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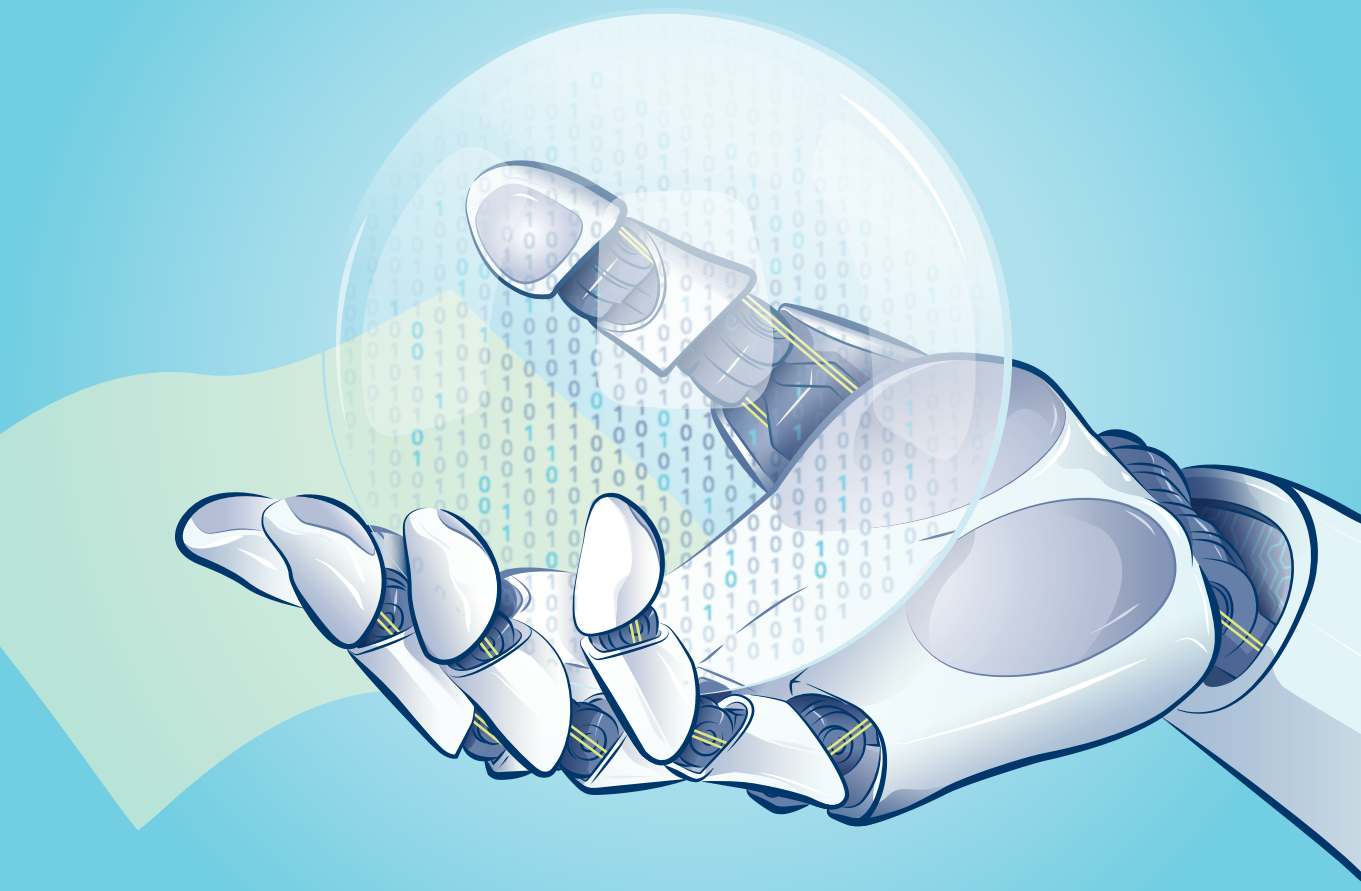

THE POWER OF DATA

Data is a powerful friend,
if we know how to handle it.

VPBANK

Data changes the world

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Digitalisation generates massive amounts of data, fuelling artificial intelligence as well as other applications.

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"Artificial intelligence is a tool," says Alexander Ilic, head of the ETH AI Centre, and explains how developments look set to go from here.

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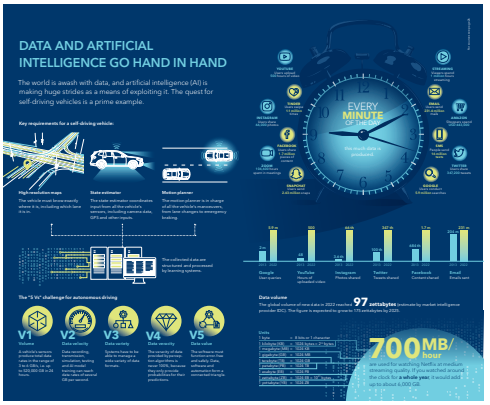
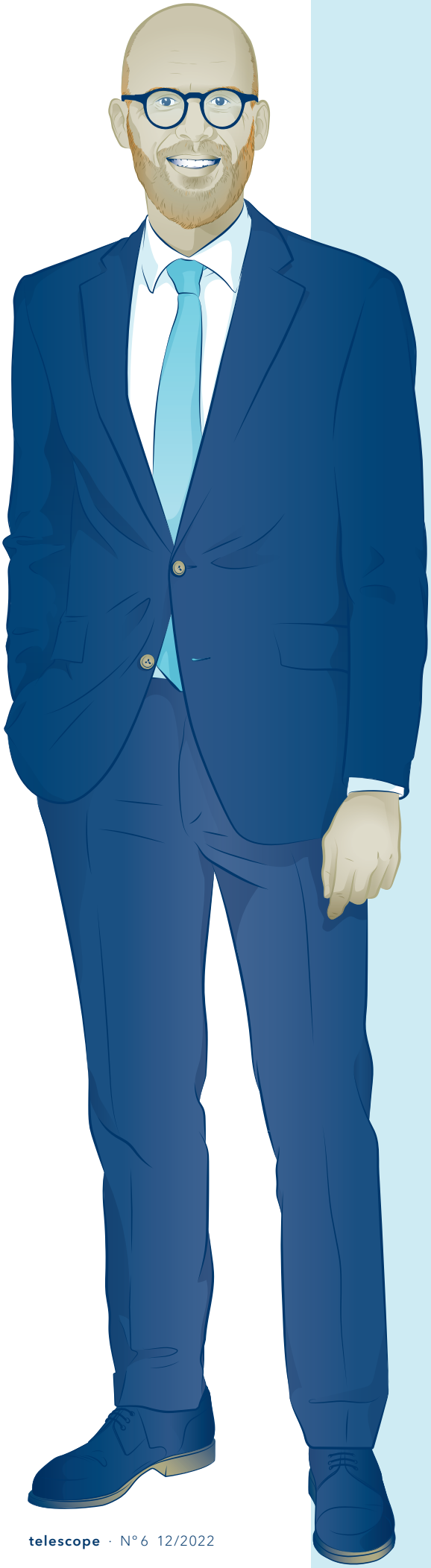
Data and artificial intelligence go hand in hand.





