Centre d'études internationales
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Université de Strasbourg

Part 1 | Dynamics of digital transformation

Chapter 1 | Evolution of the knowledge and service economy

The importance of knowledge as a driver of economy

Joseph Alois Schumpeter (1883-1950) was an Austrian-American economist who first explained the importance of innovation for an economy. Schumpeter is best known for his 1942 book titled "Capitalism, Socialism and Democracy", in which he dedicates a brief chapter to explaining the theory of dynamic economic growth known as 'creative destruction'. With this term, the economist explained how old paradigms are constantly replaced by new ones. At the time, Schumpeter's chapter offered a new, unique insight into how economies grow, explaining that economic progress is not gradual and peaceful, but rather disjointed and sometimes unpleasant. Schumpeter is also believed to have been the first scholar to introduce the concept of entrepreneurship. He coined the term 'entrepreneur-spirit', referring to individuals who control the economy by delivering innovation and technological change. Here, the concept of knowledge as a driver of the economy was introduced the first time, because knowledge was necessary to change and improve.

Figure 1: Joseph Alois Schumpeter. Source: *Volkswirtschaftliches Institut, Universität Freiburg, Freiburg im Breisgau, Germany*

Knowledge work and the knowledge worker

The idea of knowledge work and the knowledge worker, necessary for a knowledge economy, goes back to Peter Drucker and he invented the knowledge worker as a counterpart to the industrial worker. The knowledge worker does not perform manual labor but is a thinker instead. This has important consequences because compared to the industrial worker using the machines of the company, the knowledge worker owns the own means of production, i.e. the brain and knowledge. Nevertheless, also factors like the access to knowledge networks and information can be seen as means of production, which are not owned by the knowledge worker. This led to a dramatic change in economy, since knowledge replaced capital as the most critical asset in the knowledge economy.

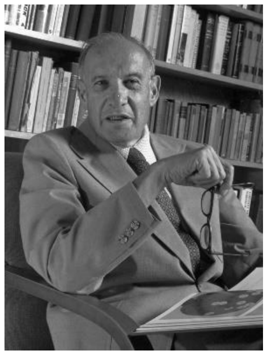


Figure 2: Peter Drucker. Source: *https://de.wikipedia.org/wiki/Peter_Drucker#/media/Datei:Drucker5789.jpg*

Knowledge workers are also referred to as white-collar workers, who are professionals, in contrast to the industrial blue-collar workers, who perform manual labor. Examples for knowledge workers can be found in technical areas, e.g. engineers, physicists, chemists, in the legal area, e.g. lawyers and patent attorneys, in finance, in medicine and in administrative roles.

Peter Drucker also introduced the first measures and methods to increase the productivity of the knowledge worker. The six steps to increase productivity introduced by Peter Drucker are:

- Identify what it is that workers do. What are their tasks?
- Give them autonomy. The knowledge workers' productivity must be their responsibility; they must manage themselves.
- Continuing innovation must be a part of every knowledge worker's job.
- Knowledge workers must continuously learn and continuously teach others.
- Productivity must be measured by quality of the out-put, not quantity.
- Knowledge workers must be treated like an asset, rather than a cost.

The three economic sectors

The economy can be described as set up by three different economic sectors. Those three sectors are agriculture, manufacturing, and services. They are also called the primary, secondary and tertiary sectors. Historically, and due to the industrial revolutions, the number of employees in the different sectors heavily shifted during the last century. In Figure 3 it can be seen for the United states of America, that the employment in the agriculture sector decreased very fast, while the number of employees in manufacturing stayed more or less stable in the last century and only decreased recently. The service sector with the knowledge workers is now the most prominent employer in the US like in most developed countries.

This change of shares in employment is often credited as deindustrialization, but this term blurs the effects of digital transformation. Here, the jobs in classical manufacturing industries are not lost, but the work is less often done by classical workers and instead knowledge workers are taking over that share. One practical example can be seen in the transformation of the farming industry. While in traditional farming the farmers only applied manual labor, they are now managing a fleet of smart and connected machines. Also, the manufacturers of farming machines are not only producing the heavy machinery, but they are increasingly switching to measuring and analyzing the farming data with their machines to assist the farmers in their management practice. They are also setting up digital service platforms for the framers and so they are becoming service providers. So, there is not really a shift happening between industries, but the type of work done in an industry changes. How digital farming becomes a success story with a proper IP protection can be read in the case study Claas (see Additional material).

Measures of the knowledge economy

The measurement of the change towards a knowledge economy is complicated, since knowledge cannot be quantified as easy as capital. Next to the number of employees in knowledge intensive jobs, also the R&D expenses and patent activities can be used as a measure for the state of the knowledge economy. The expenses into R&D and the patent activities surged in the last decades worldwide (see Figure 4). The role of IP in the knowledge

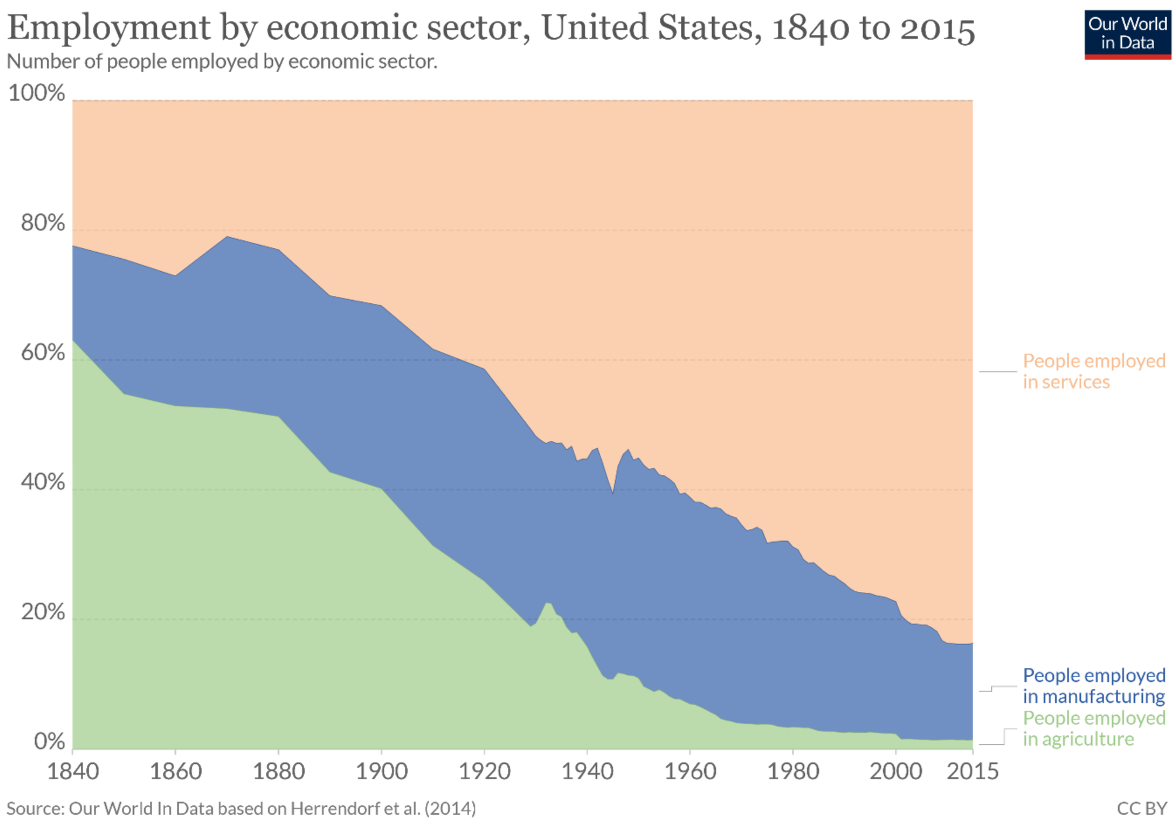


Figure 3: Distribution of employed people per economic sector in the USA from 1840 to 2015. Source: *Our World in Data, Herrendorf et al. (2014), https://ourworldindata.org/structural-transformation-and-deindustrialization-evidence-from-todays-rich-countries*

economy is that IP is an intangible asset for the company and a form of property in the knowledge economy. Therefore, it can be used as a tool for the creation of competitive advantages by its nature as a prohibitive right.

Immaterial and/or intangible assets such as IP are defined by the fact that they are of non-material and non-financial nature. They thus do not concern machines, production plants or factories and also not cash, treasury bills or liabilities. The quantification of those assets is increasingly important, since their share in the market value increased drastically in the last decades (see Figure 5) and only the correct knowledge about their size and quality in a company allows decisions about the investment into that company. This is determined by the future economic benefits of the IP which is owned by the company. The future economy benefit is derived from the nature of the IP as a prohibitive right and the associated economic use within an appropriation strategy. For example, in a value-added monopoly (see "Value-added monopoly" -> IP Strategy Development: Part 4 Chapter 3) the IP is used to protect single customer relevant features, which are creating a huge customer benefit.

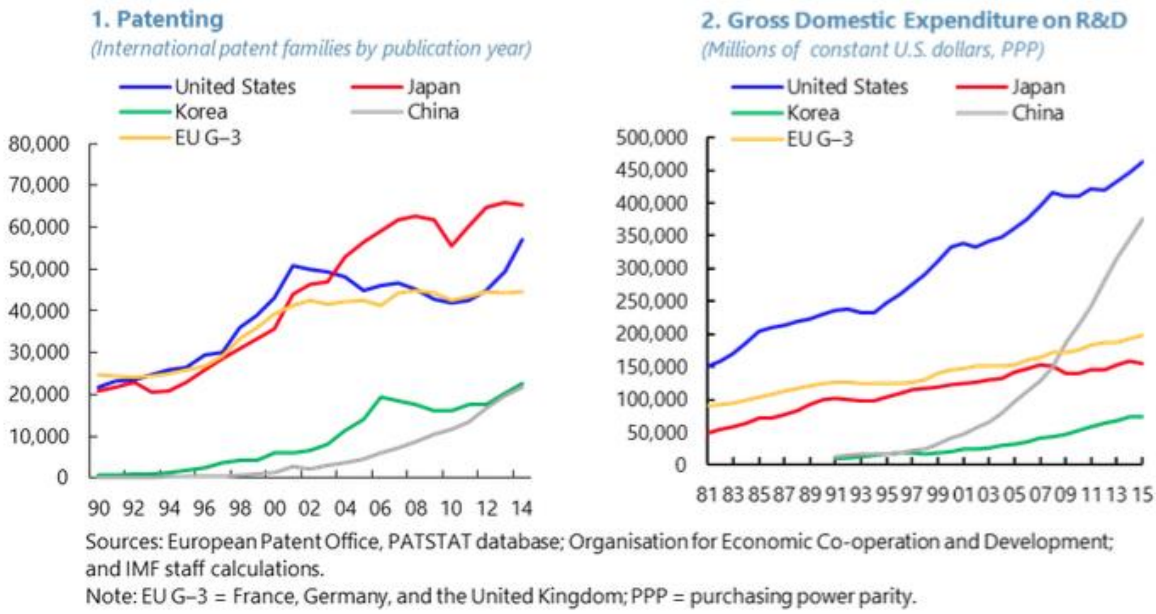


Figure 4: Growth of the number of international patent families (left) and gross domestic expenditures on R&D (right) in the USA, Japan, Korea, China and the EU between 1990 and 2014. Source: *https://voxeu.org/article/technology-diffusion-and-global-living-standards*

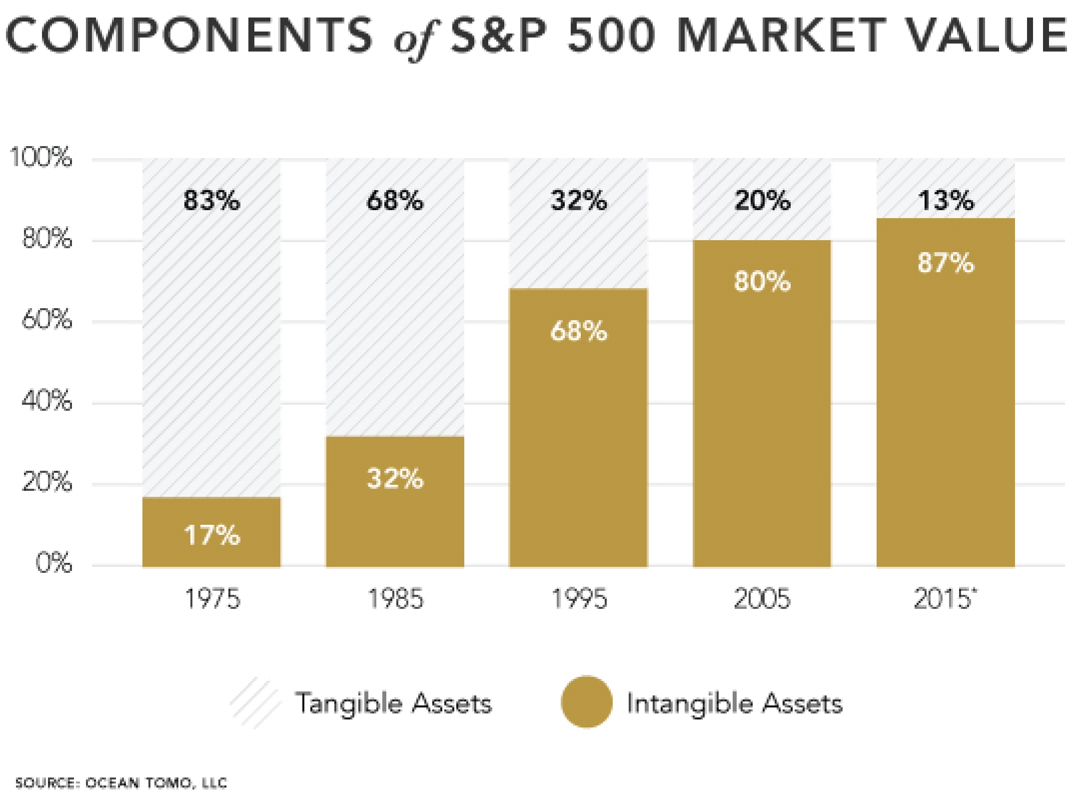


Figure 5: Share of tangible and intangible assets in the market value of S&P 500 companies over the last 40 years. Source: *OCEAN TOMO, LLC, Intangible asset market value study, 2017 (https://www.oceantomo.com/intangible-asset-market-value-study/)*

The 4 industrial revolutions

When the evolution of the economy is not analyzed from the role of a worker, but from the viewpoint of the change of production, we speak of the four industrial revolutions. This is why the latest change of production due to the digital transformation is also called industry 4.0. The first industrial revolution happened with the introduction of the steam engine (see Figure 6). Here, the first time industrial production could be mechanized which transformed the primarily agrarian societies to industrial societies. The next industrial revolution was based on the use of electricity. This made the use of power more flexible and enabled the construction of assembly lines, which finally made mass production possible. The third industrial revolution was then using information technology (IT), electronics and computerization for automatization. Today the 4th industrial revolution is about to happen. In the fourth industrial revolution the tools of computerization from the 3rd revolution become optimized in a disruptive speed, so that completely new ways of production become possible. This is enabled through the increased networking between computers, machines, and humans. Thereby, the speed of the transformation, the global size of the transforming networks and the impact on every part of society make this development more than a trend, but a new industrial revolution.

