture, we have time and again created something new. That makes me very confident about the profound changes ahead, which will redefine technologies, business models, and the geography of markets. In the mobility sector, where I am based, this is very evident. In the past, we worked in a strongly innovation-driven manner and in very close collaboration with customers, especially in Europe and particularly in Germany. Today, innovation is increasingly multipolar. And especially in Asia, we see enormous dynamism that is also profoundly reshaping our view of the continent. "Low cost, high performance" is a very challenging combination from a European perspective. That is why, as a globally operating technology leader, we must be present in these new innovation markets, with capacity, competence, and intelligence. This development presents us with many organizational, cultural, and technological tasks.

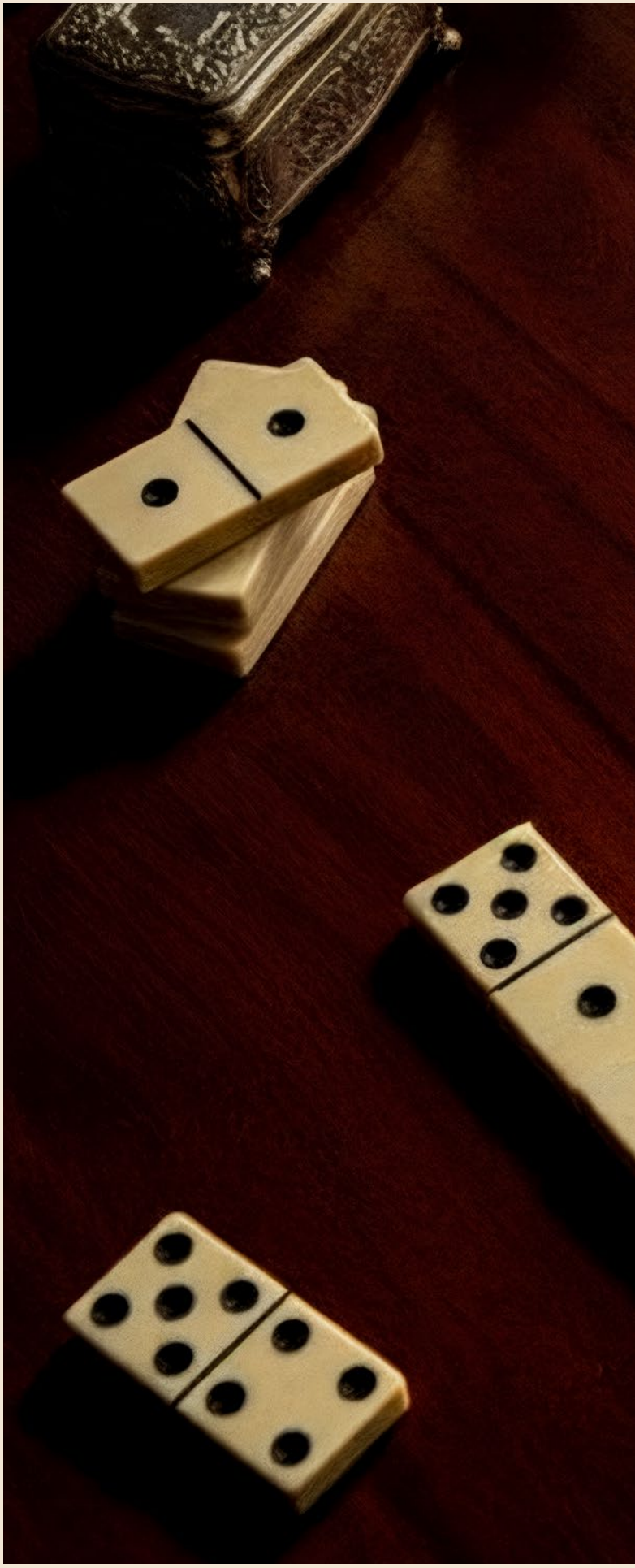
How do you perceive this qualitative change and, so to speak, globalization of innovation?

I see two very important things when working with our colleagues in China: First, they rely on a very fast-paced, highly iterative approach. They move quickly in shorter steps and are also very agile in correcting, even to the point of a complete pivot. And second, I see a very strong willingness to learn, great energy, and motivation not to repeat mistakes, to continuously develop in both manufacturing and indirect processes, while actively using modern digital tools. This achieves an enormous pace of rationalization. Intelligence, one must not lose sight of this, is also a function of speed. And the connection of speed and effectiveness is critical for us as a business enterprise and will become even more critical in the coming years.

What role will artificial intelligence play in these changes - is it another evolutionary step in the digitalization process, or a disruption?

Both are true. Successful use of AI also requires lean processes that generate structured, standardized data; platforms that allow seamless handling of this data across different applications; and the connection of machines. These topics were already critical in the industry 4.0 context, not only with the advent of AI. If you don't create these prerequisites, AI won't help you either.

At the same time, however, the speed of automation and scaling that can be achieved with AI is nothing short of breathtaking. It will enable business models we cannot yet even imagine and trigger a wave of productivity across every area of the company that is hardly conceivable today. This rationalization movement will also massively affect activities outside the shop floor, which are still far from the levels of automation, transparency, and measurability that already prevail on a production line. What is emerging here is a profound transformation.



This transformation is obviously not only technological in nature, but also touches our fundamental self-positioning. How much is our general adaptability being challenged?

Job profiles and roles will change profoundly. The markets will not give us much time to cope with this transformation. That is why it is important to focus on topics that are truly critical and relevant to the future. Human domain expertise and domain intelligence will continue to be required. Even with increasing use of AI, we will still need a deep understanding of what lies behind the data, what the context is, and what truly makes sense.

In our plant in Blaichach, for example, we have introduced an AI-based system for monitoring conditions and detecting problem situations, which supports our employees in rapid troubleshooting when disruptions occur. The key lies in the combination of AI technology and human capabilities.

What concerns me, however, is the question of how we preserve this human domain expertise when more and more standard tasks are taken over by machines, and as a result, we increasingly lose direct insight into the machinery and contact with the respective domain. That is a challenge we must solve, and we are not very far along yet.

In addition, even in the future, we must continue to answer the question of what makes a process not only efficient but also good. Can I still look at myself in the mirror tomorrow if I make a certain decision today? Does my action have a deeper ethical and economic meaning? At present, I do not see these qualities as transferable to artificial systems, which at their core extrapolate into the future based on statistical patterns from the past.

Is that the question of the limits of automation?