THE POWER OF DATA

Dear Reader

Knowing is better than guessing. Nobody puts it better than Sherlock Holmes. "I have no data yet," he says in A Scandal in Bohemia. "It is a capital mistake to theorise before one has data." A company that has not yet evaluated all the data available to it is in exactly that position.

Data is knowledge – if properly used. Only companies that systematically collect, organise and analyse data can derive competitive advantages from it (→ page 18). You don't have to be Amazon or Google, but they are the companies that are blazing the trail. By managing huge volumes of data they make themselves cleverer.

Thanks to digitalisation, data is not in short supply. The problem is how to analyse it. A clean and well-structured database is crucial. Otherwise the wrong conclusions will be drawn, whether by a human user or by artificial intelligence (AI). As data volumes soar, AI looks set to play an even greater role in future (→ page 16), and it is no surprise that some AI applications are now viewed with suspicion, including by lawmakers (→ pages 10 and 12).

Data and AI dominate this issue of Telescope (→ Glossary, page 25). But as usual we also spice the contents with other topics. So you will find a feature on top chef Fabian Zbinden, who is successfully marketing plant-based instant foods. I wish you a stimulating read.

Dr Felix Brill
Chief Investment Officer VP Bank

DATA CHANGES THE WORLD

Data volumes are soaring, computer chips are getting more and more powerful, and machine learning is spreading fast. Welcome to the age of exponentially growing digitalisation. Things that computers are now doing – understanding language, helping us drive our cars – were inconceivable just a few years ago. But the new applications are not without risk.

Felix Brill

Is that a cat or a dog in the photo? An easy question for a human being. We know at a glance, though different people might give different reasons to explain how they know.

For a long time computers were simply unable to answer this question. But that has changed. These days they can solve the problem instantly with a high degree of accuracy. And not just for one photo, but for thousands. True, a computer cannot explain why it knows. That is still a big difference between humans and machines – between human intelligence and artificial intelligence (AI).

The cat vs dog problem is a popular example for illustrating the enormous potential of AI, and also its limitations. AI is a buzzword that everyone has heard. It inspires both fantasy and fear, but as a concept it is hard to pin down. What we understand by AI today (→ Glossary, page 25) might be obsolete tomorrow.

The latest twist is generative AI, in which a system creates images or texts autonomously on the basis of input provided by the user.

We tried out the Dall·E generative application by instructing it to produce pictures of a spaceship flying over Liechtenstein. The results (→ page 7) came within seconds and are not at all bad. We see mountains, a village and a typical church steeple. But a second look shows that it is not Liechtenstein at all. The scene produced by Dall·E does not actually exist, though it is a good approximation. Impressive results are also achieved by text robots that produce a text based on prompts by the user.

Despite the breakneck speed of development, there is one aspect that does not change. No computer is yet clever enough to pass itself off as a human being. This was the challenge proposed by Alan Turing when he devised the "Turing test" in 1950 (→ The Person, page 13): can a computer convince a user that it is not a machine? So far the answer is no. Even so, progress in the field of AI has been enormous. Systems are now able to solve problems that a few years ago were thought solvable only by humans. This applies to image recognition (e.g. the cat vs dog problem), speech recognition, robotics – wherever the human senses of hearing, sight and touch are involved rather

From simple analysis to machine learning: how data power is deployed

Machine learning	**Artificial intelligence**	What is the best way to automate decision-making?
Statistical modelling	**Identifying best practice**	How can processes be improved?
Optimisation		
Predictive modelling	**Identifying risks and making predictions**	What might happen?
Forecasting		
Stress testing		
Simulation		
Alerts		
Anomalies in the data	**Descriptive analytics**	What happened?
Key figures		
Ad hoc reporting		
Standard reporting		

than simple arithmetical tasks like 9 – 3 ÷ ⅓ + 1 = ?, for which computers have long been able to perform much better than any human.

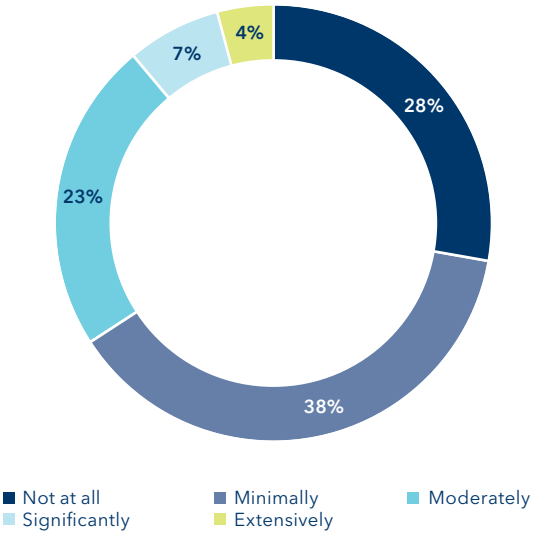
The huge progress achieved in recent years is due to multiple factors. Besides more powerful computers, the main driving force has been the availability of data. Data, of course, is nothing new. Nor is data analysis. But never has there been so much data as now. Masses of it are generated minute by minute, second by second. Every minute 500 hours of video are uploaded on YouTube and 16 million text messages sent by SMS (for more examples → page 15).

> // Accurate data and correct analysis are essential. //

Fast, but limited

This cornucopia of data created by the growing digitalisation of our everyday lives has enabled computer algorithms and artificial neural networks to be trained to tackle harder and more complex tasks. "Data" does not just mean numbers. Data is everything that a computer can deal with: digital images, texts, voice messages, video sequences, location data and sensor readings. To stay with the example of image recognition, the more images a self-learning algorithm has at its disposal, the more opportunity it has to "practise". It identifies patterns, compares them with further images and refines them accordingly. This process continues until accuracy comes within a whisker of 100%. Dog! Cat! Problem solved.

How much are you personally using AI now in your job?



But only this problem. If we then ask the system to distinguish between a cat and a mouse, we will get no answer. The system has only learnt to tell a cat from a dog. There were no mice in the training data. This highlights the limits of AI. Abilities cannot be transferred, and the systems cannot understand or create contexts. AI systems handle many processes faster than humans and often with the same degree of accuracy. But the problems are always very specific.

If a new problem comes along, the algorithm must first be trained again. The Deep Blue computer beat grandmaster Garry Kasparov at chess in 1997, a milestone in the evolution of computers and artificial intelligence. But that does not mean you can just press a button and get it to beat a 10-year-old at a simple board game like ludo.

AI is often described as a tool. Just as a hammer is useful for driving in a nail, so AI helps us to recognise images fast and automatically. It enhances efficiency and helps in the creation of new solutions, like unlocking a mobile phone by face ID instead of a passcode. Thus more and more companies are looking at strategic uses for data and AI (→ page 18). How can they use data systematically? What processes can be automated? Can data enable customer needs to be met better?

Discussion tends to kick off with buzzwords like "big data" and "deep learning". In most cases, however, this is not where the main benefits for businesses lie – except for Silicon Valley giants like Google and Apple. But even tech companies do not use data exclusively



These three pictures show what the AI-based Dall·E image-generation system produced in response to the text prompt "spaceship flying over Liechtenstein". Three styles were specified (from left to right): watercolour, painting and digital art.

for AI applications. Data also helps companies track their business performance, analyse operational processes and spot abnormalities. AI is not needed for this. What is needed is a good database. Raw data comes from multiple sources and in various forms. An input like "12 Jan. 1989, 3,000 gr, Vaduz" does not mean much to a computer. Data first has to be "wrangled", i.e. standardised, formatted, structured, cleansed, aggregated and perhaps graphically represented (→ Workshop report, page 9). This is a time-consuming process but necessary and worthwhile. Even simple descriptive analysis can yield a lot of useful information.