The economist Jeremy Rifkin identified three major components, which are needed to foster such an economic revolution. Those are new ways of communication, new sources of energy and new modes of mobility. An example he made for the first industrial revolution was the use of telegraphs and steam-powered printing to transfer information over longer distances and with higher edition. The use of coal to power the steam engines and the introduction of steam powered trains and ships to faster transport goods over land and sea.

In the 4th industrial revolution, the main driver of transformation comes from the new ways of communication due to the use of new information technologies and increasingly the role of communication networks between people, e.g. social media, but also human machine communication, e.g. through voice recognition. But also the change of energy use with renewable energies and more efficient energy use through digital technology is a driver as well as the developments in new mobility with the use of drones and smart mobility with a more connected, energy efficient and cheap way of transportation.

The three dimensions of the digital transformation

That the digital transformation is not just a trend, but a new industrial revolution can be seen by the three dimensions of the digital transformation. The digital transformation is:

- Happening with a high speed
- Happening in global networks and
- Happening in every industry

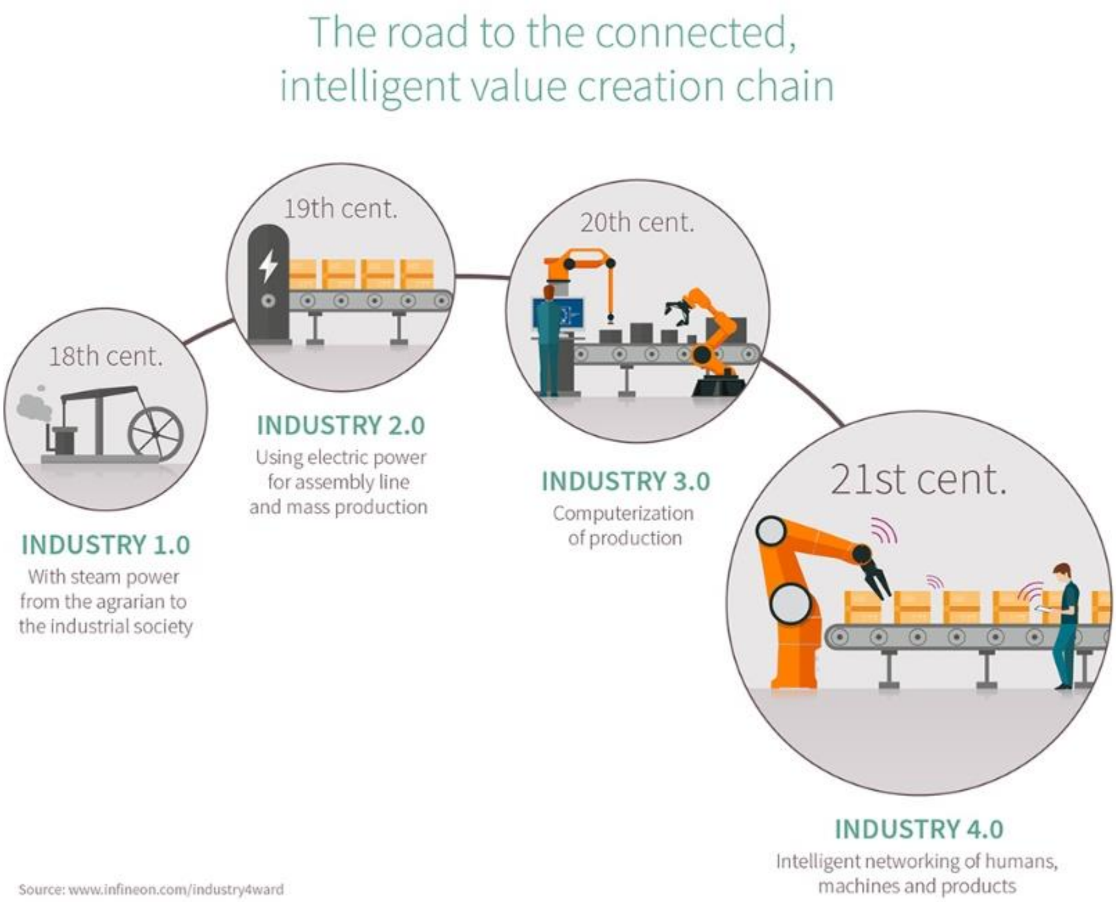


Figure 6: The road to industry 4.0. Source: *https://www.infineon.com/cms/en/discoveries/industrie-4.0-smart-factory/*

The high speed of the digital transformation can be seen for example with the high adoption rates of modern technologies (see Figure 7). The adoption of technologies like telephones, cars, and the radio in the last century took still 30 to 60 years. The adoption of mobile phones took about 20 years and the adoption of smart phones reached more than two third market share in less than a decade. This forces businesses to react also very fast on the new developments.

The digital transformation happens ubiquitous through new digital networks and increased connectivity which is powered by the ever-increasing number of digital devices (see Figure 8). The use of digital sensors on machines and the use of the computational powers of cloud computing made it possible, that the so-called internet of things emerged. The internet of things allows that not only the machine, but also the machine environment can be digitalized and activities like performance improvement and predictive maintenance can be handled with digital technology. This creates a challenge for traditional businesses which are threatened by software companies to be degraded to equipment providers when they do not digitalize themselves.

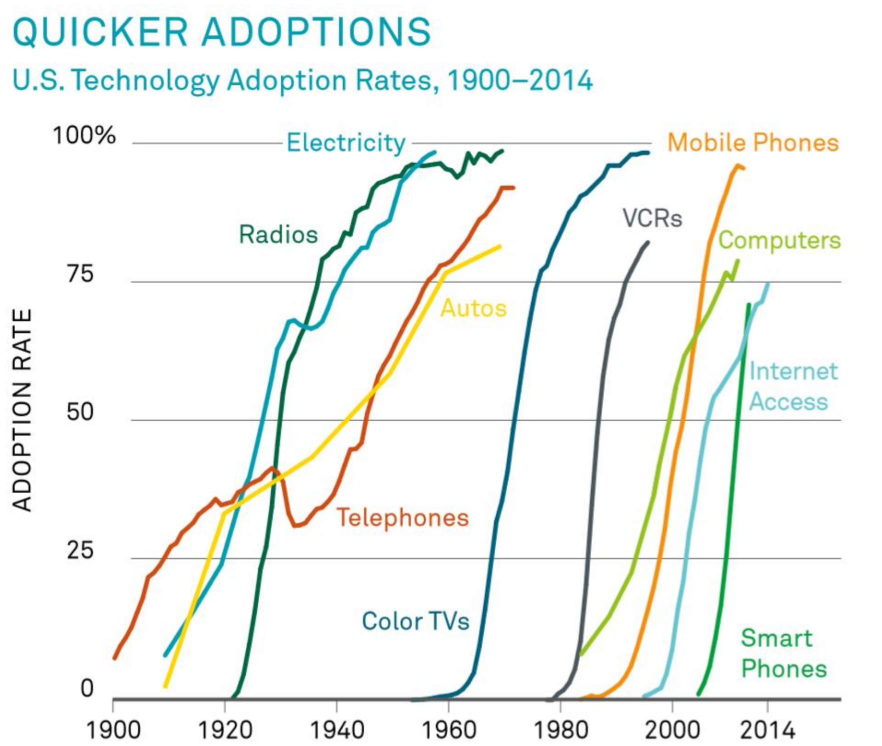


Figure 7: Technology adoption rates of various technologies in the USA. Source: *Interpreting Innovation, Impact on Productivity, Inflation & Investing, Blackrock Investment institute, Blackrock (2014)*

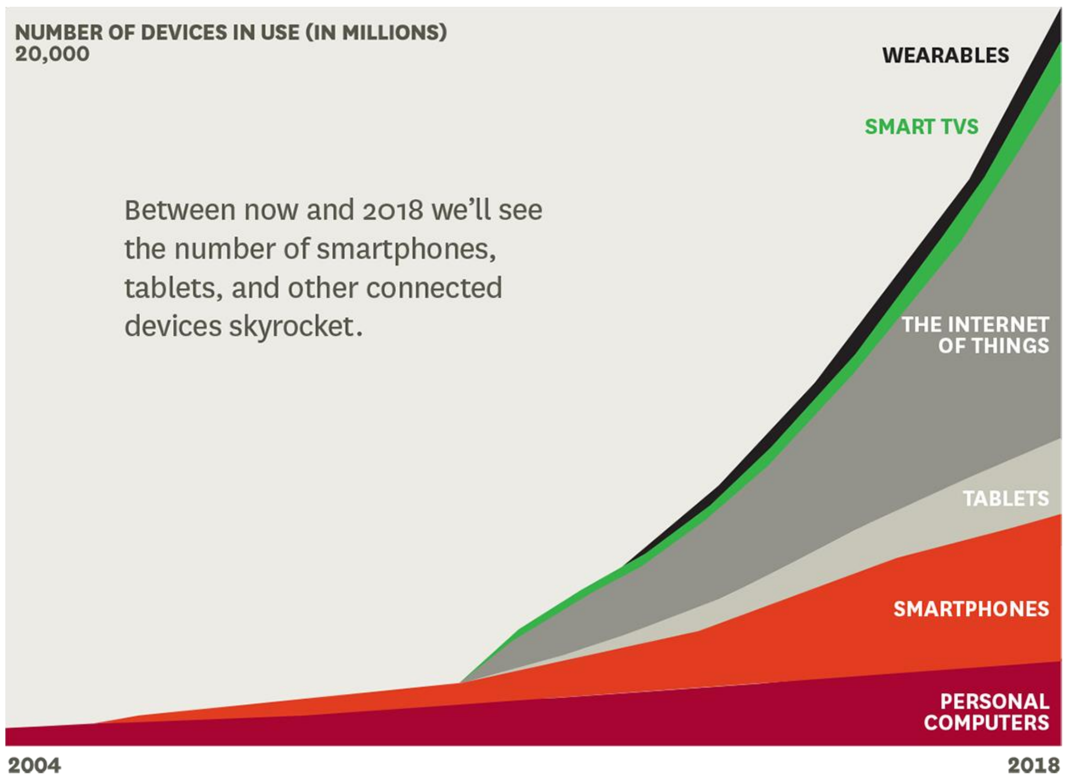


Figure 8: Number of devices in use between 2004 and 2018. Source: *BI Intelligence estimates based on data from Gartner Research, IDC, Strategy Analytics, Machina Research, and others; Harvard business review: https://hbr.org/2014/11/digital-ubiquity-how-connections-sensors-and-data-are-revolutionizing-business*

Finally, a characteristic of the digital transformation is that it happens in every industry due to the network effects and the internet of things. The influence is not the same in every industry, which can be seen in Figure 9, but some part of each industry is fundamentally transformed through digitalization. A result of this is also the creation of eco-systems, where the value chain in an industry is digitally transformed and new ways of value creation and new competition arise. Therefore, every industry is forced to react to these new competitors.