Artificial intelligence can help us impressively well and quickly to avoid false conclusions that arise from overlooking important data points or correlations, lacking data, or interpreting them incorrectly on a factual level. But this only helps to a limited extent when it comes to making decisions. Heinz von Foerster once observed that humans can "decide undecidable decisions." Decisions are necessary precisely when the facts are not clear. If the solution follows logically from the facts, I am not making a decision. Real decisions, therefore, involve elements such as intuition and empathy, the ability of people to engage with one another. To change, encourage, and motivate a person, to increase their willingness to learn and not just their knowledge of this requires human leadership. And that calls for qualities that are an indispensable complement to so-called academic intelligence, and increasingly also to AI. We can automate the physical and rational parts, but not the care and attention people give to one another. And that makes me optimistic about our role in the future.

CORNELIUS SURKAMP
Senior Vice President & Plant Manager
Robert Bosch GmbH

“THE PERSPECTIVE OF ART HELPS US DEAL WITH THE UNBEARABLE AND THE INCOMPREHENSIBLE”

PROF. CHRISTIANE HELLMANZIK

You observe creative production as an economist. How does your perspective differ from that of the cultural world?

Economists primarily focus on the output of a creative production process, its genesis, the price it can fetch on the market, the strategies and business models of successful artists, the possibilities of serializing the creative product, issues of scarcity, and so on. By contrast, the cultural world takes very different perspectives, precisely because it is itself highly heterogeneous. There are artists who see their creative product as the result of an interplay of inspiration, intelligence, and resources, something so unique that it cannot and should not be replicated or integrated into the economic logic of production and commercialization. This reflects the classical understanding of art, dating back to antiquity, in which transcendent concepts, such as the aura of an artwork or the notion of genius, play a major role. By contrast, a film or music producer, or a game designer, tends to think differently. For them, economic categories such as reproducibility, marketing channels, and data are more compatible with their products.

The term "production" implies a specific process that is clearly defined, analyzed, and often standardized in the industry. Can creative production also be described in these categories?

The question of how art comes into being is as old as art itself, and it is highly complex. It has long occupied the economic sciences as well. Accordingly, there are many theories and models. One approach by economist David Galenson, which I find particularly fruitful, distinguishes between two archetypes of creative producers. Some work experimentally, think of Monet, who painted his water lilies again and again, especially always differently. In such cases, the outcome emerges directly from the act itself. Others work conceptually, like Picasso, who first made sketches and drawings almost like an engineer, and then realized them on canvas. Of course, this taxonomy is only an approximation, even conceptually oriented artists include experimental elements in their process, and vice versa. But this distinction helps to analyze fundamentally different types of creative production processes and to connect them with concepts from other disciplines, such as the psychology of flow experience.

In business, many systems appear unable to cope with escalating complexity. Does art have different mechanisms for organizing and managing complexity, as in the creation of multifaceted works like Picasso's "Guernica," to use your example?

Humans are evolutionarily predisposed with a basic pattern for dealing with complexity: we deconstruct complex phenomena into observable, definable, and manageable elements, and then recombine them in various ways. We start at some tangible point and proceed from there, whether with a strategy, a theory, or a work of art. I believe this basic pattern can be observed not only in everyday life but also in management, science, and art for instance, when intensive movement studies and partial sketches precede a work, as in Guernica. This allows us to bring order to chaos.
But there is also another level: symbolism, surplus of meaning. Why does an image move us? Why does Guernica strike us so deeply? What symbolic language is at play here? On this symbolic level, art has immense potential to deal with complexity.

What makes art special compared to business is that it offers far greater degrees of freedom and, in general, far fewer expectations and conflicts of interest to manage. This creates both temporal and intellectual buffers, allowing far more scope to tolerate complexity and chaos, to view them holistically, and to endure them. In business, by contrast, the pressure to act is higher, there is a quick drive toward complexity reduction, transparency, control, efficiency, and organization. This is necessary and reasonable.
Yet I believe it is crucial, especially when dealing with the unbearable or the incomprehensible, to open ourselves to cultural perspectives, and thus to creativity. Systems that are too narrowly focused on efficiency reach their limits when it comes to creativity and the processing of novelty.

What role does intuition play in this process?

Economically speaking, intuition is endogenous, it arises from internal causes. I cannot verifiably prove why I do this or that, but I know that it is right. Intuition is the product of my life path: my experiences, my knowledge, the matters close to my heart that inspire me. This guides me both as a person and as a researcher. In this sense, intuition plays a much greater role in science than we often admit.

At the same time, there are path dependencies and rationalities that I can and must rely on, because a purely intuitive approach would mean giving up reason and verifiability. That is why we also need people with deep specialized knowledge, who focus on their subject and work theory driven.

Doesn't that mean two fundamentally incompatible ways of thinking collide?

The key is to allow both. I would not be a scientist if I were not convinced that models are useful to simplify the world and to gain systematic insights. But once I have mastered the model, there comes a phase in which I can think beyond the boundaries of my field and feed the insights back: what happens if I go further and look at my findings from a radically different perspective? I believe that true wisdom manifests itself in the ability to combine deep expertise with openness to other worlds, to link things, and to translate between contexts. Achieving this is truly an art form.

Another focus of your work is urban economics. How important is the city as a place of creative production in the digital age?

That importance remains very high. At best, cities combine creativity, entrepreneurship, and an innovative spirit. They generate that special mix of freedom and exposure that releases innovative energy. Physical proximity and local communication networks are just as critical as the global connectivity and openness of a city. We see this, for example, in our current work within our German Research Foundation (DFG) graduate program, which deals with the significance of spatial contexts for the economy, including the Ruhr region. Cities and innovations play a crucial role here.

PROF. CHRISTIANE HELLMANZIK

Expert in Creative Production & Urban Economy

DO WE REMAIN IN THE EQUATION?

HUMAN AND ARTIFICIAL INTELLIGENCE IN COMPANIES

DR. CHRISTIAN KÖNIG, GERNOT SCHÄFER & JONAS VAN THIEL

EFESO Experts

Lean initiatives, efficiency programs, standardization, automation, and complexity reduction are central principles of our industrial value creation. Yet the strategy that ensured growth and prosperity during a long era of stability is coming under pressure. The structures that were built have proven vulnerable to disruptive events and are often insufficiently prepared to handle massive and rapidly emerging complexity. This does not mean that the industrial world has suddenly been turned upside down. "The principle that a simple, and therefore robust, process should always be the target principle still holds," says Jonas van Thiel, production and AI expert and Partner at EFESO. "But our future is no longer linear and deterministic. Therefore, not everything can be designed for simplicity. We must learn to deal with uncertainty and to master complex processes where it is unavoidable."