Data analytics is key

Once the data has been put into a computer-friendly form, much more can be done. Scenarios can be simulated, early warning indicators defined and then followed in real time, and business performance predicted on the basis of statistical analysis. A good database also enables companies to identify risks and optimise processes. A large array of statistical methods is available for these purposes.

AI is still far from ubiquitous, however. This was underlined by a survey carried out by the US magazine MIT Sloan Management Review and the Boston Consulting Group earlier this year. Of 1,741 respondents from over 20 business sectors, only 11% said they regularly and consciously used a significant amount of AI in their jobs (→ chart on page 6). 28% said they used no AI at all, or at least were not aware of doing so.

But now does not mean forever. In any case, data can be a game changer. Its motive power helps companies become more efficient and speeds up decision-making. But like any tool, data can be misused, whether deliberately or otherwise. The resultant damage can be painful. Hammers are good for driving in nails, but they can also cause injury, to oneself or others. A bloody thumb may be the least worst result.

This applies to all levels of data processing. Erroneous cost entries can make a financial controller's report useless. If data is fed in with the wrong plus or minus sign or wrong unit of measurement, the most sophisticated stress test can achieve nothing. Accurate data and correct analysis are essential. That sounds obvious, but in practice things can go wrong. A well-known and costly example was the crash of the Mars Climate Orbiter probe in 1999. The NASA scientists had mixed up kilometres and miles. The result was media ridicule and the loss of USD 125 million worth of hardware.

But even if plus/minus signs and units of measurement are carefully checked for accuracy, problems can still arise that are not initially apparent. This is due to the fact that all datasets are limited. Even colossal datasets (big data) are not necessarily fully representative. That can lead to significant errors, especially in AI applications based on self-learning algorithms, because the algorithms are dependent on the training data used.

If, for example, white people are overrepresented in the training data used to develop a system for assessing the creditworthiness of house buyers, the algorithm will favour white people over others. This happened notoriously in the United States. Credit

providers' algorithms systematically turned down loan applications from areas where the population was preponderantly black, because the training data contained a racial bias that was cemented and even reinforced by the self-learning algorithms. Personal prejudices can also play a role, with programmers consciously or unconsciously feeding their biases into the programming code.

Another instance of bias hit the headlines in 2019. When Apple introduced a credit card in collaboration with the bank Goldman Sachs, cases were reported of women getting lower credit limits than men, even when they were married and had a joint account. The initial reactions by Apple and Goldman Sachs were unhelpful. Apple's response seemed to imply that no one actually knew how the algorithm worked. And a statement by Goldman Sachs that gender had deliberately not been included when the algorithm was being trained showed imperfect understanding of the way the process works. Even if a variable (in this case gender) is not explicitly included, it can still come into play indirectly via proxy variables, e.g. variables that are highly correlated with gender, such as spending on goods targeted specifically at women.

These examples show how AI, if used incorrectly, can entrench discriminatory racial and sexual stereotypes. That is why "responsible AI" is so important (→ pages 10 and 12). This does not mean that businesses should steer clear of data. On the contrary. But they should not necessarily plunge straight into highly ambitious AI projects. The first priority is well-structured data analysis.

> // Companies should not start with ambitious AI projects. The first priority is well-structured data analysis. //

It is usually advisable to start with simpler applications and gradually learn the ropes. From day one steps should be taken to create an appropriate data structure and establish rules to guard against erroneous decisions and avoid errors like those described above. In this way it is possible to gain a competitive advantage over rivals that do not appreciate the strategic importance of data and fail to handle it responsibly.

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NOTE

The Glossary on page 25 explains the most important terms.

DATA IS A RAW MATERIAL

How to transform a messy set of data into something which makes sense to a computer.

Edward Gaere

Most materials on earth cannot be used directly in their raw form. Minerals, crops, gas, cotton, even electrons, require a great amount of technology and resources to process and convert them into a form convenient for everyday use.

Data is no different. In its raw state it is usually messy and of low value, unsuitable for analytics. This is because the primary consumers of data have long been humans: data is stored in a way convenient for them to read. Also, there is no globally accepted standard for data representation. This makes it very difficult for computers to understand raw data. It must be cleaned by hand before it can be used, a difficult and gruelling task known as "data wrangling". To complicate things further, data is often missing, which can lead to incorrect interpretations.

An unlimited mess

Let's start with the lack of globally accepted standards. The date 1st January 1990 can be represented in hundreds of thousands of ways:

- 1-01-1990
- segunda-feira 1.jan. 90
- 1990 janeiro 1
- 90 jan. 1
- etc., etc.

Surprisingly, a computer will not understand what 1990 janeiro 1 means, unless it is explicitly programmed to split the string into three parts and then translate the month from Portuguese, which in turn requires a language database. And that was an easy example.

John William Smith will not match John W. Smith if we are performing a lookup on two different databases, even if they are the same person. Naively removing the middle name may yield many matches for John Smith, but the matched records may no longer relate to the same person. And so small variations in raw data remain big problems for computers.

Missing data

Another problem is missing data. Consider the ESG (environmental, social and corporate governance) metric "CO_2 emissions" that measures the number of metric tons of CO_2 produced by a company each year.

Company CO_2 emissions (metric tons per year):

Company A 512.2
Company B 46.1
Company C N/A

It is imperative to investigate further. Is company C not producing any CO_2 or not reporting any? Was the data not recorded? Was the data recorded but missed by the data vendor? Or is the company deliberately holding back these sensitive figures? Our working solution to this problem is to build predictive machine learning models that estimate the missing CO_2 levels using other ESG metrics available for the company. Experience shows that this approach is highly robust.

Fast, but not clever

Humans are intuitively capable of interpreting messy and missing data because they are good with natural languages. They can deal with variations in formatting, abbreviations, locales or spelling. As for missing data, they can conceive and evaluate reasons.

Conversely, computers have no interpretation or reasoning capabilities whatsoever. Extremely sophisticated software is required for handling natural language problems, with debatable levels of success.

And so the process of data wrangling remains a manual task and consumes 60% or more of a data scientist's time.

DATA INVOLVES RESPONSIBILITY

Data lets us analyse and solve countless problems. But only if it is clean and accurate.

Clifford Padevit

It's the next step in human development: tasks that human beings find tiresomely repetitive can be delegated to a system. And this system – we call it artificial intelligence (AI) – learns to handle the task by autonomously analysing a huge input of data.

But what if the data is wrong, messy, incomplete or irrelevant to the problem in question? Then even the fastest computer will dish up meaningless results or be baffled by simple problems (Is it a cat? Is it a dog?) To put it another way: an algorithm has no experience and no values of its own; it knows only the data that has been fed into it.

Bias

Lisa Falco, lead consultant for artificial intelligence and data at the Swiss consulting firm Zühlke, knows these problems very well. She offers an example: "If applications for an engineering job are fed into a computer, the system might well pick a white male simply because so many engineers fall into that category." The computer assumes that the prevalence of white males means that they are the most suitable people for this line of work.

