Logistik
Praxis

Alexander Pinker
Marco Prüglmeier

Innovations in Logistics

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Dear Reader,

We live in turbulent times. Amidst of the numerous lockdowns of the COVID-19 pandemic, the rapid increase in digitalisation and the change in our consumer behaviour, it is becoming clear how versatile we can be as people, entrepreneurs and employees.

As has often been the case in the history of mankind and also in the history of logistics, we are in a constant state of change. But if we become consciously aware of the current situation, one thing becomes clear: this time something is different.

While the development from the steam engine to the first computers was slow, technologies, innovations and trends now evolve faster than ever. Technologies follow a digital and exponential development path. Just think about how speedily new smartphones, laptops or tools come to market. The pace of innovation rapidly speeding up, innovation cycles become shorter and shorter.

These exponential developments do not correspond to how we as humans mostly experience natural developments as linear. Initially, change happens slowly; almost unnoteably. Then, at a certain point, the curve steeply increases and we become aware. Only when this point, this "point-of-no-return" is passed, do we notice a development – but from this point on, progress is already so fast that we are almost overrun.

This book is therefore intended to inform at an early stage and to help all logisticians, entrepreneurs and employees. Together we describe the "new" exponential technologies, future trends and developments in logistics. Combining the expertise from logistics and future strategists, we describe what needs to be done, with a practical link to hand on work and adaptable for every company, no matter if start-up, SME or major corporation.

So whether you want to learn about artificial intelligence, robotics or the next steps to implement it in your warehouses – you will find the solution here. Our goal with this book is that once you have worked your way through the entire paper – or even just revised individual chapters – you will have gained a comprehensive understanding of the most relevant technologies in logistics and enabling you to approach the various aspects with a more open mind and clear vision.

In our view of the future, we do not restrict ourselves to the factory of the future and its associated logistics processes, but also address the entire supply chain, from suppliers to the factory to the route to the customer. Our practical implementation plans have been tried and tested in years of practice.   >>

Foreword by the Authors

Marco Prüglmeier is an expert in the field of supply chain, lean production and logistics innovations. He built and managed the innovation lab and the company start-up idealworks at BMW AG. Today he is the founder and consultant of the management consultancy i2market. Alexander Pinker is an innovation profiler, future strategist and new media expert. He helps companies not only to look into the next two years, but to understand the trends in technology and society for the next five to ten years. To do this, the innovation profiler and his companies "Alexander Pinker – Innovation Profiling", "Medialist Innovation" and "innovate! communication", embark with their clients on a search to trace the change and find the appropriate communication channels and technologies.

This experience is the leading thread through the entire book. This is why we don't just look at the technologies and their use and effectiveness, but always bear the human being in mind as well. How will occupations change in the logistics of the future? What does management already have to consider today so that implementation succeeds together with the people? How can I, as an employee in logistics, adjust to this change and deal with it?

As authors, we are driven by the deep conviction that the future of logistics can be shaped to benefit the people and to benefit shareholders and entrepreneurs alike at the same time. However, this requires thoughtful, foresighted change, and we must not wait until the technologies are ready to be deployed at companies' doorsteps. We must act today and help shape the change responsibly!

From our point of view, and this is what we experience when planning and implementing innovation projects with leading companies, the changes in logistics will be dramatic in the coming years. With this book, we want to prepare for this and contribute to the success of this revolutionary change in logistics as an industry of such outstanding importance for Germany.

Therefore, we invite you to actively shape the future of logistics! Get involved in a personal and entrepreneurial change and embark on an interesting and fast-paced journey of learning and implementation. Together we will go into the future, shape it and bring the hashtag **#LogisticsGoesHightech** to life.

We look forward to journey together with you dear reader into the world of logistics of tomorrow!