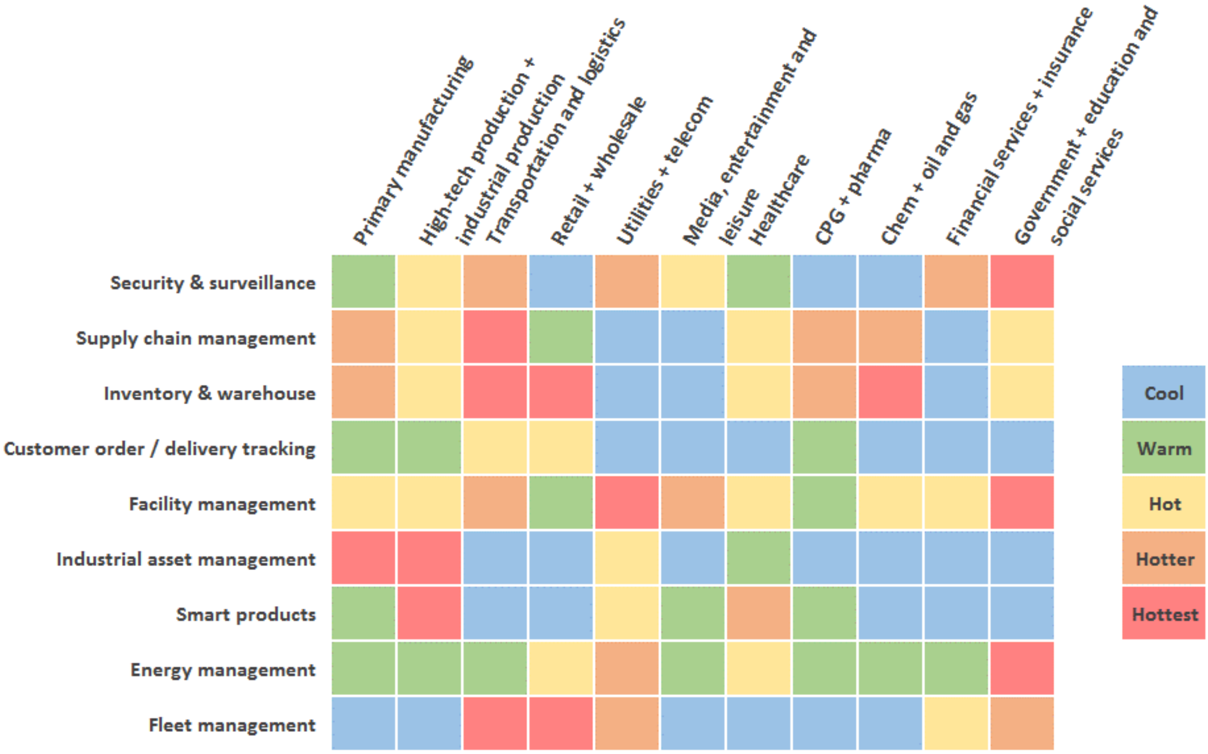


Figure 9: Technology heatmap for the internet of things. Source: *Forrester Report, The Internet of Things Heat Map, 2017*

Chapter 2 | Technologies of the digital transformation

The role of technology in industry 4.0

Often the question arises if digital transformation is a trend or an industrial revolution. To answer this the role of technologies in digital transformation can be analyzed. In an industrial revolution technology always enables the change of production. This was for example true for the mechanization of industry by the steam engine and the use of assembly lines once electricity became widely available. Also, in digital transformation and industry 4.0 this effect of enabling technologies on the production can be observed, so that digital transformation can be seen as an industrial revolution under this aspect. Some examples for typical enabling technologies can be seen in Figure 10 but there is no consensus, yet which technologies should be counted as enabling technologies for digital transformation.

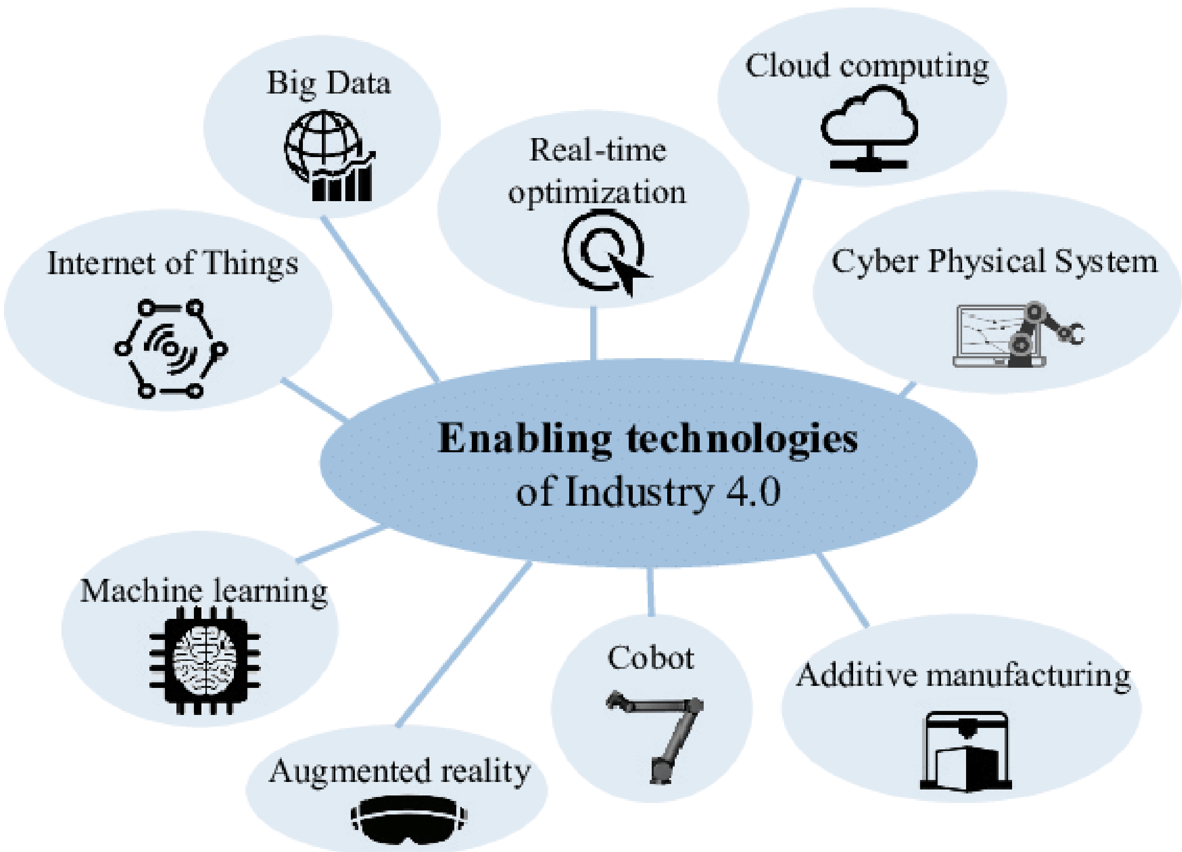


Figure 10: Enabling technologies of industry 4.0. Source: *Bortolini, Marco & Ferrari, Emilio & Gamberi, Mauro & Pilati, Francesco & Faccio, Maurizio. (2017). Assembly system design in the Industry 4.0 era: a general framework. IFAC-PapersOnLine. 50. 5700-5705. 10.1016/j.ifacol.2017.08.1121.*

Enabling or general-purpose technologies are inventions and innovations that have the potential to enhance existing technology and strongly increase the performance and capabilities. This has a huge impact for the users, since applications become suddenly available, which were not thinkable before. Those technologies are often able to change dramatically social and economic structures.

Following this logical of enabling technologies another important aspect is that the digital transformation is not about the technology, which is enabling it, but the use of digital technology to transform the business. Therefore, a digital strategy is needed to define which technologies should be used, instead of starting with the technology to be implemented. This is a typical mistake many businesses make because they know of the importance of the digital transformation and hurry with the implementation of a single digital technology. So, typically this leads to an implementation of digital technology in a traditional business model, which is also called digitalization (see Figure 11). Digital transformation nevertheless creates completely new business models which are enabled through the new technology (see "Digitalization of services and products" -> Integrated IP and innovation management: Part 3 Chapter 6). Here, also IP plays an important role in the protection of the new business models.

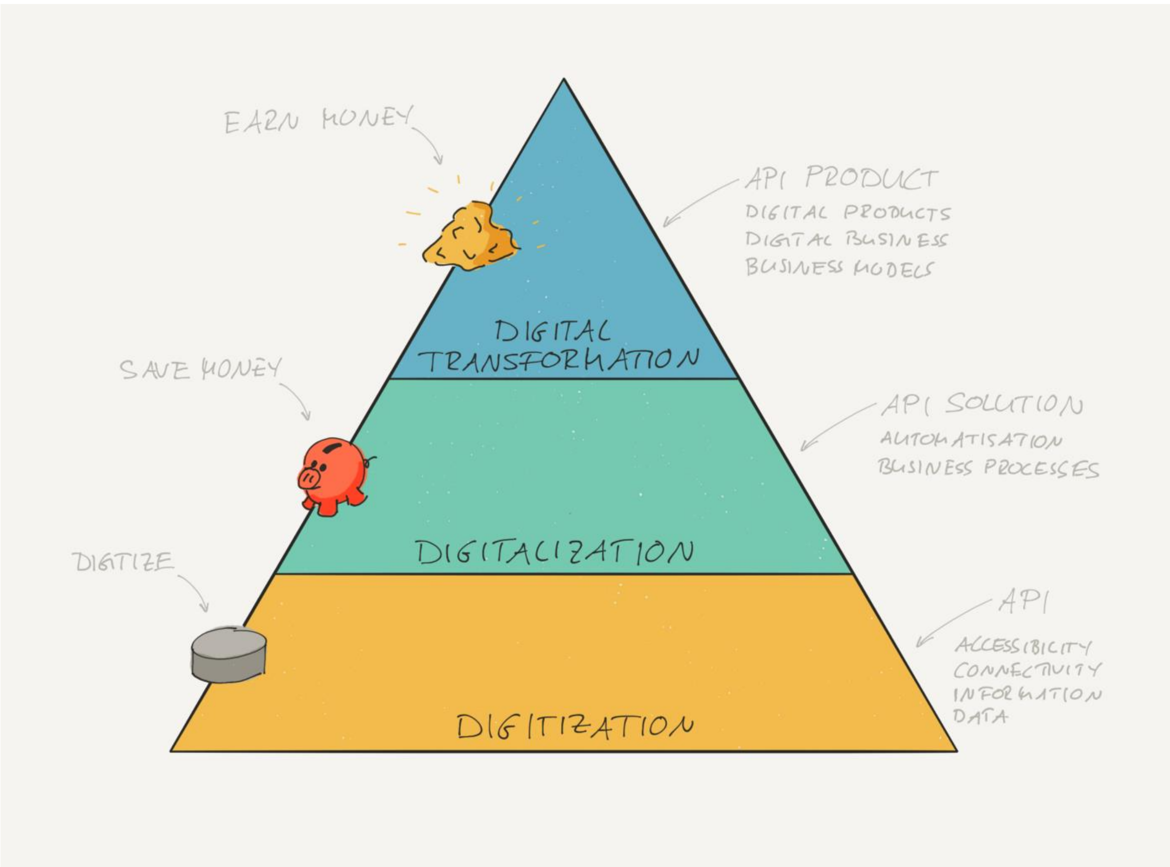


Figure 11: Digitization, digitalization, and digital transformation. Source: *https://medium.com/api-product-management/what-is-digital-transformation-digitalization-and-digitization-c76277ffbdd6*

As a summary, in the digital transformation the role of technology is not the role of the starting point of the transformation. Instead a digital strategy should be developed to identify how the goals of the business can be reached with the use of digital technology in new digital business models. Parallel to that an IP strategy must be developed to protect the new digital business model. Also, for IP the focus lies not on the technology per se, but on the role of IP within the digital business model to reach the defined goals. Examples for such digital business models and the role of IP within the business models are shown for some of the key enabling technologies of the digital transformation.

Augmented reality

Augmented reality describes technologies which add usually audiovisual signals, but also other sensory perceptible signals, to the real-world environment. This technology becomes more and more available, since also smartphones and smart glasses with good cameras are available on the market, so that computer generated images can easily be added to the filmed real-world environment. Here, the augmentation can have many degrees and cover only the visual world or also other senses. For example, full visual augmentation can be achieved with virtual reality glasses, where the wearer is fully immersed into a virtual reality, or it can be achieved to a smaller degree with the addition of filters to a video or picture like it is possible in many social media apps.

One example for the implementation of augmented reality in business processes is the quality control process. This is done by Renault Trucks with the Microsoft HoloLens. Here, the reality is not only augmented, but the user can also interact with the computer-generated elements (see Figure 12). So, the quality control process can be performed paperless and the employees still have all relevant information at their hand.

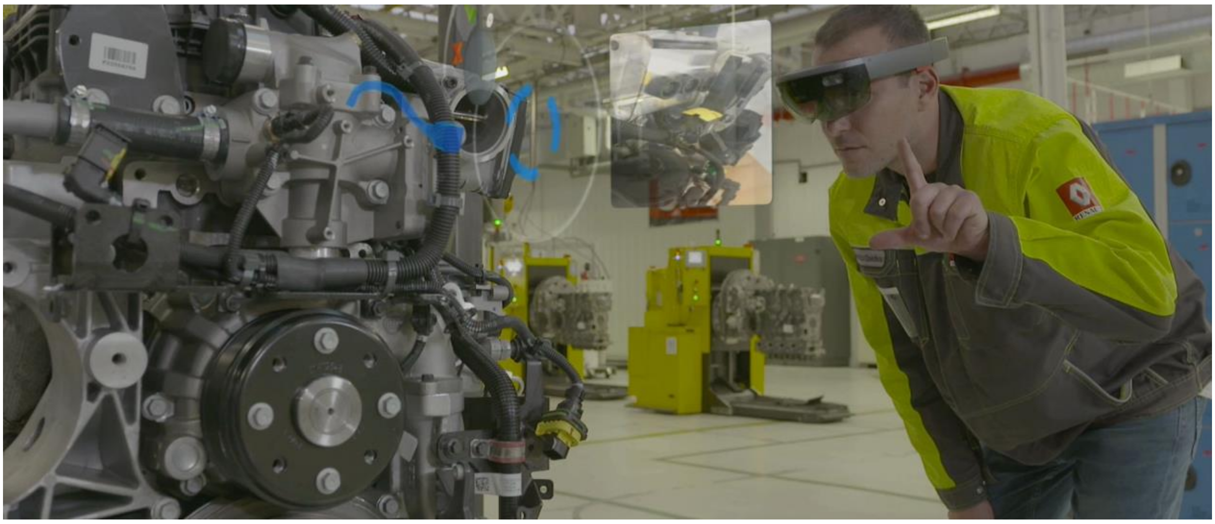


Figure 12: French manufacturer Renault Trucks is looking to the HoloLens to improve quality control processes with its engine assembly operations. Source: *https://corporate.renault-trucks.com/media/image/CP-jpg/immersion_renaulttrucks_hololens02.jpg*

Another application is the improvement of the sales process in the stairlift business of ThyssenKrupp. Also, here the HoloLens technology by Microsoft helped to digitalize the sales process and to improve efficiency and the customer experience. From the first on-site visit at the buyer's home to the installation of a stairlift it took over two months but with the new sales process this time could be reduced to two weeks. HoloLinc shortens the delivery time because the salesperson can measure the entire stairwell with the augmented reality glasses on-site with just one visit and make the homeowner an offer. They can even use the on-site data to calculate the optimal stairlift solution and visualize it on a tablet when the salesperson is at the customer's home (see Figure 13).