This is obviously a misunderstanding. So a human being has to correct the algorithm's decision. Data can present a warped picture. When human beings have a similar flaw, we call them biased. But an algorithm is incapable of filtering bias out of the data that is fed into it. That is a job for the people who prepare and tidy up the data.

The use of data-driven automated systems has uncovered problems that were overlooked in the initial euphoria surrounding artificial intelligence, self-learning machines, neural networks and deep learning (→ Glossary, page 25). "It was a bit like the Wild West," says Falco. "We didn't even understand what deep neural networks were doing." From a human perspective it clearly all depends on the data: how to gather high-quality data, how to eliminate bias, how to ensure that limits on data collection (privacy) are respected.

This underscores the importance of data analytics. Data has to be explored and analysed to ascertain its distribution and find out exactly what it shows. In Falco's projects, data specialists therefore always need to work hand in hand with professionals in the field concerned. "A lot of common sense is needed – it is not enough to simply look at the data."

The need to be responsible

Analysing and preparing data is an enormous task. "A typical machine learning problem is 80% data cleaning and aggregation," says Falco, who was previously director of data science at the Swiss firm Ava, where she developed an algorithm that helps women increase the chance of pregnancy by analysing physiological data gathered via a bracelet device. It was this experience that prompted her to write a book on the science of the female body ("Go Figure!", → Profile).

The increased focus on data quality and the need to know why artificial systems produce

> We need to understand what is happening in our data models. Otherwise there is a danger of unintended consequences.

the results they do is summed up in the concept "responsible AI". Results have to be comprehensible and replicable. We need to know, for example, why an algorithm decides whether a photo shows a man or a woman and whether the criteria are correct. This derives naturally from the evolution of artificial intelligence. But there is also a political dimension. Moves are afoot in the US and Europe to create a legal framework governing the use of artificial intelligence (→ page 12).

Slower, but more sustainable

"Simply feeding available data into a system and then uncritically accepting the result is fraught with danger. We need to understand what is happening. Guesswork is not enough," says Falco, who has been closely involved in AI development for around 20 years. "I think a model should be interpretable and explainable. It is the only way you can guarantee not having unintended consequences when a system receives data it hasn't seen before."

Responsible AI involves a more circumspect and cautious approach. "This might slow down progress to some extent, but first we have to lay the foundations and then move forward from there," says Falco. And she still sees many possibilities for applications that enhance efficiency in the work environment. "Many people were or are afraid that artificial intelligence would replace humans in the workplace. But that is really not going to happen. AI is useful when it involves delegating repetitive and laborious tasks to a system. Human beings are still way more intelligent than machines, so it is better to free them from tedious and boring work, so that they can concentrate on difficult tasks." Such applications already exist, e.g. in radiology for evaluating medical images. But here again, data quality and the transparency of the system are decisive for ensuring that the dream of autonomous systems does not become a nightmare.

PROFILE

Lisa Falco is Lead Consultant in AI and Data at the Swiss IT service firm Zühlke and author of the book "Go Figure! – The astonishing science of the female body" (2021). Falco, now 46 years old, has been working at the interface between medicine and technology for around 20 years. She was previously Director of Data Science at Ava, a Swiss FemTech startup that helps women get pregnant faster by using their physiological data. She studied physics in Sweden and holds a doctorate in biomedical image processing at the Swiss Federal Institute of Technology Lausanne.

LAWMAKERS GET ACTIVE

In the world of automated systems and artificial intelligence, everything is allowed that is not forbidden. But Europe and the US are now introducing tougher rules.

The limits of artificial intelligence (AI) are not yet clear. But we already know that the potential is enormous. Whenever a new technology emerges, we have to ask ourselves how it should (may, must) be employed, and whether boundaries need to be imposed. This discussion is already underway in the AI world. Approaches that seek to avoid harmful consequences and distorted results in the use and management of data are summed up in the term "responsible AI" (→ page 10). Lawmakers in the US and Europe are now also addressing these problems.

US: "AI Bill of Rights"

In October the Biden administration published a "Blueprint for an AI Bill of Rights". The introduction states that algorithms can reflect and reproduce existing inequities and embed new harmful bias and discrimination. Reference is also made to data collection by social media, which the blueprint says has been used to threaten people's opportunities and undermine their privacy. To protect the public in the age of artificial intelligence, five principles are enumerated that should guide the use of automated systems. But so far only 17 of the 50 states have come up with concrete laws or proposals along these lines.

The regulation drive has made more progress in Europe. The European Union's General Data Protection Regulation (GDPR) that came into force in 2018 creates a legislative standard for handling personal data and protecting the associated rights of individuals. Now it is the turn of artificial intelligence. A proposed Artificial Intelligence Act to regulate AI is currently in the negotiation process. But this is where the problems start. What counts as an AI-based system? Some decision-makers only want to target machine learning, leaving simpler applications unregulated. Another question is whether military and national security applications (e.g. mass surveillance) should be covered.

EU's risk-based approach

The EU proposal is designed to tackle negative consequences of artificial intelligence. Systems are classified into four levels of risk: unacceptable, high, limited and minimal. The highest level is not permitted. This includes systems that are manipulative or exploitative or that grade social behaviour and withhold certain services depending on the results ("social scoring"). High-risk systems are not prohibited but have to meet precise conditions. This includes, for example, evaluation systems for public welfare payments or bank credit ratings and systems that select job applicants.

People should also be told when they are dealing with a computer system or when information is computer-generated. A good example is the note on the website of the European Commission which states that the German translation of the original is a machine translation.

We can assume that the new rules will find an echo far beyond the EU's borders – not only because any systems used within the EU will have to follow the EU rules, but also because this legislation will be the first of its kind in the world. It will come into effect in 2023 at the earliest. **CP**

THEY ALL FAIL THE TURING TEST

Clifford Padevit

Decades have passed since the death of the inventor of the "imitation game", but still no computer has passed Alan Turing's test.

In 1950 the word "computer" was still mostly used to mean a person who could calculate fast and accurately. But it was in that year that the British scientist Alan Turing devised a simple test that still presents an insurmountable challenge to artificial intelligence.

In this test, which Turing originally called the "imitation game", a person communicates with two test subjects via a teleprinter, knowing that one of them (but not which) is a machine. The machine would pass the test if its answers convince the person at the other end that it is a human being. CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) is a modified version used in the internet to determine whether or not a user is human by asking people to click pictures to prove that they are not a computer.

Turing was sceptical. He regarded the question whether machines were capable of thought as essentially meaningless. Computer science was his home turf. In 1945 he designed an electronic "automatic computing engine" that was able to calculate and store data. The engine was never built, but Turing's work made a major contribution to computer development.

Even before the war Turing had made a name for himself as a brilliant mathematician. After graduating from Cambridge in 1934, in 1936 he solved the famous "decision problem" (simultaneously with the American Alonzo Church) by showing that there cannot be a systematic computational procedure for solving every mathematical question within a given set of axioms. He was then invited to study at Princeton University in the US, where he obtained his PhD.

When World War II broke out, Turing joined the Government Code and Cypher School at Bletchley Park in the UK. He and his team succeeded in cracking coded German messages that had been encrypted using the Enigma machine. By 1942 they had constructed a system for automatically deciphering up to 84,000 messages a month. This work provided information that affected the course of the war.