Marco Prüglmeier and Alexander Pinker

> *For the sake of a better flow in reading the following text, dear readers, we will use the generic masculine. Of course, this always includes the female form.*

Prof. Dr. Thomas Wimmer

The Trends and Strategies Study published by the German Logistics Association in summer of 2020 identifies three top challenges for the next few years: digitalisation of business processes, transparency in the value chains and omnipresent cost pressure. Closely linked to digitalisation and transparency are technical and organisational aspects such as the willingness to trustfully exchange data, intensive networking of people and systems, but also the use of sensor technology, artificial intelligence and robotics besides business analytics. The top trends also include the sustainability of logistical processes and the shortage of skilled workers. Those who want to be successful or stay on the cutting edge must actively address all these topics. The future always begins now.

Those who wait will fall behind. However, those who consistently overcome old thinking and traditional structures to engage in new, possibly digital processes can save high costs. Organisational agility, rapid decision-making and leadership closely connected to the employees are also of great value.

These are precisely the ideas addressed by this publication. In their present book, Marco Prüglmeier and Alexander Pinker provide tangible support in competing for logistical excellence. They write about a broad canon of topics that concern the far-sighted logistician.

They comprehensively explain the technologies that will have a significant impact on logistics: From individual components in modern Autonomous Mobile Robots (AMRs) to LIDAR scanners, camera technology and SLAM algorithms, to augmented and virtual reality and artificial intelligence. They describe how ways of working will change with or by 3D printing, network technologies and IT trends, like cloud or edge. In doing so, they also keep an eye on the effect this will have on people. They make clear what role new technologies play for sustainability in logistics – a field of action in which this industry must and will assume more and more responsibility in the future.

They take the reader to detailed insights into the future of the various logistics processes, be it in production, in warehouses, or beyond that throughout the entire supply chain to distributing goods to the consumer. But one thing is very important: it is not a mere description of a coming logistics world, but also a very practical guide on how to   >>

get there. Marco Prüglmeier, project manager of an innovation team at BMW, whose concept was awarded the BVL's German Logistics Prize in 2019, provides valuable practical advice to implement future-oriented logistics and the future logistics' developments towards high-tech and effectiveness. Future strategist Alexander Pinker, as an international innovation expert, lecturer and author, completes this practical perspective with a futuristic look at the trends that drive our corporate world, our everyday life and our logistics today.

As a "trained" production logistics expert and also as chairman of BVL, I am pleased with the commitment of the team of authors, who combine practical experience with strategic orientation. The systematics developed for the Technology Radar by BVL, Huss-Verlag and Capgemini have been reflected in the present elaborations. The book encourages the reader to develop their own vision, to open up new business fields and to dare to innovate.

Prof. Dr.-Ing. Thomas Wimmer
Chairman of the Board, German Logistics Association (BVL) e.V.

Prof. Dr.-Ing.
Johannes Fottner

For a few years now, one has had the impression that the world is about to be flooded with autonomously driving passenger cars. Another year or two, and then – or so one might think – and they will be everywhere. Travel, watching a movie in peace or work through your emails without feeling guilty. Back in 2015, it was believed that it would only take another 2 to 5 years, for the technology and the market to be ready. To date, some driver assistance systems are available, even far-reaching and well-functioning ones, but there is still some way to autonomy.

With the use of artificial intelligence, augmented or virtual reality the situation is quite similar. Although there are use cases, the technologies remain largely unapplied in everyday life.

However, there is one area that has been using new technologies as a pilot application for many years: Logistics; foremost: intralogistics!

Since the 1970s, "autonomous" (technically correct, of course, "automated") transport vehicles, long known as automated guided vehicles (AGVs) or in large, entirely automated systems referred to as automated guided systems (AGSs), have been in use since the 1970s. Hyped over and over and in the beginning they were unfortunately relegated to the test track due to initial problems but have now set onto a triumphant march forward over the past 20 years.

Today, virtual reality is another reliable companion in the planning process of new factories and distribution centres, helping project teams to work intuitively across different disciplines and remotely off-site.

Augmented reality, such as pick-by-vision, is a method to facilitate order picking, making the process more intuitive and more reliable.