Figure 13: Planning of a staircase with the HoloLinc. Source: *https://engineered.thyssenkrupp.com/en/hololinc-the-mixed-reality-revolution-on-the-staircase/*

AI and machine learning

Artificial intelligence (AI) and machine learning as well as deep learning are often confused and used as synonyms (see Figure 14). Nevertheless, they mean completely different things. Artificial intelligence itself is not a single method or approach, but a category to cover all methods by which a computer can solve problems on its own. Here, also strong, and weak AI can be distinguished. Strong AI is seen as an intelligence comparable to the human intelligence, while weak AI is used to solve single problems autonomously.

Machine learning in contrast is a method within AI. Here, a machine is taught a method, so that it can learn on its own. This is done with training datasets, which consist of input and output values, that should be correctly combined by the algorithm. Based on these learning data sets the algorithm is iteratively optimized. When the algorithm is capable to constantly improve the accuracy of predicting the right output, the algorithm learns on itself and can also be applied to other datasets.

Deep learning is a method within the toolbox of machine learning methods. Here, neural networks, which are inspired by the human brain, are trained with data. In a neural network multiple hidden layers of neurons are positioned between the input and the output. Those neurons have weighted connections between each other, where the weight defines the signal transmission to the next neuron of the next layer. The weights can be changed depending on the positive or negative outcome of the found solutions.

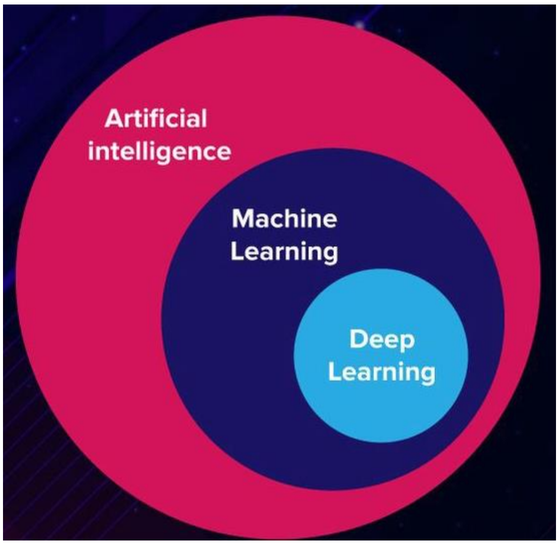
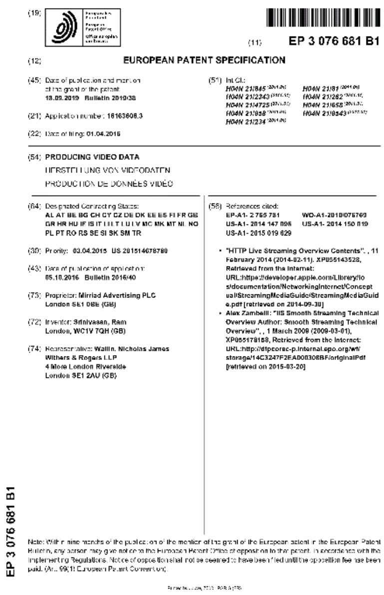


Figure 14: The three levels of AI, machine learning and deep learning. Source: *https://medium.com/ai-in-plain-english/artificial-intelligence-vs-machine-learning-vs-deep-learning-whats-the-difference-dccce18efe7f*

A practical example for the application of AI in a business model and also the use of IP within a business model are streaming platforms. Within the new logics of digital transformation streaming services try to make use of the data of the buying behavior of the streamers to introduce targeted advertisement personalized for the individual streamers. Therefore, in 2019 the Chinese tech-company Tencent started a partnership with the British AI and product placement experts of Mirriad.

Mirriad is capable of digital product placement, where the product placement is subsequently inserted into the original content using digital technology, compared to traditional product placement, which had to happen during the shooting of the movie. This has many advantages over the old method:

- The product placement can be integrated without the usual time and organizational pressure, since the product is not integrated directly on the set and the integration does not need to be synchronized with the usual film processes.
- The artistic creation process is not disturbed. The director and the actors do not have to adjust to the product during the actual production and can fully devote themselves to the film.
- The product placement can be controlled in detail. While the design of the placement is influenced by many people in the classic case and rarely can be planned perfectly beforehand, you have full control when you edit it later.
- The product placement can be removed, updated, and customized at any time analogous to today's search engine marketing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(11) EP 3 076 681 B1
(12) EUROPEAN PATENT SPECIFICATION
(45) Date of publication and mention of the grant of the patent: 18.09.2019 Bulletin 2019/38
(21) Application number: 16163606.3
(22) Date of filing: 01.04.2016
(51) Int Cl.: H04N 21/845; H04N 21/2343; H04N 21/4725; H04N 21/858; H04N 21/234; H04N 21/81; H04N 21/262; H04N 21/658; H04N 21/8543
(54) PRODUCING VIDEO DATA
HERSTELLUNG VON VIDEODATEN
PRODUCTION DE DONNÉES VIDÉO
(84) Designated Contracting States: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
(30) Priority: 03.04.2015 US 201514678780
(43) Date of publication of application: 05.10.2016 Bulletin 2016/40
(73) Proprietor: Mirriad Advertising PLC London SE1 0BE (GB)
(72) Inventor: Srinivasan, Ram London, WC1V 7QH (GB)
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(56) References cited: EP-A1- 2 765 781; WO-A1-2010/076769; US-A1- 2014 147 096; US-A1- 2014 150 019; US-A1- 2015 019 629
- "HTTP Live Streaming Overview Contents", , 11 February 2014 (2014-02-11), XP055143528, Retrieved from the Internet: URL:https://developer.apple.com/Library/ios/documentation/NetworkingInternet/Conceptual/StreamingMediaGuide/StreamingMediaGuide.pdf [retrieved on 2014-09-30]
- Alex Zambelli: "IIS Smooth Streaming Technical Overview Author: Smooth Streaming Technical Overview", , 1 March 2009 (2009-03-01), XP055178158, Retrieved from the Internet: URL:http://dtpcorec-p.internal.epo.org/wf/storage/14C3247F2EA000308BF/originalPdf [retrieved on 2015-03-20]

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
EP 3 076 681 B1

Figure 15: European patent EP 3076681 B1 Producing Video Data. Source: *https://worldwide.espacenet.com/patent/search?q=pn%3DEP3076681B1*

The cooperation between Tencent and Mirriad is especially powerful, since Mirriad has a very good strategically filed patent portfolio. An example can be seen in the European patent EP 3076681 B1 Producing Video Data (see Figure 15).

Cyber physical Systems

Cyber-Physical Systems (CPS) are systems of collaborating computational entities which are in intensive connection with the surrounding physical world and its ongoing processes, providing and using, at the same time, data-accessing and data processing services available on the internet. So, CPS are systems combined of information and software components on the one hand and mechanical and electronic components on the other hand. Through the increased connectivity of the digital transformation and the combination of components the machines become able to communicate with each other, so that for example the manufacturing process can become more and more autonomous. The special emphasis in CPS lies within the strong connection and the interactions between the physical and the virtual components. This point is less important in an embedded system, where e.g.

microprocessors are only integrated into a bigger mechanical and electrical system to control a specific machine operation.

A practical example how to use IP to effectively protect a digital business model using CPS can be found at the switchgear manufacturer Rittal (see Additional Material). In order to protect digital business models, it is necessary to identify those components which must be protected against imitation, as well as those components which are of particular importance for a company's market position, and therefore enable and merit protection. Here, the entire CPS is analyzed along the value chain in order to precisely extract the decisive positions at which it is important to develop proprietary exclusivity positions for the implementation of a digital business model (see Figure 16). These analyses provide indications of points at which non-trivial technological challenges and solutions can be found which form the basis for the subsequent elaboration of the company's own exclusivity positions derived from patents.

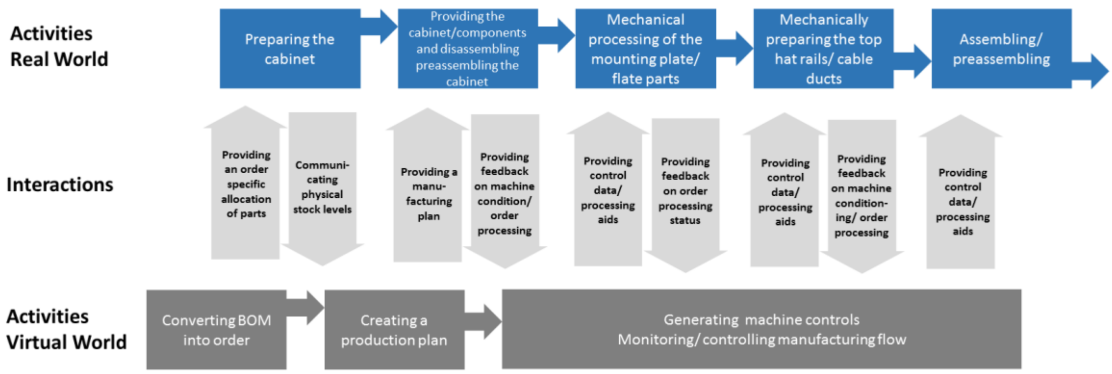

Figure 16: The real and virtual elements with their interactions in a cyber-physical system. Source: *MIPLM case study Rittal.*

Apps

App is the abbreviation of application software. This type of software can be distinguished from the system software of the operating system. This system software keeps the computer, tablet or smartphone running, while the application software in contrast adds a very specific functionality for the end user. Therefore, a wide range of apps for different purposes and different devices is available in the app stores. There is also a differentiation between web apps and native apps. Native apps are run directly on a device like traditional software, while web apps are run online and are not dependent on the system compatibility with the device running the web app. The character of an app to create a very specific functionality and customer benefit to the end user is also very important from an IP perspective. Here, IP needs to be filed based on the needed customer benefit and functionality not only the technology.

A practical example of the combination of an app with a water station can be seen at LUQEL (see Additional Material). LUQEL developed a water station for filtering and mineralizing individualized water without the use of plastic and integrated an app as a first touchpoint with the user (see Figure 17). Typical use cases are to remind the user to stay hydrated, to test the water quality and to create individual water recipes for the user, which will be handled by the water station.

Figure 17: Structure of the LUQEL eco-system consisting of an app, a smart bottle and the water machine. Source: *MIPLM industry case study LUQEL*

The systematic use of IP design as a management tool helped LUQEL to evaluate and develop their business model options in all their digital complexity. Especially the combination of well-established, consistent thinking in terms of customer benefits with digital potentials and their protectable technological implementations of apps and system architectures helped LUQEL to identify and protect viable future-proof strategies. The tool-based IP design methodology supported the strategic goal of operational excellence, including the digitalization of internal processes.

Another IP protected smart home case, where an app was used to digitalize a traditional business, is the digitalization of the showering experience by Hansgrohe (see Additional Material). They analyzed the showering behavior of different people and identified showering personas, like the indulgence showerer, the grooming showerer, the quick showerer, etc. To fulfill those individual customer needs, Hansgrohe brought the RainTunes showering system to the market, which is capable to individualize the showering experience with additional sound, lighting, and fragrance. RainTunes is controlled by an app, which offers the user a multitude of showering scenarios, created for typical situations like the morning shower, the wellness shower, and the good night shower. Like in the LUQEL case, IP design was used in the development of RainTunes to digitalize the showering experience and to make the digital business model exclusive.

Blockchain

The blockchain technology was invented by a person operating under the pseudonym "Satoshi Nakamoto" to make especially financial transactions more transparent. In the financial field the blockchain technology works mainly as a public ledger, where all transactions are transparently listed. In general, the blockchain technology describes public decentralized databases. The single entries of those databases or ledgers are called blocks and are cryptographically connected with each other to from a chain, the block chain. This makes it impossible to manipulate an individual block in the blockchain without changing the later blocks. This helps to increase the transaction security and transparency.

A practical and IP protected blockchain solution are the "CryptoKicks" by Nike. Nike, the sports footwear, apparel, equipment, and accessories manufacturer, patented in 2019 the "CryptoKicks" to track counterfeits of its products. The patent US 10505726 B1 (see Figure 18) outlines a system where blockchain is used to attach cryptographically secured digital assets to a physical product. In the case of Nike this is e.g. a sports shoe. The patent describes a platform which is used to track ownership and verify the authenticity of products like sneakers using the blockchain-based technology. When a customer buys a pair of the "CryptoKicks", they will also receive a digital asset attached to a unique identifier of that shoes. As a result, there is digital scarcity of the digital assets, because their production is effectively tied to the production of real and original sneakers. When sneakers are sold to someone else, ownership can be transferred by trading both real shoe and/or associated digital assets. These digital assets can be stored in what is called a "Digital Locker", an app similar to a cryptocurrency wallet.