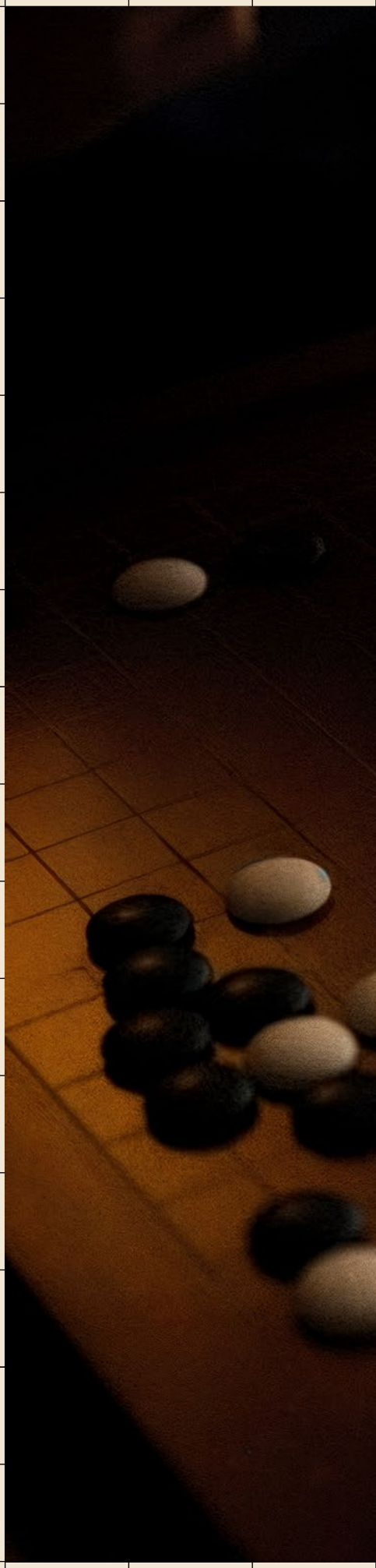
This primarily means not only reducing complexity but also being able to manage it, whether in terms of certain technologies or in relation to strategic and technical aspects. Proprietary technological knowledge and baseline intelligence in dealing with innovation are essential to reduce dependencies and to remain in the driver's seat even in highly complex environments, says van Thiel. He cites make-or-buy strategies as an example: "Cost pressure forces European companies to specialize and focus, which initially reduces complexity. But when commodities and capabilities are outsourced, complexity in the supply chain increases in turn."

DYNAMICS AND ACTION INTELLIGENCE

Complexity is only one side of the coin. The other is dynamic: companies must not only find future-proof answers to profound transformation processes, they must also do so very quickly. Yet many experts and executives often lack the experience for this, having pursued their careers during a period of incremental work and continuous improvement processes. "To remain effective and able to act when the sirens sound in the face of existential threats, subject-matter expertise and established leadership techniques are not enough," says Gernot Schäfer.

For Schäfer, Partner at EFESO responsible for a wide range of digitalization projects, the key to true organizational intelligence lies at the interface between thinking and acting: "Content-related and technological excellence should not lead to overengineering, a loss of speed, and concepts that never translate into movement," he warns. "A truly intelligent company knows that intelligence manifests itself both in thinking and in acting." However, action orientation must not degenerate into pure activism or a denial of complexity: "There is an increasing tendency today to avoid the abstractness and complexity of strategic challenges by approaching them through a series of proof-of-concept sprints, focusing only on individual elements. But in doing so, one loses the overall perspective and ultimately fails," Schäfer explains. "It is not wrong to work with lean, focused projects. But it is wrong to do only that."

Dr. Christian König, Principal at EFESO with a focus on AI and digitalization topics, adds that intelligence lies in seeing the big picture and linking it with operational activities. This especially concerns the handling of data: "An analysis without a coordinated framework and without context has no sustainable impact. Simply pointing out correlations does not bring



real progress. The added value only arises when companies learn from data, recognize dependencies and causalities, and thereby derive effective levers for the future," König emphasizes. "Intelligent companies can quickly understand relationships and grasp particularly complex and large topics more quickly. This ability is becoming increasingly important to stand out from the competition."

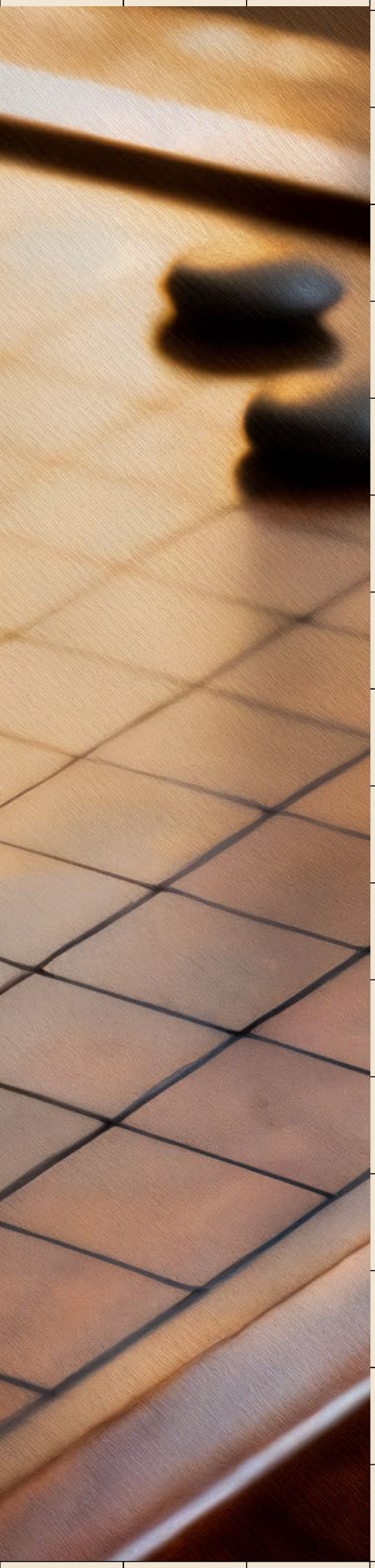
ARCHITECT AS A KEY ROLE

But what can companies do to increase their intelligence or, more precisely, to effectively use the intelligence circulating in their teams and structures? For the EFESO experts, the role and self-concept of an architect is particularly important. "An architect can abstract on the basis of experience and intuition and can recognize interconnections in a complex and dynamic system - even beyond established solutions, routines, and processes," says Gernot Schäfer. "He can decisively and quickly move a company forward and prevent every single activity from being right in itself, but the overall outcome being wrong."

This is also essential in dealing with Artificial Intelligence, adds Jonas van Thiel: "We must continue to see ourselves as architects. That means understanding complexity, recognizing the consequences of decisions, and keeping in mind the capabilities and limits of the models. One must be able to build and manage one's own thematic complexity. If we let the systems run blindly, we will not achieve decision-making quality." Van Thiel is convinced that humans will not disappear from the equation: "It is not AI that solves the problems, but the interplay between AI and humans. With less intelligence, we will not be able to get a grip on the future."