After the war Turing was awarded the OBE (Order of the British Empire) for his wartime services, but most of his work was not publicised because it was covered by the Official Secrets Act. It was a long time before his contribution to the war effort became public knowledge.

Public recognition came too late for Turing. While investigating a burglary at his home in 1952, the police discovered that Turing was involved in a sexual relationship with a man. Homosexual acts were a criminal offence in the UK until 1967. He was convicted of gross indecency and obliged to undergo "chemical castration". In June of the same year he was found dead in his house. The official verdict was suicide by cyanide poisoning, though this has since been questioned. Turing was only 41 years old. His role in the war was officially recognised in England only much later. In 2009 Prime Minister Gordon Brown apologised for the treatment meted out to him, and in 2013 Turing was granted a royal pardon. In 2014 his name became known to a wider public when his biography was depicted in the film "The Imitation Game".

DATA AND ARTIFICIAL INTELLIGENCE GO HAND IN HAND

The world is awash with data, and artificial intelligence (AI) is making huge strides as a means of exploiting it. The quest for self-driving vehicles is a prime example.

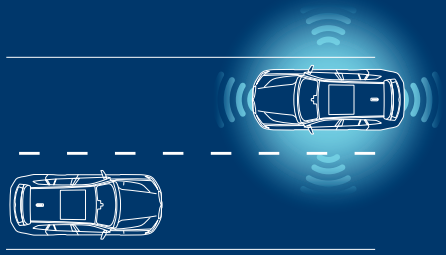
Key requirements for a self-driving vehicle:

High resolution maps

The vehicle must know exactly where it is, including which lane it is in.

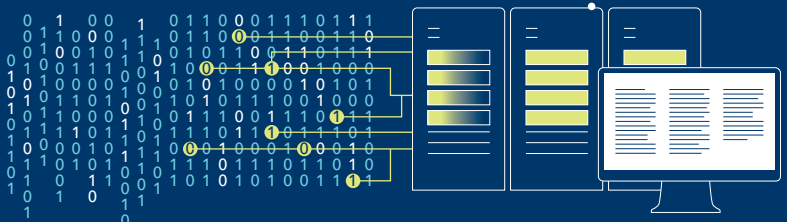
State estimator

The state estimator coordinates input from all the vehicle's sensors, including camera data, GPS and other inputs.



Motion planner

The motion planner is in charge of all the vehicle's manoeuvers, from lane changes to emergency braking.



The collected data are structured and processed by learning systems.

The "5 Vs" challenge for autonomous driving

V1
Volume

A vehicle's sensors produce total data rates in the range of 3 to 6 GB/s, i.e. up to 520,000 GB in 24 hours.

V2
Data velocity

Data recording, transmission, simulation, testing and AI model training can reach data rates of several GB per second.

V3
Data variety

Systems have to be able to manage a wide variety of data formats.

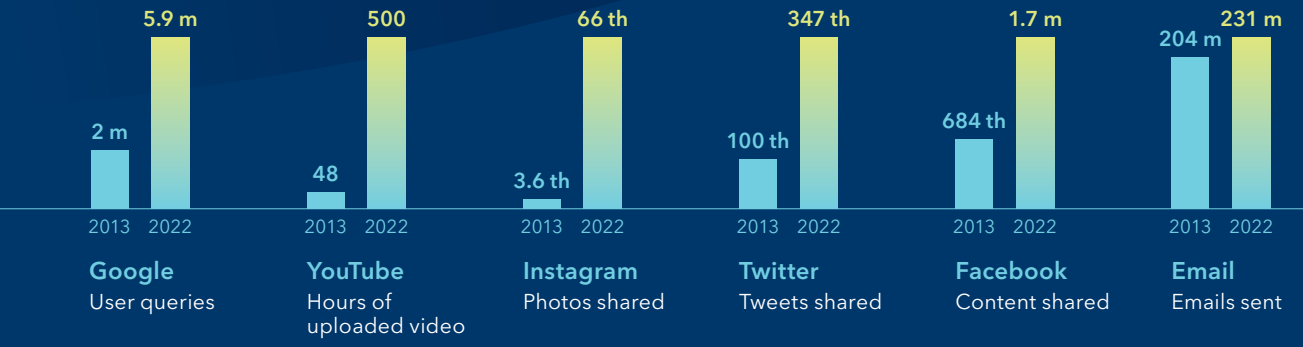
V4
Data veracity

The veracity of data provided by perception algorithms is never 100%, because they only provide probabilities for their predictions.

V5
Data value

The software must function error-free and safely. Data, software and automation form a connected triangle.

For sources see page 26



Data volume

The global volume of new data in 2022 reached **97 zettabytes** (estimate by market intelligence provider IDC). The figure is expected to grow to 175 zettabytes by 2025.

Units

1 byte	=	8 bits or 1 character
1 kilobyte (KB)	=	1024 bytes = 2^{10} bytes
1 megabyte (MB)	=	1024 KB
1 gigabyte (GB)	=	1024 MB
1 terabyte (TB)	=	1024 GB
1 petabyte (PB)	=	1024 TB
1 exabyte (EB)	=	1024 PB
1 zettabyte (ZB)	=	1024 EB = 10^{21} bytes
1 yottabyte (YB)	=	1024 ZB

700 MB/hour are used for watching Netflix at medium streaming quality. If you watched around the clock for **a whole year**, it would add up to about 6,000 GB.

“WE REGARD ARTIFICIAL INTELLIGENCE AS A TOOL”

Artificial intelligence (AI) is making rapid strides, driven by vast amounts of data and huge computing capacity. Alexander Ilic, head of the AI Centre at the Swiss Federal Institute of Technology (ETH) in Zurich, explains where developments are heading.

Interview: Clifford Padevit

The ETH AI Centre involves 110 professorships spread over all 16 departments at the ETH. Are there fields in which artificial intelligence is farther advanced than in others?
AI is already widely used. Teaching a system by feeding it with data rather than programming it manually with lines of code and rules has proved to be an efficient approach. There are many applications in the health sector and also in manufacturing, for example the use of AI in the field of preventative maintenance, obviating the need for a fixed maintenance schedule. An AI system has recently been deployed in the architecture sector to provide aesthetic input for the greening of building projects and to calculate parameters for sunlight exposure.

That sounds as if AI mostly means optimisation.
We regard AI as a tool, not as something akin to a person or legal entity. AI supports us by enabling us to handle processes more efficiently for which humans are not so suitable – mostly repetitive or dangerous processes.

Will machines replace people?
Like electricity and information technology in previous industrial revolutions, AI will bring changes in the economy and society. Many processes will be transformed, resulting in changes in the way we work. But fears that machines will take over the world are unhelpful. It is not a problem that we have to worry about in the foreseeable future. Critical scrutiny of AI is needed because, like any tool, it can be used for good or bad. We should concentrate on ways of shaping the future positively.

Are there interfaces where we can see AI at work? In chatbots, for example?
Chatbots do not usually involve much AI. But there are now new forms that understand speech better. This is relevant for customer service. I see numerous applications for contents that are consumable in other languages. There are also systems that automatically turn a video into text. Currently there is a trend in generative image models, where a tool can be used to create an image, for example a spaceship flying over Zurich.