Digital twins are an integral part of complex warehouse systems in order to be able to successfully implement optimisations and entire product changeovers during ongoing operations.

Digitalisation has been implemented almost across the board in many logistics facilities, and the Internet of Things (IoT) is certainly no longer an abstract future concept.

Notice how in logistics, science does not cover in a white coat in front of a microscope but goes hand in hand with practice. Relevance is a must. The quick and successful practical test is more important than the theoretical publication. Industry 4.0 is largely driven by logistics – a precondition for individualised, efficient production.

Foreword

Over many years in his professional life Marco Prüglmeier has directly followed and driven such processes. He was part of the ever faster implementation of innovative technologies in the context of modern intralogistics. Few can explain and describe more impressively how to identify, analyse, test and, above all, successfully implement technology with relevance and future significance in practical industrial environments.

As a future strategist, start-up expert and lecturer, Alexander Pinker always draws the greatest added value from the future. His focus on current innovation technologies, trends and the associated communication with employees, as well as with partners and customers,
clearly emerges when reading this book. He takes us practically through the process of innovation to the world of tomorrow.

In this book, Marco Prüglmeier and Alexander Pinker impressively show the new technologies deployed and what effect they have. It explains impressively clear and comprehensively how mechanical processes and machines are no longer conceivable without state-of-the-art IT and computer technology. Additive manufacturing and cloud computing are just as much a part of modern logistics systems as autonomous mobile robots are. Just like in a perfect construction kit, modern industrial systems are built from the most suitable technologies – interfaces are smooth seams and no longer insurmountable boundaries, neither on the software side nor on the mechanical hardware side. This book also sheds excellent light on the role that project partners play in the implementation of such systems, in addition to the technologies.

This is precisely the appeal of the book:

High practical relevance, an impressive and comprehensible overview over the portfolio of new technologies and their respective fields of application, clear advice for a targeted, solution-oriented implementation, and finally a vision of where it can still go – hypothetical and "visionary" in the truest sense, but also quite rationally a vision for one's own company.

Especially for me, as a long-time employee of small and medium-sized businesses: a clear path, not only for large corporations, but also specifically for small and medium-sized businesses. SMEs in particular are often very open to innovation and predestined to drive the pilots of new technologies in logistics. Enjoy the reading!

Congratulations on this fine book, dear Marco, dear Mr Pinker.