Christian König stresses that intelligence manifests itself in organizational capabilities and ideas that arise and act decentrally, whether at the production plant, in the development department, on the shop floor, or in the supply chain. "This intelligence circulates within the organization. Therefore, explicit roles are needed to synchronize and harmonize it, and to specifically support and multiply it through Artificial Intelligence."

Given the fundamental importance of AI, its cross-functional potential, and the enormous pace at which the technology is evolving, it is not enough simply to adapt the organizational chart. The EFESO experts emphasize that it is crucial to identify people within the company who both have an affinity for AI and the potential to use it in value-creating ways. These people must then be placed in relevant positions and provided with fertile ground so that their talents can flourish. "Every organization has many smart and committed employees who can contribute creative ideas. But today they are often more inhibited than encouraged," observes Jonas van Thiel.



TECHNOLOGICAL AND ORGANIZATIONAL CHANGE

The sluggish adaptation of organizational structures is not the result of ignorance. Rather, it can be explained by the fact that organizational and cultural structures cannot change at the same pace as technology. In particular, the development of Artificial Intelligence is characterized by a speed at least twice as fast as previous technology cycles, explains Dr. Niels Syassen, Board Member for Technology & Digitalization at SICK AG. “These trends result in enormous structural challenges for the entire company.” Jonas van Thiel points out that this also becomes evident at the communicative and strategic level: conventional images and scenarios are insufficient to describe these profound changes. One must imagine AI as a cognitive extension of human consciousness, rendering familiar relations obsolete. “If you have real-time access to 50 agents at any time, you get an incredible neuro-enhancer. In the extreme case, a single person can control an entire factory. I am no longer just myself; I suddenly become 50, part of a novel human-artificial system,” van Thiel says.

In the near future, agentic AI systems will autonomously and in coordination with one another takeover process optimization and monitoring, product review, and product design, actively making suggestions instead of waiting for prompts. The first companies to successfully implement such scenarios will gain immense advantages over the competition.