The AI Centre is also involved in startups. How important is this?
Very important. We believe there will be new business models. Startups are small enterprises for which innovative business models are crucial. They therefore move much faster along this path.

One spin-off from the AI Centre is EthonAI. What does it do?
EthonAI has developed ground-breaking quality management applications for industry to make automation simpler. This used to be done by using equipment that costs hundreds of thousands of francs. With this new solution a system can learn to detect defects on the basis of just 20 good images. Firms are enthusiastic because processes can be started without a long feasibility analysis.

Only 20 images? It was always said that training an AI system required a huge data input.
People still assume that AI requires vast amounts of data. That is no longer necessarily so. Models that have already been trained can be adapted to other uses. If a system has

already been trained with millions of images, it merely has to be fine-tuned. Second, it is possible to generate artificial images, so-called synthetic data, that are indistinguishable from genuine images. In this way situations that occur rarely or never can be simulated. And thirdly, there are tools like LatticeFlow, also from the ETH, that diagnose and improve models and data in order to build trustworthy and reliable AI systems.

So AI is no longer a black box?
Not with these tools. Risks can now be eliminated systematically. This change has happened over the last five years. The solution used to be simply to feed in more data and hope it would help. Now we say there is too little data at a particular point for the risk involved, so more needs to be fed in – or perhaps the model is at fault.

So biases will soon no longer be a problem?
AI is a tool that makes things stronger. If I've got a recruitment process that always chooses the same sort of people – same skin colour and same background – then a model that has been trained with these data will not suddenly do something completely different. Biases can occur at many points: in the data, in the labels, in the model and in the way the user uses it. That must all be systematically taken into account when an AI system is being developed. The data does not necessarily represent the world as it is. A good example is a banana. If we train a system using data from the internet and then ask what colour a banana is, the answer is green. For us consumers a banana is obviously yellow, but the system has not been told that.

How do you see the time horizon for self-driving vehicles as an AI application?
Self-driving technology is already well advanced. But people have probably underestimated the regulatory implications and the parameters that have to be clarified. I could imagine it starting in designated areas to show that it works. I do not know where that would be. Perhaps parking, where much has already been done. You press a button and the car parks itself automatically. Multistorey car parks are a difficult environment for humans, because they are cramped. But such situations are easy for a machine with sensors to cope with – the structure is clear and the speed low.

And how will AI continue to develop in general?
We don't think the basic research has been completed. The use of AI will really get going in the next ten years. In the AI Centre we are endeavouring to speed up the introduction of new AI methodology into fields of application where it brings the greatest social benefit, such as medicine, sustainability and mobility. Compared with human beings, these systems still need a lot of data in order to learn new tricks. First you train the model, then you use it. A human being learns with each interaction. We are not that far yet.

What about acceptance by humans?
We want to demystify AI, to change the perception that AI is competing with human beings and coming out on top. When referring to milestones in AI development, we repeatedly hear how computers have beaten human beings at something, e.g. chess or the Asian board game "Go". That is not an inspiring picture. I would prefer if, in ten years from now, we are talking about how AI enables people to do things they couldn't do before, using AI as a tool to achieve more. A robot is not there to take my job. But working together with a robot I can very quickly install a new manufacturing process, for example. We should think in this direction and see the whole picture in a spirit of collaboration.

PROFILE

PD Dr **Alexander Ilic** co-founded the ETH AI Centre in 2020 and has since been its Executive Director. Now 41 years old, he completed his habilitation at the University of St Gallen in Switzerland and holds a PhD from the ETH Zurich and an MSc from the Technical University of Munich. He is also an entrepreneur. He co-founded the computer vision startup Dacuda, which has received multiple awards and was acquired by augmented reality pioneer Magic Leap in 2017. At Magic Leap he developed an R&D centre for computer vision and deep learning.

Note: The opinions expressed in this interview may differ from those of VP Bank.

WOE TO THOSE WHO NEGLECT DATA

Every company can benefit from the systematic use of data. In the age of digitalisation, firms that ignore the data imperative will be losers.

Harald Brandl

Digitalisation is permeating society and forcing companies to rethink the way they do business. Data can help companies to optimise their operations and open up new fields of activity. The challenge is to find the right data to work with.

The datasphere is growing exponentially worldwide. The total volume of data created and consumed is estimated to reach 97 zettabytes in 2022. That's a number involving 21 noughts (→ chart opposite). The rapid growth of online shopping and related social media are turning the retail sector into a data monster.

But although data volume is exploding, only a fraction of it is genuinely value-creating. Data provider Statista reckons that 90% of all data is replicated and 80% is stored in unstructured form. Beneficiaries of the data explosion include cloud storage providers, notably US-based market leaders Amazon, Google and Microsoft.

Don't miss the boat

The sheer volume and multiplicity of data explain why many non-tech companies still fail to grasp the real value of their data or do not have the necessary expertise to store, process and use it in a rational way. They are then in danger of missing out on digital transformation.

> // Many companies fail to grasp the value of data. //

The tribulations of the taxi sector after the advent of Uber are a vivid case in point. Uber's business model has not reinvented the taxi or created a new form of personal mobility. Uber drivers convey passengers from one place to another. But thanks to a platform linked to navigation software that is supported by artificial intelligence, Uber has brought a new competitive element into this relatively closed sector and positioned itself as an alternative mobility provider. Uber aims to mine the data created by its ride-hailing activity in order to expand its services into other transport offerings. Its goal is to achieve a dominant position in autonomous mobility and future logistics in the urban environment. Traditional taxi operators missed this opportunity and have consequently lost their prime position.

The digital optimisation of operations should be a prime concern of any modern company. If traditional manufacturers and service providers are to safeguard and further develop their business models in the future, they must intensively re-examine all processes and data along the whole length of the value chain.

Data analytics as a service

First they must decide which inputs are relevant. Then the data needs to be stored in a structured form, with errors and gaps eliminated (→ page 9). On this basis, data can be integrated throughout the company and made available without delay at the right place and time. When companies implement digital transformation, they initially expect to see an optimisation of their operations (→ chart on next page), i.e. enhanced efficiency and improved profitability. Data analytics can be used, for example, to rationalise inventories and thereby reduce the company's working capital requirement.

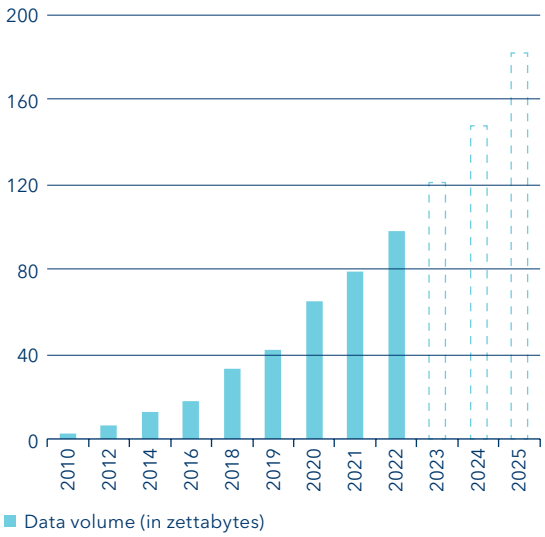
By analysing customer data, companies also hope to boost sales by gaining insights into customer behaviour. A further step is innovative development of the business model. This involves deeper analysis of the data and hence a high degree of strategic and technological expertise. Senior management roles in this field are not limited to the corporate sector. Cities like London and Amsterdam and countries like Singapore have also appointed chief technology officers responsible for implementing a comprehensive digital transformation process.