FIG. 7

Figure 18: Patent US 10505726 B1. Source: *https://patents.google.com/patent/US10505726B1/en?oq=patent+US+10%2c505%2c726+B1+*

Cloud computing

Cloud computing describes services, where computing power, data storage or other IT resources are provided remotely through the internet on demand. So, the IT resources are not needed locally and a company using cloud computing services can focus on their core business instead of running the IT. This is typically saving costs and increases the productivity. In practice there are three main service models (see Figure 19):

- SaaS: Software as a service
- PaaS: Platform as a service
- IaaS: Infrastructure as a service

In the software as a service model application software is licensed to the customers on demand, while the application itself runs in the cloud on the provider's infrastructure. The customers can then use the software for a limited time on any device. Examples for SaaS cover many applications ranging from on demand gaming to the office software included in Microsoft Office's 365. SaaS has the end customer at the target.

The platform as a service model focusses on developers. Here, not a software is provided to the customer, but a platform to develop software. So, the resources, i.e. operating systems and data storage etc., are provided to the developer, who would traditionally develop everything on a stationary computer.

Finally, infrastructure as a service models are providing fully virtualized platforms. Here, the consumer has the control over operating systems, storage, and applications in the cloud infrastructure. Therefore, the customer does not need to purchase the resources themself.

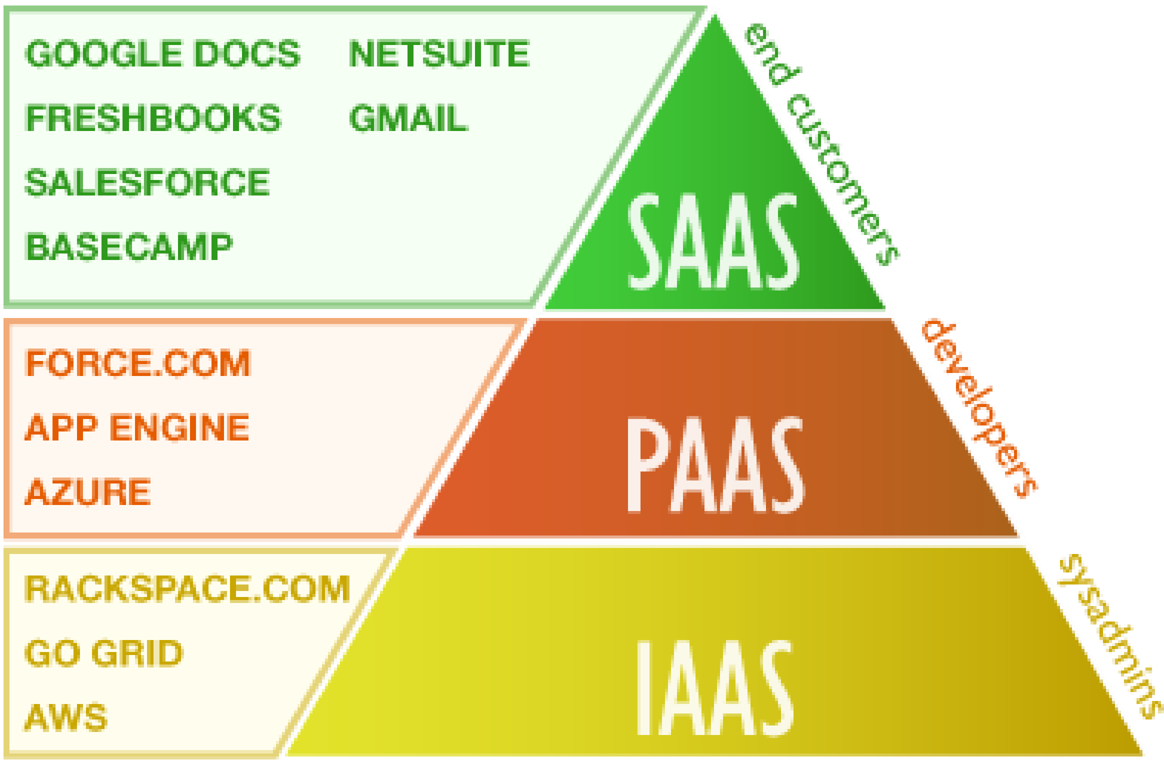

Figure 19: Service models of cloud computing. Source: *https://www.eztalks.com/cloud/types-of-cloud-services.html*

A successful cloud solution, which digitally transforms a whole business eco-system is DataConnect. In smart farming 365FarmNet, CLAAS and John Deere introduced with DataConnect the first direct industry-wide and manufacturer-independent cloud-to-cloud solution which overcomes one of the main issues in the Smart Farming eco-system, namely interoperability. Exchanging data via a common interface in real-time as well as controlling and monitoring the entire machinery fleet using their favorite system is the key requirement of farmers. DataConnect allows for the secure viewing and handling of these basic machine data elements, including current and historical machine location, current fuel tank level, working status and forward speed. For the future the transfer of additional relevant agricultural information is intended.

CLAAS, one of the leading agricultural machinery manufacturers started to rethink and adjust their corporate strategy in the early 2000s, while anticipating the dramatic change within the agricultural industry initiated by the emerging digitization. Through new business models and the integration of IP management, Claas has been able to gain a foothold in the field of digital farming and to prevail against the international competition. To advance the digitization of business models, Claas has not only built competencies in key enabling technologies such as electronics, software and telematics, but also changed its own IP-work from a reactive, R & D and inventions-oriented approach to an active IP-strategy aligned with the protection of new business models. This can be seen in the MIPLM case study Claas (see Additional Material).

Chapter 3 | The three driving forces: Moore's, Nielsen's, and Metcalfe's Law

Digital business transformation and its three driving forces

Digital business transformation is driven by the search for competitive advantages based on digital technologies. This phenomenon is not specific to a certain industry, sector, or technology. In fact, it is a ubiquitous experience across industries and sectors. According to data from 2017 (see Figure 9), there are several 'hotspots' of digital transformation, as well as others where the rate of change is slower, but an overall transformation based on digital technologies is taking place.

Three basic technology laws are explaining the impetus and momentum of the digital business transformation phenomenon. Those are Moore's, Nielsen's, and Metcalfe's Law.

Moore's law

The first technology law is the so-called Moore's law, formulated by Gordon Moore (see Figure 20), CEO of chip manufacturing company Intel in the early 1970s. It holds that the processing power of a microchip doubles every 18 months, with the consequence that computers become faster exponentially, and the price of a given level of computing power halves every 18 months (see Figure 21). As a result, one modern smartphone has more computing power than all of NASA's computing technology combined during the Apollo moon mission in 1969. The exponential character of computer chip development has also led to the current iPhone being more powerful than IBM's 1997 Deep Blue supercomputer which beat Garry Kasparov in a historic chess showdown.


Figure 20: Gordon Moore. Source: *https://de.wikipedia.org/wiki/Gordon_Moore#/media/Datei:Gordon_Moore_ID2004_crop.jpg*

The economic implication of Moore's law is the strong increase of productivity due to the increase in processing power. But not only processing power is increased due to Moore's law. Many other laws for digital applications can be directly derived from Moore's law. For example, the costs of a pixel in digital cameras or on LCD and LED screens were plotted by Barry Hendy of Kodak, where he also found a consistent trend of exponential growth of pixels per dollar. The effects of this performance improvement are called scaling.

Nevertheless, the miniaturization of transistors which forms the basis of Moore's law will come to an end by physical limits. At some point the transistors will consist only of few atoms and miniaturizing beyond that point is impossible. The physical limitation is expected to be reached around the year 2025. Nevertheless, innovation in computer technology can further increase the speed of computation. One example is quantum computing.

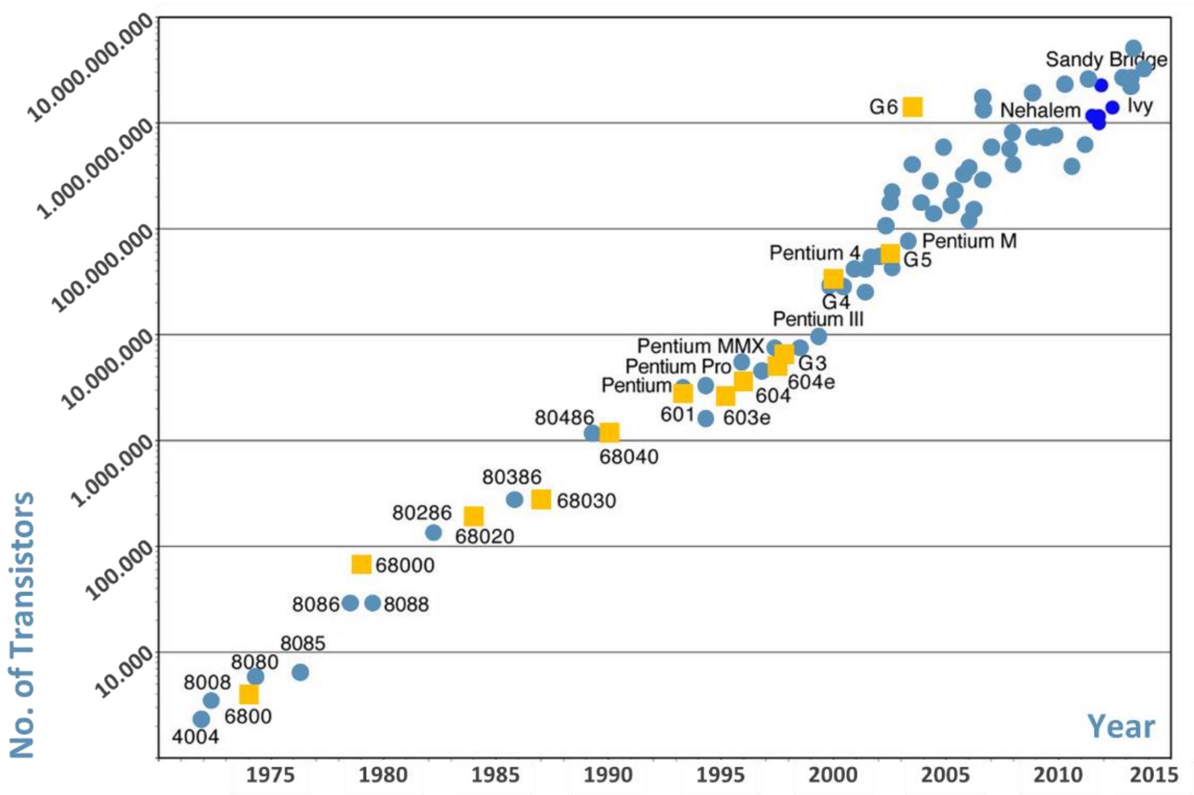

Figure 21: Moore's law claims that the number of transistors on microchips doubles every second year and the corresponding processing power doubles every 18 months.

Quantum computing

Quantum computing differs from traditional computing by the use of quantum phenomena like superposition. So, instead of using traditional bits, which can have only the binary 0 and 1 states, a quantum computer uses qubits, which can represent any superposition of those two states (see Figure 22). This makes some computations exponentially faster compared to traditional computing, because multiple calculations may be executed at the same time.

These features of quantum computers are especially useful in some areas, e.g. cryptography. Today most services on the internet are typically encrypted based on a public key cryptography. This type of cryptography makes use of the fact, that one can easily multiply two 300-digit prime numbers, but only with extremely huge computational power the resulting 600-digit number can again be split up into the two 300-digit prime numbers. This results in a mechanism which can encrypt messages fast and is very safe unless huge computational power is applied to decrypt the message. Nevertheless, there is an algorithm, called Shor's algorithm, which is capable to decrypt a message and through quantum computing the power needed to run the algorithm may now become available. This made research in so-called post quantum cryptography necessary. Post quantum cryptography develops new encryption mechanisms, which cannot be decrypted by the pure computational power of quantum computers.