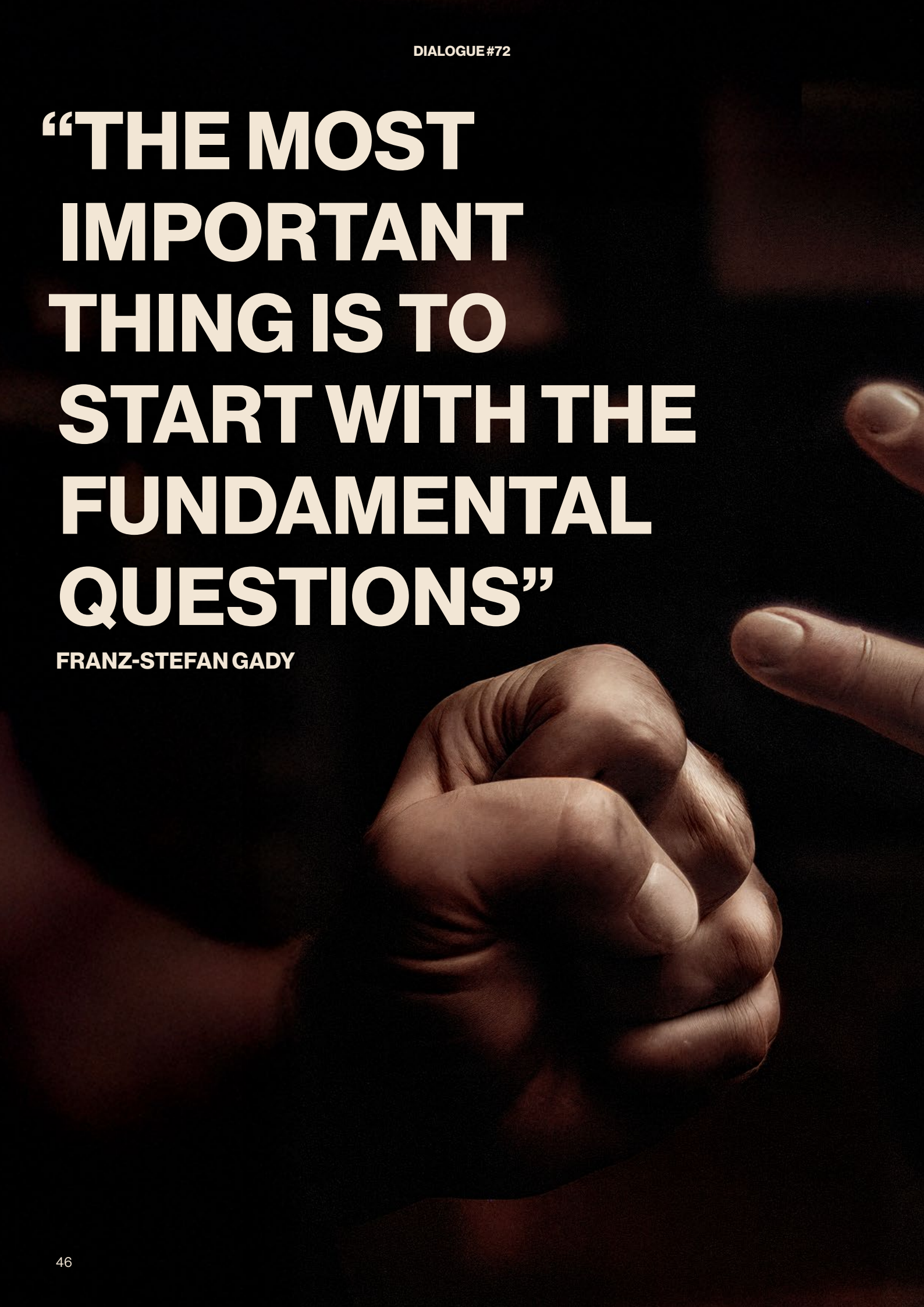
THE BOUNDARY – SO FAR

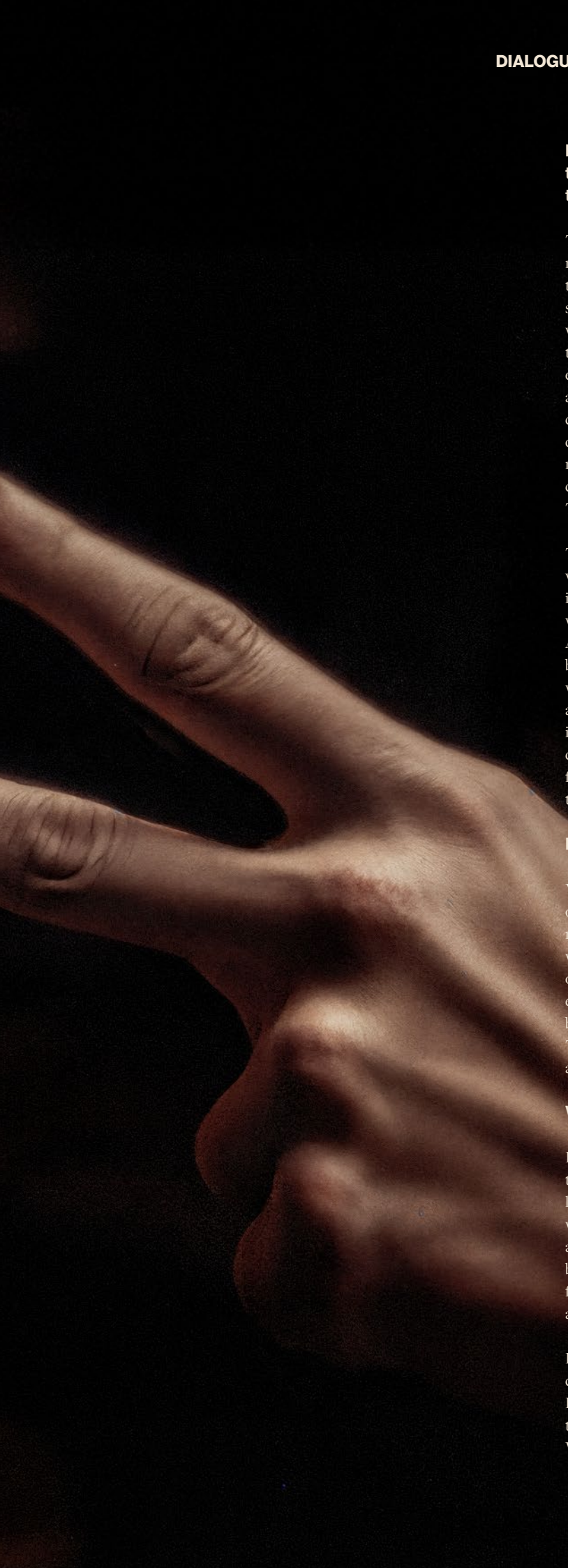
But where are the structural limits of these human-artificial systems? Or, in other words: will humans truly never disappear from the equation? Christian König points to the fundamental way today’s AI systems work: “We cannot write a prompt that says: ‘Develop a new theory I don’t know could exist.’” AI can handle correlations and algorithms extremely well, but not abstraction or creativity. It is not capable of a paradigm shift. That is precisely why the role of humans remains critical. “We must be able to set the target system, both strategically and ethically,” says Jonas van Thiel. “And that cannot be reduced to statistical parameters.”

Cornelius Surkamp, Senior Vice President and Plant Manager at Robert Bosch GmbH, agrees: “We must continue to answer for ourselves the question of what makes a process not only efficient but also good. Can I still look at myself in the mirror tomorrow if I make a certain decision today? At present, I do not see these qualities being delegable to artificial systems.”

“THE MOST IMPORTANT THING IS TO START WITH THE FUNDAMENTAL QUESTIONS”

FRANZ-STEFAN GADY





In your current book, you describe two phenomena that can lead to fatal errors in situational assessment: the "fog of peace" and the "fog of war." What lies behind these two concepts?

The fog of peace is a phenomenon inherent to all armed forces that are not engaged in direct military confrontations and therefore cannot test their combat strength, operational readiness, concepts, tactics, weapons systems, and carriers. To put it casually, it is like playing tennis against a wall without a real opponent. This is a fundamental difference compared to business enterprises, which have a market where they can continuously evaluate their products and business strategies. When a military conflict actually occurs, it is often too late to correct mistakes, with sometimes catastrophic consequences. This was very evident, for example, in the first days and weeks of the invasion of Ukraine. Neither the Russian general staff nor the political leadership had accurate knowledge of the actual readiness, capacities, and capabilities of the Russian armed forces.
They had overestimated their own forces and underestimated Ukraine.

The fog of war, on the other hand, is a concept that goes back to Carl von Clausewitz and is based on the insight that war always involves an inadequate situational picture, both enemy and of one's own forces, along with terrible contingencies to overcome. Emerging technologies such as Artificial Intelligence or quantum computing are therefore intended to be used on the modern battlefield on a larger scale to clear away the fog of war. For instance, sensors and AI-based data processing are integrated into an effective sensor-to-shooter chain, the so-called kill chain. The sensor is connected to a weapons carrier or platform to identify the enemy more quickly and engage more precisely. At least, that is the theory. This is the focus of most startups in the Defense Tech sector. However, I am skeptical that the fog of war can ever truly be eliminated.

Do you also see risks in the excessive use of technology?

Yes, and that is why I repeatedly warn against an uncritical technological optimism that has spread strongly in recent years. Digitalization, networking, and the use of sensors on the battlefield, as well as integration with precision weapon systems, do indeed allow us to conduct military operations faster and more effectively. But it is a mistake to believe that this enables us to make smarter decisions at the operational or strategic level, because a completely different form of logic applies there.
This differentiation is often lost in the debate. In addition, we risk violating a central axiom of military affairs: "Keep it simple, stupid."

What exactly does that mean?

In Western-oriented armed forces, too much complexity has flowed into the systems. War must be soldier-proof, with understandable, scalable, low-maintenance systems. Ensuring that is only possible to a limited extent with multi-purpose platforms such as fifth- or sixth-generation fighter aircraft, battle tanks, or precision weapons systems. At the same time, we believe we can compensate for the lack of firepower and mass in our armed forces through the use of superior and networked technology and through an effective sensor-to-shooter chain.

But when we network systems in the air, at sea, on land, in space, in cyberspace, and in information domain, when does it become too complex? Here again, I see the fog of peace, because these concepts have never been tested in a real military conflict where two nearly equal opponents clash. We risk building technological castles in the air.

Will new technologies change the role of the infantryman, and are people on the battlefield up to this level of complexity?

The infantryman will remain the most effective weapon even on the battlefield of the future. His role will become even more significant, and his decisions will have greater consequences. With systemic combat support for specific tasks, he will control various, partly autonomous weapons systems and carriers, thereby acting to some extent as a manager on the battlefield. As a result, there will also be a quantitative shift from combat troops toward command and support units. Strategic questions are often weakly structured and complex. Therefore, the interplay of intelligence and intuition, and the ability to think the unthinkable is crucial.

Strategic issues are often poorly structured and complex. That is why a combination of intelligence and intuition is crucial, as is the ability to think the unthinkable. Has our fixation on technology-heavy doctrines and inductive logic blinded us to this?