Instead of opting for in-house solutions to the challenge of digital transformation, small and medium-sized firms can avail themselves of service providers in the field of data analytics. According to an estimate by Precedence Research, the market for such services has a growth potential of more than 30% per year between 2022 and 2030, which could bring it to a total volume of over USD 345 billion.

There are also providers that offer more specific software services. One example is the German software company Nemetschek, which markets a programme for architects and engineers that enables them to model construction projects in three dimensions accompanied by a calculation of the material and labour costs involved.

Also in the construction sector, the US company Bentley Systems offers solutions that combine topography with underlying geological features and data updates in real time. By combining the physical and virtual worlds in this way, Bentley's software enables architects and engineers to achieve extremely realistic planning of infrastructure projects like bridges, dams and high-efficiency solar and wind parks.

Amount of data created, captured, copied and consumed worldwide



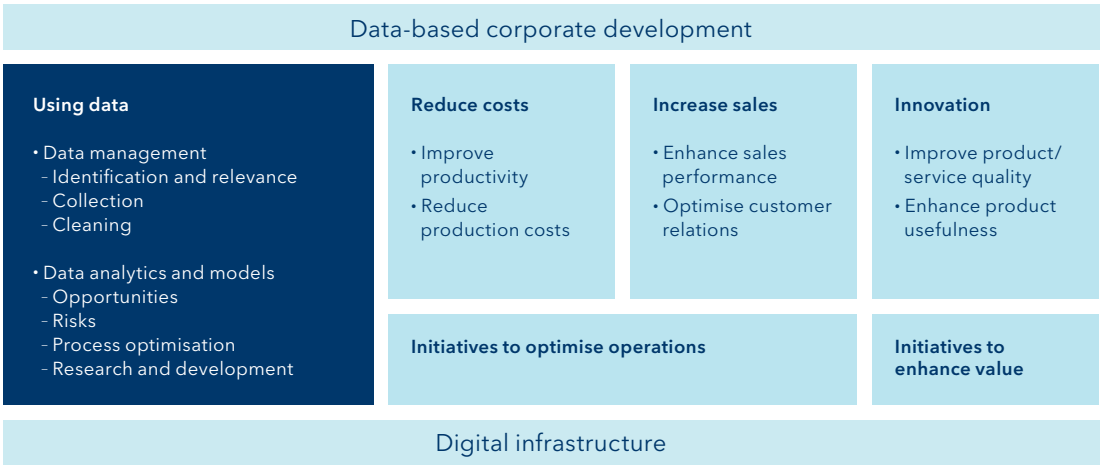
Data storage and networking also have their downside. According to the British IT service provider AAG, cyberattacks climbed by 125% in 2021, and the war in Ukraine has magnified this trend. Since the start of the war, phishing attacks on email addresses of European and American companies have risen eight-fold (phishing emails are fake emails designed to steal private data). Bloomberg reports that ransomware attacks (where systems are blocked until a ransom is paid) extracted more than USD 1.1 billion from US banks in 2021.

> // Two-thirds of SMEs do not have the expertise to protect their data security. //

Supply chains as a weakness

AAG has discovered that two-thirds of small and medium-sized enterprises (SMEs) believe they do not have the necessary internal expertise to avoid infringements of their data security. As transactions become more digitalised, supply chains are also becoming more interlinked and complex. Security breaches in one company can reveal the identity of business partners along the chain. Since the outbreak of the war in Ukraine, more than 40% of cyberattacks have targeted this weakness. These problems reinforce the role of tech companies offering internet security services.

The data explosion is fuelling the growth of intelligent data management systems. Demand for storage infrastructure is still high, but the qualitative focus is shifting towards data analytics, risk management and services offered by expert providers to non-tech companies, including SMEs.



GETTING DATA TECHNOLOGY INTO YOUR PORTFOLIO

Bernd Hartmann

01

New fields of application

Developments in data technology create new fields of application that will transform our daily lives. Examples are self-driving vehicles, telemedicine and "smart cities". Innovative companies that position themselves to exploit these forward-looking themes will enjoy above-average growth. We offer investment fund solutions that provide an exposure to these themes.

02

Data security

As business activity becomes increasingly digitalised, criminals too are moving into the virtual world. This means that digital transformation and enhanced networking create an increased need for cybersecurity. Companies operating in the field of data protection and IT security will benefit from this. We can point you towards relevant products in our list of recommended investment funds.

03

Artificial intelligence (AI)

When large amounts of data are involved, AI is frequently deployed as an analytic tool or as an efficient means of carrying out laborious business processes. Companies are usually dependent on specialist external partners for operating such systems. We can direct you towards companies offering relevant AI services.

04

Trailblazing partners

Companies outside the technology sector that wish to make greater use of data science have to call on the services of a wide range of specialists. Cloud computing (e.g. as a foundation for big data) , data analytics, data architecture and specialised software packages enable companies to optimise their operational processes and avail themselves of new business opportunities. We can tell you which companies in our equity recommendation list meet these criteria.

05

Sustainability ratings

Increased use of data opens up new opportunities for companies but also exposes them to greater security risks. Data is already one of the biggest operational risk factors in the business world. Sustainability ratings can help identify companies that are not sufficiently protected against risks of this sort. The VP Bank sustainability score (VPSS) is a useful tool for this purpose.

FABIAN ZBINDEN

Combining Excel spreadsheets with plant-based cuisine – Swiss TV chef Fabian Zbinden launches his healthy instant foods in German-speaking Europe.

Clifford Padevit

34 years old and already starting his second business, Fabian Zbinden creates and sells meals that are healthy and quick to prepare. His Feelfood ready meals have been available online since 2021. Then came a breakfast drink. Now the range is going to be further enlarged, with shop sales being launched throughout German-speaking Europe. As from January 2023 Feelfood products will be on sale in Switzerland through the retail chain Lidl, for which Zbinden is a brand ambassador. And there will soon be a second drink in the line-up.

"We want to make people's everyday lives easier," says Zbinden, "by providing practical and healthy foods." The focus is on busy people who are keen to eat healthily but often do not have enough time. "We offer them top quality products with certified organic ingredients, everything plant-based." Add hot water, wait a little, and the red lentil dal or chili sin carne is ready to enjoy. "Creating instant foods is extremely difficult," says Zbinden. "Everything must be just right in six minutes with only hot water added: the pasta al dente, the spices properly dissolved."

The product suits Zbinden's personality. He has no difficulty combining things that others would find irreconcilable: fast and healthy, top chef and instant food, simple TV recipes and complicated nine-course menus. He trained as a chef in the five-star Victoria-Jungfrau Grand Hotel in Interlaken and gained experience and inspiration in Nobu in Los Angeles, where Hollywood stars dine on Japanese-Peruvian cuisine. When he'd had enough of Tinseltown, he came back to Switzerland, made a food truck for himself and sold his "La Ribollita" one-pot meals on the streets of the city of Bern.