Garching, April 2021
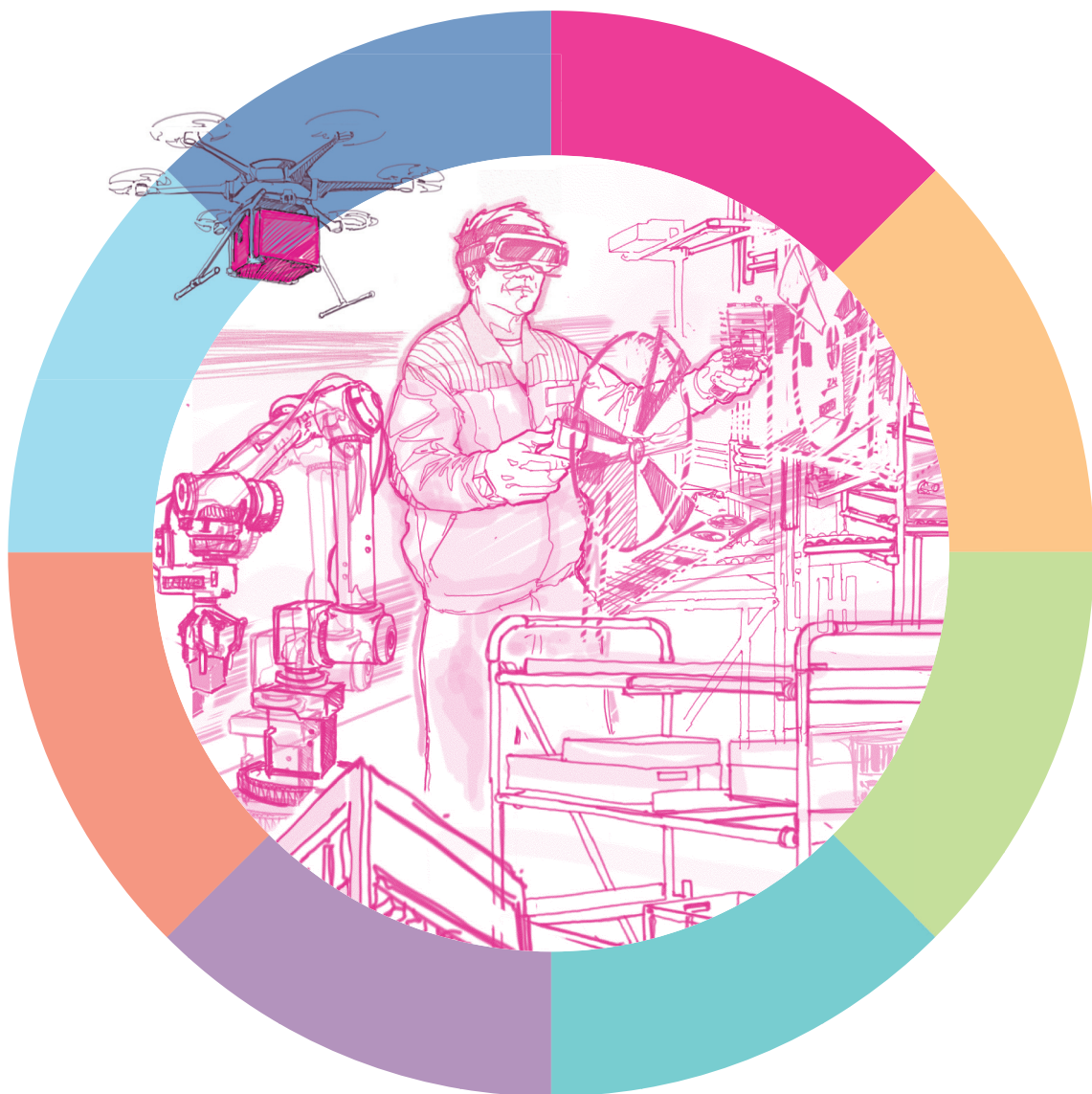**Prof. Dr.-Ing. Johannes Fottner**
TU Munich

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Everything that can be digitised will be digitised – a currently widespread saying. But one thing is clear: digital transformation is making its way into most companies and industries. In times of change, there is a lot of talk about the so-called VUCA world. VUCA stands for "volatility", "uncertainty", "complexity" and "ambiguity" – terms that perfectly describe our times. It is easy to see that every company faces these challenges. But in order to prepare for tomorrow's world, it is important to overcome the fear behind these words and recognise the opportunities behind the VUCA world. From automating operations to digitising processes, everything is possible.

Fig. 1: VUCA world at a glance
Source: Alexander Pinker, adapted from Transformation Magazine

VOLATILITY	UNCERTAINTY
Volatile markets	Uncertain events tip the market balance
COMPLEXITY	**AMBIGUITY**
Complex impacts strongly affect innovation and development	Ambiguous effects of different market impacts

We are experiencing fast developments in production, technology, communication and mobility. Start-ups and creative companies are fundamentally changing the previously known market, breaking new ground and completely reinventing traditional business models. In this environment, volatility, uncertainty, complexity and ambiguity are now almost normal, even in logistics. Some sources, even though everyone wants to hear this, even go so far as to call "VUCA" the new digital normal.

But what exactly is behind these market-changing components of the VUCA world and why do logistics professionals also need to adapt to the topics of digitalisation, disruption and change?