Western troops tend to win battles but still lose the war. That is what I see as a problem of strategic culture. We are moving too quickly on a technical and tactical level, dominated by inductive logic, and spend too little time on fundamental questions at the strategic and operational level. What is needed there, however, is abductive logic, much empathy, an understanding of the psychology of the opponent, and the ability to see the big picture.
We have neglected this, and the best example is once again Ukraine: many in Europe's political class were unable to imagine a full-scale invasion of the country by Russia and remain unable to clearly define Europe's interests in Ukraine vis-à-vis Russia.

When confronted with a failure of imagination like this, the data provided by technology is of little use. That is why I am skeptical even at the tactical level regarding command and control systems that rely purely on inductive logic.

The other side is what George Orwell described as "In Front of Your Nose," especially with regard to all the things before the outbreak of the Second World War that everyone saw but no one really wanted to acknowledge. The problem was so overwhelming and the consequences so catastrophic that people mentally refused to go where they would have had to face this scenario. The obvious is often deliberately ignored twice over. This reminds me of the Russian troop buildup along Ukraine's border in the fall of 2021, when the most obvious reason for the buildup was denied.

Last but not least, we are strongly fixated on quasi-economic, cool cost-benefit rationality when analyzing reasons for war. We systematically ignore other factors such as the personal ambitions of autocrats like Vladimir Putin and, unfortunately, are repeatedly proven wrong.

What is your personal way of dealing with complex phenomena, which you analyze on an ongoing basis? How do you manage to make this complexity tangible for yourself?

The most important thing for me is to start with the fundamental questions and to be clear about what I want to achieve with my analysis. Secondly, to acknowledge my own typical weaknesses, the blind spots. Thirdly,
I always want to be aware that my analysis is influenced by various cultural and personal circumstances, and I try to balance that as best as possible through the input of others. The people who make the most mistakes are those who work alone. And finally: a 70–80% product at the right time is ten times more effective than a 100% product at the wrong time. Timing, is something essential in every field.

FRANZ-STEFAN GADY

Author, Analyst, & Military Advisor

“WE MUST BUILD TRUST IN NEW FORMS OF INTELLIGENCE”

TOBIAS ERIKSSON

Collecting, processing, and contextualizing complex information and drawing conclusions from it - these are the abilities we typically associate with intelligence. The rapid growth of these abilities is characteristic of the development of Artificial Intelligence, and it shapes the strategic discussions in industry. In May this year, EFESO co-hosted the Industrial AI Summit in Stockholm, which you moderated. In light of the discussions held there, how would you expand this picture?

AI engines are not only capable of processing an infinite amount of data effortlessly. They have also become very good at placing things into a logical context. We must use these capabilities instead of debating whether humans can compete with them. We cannot, and we don't need to. Beyond these logical processes, however, AI solutions are barely able to understand what people feel and why they behave in a certain way. And perhaps they never will be.

It is precisely this dimension that will be crucial to establishing principles in organizations that ensure AI agents do not drift in a direction we do not want. The human ability to feel empathy and integrate it into actions and decisions will be a central component of the future collaboration between humans and AI in "intelligence systems." Personally, I find the concept of wisdom both interesting and important, because it refers not only to intelligence but also to the experience acquired over time, which has an empathetic quality. The goal must be to complement formal intelligence with these empathetic qualities, and here humans will play a decisive role.

A core task of strategic and operational management in the future will be to define guardrails for human and artificial intelligence based on wisdom, empathy, and firm ethical values, and to integrate these guardrails into fields of action.

How does AI specifically influence work processes in the industrial environment?

Two perspectives can be distinguished: First, intelligent systems already provide frameworks today that allow us to make better and faster decisions. While complex and critical decisions will likely continue to be made intuitively and predominantly by humans, intuition in the future will be based on better structures, analyses, and groundwork provided by intelligent tools. As a result, decisions and their implementation in organizations will become exponentially better and more efficient. This area currently shapes discussions under the term Decision Factory.

Second, every company has an industrial value stream at the end of which there is a product delivered to customers. This is the Solution Factory. It is where all production knowledge originates, where newly emerging knowledge flows back into the process, and where money is earned. We will make a real leap when we embed strong intelligence components into every process step of the Solution Factory. If we create an end-to-end connection between humans, robots, and agents within this flow, we enable an enormous degree of autonomy. I am convinced this is truly the Holy Grail of AI application in manufacturing companies.

Algorithms recognize complex patterns and can act before humans even notice them in many core areas of value creation. How does that fit into your concept of autonomy, and how should people overcome fears and reservations?

AI opens up new possibilities and enables new ways of working beyond old routines. This is a very important part of the entire development, and in the next five to ten years it will be a central task, and an ethical responsibility, of leaders to prepare people for this journey and accompany them along the way. We need a clear understanding of how AI works to collaborate with it and define our future role. For me, it is primarily about building trust in these new forms of intelligence that come into play here. To do this, we must explain the core of the technology to people and the principles according to which it operates and interacts.

There are numerous proven approaches for this. The Technology Adoption Model (TAM) is an excellent framework for understanding how people adopt new technologies. In this model, perceived usefulness and ease of use are key factors that significantly influence attitudes toward a technology and the willingness to adopt it. Another example is the Theory of Planned Behavior, which supports leaders in developing competencies and communicating purposes, thereby helping to increase willingness to change behavior. There are also models of skills adaptation that precisely identify further training needs and harness the opportunities of new technologies through upskilling and reskilling.

Scenarios for AI adoption range between two extremes. Will AI make intelligence and efficiency a commodity, or will it further amplify inequality in markets?

AI systems merely provide the infrastructure. Uniqueness emerges when you train your agents with insights derived from the core stream of your Solution Factory, from a truly deep understanding of processes, errors, and potentials. This generates unique know-how that is linked to core processes and products, anchored in the company, and integrated into development programs for employees and systems.

This fundamental model, the embedded industrial knowledge, the effectively trained agents and algorithms, will make up a large part of enterprise value in manufacturing and massively drive performance in the Solution Factory. In this acceleration game, market participants with strong AI algorithms will pull ahead at an ever-faster pace. And since you cannot go back in time and "collect" historical data, it will be very difficult to catch up with someone who started using data early on.

What challenges does this development pose for management?

One must understand the significance of AI for one's own manufacturing company, gain clarity about the current organizational core model, and consider what it should look like in the future. To do this, you must be willing to dive deep into the organization and technology and bring insights back up. If you don't, you are standing on quicksand.

In any industry, a new player with capital and know-how could emerge tomorrow, applying AI to core processes and thereby becoming 30–50% more productive, efficient, and faster than traditional players. This disruption will not announce itself, but the moment it happens, it will already be too late for the others. Established companies must prepare with AI-first models. Otherwise, they will have no protection, we are not talking about evolution, but about revolution.

Against this backdrop, are companies that introduce the ethical frameworks you described not at a disadvantage compared to those that do not adhere to such guardrails?