These one-pot meals enabled Zbinden to lay the foundations of his career as an entrepreneur and to seek funding. Not in a boring office, but on the German version of the TV show "Dragons' Den", in which contestants make a pitch to wealthy figures in the business world, who then invest directly in the contestant's business if they like what they see – or eat! In this way, Zbinden attracted an investment of EUR 40,000 in 2019, which helped him market two ready one-pot meals. But he was dissatisfied with the products' quality, so he made a fresh start, this time with a co-founder, and called the brand Feelfood. The company is based in Cologne, where he made his successful TV debut. These days he commutes between Cologne and Bern.

Zbinden's first startup taught him to be patient and how to tackle big projects. "And I learnt how to operate Excel spreadsheets," he says with a chuckle.

What matters to Zbinden is the flavour, whether it is a ready meal or haute cuisine. He reaches out to people through the taste of his creations. If the taste is right, it is not necessary to point out the advantages of plant-based eating. "I create the dishes, and if they taste good, that's all that matters. In any case I think an attractive colour mix is more exciting than a brown lump of meat." Zbinden is keen to encourage people to ditch their preconceptions and be open to new ideas.

My best investment

"The time, energy and love that I put into my projects."

"Money helps you plan big projects, but you can't buy the ideas and hard work that go into creating world-class products. Nobody tells me what to do – that is the great freedom of being an entrepreneur. I'm completely autonomous and can shape my time as it suits me."

My worst investment

"I've thrown away a lot of money, but that's not necessarily a bad thing."

"When I invest time and money in a project that doesn't work out, I tell myself it has been an investment in valuable experience. We learn when we make mistakes and something doesn't turn out as we expected. Then the question is what benefit can we get out of it? The clearer the idea, the clearer the path ahead."

LIGHT AT THE END OF THE TUNNEL

Bernd Hartmann

Hefty losses and the rare spectacle of simultaneous corrections in equity and bond prices have made 2022 a year of upheaval on global capital markets. On top of disrupted supply chains, economies have been additionally hit by shortages in the energy market following the Russian invasion of Ukraine. Inflation, initially regarded as temporary, has escalated and forced central banks worldwide into a monetary U-turn.

Change of trend

Resurgent inflation and monetary tightening have put an abrupt end to years of falling bond yields. Soaring yields on global bond markets have led to unprecedented capital losses. At the same time, equity valuations tumbled as higher interest rates removed the justification for the elevated valuation levels that equities have enjoyed in recent years. When interest rates rise, the value of discounted earnings falls. Hardest hit were growth stocks, which for a long time had been equity investors' favourites. A similar effect has been felt in the gold market. The yellow metal provides no current return, so its attractiveness is diminished in a higher-interest environment. This consideration has outweighed the impact of heightened geopolitical risks, which are usually good for the gold price.

Growth in the major economies initially held up reasonably well in the face of these difficulties, but recession is now on the cards for the start of the new year. Inflation should decelerate substantially during the course of 2023, partly due to softer demand. Even so, inflation expectations for the years ahead are still likely to be at an elevated level – inflation remains an issue.

Opportunities in the bond market

Steep falls in bond prices, combined with the growth and inflation outlook, have made fixed income securities more attractive. Investors should take advantage of current higher yields to build positions in good-quality bonds, using the cash from matured bonds that has not been reinvested in recent years. Caution should continue to be exercised regarding qualitatively weak borrowers. Although credit spreads have widened, they have not yet reached the levels that can be expected in a recession. However, opportunities in the lower-quality bracket could arise later in the year in the event of a further correction or signs of an easing of market stress.

> // Investors should increase their risk exposure gradually. //

In the equity market a rapid rebound such as we saw after the coronavirus crash seems improbable. Valuation levels in the US market are admittedly comparable with the phase preceding the last recovery, but conditions are now very different. Investors in search of useful returns can now find alternatives to equities. Even so, equity markets should perform better in 2023. Despite inevitably stronger operational headwinds in the corporate sector, the market should be helped by a peaking of key interest rates, with further support coming from signs of an economic improvement in the course of the year.

Thus 2023 could be an interesting year for financial markets. Investors are advised to act cautiously, starting with a defensive positioning and gradually assuming a greater exposure to risk.

GLOSSARY

Algorithm
A precisely defined set of processes for solving a problem in simple steps.

Artificial intelligence (AI)
Artificial intelligence attempts to imitate human behaviour by means of computers. What intelligence means is not clearly defined. Applications often involve processes for recognising text, speech or images. AI systems are mostly designed to solve a particular problem. The AlphaGo programme, for example, learnt to play the Asian board game "Go", partly through the use of neural networks, and eventually beat the world champion.

Artificial neural network
"Neural network" is a term borrowed from biology, where a neuron is an electrically excitable cell in the nervous system that communicates with other cells via bioelectrical signals (nerve impulses). Artificial neural networks are composed of levels of networked computing units. A self-learning algorithm changes the network until it delivers good results. The model's capability depends on how many neurons, levels and connections it contains.

Bias
Bias occurs in data processing if data relating to a particular category is unbalanced, e.g. if a population group is underrepresented. For example, the AI research company OpenAI recently had to admit that its Dall·E imaging system overrepresented a particular gender or skin colour for search items like teacher or CEO. Adjustments had to be made to correct this. Bias can also occur through programmers unconsciously causing the system to reflect their own experience or values.

Big data
Very large data sets that are too complex, too fast-moving or too weakly structured for traditional databank systems to manage and analyse.

Data analytics, data science
Data science is concerned with methods, processes and algorithms for extracting knowledge from structured or unstructured data. Data is analysed using statistical processes. A large part of data analytics consists in putting data into a form that makes sense to a computer (data wrangling, → page 9).

Deep learning
Deep learning is machine learning by means of artificial neural networks that consist of large numbers of artificial neurons aggregated into several or very many levels. The extraction of relevant features from the raw data occurs autonomously. Deep learning is responsible for successes in language, text, image and video processing. Deep learning works when large quantities of data are available for training. A well-known example is DeepL, a translation service based on deep learning.

Generative AI
Generative AI uses machine learning to enable machines to create new content from existing texts, audio files, images or original patterns. Computers use training data to learn the underlying patterns associated with the data and thereby produce new content in a plausible form. Examples are GPT-3, Midjourney, Stable Diffusion and Dall·E.

Machine learning
Self-learning algorithms learn by experience, creating a complex model solely on the basis of data input. A system trained in this way can use its acquired knowledge to process new data of the same sort. Machine learning is useful wherever processes are too complex to be described analytically but where a large amount of data – e.g. sensor data, images or texts – is available. The learned models can be used to generate predictions, recommendations or decisions.

Responsible AI
Unless designed and used responsibly, AI applications cannot guarantee IT security, effective control, legal security, responsibility or transparency. That is why guidelines are being drawn up at the corporate, societal and political levels to ensure ethical standards in artificial intelligence. The aim is also to make AI results replicable and subject to scrutiny (→ page 10).

Self-driving vehicles
Cars driven purely by artificial intelligence systems with the aid of cameras, sensors and navigation data are still far from being a reality. But the evolution from driver assistance systems to fully automated driving has already been mapped out theoretically. It is usually divided into five steps: driver only, assisted, partly automated, highly automated, fully automated.

Self-learning algorithm
A self-learning algorithm is an algorithm that uses data such as images or documents to construct a model or recognise patterns in order to solve a particular problem. This means it is also able to process new data.

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