1.1 How Digitalisation Changes our Everyday Lives and our Companies

The digitalisation of our corporate world and our everyday lives continues to advance due to the increasing spread of internet-enabled mobile devices. According to a study by the Federal Statistical Office in Germany, currently 62 % of smartphone owners aged 25 to 44 use the mobile internet. In 2012, the figure was still 46 %. The trend is even more pronounced among 16 to 24-year-olds, with 81 % of the age group surfing the web with a smartphone or tablet.

The annual study "D21-Digital-Index" also shows a similar picture of the situation regarding the digital society in Germany and gives a good picture of how the population uses and adapts new technologies and digital tools in their professional and private life. After initially showing little momentum, the level of digitalisation has continued to rise steadily since 2017. Digital literacy, openness to technological change and usage behaviour are improving as well. But despite all this, the digital divide is still clearly noticeable.

The behaviour of users at work and in everyday life is also changing: "People are increasingly starting their search for a desired product on Google and expect detailed product information, help videos, outfit recommendations or expert tips as a result," says Kathrin Haug, Digital Innovation Specialist. By linking companies with the digital world, technologies are also changing. The coming few years will see a multitude of new concepts, telecommunication technologies and systems which will further change the dynamics of the customer approach and process chains. The daily work routine in logistics is also new.

Where industrial trucks or manually operated pallet trucks used to determine transport, more and more transport robots take over. Employees in logistics are increasingly supported by digital gadgets and the smartphone has advanced to be an indispensable part of a logistician's everyday life.

To enable the digital transformation, it will be necessary to expand the existing core competencies of German companies with digitally networked applications in the future.

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Germany is well positioned for this change. Especially in process optimisation, productivity and implementation quality, German companies often show impressive skill and innovative spirit. However, as far as creative new ideas are concerned, these have so far mostly come from the USA or Great Britain. The necessary technical innovations are developed there and only then brought to Germany from there. German entrepreneurs can be characterised by competitiveness and price pressure rather than technical innovation. This is culturally explainable, because taking up and adapting innovations undiscussed is not necessarily part of the German culture. Innovations and spontaneous business model changes therefore often originate in the USA.

One area that extends from smart home to smart factory is data. Data will determine tomorrow's workplaces. In times of Big Data, information needs to be analysed faster and more efficiently. In the coming decades, digitisation and automation will play an increasingly important role. These are the trends of the workplace of the future, which will also have an impact on the logistics of the future.

Big data and analytics are no longer foreign words in the data-driven logistics industry. For some time now, there have also been more and more applications of blockchain technology in the supply chain.

Logistics is just one area to automate and digitise business sectors. The Digitalisation Index, a study conducted by Deutsche Telekom, shows that many companies, especially SMEs, have now understood digitalisation and that it is worthwhile. More and more processes are digitised. This means that companies with a high level of digitisation are more resistant to crises, react more flexibly to changing requirements and implement new business models more faster. The index also shows that it pays to invest in digital transformation. With the help of digital processes, the pioneers in analysis were able to increase their turnover by at least 38%, and for some even by almost 75%. These are just some of the benefits of digitalisation – service and product quality also increased, driving innovation and inventiveness forward.

Despite all the results, it is unfortunately clear that far too few companies are currently digitising and efficiently using the opportunities innovation and transformation offer. For this reason, new ways must be found to advance both industry and logistics.

The study "Start-up funding in Logistics" (2020) by McKinsey even attests logistics a wide-spread presence of inefficient processes in the form of

system breaks, complex pricing and a low degree of data standardisation – worldwide. For example, about half of the largest US importers plan and monitor their international supply chains with spreadsheets instead of data analytics processes or artificial intelligence, which leads to enormous losses in time and efficiency.

A rethink is not only called for, but urgently needed, because in the coming years more and more multimedia technologies will evolve into corporate processes. This is precisely what logistics must commit to and actively shape the transformation.

1.2   Technologies on the Rise

Technologies dominate our world. With ever shorter innovation cycles and new technologies, our everyday lives and our work are being revolutionised almost on a daily basis. The inventions and developments of recent years have created amazing tools and resources that not only make us more efficient, but also give us a new focus on the actual work at hand.