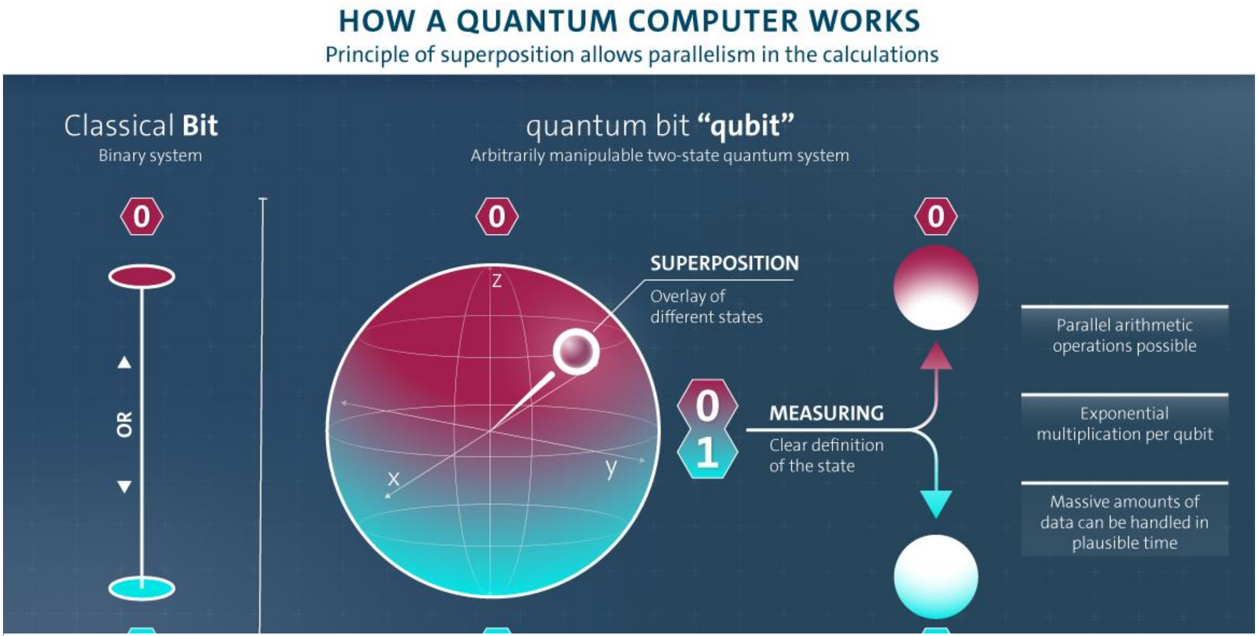

Figure 22: Comparison of the working principles of a classical computer and a quantum computer. Source: *https://www.volkswagenag.com/en/news/stories/2019/11/where-is-the-electron-and-how-many-of-them.html#*

Nielsen's law

The second technology law is the so-called Nielsen's law of broadband connectivity (see Figure 23). It holds that users' available bandwidth doubles every second year (see Figure 24). This also constitutes an exponential growth, albeit a slower one than that of computing power. Bandwidth grows by 50% a year and computing power by 60% a year. The user experience of the internet is therefore driven by bandwidth rather than computing power.

Figure 23: Jakob Nielsen. *https://www.nngroup.com/about/*

The slower growth in broadband connectivity can be explained by multiple factors. First, the investment in new bandwidth is more expensive compared to new computing hardware. New processors can easily be built into new computers, but for new bandwidth the infrastructure has to be built completely new, e.g. new optical fibers have to be laid in every street. Second, the customer benefit is not the same for computing power and bandwidth and customers are reluctant to invest. A computer with double processing power can really work with double the speed. But double connectivity does not mean, that there is double download speed. This also depends on the infrastructure and servers, from where people download files, so that the customer does not see the same improvement.

Similar to Nielsen's law is Butters' law of photonics. Gerald Butters claimed that the amount of data transmitted through optical fiber doubles every nine months per dollar. This became possible through the advancements in wavelength-division multiplexing technology (WDM), where multiple optical signals can be sent with different wavelength through the same

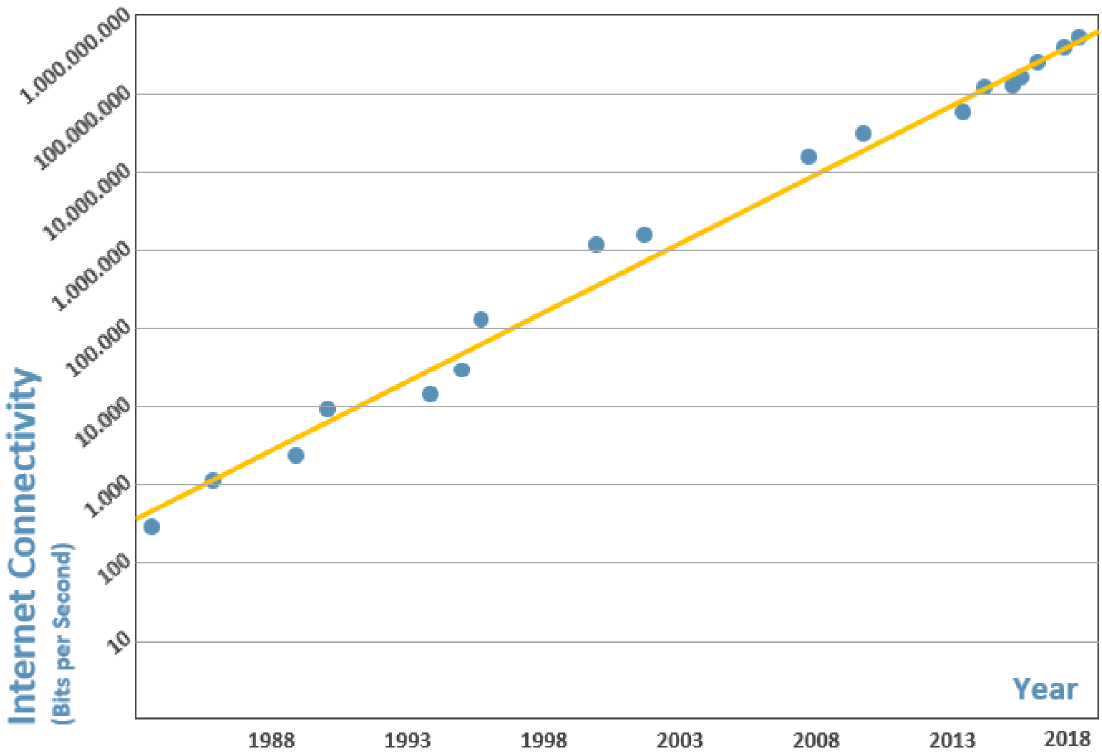

Figure 24: Nielsen's law claims that the internet connectivity doubles every second year.

optical fiber even in both directions. So, the increase in optical fibers grows with more than double the speed compared to broadband connectivity. Nevertheless, the access to optical fibers is still very limited.

Bandwidth is therefore still an issue, which digital companies must keep in mind. Especially when the business is not offering services like video streaming, for which high bandwidth is necessary, they should keep in mind, that most users have small bandwidths. This is also true since many users are accessing online content mobile from their smartphones at places with low mobile bandwidth. When such potential customers try to load a web application and it takes some time to load, they will not wait for it and are lost as customers. So, web applications should be designed in a way, that they load fast even for mobile users with low bandwidth (see Figure 26).

Figure 25: Robert Metcalfe. *https://en.wikipedia.org/wiki/Robert_Metcalfe#/media/File:Robert_Metcalfe_National_Medal*

Metcalfe's law

The third technology law, Metcalfe's law about the cost-benefit ratio in communication networks, is attributed to Robert Metcalfe (see Figure 25), the originator of the ethernet and founder of 3COM. This law suggests that the value of a network such as the Internet is proportional to the square of the number of nodes (see Figure 27). This means that, when a network grows, the value of being connected to it grows much faster, while the cost

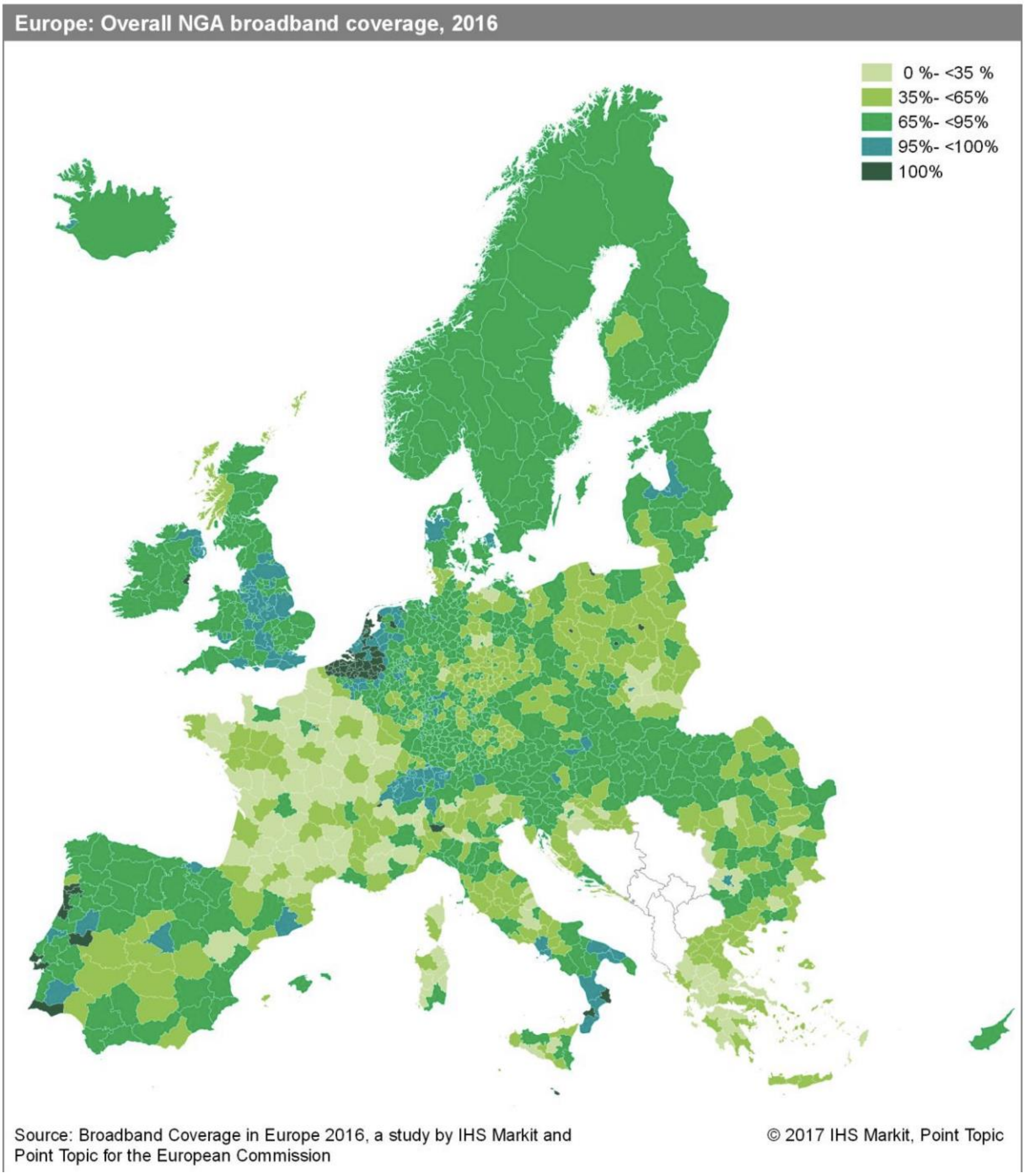

Figure 26: Broadband coverage in Europe. Source: *IHS Markit, Point Topic, http://point-topic.com/free-analysis/broadband-coverage-europe-superfast/*

per user remains the same or even reduces. In 2015 the effect of Metcalfe's law was confirmed with data from Facebook and Tencent, where the number of active monthly users (number of nodes) was compared with cost and revenue data based on the financial reports of both companies between 2004 and 2014.

A practical example of the monetarization of a network after it reached substantial size is the Skywise platform by Airbus. The Skywise data platform was launched in the summer of

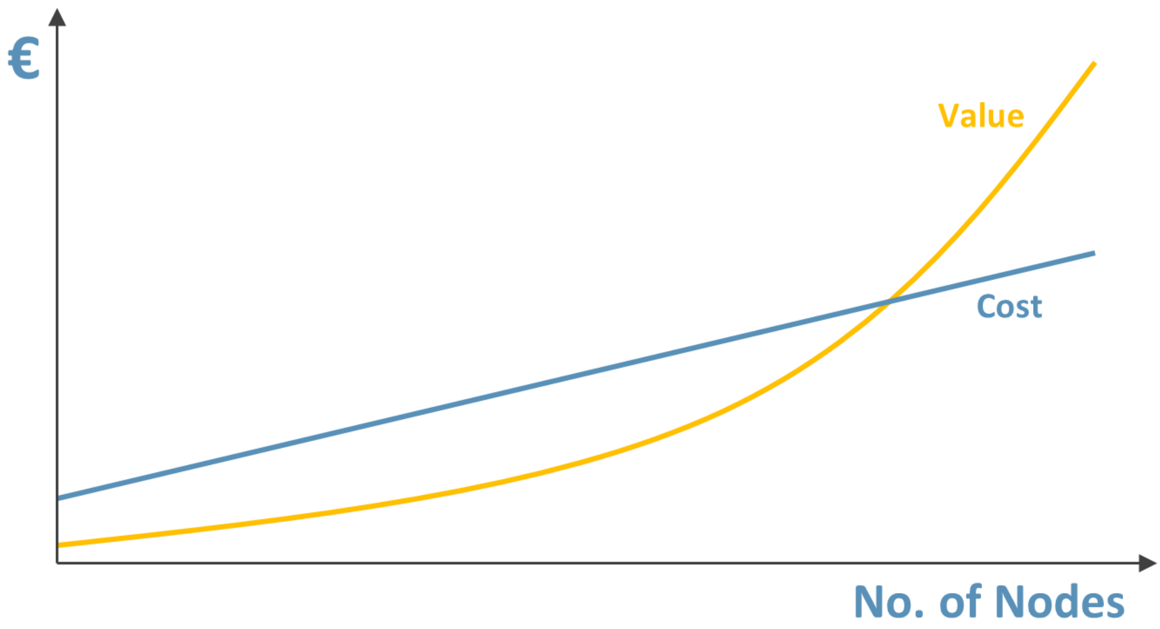

Figure 27: Metcalfe's law claims that the value of a network is proportional to the square of the number of Nodes.

2017 and collected millions of data during the operation of over 8,000 aircraft also from the competitor Boing. Skywise is a basis for developing, building, and operating new aircraft, and maintenance companies and suppliers are increasingly integrated into the platform (see Figure 28). So, Skywise has become the most important data hub for commercial aviation.