This very fundamental question goes far beyond purely economic logic. Either we believe that values, ethics, morality, and empathy are indispensable, or we do not. If we do, then we must establish guardrails as long as humans are involved in the process. Regarding AI, one thing should be clear: once we leave the rule-based world and experiment with how things work without rules, we may not get another chance to do it differently.

TOBIAS ERIKSSON
Senior Partner & Managing Director
EFESO Nordics

“THE MORE FLEXIBLY A SPECIES CAN COPE WITH NEW DEMANDS, THE MORE INTELLIGENT IT IS”

DR. JAKOB PIETSCHNIG

What is human intelligence - and what is it not?

Conceptually, intelligence must be clearly distinguished from fundamentally important concepts such as emotional intelligence or social competence. These are not forms of intelligence but rather personality traits. Intelligence measurable through psychological methods refers to general cognitive abilities needed to successfully interact with the environment. It does not merely reflect school knowledge but also includes many specific components and filters, helping us to understand rules and draw conclusions.

We see intelligence as a hierarchically structured construct with three levels. At the top is the so-called g-factor or general intelligence factor. This is the cross-sectional dimension of our abilities, representing general cognitive potential. On the next level, there are, according to current scientific knowledge, eleven broad abilities. Finally, there are around 90 specific abilities at the third level.

These abilities are positively correlated across all levels. Someone who is a good problem solver is therefore also generally good at spelling, has strong spatial reasoning, and can complete number sequences well, and vice versa. There are exceptions to this positive correlation, but overall, this is one of the most robustly confirmed findings of empirical research.
High intelligence, empirical evidence is very clear on this, helps people lead more successful, longer, healthier, and more satisfying lives.

Given this, how well can intelligence be fostered and trained?

The answer is rather sobering. In adulthood, not at all; in childhood, only to a limited extent. This does not mean that cognitive training is unimportant at any age. On the contrary, if you don't do it, intelligence declines.
Early cognitive support is extremely powerful regarding indicators correlated with higher intelligence. Children from so-called cognitive risk groups who receive early support usually do not show significantly higher IQ scores compared to control groups. However, they are more likely to graduate from school, have fewer addictions and health problems, and earn higher incomes. Early support thus has effects similar to those of a higher IQ, even if it does not significantly increase IQ itself.

What does intelligence research reveal about giftedness and the characteristics of gifted people?

There are several long-term studies following gifted individuals - those cognitively more capable than 98% of the population - over decades. The findings show, on the one hand, that every increase in IQ has a positive effect, and on the other, how strong the predictive value of intelligence, especially the g-factor, is.

Gifted individuals appear to have somewhat different personality traits compared to the average. For example, they tend to score higher in honesty/humility and conscientiousness and lower in emotionality.

They are also above average in curiosity and openness to new experiences. Worth mentioning here is the well-supported neural efficiency hypothesis. Research has shown, for instance, that very intelligent people activate only isolated areas of specific brain regions when solving classic logic tests, whereas less intelligent individuals expend much more energy and display far less selective activation of brain regions during the same tasks.

Does this mean there is a correlation between high intelligence and moral behavior?

No. Prosocial behavior correlates with intelligence, but morality does not. Crime rates are similar between gifted and non-gifted individuals.
The irony is that people with higher intelligence are less often, and for shorter periods, incarcerated.

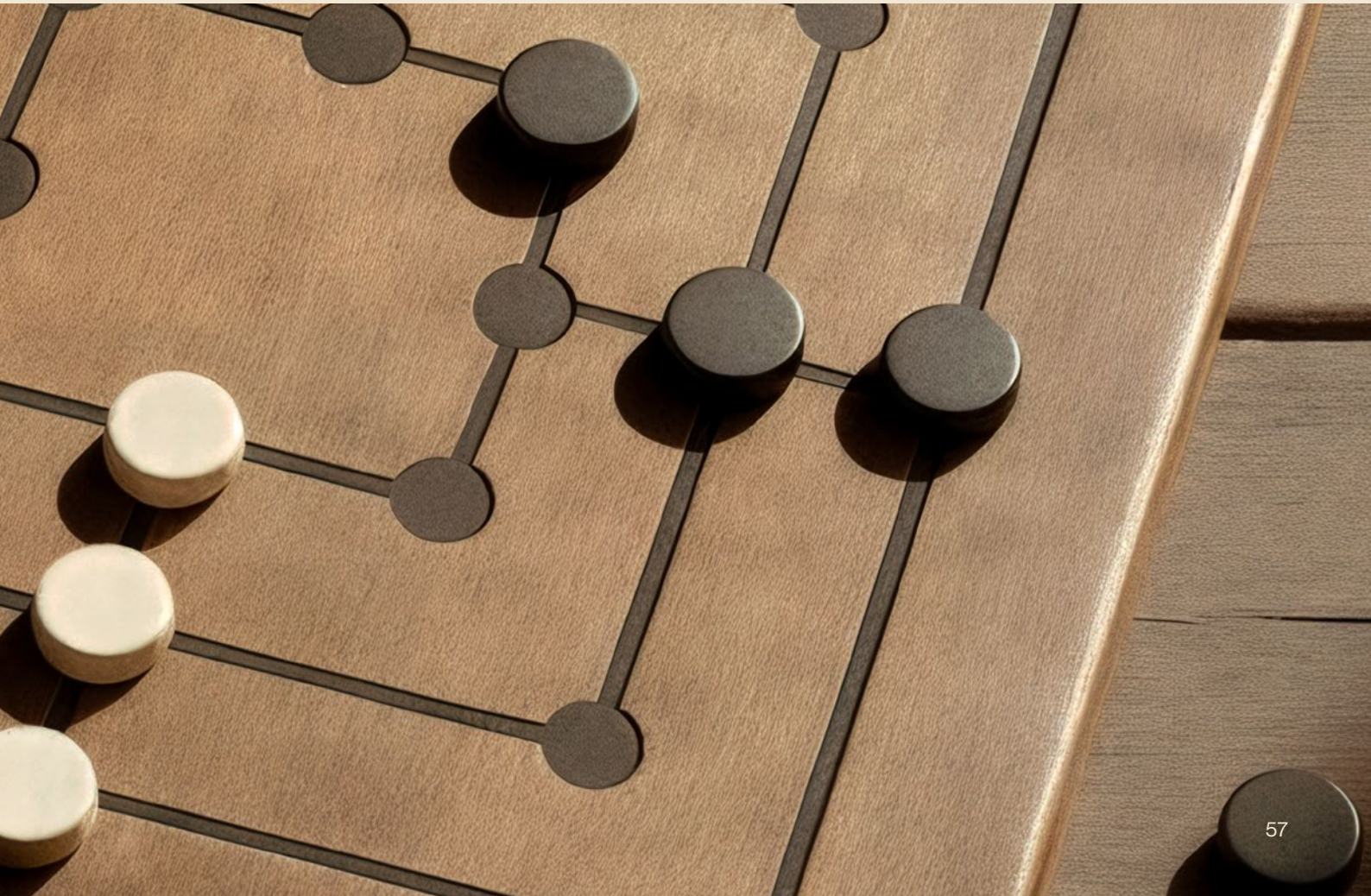
For about 100 years, the average intelligence of Europeans steadily increased. Yet some years ago, the trend reversed. You were among the first researchers to analyze this phenomenon scientifically. The core of your analysis was the specialization thesis. What does it propose?