Modern technology has not only paved the way for multifunctional devices, such as the smartphone or the smart watch, but also moves robotics and automation into warehouses and office buildings. All these changes have made our lives easier, faster and, to some extent, more fun.

The devices we now rely on through technological developments are also something to behold. Twenty years ago, it would have been unimaginable to carry a supercomputer in our pocket; today, smart watches, tablets and devices with voice assistants and super-fast network connections are part of our everyday lives. Mobility and flexibility have consequently found their way into our lives. We can transfer money from anywhere in the world, do our shopping without leaving the house or make logistics processes efficient and cost-saving. These developments have changed the way we entertain ourselves, consume media and how we work.

It's easy to lose sight of the big picture here, but with a vigilant eye it's easy to see which technologies really add value to life and work and which are mere gimmicks. Not every company needs to change radically, but sometimes a little disruptive thinking doesn't hurt.

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Disruption – a Necessary Evil?

In his book "Disruptive Thinking", Bernhard von Mutius sums up the topic very vividly: "A spectre is haunting Europe: disruption." And disruption probably really does strike many entrepreneurs as a spectre spreading fear and dread. After all, all processes are changing. Start-ups from all corners of the world are on a mission to flood the world with these disruptions and change everyday life.

But is it really that bad? Companies want disruption, but at the same time they are unsettled by what it means. There is uncertainty about what one really needs and what one can keep from the "old" world.

There is a message for precisely these companies, also to reassure them: Everyone can be a disruptor, but not every industry and not every company is suited for big, radical innovations.

As already described, it is no longer deniable: The world is changing, speeding up and becoming more dynamic, but whether this change always is disruption, I doubt. Not every change in a process has to be "earth-shattering" and "industry-disrupting". Whether in logistics, service or management – innovation and change always manifest on different levels and depending on the desired added values and goals, it may cause a major or a minor change.

So do we need to watch out for disruption in our field business and be afraid of being overtaken? I'm sure some consultants would say "yes" without hesitation, looking at their service offering and day rates. But, quite frankly, what is needed is not innovation at any cost, but innovation that matches the business and the process in question. This means, the need is for developments that advance the business model and create real added value for the customer or their employees.

So it doesn't need disruption without reflection, it needs a new way of thinking. Innovations should not be communicated as radical, disruptive and different. Even though the press and investors love it when start-ups talk this way, in traditional companies that want to break new ground this tends to scare employees. Words like "radical" and "different" are not necessarily favourites in the ear of the somewhat change-shy employee. Therefore, when it comes to change, it is more important to show the added value. To show that it would be "stupid not to use it".

Managers in any industry can use this argument of benefits to face the spectre of disruption and take away its terror. It can mutate to a spirit of innovation and inspiration in our warehouses, factories and offices.

Technology and us

To develop this new kind of mind-set we naturally need to question our relationship with innovation and technology. Technologies are on the rise and they are changing our everyday lives, but we need to be open to the opportunities. The past shows that our relationship with machines and technologies has always been a difficult one. It starts with simple everyday processes, of us yelling at the inanimate computer when it goes on strike again, and ends with a great distrust in automation, robotics and artificial intelligence. The introduction of the loom had caused public unrest as well. So did the steam engine. This was the birth of the so-called "Luddites". But machines are part of our everyday lives. Whether it's the oven in our kitchen, the smartphone in our pocket or the car that gets us from A to B.

So why do we make a distinction when it comes to machines in everyday life and machines at work? How can it be that we so readily accept gadgets that make our lives easier, but often perceive them as a threat in factories and warehouses?

Fear of the new may serve as an explanation. We are often concerned that the next generation of machines will take our jobs away. That automation and robotics will drive out humans and artificial intelligence will completely take away our thinking. But this assumption is not helpful. It is much more important to see where we truly need machines and when we don't. As we already saw with disruption, no company is the same. It needs an assessment of when to use which advantages and how we can go about our day better and more efficiently. Of course, there may be professions that are automated, but at the same time, entirely new professions arise.