In 2019 the network became strong enough that Airbus wanted to monetize the data and its investments. Maintenance companies are expected to pay money for the access to the data from the data platform in the future. From Airbus' point of view, previous free services based on Airbus' intellectual property will have to be economically rewarded in the future. So, the network creates by its own growth now more profit, that the extension of the network costs.

These three technology laws by Moore, Nielsen and Metcalf are strongly interdependent and self-energizing. They are the central drivers of the digital economy.

Figure 28: Components of the Airbus Skywise platform. Source: *https://skywise.airbus.com/*

Chapter 4 | Network economy

Fundamentals of the network economy

A network economy is an economic system in which interaction between economic agents occurs in networks. A key attribute of the network economy is that products and services are created, and value is added through social networks operating on large or global scales. The network economy arises through digitalization within the knowledge economy.

The main drivers of the creation of the network economy are increased connectivity and computational power. Due to increased connectivity every person, but also every machine carrying a sensor can be connected with each other. This leads to the emergence of social networks, business networks and the internet of things (IoT) which is effectively a network of machines and devices. But also, data can be connected and transferred in networks due to the ever-available computing power.

Network externalities

The power of these networks stems from the network externalities which are arising with the growth of networks. Network externalities are effects which a product or service has on a user depending on the number of users of the same or compatible products and services. Positive network externalities are effects, where the utility of the product or service increases with the number of other users. One example can be the number of connections in a telecommunication network (see Figure 29), where the utility of the network grows fast for each user due to network externalities (see Figure, "Should I lead or follow?" -> Integrated IP and Innovation management: Part 4 Chapter 3).

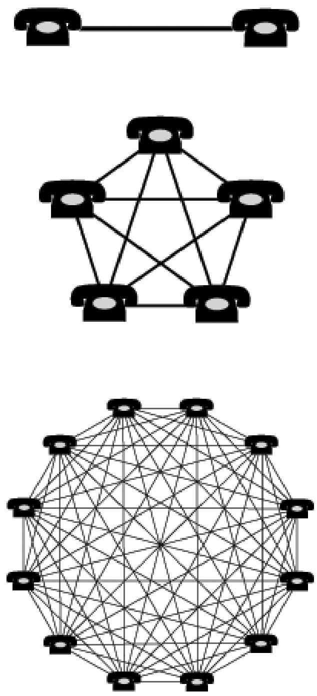
Figure 29: Network externalities in phone networks. Source: *https://de.wikipedia.org/wiki/Netzwerkeffekt#/media/Datei:Network_effect.png*

The positive network externalities are then directly leading to Metcalfe's law about the cost-benefit ratio in communication networks, which suggests that the value of a network such as the Internet is proportional to the square of the number of nodes. So, when a network grows, the value of being connected to it grows much faster compared to the cost per user, which remains the same or even reduces.

Intangible assets

Another important aspect of the network economy is the increased relevance of intangible assets and intangible economic goods. Immaterial or intangible economic goods are distinguished from material or tangible economic goods by the fact that they do not possess a material embodiment (see "Assets, intangible assets, intellectual capital and intellectual property" -> IP-Valuation I: Part 2 Chapter 1). E.g. software may not be equated with a data medium, a text not with a book, and IP may not be equated with the invention but must rather be carefully differentiated from it. Immaterial or intangible economic goods are distinguished from financial economic goods by the fact that they do not possess a direct financial embodiment and also cannot be transformed into liquid financial means directly through a conversion mechanism.

The economic behavior of intangible economic goods is characterized by scalability, non-rivalry in the use and irreversible costs (''sunken costs''). Scalability means, that a company is capable to increase its sales with an increase of resources. So, a company selling e.g. software as a Service (SaaS) can increase their sales without the need of physical infrastructure and low operating overhead. So, the company is able to grow without reducing the performance or efficiency.

Non-rivalry means, that a product or service can be consumed by multiple people without affecting the consumption of the product or service by each other people. So, when somebody uses an application software of a company every new customer of the company can also use the software without depleting the software. Or in other words there is no additional cost in selling the good to another marginal customer. A related aspect is that the costs for intangible assets are sunk costs, which means that the costs for the creation of the intangible assets cannot be recovered. So, compared to physical goods they cannot be sold to create some compensation value.

Types of networks

In a network economy, different types of networks exist and all of them have different impacts on businesses. Those networks are social networks, business networks, and the internet of things (IoT).

Social Networks

Social network sites are defined by Boyd and Ellison as web-based services that allow individuals to:

- construct a public or semi-public profile within a bounded system,
- articulate a list of other users with whom they share a connection, and
- view and traverse their list of connections and those made by others within the system.

The fundamental part of every social network site are the profiles of the individual users. Here, users describe who they are. The type of information depends on the social network site. So, on a professional business network like LinkedIn the personal information in a profile contains information such as expertise, professional affiliations, status, and geographic location. Social media profiles on sites like Facebook show more private information such as personal interests and recent activities of the user.

But the power of social network sites comes not only from the individual profiles but from the connection of the profiles. Here, every user has a personal network of contacts, which are also named friends or followers on the different platforms. Depending on the network and the privacy settings the list of these contacts may be seen by all other users of the network. Social network sites also enable users of the networks to interact with their list of connected users either per public or private messages. The explicit power of social network sites lies now in the feature that it is also possible to get the attention of the contacts of one's own contacts. This makes it possible to increase one's network specifically with contacts who already share a common list of contacts.

Historically, the development of social network sites started with bulletin board systems in the 1970s. In bulletin board systems users were able to up and download software and data and message other users on public message boards. That is why it was called bulletin board. By the time the bulletin boards were substituted by internet forums. Forums are web applications, where users are able to share content with each other. In the early 2000s the first modern social network sites were introduced with Friendster, MySpace and Facebook (see Figure 30). Since then the social network landscape became very diverse and sites with very different target groups were established. One example is Snapchat, where users can upload pictures and messages, which are deleted after a short time.

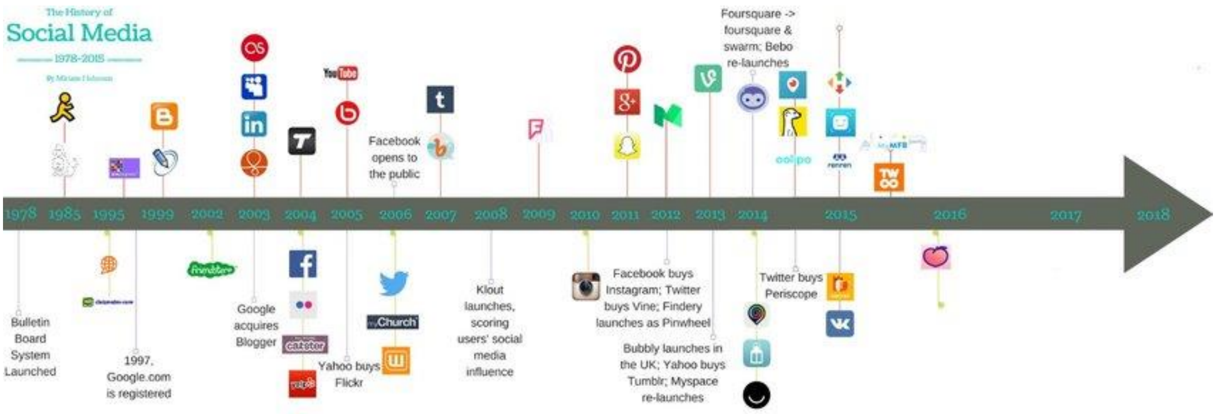

Figure 30: Timeline of the evolution of social media networks. Source: *https://www.booksaresocial.com/timeline-social-media-2017/#lightbox/0/*

Business models of social network sites

An important question is also how social network sites make profit and what are the business models they use. Social network sites are usually free to use and social network sites rarely try to make the users pay, since they just switch to another network. The loss of a network on a platform does in most cases not create a big enough lock-in effect to stop this switching to other services.

The main business model of social media sites is advertisement. For example, Facebook enables its users to connect, share, and communicate with each other in their News Feed. In this News Feed the stories of users but also advertisements are ranked by an algorithm and individualized for each user. So, advertisers can precisely target the audience based on age, sex, location, time, language, education, status and many more identifiers. They can also monitor and manage the advertisements themselves. This makes Facebook an extremely attractive advertising space and explains why 98% of Facebooks revenue comes from advertising.

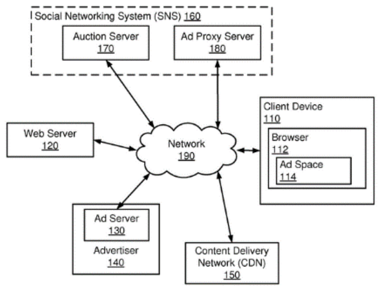

Figure 31: Patent EP2772881B1 (Providing advertisement content via an advertisement proxy server), Source: *https://worldwide.espacenet.com/patent/search?q=pn%3DEP2772881B1*

This digital business model of course only works thanks to a solid IP portfolio. One example is the patent EP2772881B1 (Providing advertisement content via an advertisement proxy server, see Figure 31). It describes how images and videos in advertisements are saved on an intermediate proxy server to reduce data leakage. This way, targeted advertising works more smoothly.

Business networks

Traditional networking and modern networking technology do not only enable networks between people but also between businesses. This is contradicting the traditional notion, that companies in the market are only competing with each other, but in reality, they are often cooperating. An example is the formation of consortia. A consortium is a group of multiple companies usually from the same industry. Reasons for the creation of consortia can be the high costs of development, e.g. in the aerospace industry, or the setting of an industry standard to create more trust into a new product. An example for that is the coopetition ("Standards and format wars" -> Integrated IP and Innovation management: Part 3 Chapter 4) between Sony and Philipps in the development of the CD player. Here, Sony contributed its patent protected error correction technology and Philips contributed its patent protected laser technology to a common patent pool. The result of this cooperation was that momentum among other players in the industry shifted toward the Sony-Philips alliances. The cooperation between Sony and Philips was important because it reduced confusion in the industry and allowed a single format to rise to the fore, which accelerated adoption of the technology (see Figure 32).

The increased cooperation between companies in cooperation networks can also be seen in the emergence of technology clusters. Clusters are defined as regions with a large concentration of companies from the same industry or industries linked through their value chain. So, for example also suppliers and producers of complementary products are located within a cluster. But not only the companies of an industry are located in a cluster. Also, universities and research institutions which educate and train the workers are located in the same clusters.

So, clusters give companies a competitive advantage, because they allow the members of the cluster to behave like a bigger common entity. The companies have access to a workforce and suppliers which they could not have attracted alone. The number and quality

Figure 32: The first commercially available CD player, Sony's CDP-101. Source: *https://www.nbcnews.com/tech/gadgets/30-years-ago-cd-started-digital-music-revolution-flna6167906*

of complementary businesses is higher, e.g. many technology companies need special machinery or clean rooms for operation, so they need local and readily available complementary companies, which provide them with the needed complementary technology and can also do maintenance work fast and in a high quality. Additionally, the famous name of a cluster can boost the marketing of a company's products, which is a similar effect observed in Champagne, which must come from France's Champagne region, resulting in premium prices. Finally, the first buyers of technology, the innovators, are also parts of the cluster and innovation can be accelerated due to the high interaction between potential customers and producers.

An example is the Italian leather industry cluster (see Figure 33). Here, the whole value chain in the leather industry is located within the cluster. This covers the producers of the raw leather material needed to produce high quality fashion, and the associated machinery. It covers the producers for special CAD systems needed to design leather footwear and also the producers of the machinery needed to form and model the leather shoes. Finally, also the producers of different types of leather footwear and leather belts, clothes, bags, and gloves are accumulated in this cluster which all lead to synergies in the industry. Also, synergies with the non-leather fashion industry can be observed.