Intelligence can also be described as a function of behavioral flexibility: the more flexibly a species can respond to new demands, the more intelligent it is. Humans are very good at adapting. In the modern world, flexibility increasingly means specialization within specific niches. This development is tied to the vast amount of available knowledge and the limits of human capacity to absorb it. Thus, specific abilities developed, whereas in the past, being broadly skilled was more important.

We now have empirical evidence that cognitive abilities follow a similar trajectory. We seek niches because our environment demands it and rewards us when we can perform specific tasks very well. This changes the importance of abilities and problem-solving approaches. As a result, we train our cognitive skills with different intensities and perform worse on broadly designed tests. But this does not make us less intelligent: flexibility also means that progress does not always move upward, but sometimes sideways.

Today, however, we face global challenges that go far beyond the boundaries of individual disciplines. Has specialization led us into a dead end?

No, because the body of world knowledge is no longer manageable by any single person. Specializations are therefore indispensable. But at the same time, we also need well-organized interdisciplinarity. In other words: people who focus on making the communication of individual specialists accessible for interdisciplinary discourse and synthesis.



If we look 300 years into the future: would we be surprised by how intelligent humanity has become, or would we encounter people much like we are?

That would indeed be a surprising experience, not necessarily because we would meet people who are ten times smarter than us. Rather, the abilities required to cope with everyday life will have changed dramatically.
How exactly this development unfolds is another question. But I am certain that other abilities, different from today, will then be at the forefront.

DR. JAKOB PIETSCHNIG

Intelligence Researcher
Institute of Developmental & Educational Psychology,
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“THE DECISIVE QUESTION IS HO WE CAN ACT WE IN THE FACE OF EXISTENTIAL CR

DR. ISABELLA HERMANN

Our future scenarios are increasingly dystopian. In your recent book “Future Without Fear” you argue for a way of thinking and acting that you call anti-dystopian. Where does the dominance of dystopian visions come from, and why do utopias no longer radiate the same appeal?

Indeed, dystopian imagery has appeared ever more frequently in public discourse over the past 25 years. During this time, major challenges became increasingly visible - whether a new political paradigm in response to global terrorism, the rise of nationalism, climate change, economic crises, wars, or pandemics. This polycrisis, whose solution seems hardly imaginable, profoundly shapes our perception of the world. Against this backdrop, it is easy to envision a dark future, with collapsed or toxic political, social, or natural systems. At the same time, our perspective on utopias, much older than dystopias, has shifted historically. Today, and rightly so, we approach them with great skepticism.

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Why have utopias lost their appeal, and where does the skepticism toward them stem from?

First, classic utopian designs are constructed as if there were only one universal and desirable utopia. Yet the grand narratives and political projects of this kind were discredited by the realities of the 20th century. This holds true both for the fascist ruptures of civilization and for the neoliberal euphoria that became powerful after the collapse of the Soviet Union: the "end of history," prosperity for all.

Second, perfect utopian blueprints are always exclusive and totalitarian. A perfect utopia requires bringing everyone into line and cutting off those who do not fit the mold. What unfolds as a utopia for some can therefore quickly become a dystopia for others.

Can complexity and conflict even be addressed within such political or literary utopias?

That is very difficult, because in utopias, conflicts usually grow so large that the entire system collapses, often directly into a dystopia. Even in dystopian scenarios, conflicts are rarely processed in depth. Rather, they narratively thrive on extrapolating emerging problems into extremes.

Utopias and dystopias are imagined as endpoints, which makes them static. You contrast them with the concept of anti-dystopia, which you describe as a process shaped by ambiguities, contradictions, nonlinear developments, tensions, and coalition-building. Is the goal here to search for complex answers to complex challenges?

Anti-dystopia is, first of all, an observation that literature increasingly presents new narrative forms. Exemplary of this is Kim Stanley Robinson's major novel "The Ministry for the Future," which has been widely received globally and has sparked numerous discourses in different spheres. Robinson's central question is: "How can we create livable futures in a world that is endangered and dysfunctional?" This makes anti-dystopia a powerful narrative, opening up different courses of action and creating space for diverse answers.
After all, it is not as if there were one "train of the future" that passes by and must be caught. The future is open, and therefore shapeable, as long as we act.

So, difficult conditions alone do not define a dystopia, as long as we act future-oriented, cooperatively, and autonomously?

Exactly. A dystopia is not defined by disasters themselves. It is a negative societal order characterized by oppression, lack of human rights, lack of freedom, and so on. The decisive question is how we deal with catastrophes, and what we build from the rubble, figuratively speaking. There are initiatives, for example, that state: "We know certain climate tipping points can no longer be avoided. But we want to try to create and preserve solidarity in the collapse." From this emerge distinctly anti-dystopian concepts such as solidarity prepping. Beyond the individual preparedness usually associated with the term, this emphasizes strengthening communities, protecting vulnerable groups, and environmental protection.

The crucial question is: How can we still act well in the face of existential crises and irreversible ruptures? The concept of anti-dystopia is a discursive offering that opens up spaces of possibility and helps us allow alternative perspectives and logics of action. For as human beings, thinking in alternatives does not come easily to us, we tend toward simplification and unambiguity.

In Robinson's novel, you also emphasize the very complex interplay of small actions and spaces of possibility. The intelligence needed to cope with catastrophe seems almost like a strange force field rather than the property of individual actors. Science fiction has a tradition of conceptually dealing with alien intelligences. What can we learn from this for contemporary debates, for example around artificial intelligence?

Indeed, Robinson presents a form of networked intelligence, a true mosaic of large and small actions and narratives, that reflects the complexity of our world. More broadly, science fiction frequently explores forms of intelligence so alien that communication is impossible. Consider Solaris, the ocean planet in Stanislaw Lem's novel of the same name.

The paradox is that Lem was still able to imagine such a planet. I believe such reflections help us cultivate a deeper and more empathetic understanding of other beings, while also making us aware of our biological grounding, because our intelligence is not just in our brains. It is also our physical and creative presence in the world.

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