Today, companies need to look at the future without prejudice and realise what machines can really be used for in tomorrow's world. They need to consider which tasks require little human intervention and can be automated and where new opportunities for current employees to grow professionally and personally arise. But they also need to see how they can support employees in their current jobs for as long as possible.

Whenever it comes deploying machines in a business context, the goal cannot be to make humans redundant. Rather, it is to enable interaction between humans and machines. Employees must be able to create added value in collaboration with the machines and see them as a support to their human talent. Technology is on the rise, but it is a blessing, not a curse.

1.3   Between Moore's Law and Huang's Law

Digital transformation: a term that no industry or company can evade. Be it talks about new technologies, digitalised business models or dynamic and flexible process optimisation; all these topics shape the revolution in companies, logistics centres and factories. But what is really behind the digital transformation and is it as disruptive and flexible as it often seems or does the change follow specific rules? One answer to this question lies in three laws: Moore's Law, Metcalfe's Law and Bandwidth Law. These three laws describe the combination of computing, connectivity and the cloud.

Moore's Law of digital transformation

Fig. 2: Moore's law illustrated   Source: Max Roser, Hannah Ritchie

Moore's Law: The number of transistors on microchips doubles every two years

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.
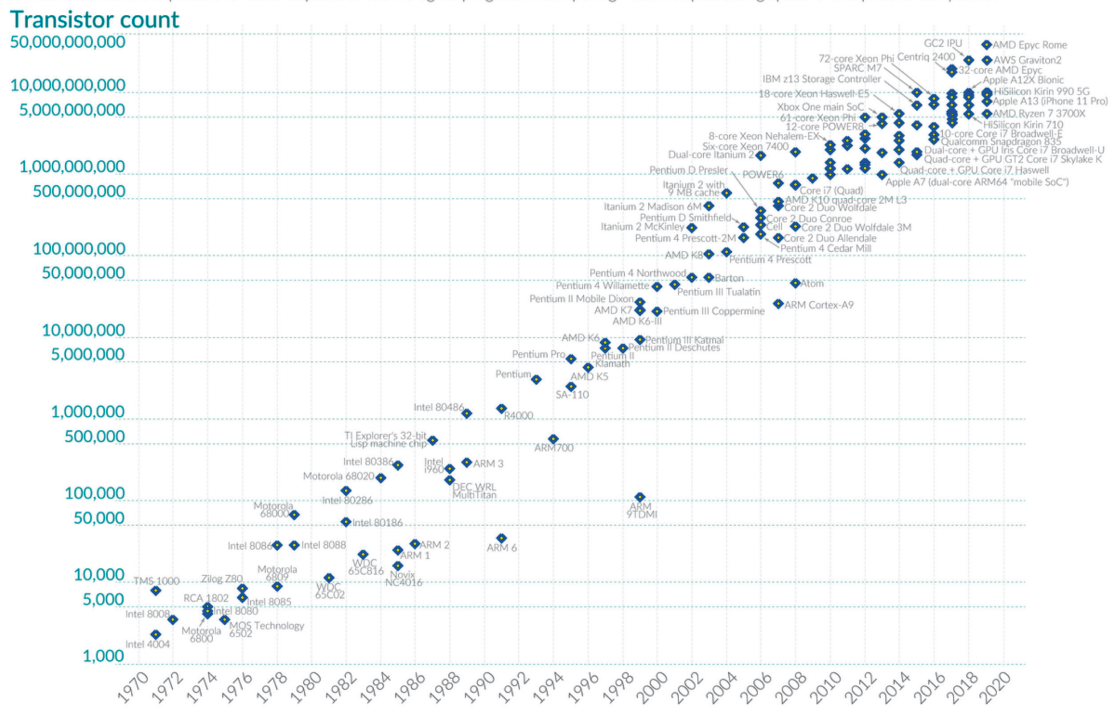
Data source: Wikipedia (wikipedia.org/wiki/Transistor_count)
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