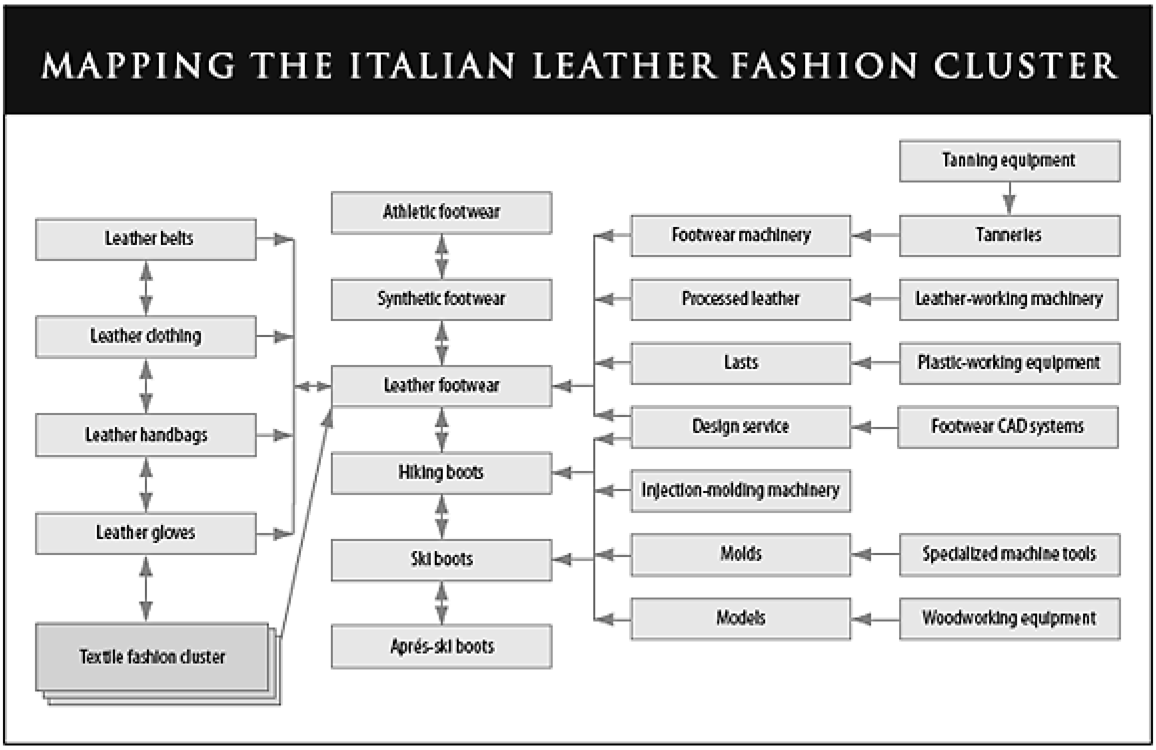

Figure 33: The Italian leather fashion cluster. Source: *Michael E. Porter, https://hbr.org/1998/11/clusters-and-the-new-economics-of-competition*

Another example for more digital industries can be seen in the Silicon Valley in California. The roots of the Silicon Valley can be traced back to mainly one company named Fairchild Semiconductor. One of its cofounders was Robert Norton Noyce who in 1959 was the inventor of the first monolithic integrated circuit which are fabricated with the use of silicon. This gave the Silicon Valley its name. At this time, the cluster was born by multiple factors. First, Stanford University actively started a policy to motivate their researchers to found companies. Second, immigration to the Silicon Valley surged, which led to an increase of the workforce in technological areas. Third, also many government and military research was located in the Silicon Valley. Fourth, a large number of patent law firms was located in the Silicon Valley with attorneys who specialized also as business consultants. And finally, venture capital became available for tech start-ups. The availability of the venture capital led than e.g. in 1968 to the founding of Intel by Gordon Moore and Robert Noyce. But also, many other co-founders of Fairchild Semiconductors started their own new businesses for more specialized products in the next decades leading to the growth of the Silicon Valley (see Figure 34). More about innovation clusters and the role of IP can be found in the “World Intellectual Property Report 2019 – The Geography of Innovation: Local Hotspots, Global Networks” by WIPO (see Additional Material).

Internet of things

Finally, next to people and businesses also machines can be connected. This is called the internet of things (IoT). Historically, the idea of the machines communicating via the internet

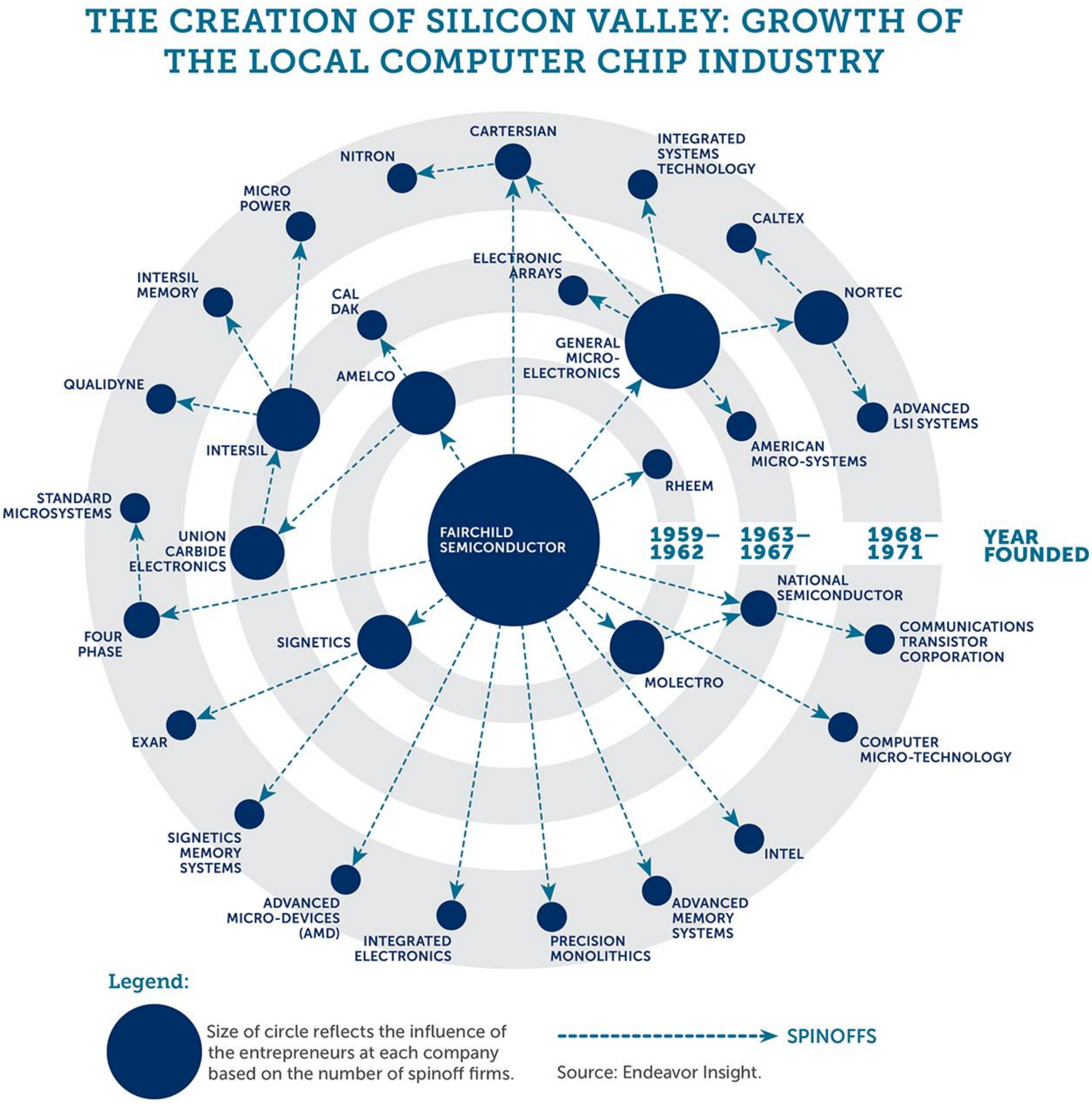

Figure 34: The creation of the Silicon Valley. Source: *https://techcrunch.com/2014/07/26/the-first-trillion-dollar-startup/*

is not so new. One early example of connected machines dates back to 1982, where scientists in the Carnegie Melon University connected a Coca Cola vending machine to the internet, so they could remotely check if a cool drink was available, before they go and get it. Nevertheless, it took till the late 2000s that the internet of things got traction, when enough computing power was available and more devices than people were connected.

A definition by McKinsey describes the internet of things as "sensors and actuators embedded in physical objects […] linked through wired and wireless networks, often using the same Internet Protocol (IP) that connects the Internet". So, the internet of things is a network of devices, which are connected to the internet, so that they can transfer data and communicate with each other. This makes many new applications and with it also business models possible. So, through the increasing importance of the IoT also business ecosystems are transforming. This leads to the emergence of new business ecosystems like smart city, smart farming, smart manufacturing, smart home, smart construction, digital health and many more.

Smart city

A smart city is a framework, predominantly composed of Information and Communication Technologies (ICT), to develop, deploy, and promote sustainable development practices to address growing urbanization challenges. A big part of this ICT framework is essentially an intelligent network of connected objects and machines that transmit data using wireless technology and the cloud. Cloud-based IoT applications receive, analyze, and manage data in real-time to help municipalities, enterprises, and citizens to make better decisions that improve quality of life.

Citizens interact within Smart City Eco-Systems in a variety of ways using smartphones and mobile devices, as well as connected cars and homes. Communities can improve energy distribution, streamline trash collection, decrease traffic congestion, and even improve air quality with the help of the IoT. Last but not least enterprises will launch dozens of new smart applications and services, which will become relevant for the progression of the urbanization trend. The availability of 5G will even accelerate the feasibility, as e.g. data rates, latency and reliability will be dramatically improved with the new standard.

These dynamic and emerging market conditions are a huge challenge to traditional businesses since new business models and players will emerge, market shares will be reallocated, and inflexible/non-digital companies will disappear. In the case of the smart city Google´s market entrance and the subsequent Google Home platform strategy via the acquisition of Nest is an example for a new digital entrant. For the „Smart City" eco-system, Alphabet started its urban innovation organization „Sidewalk Labs" via a Public Private Partnership with the city of Toronto developing a prototype of a smart city.

Alphabet has here the vision to develop and design a smart city in a way similar to a digital platform. They want to make it customizable like a smart device can be customized via the installation of a new app. To do so the smart city is imagined as a grid like structure where single elements can be easily adjusted and replaced depending on the individual needs. An example of the physical and digital structures of the planned smart city can be found in Figure 35. The lower layers describe the physical infrastructure of connected machines, which takes care of e.g. the mail transport and the garbage removal. Of course, these processes are then constantly optimized with the collected data which is represented by the digital layer.

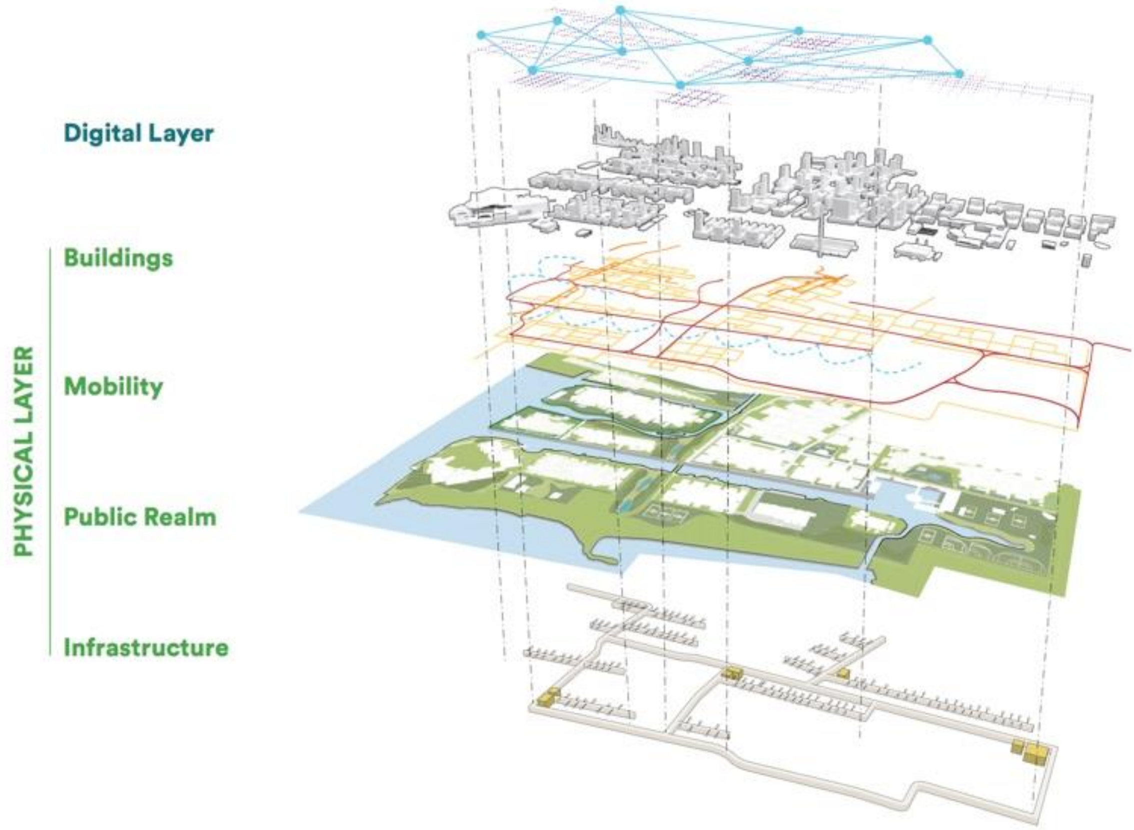

Figure 35: The physical and digital layers of the smart city as planned by Alphabets' sidewalk labs. Source: *https://failedarchitecture.com/the-deceptive-platform-utopianism-of-googles-sidewalk-labs/*

Chapter 5 | Digital product development

What is a product?

There are a plenty of definitions for products out ("What is a product?" -> Integrated IP and Innovation management: Part 3 Chapter 1). Some famous definitions are:

- A product is the need-satisfying offering of a firm. *Perreault, Cannon and McCarthy*
- A product is anything that is of value to a consumer and can be offered through a voluntary marketing exchange. *Grewal and Levy*
- A product is a good, service or idea consisting of a bundle or tangible and intangible attributes that satisfies consumers' needs and is received and exchanged for money or something else of value. *Kerin, Hartley and Rudelius*

At first glance, these definitions of a product may seem quite different, but let us now look more closely at the two key similarities between these definitions.

1. Meets a consumer need or provides value to a customer

The first commonality is that a product is designed to meet a customer's need and to provide value (benefits) to the consumer. Please note the similar phrases in each product definition, as follows:

"Of value to a consumer"
"The need-satisfying offering"
"Satisfies consumers' needs"

2. Consumers can obtain it through an exchange

The second point of agreement is that a product is made available for customers to obtain via an exchange on the market (nearly always exchanging money and sometimes information and time), as highlighted in the following excerpts from the definitions:

"Offering of a firm"
"Offered through a voluntary marketing exchange"
"Is received and exchanged"

A simple definition of a product from a marketing perspective is "anything that meets a consumer and provides value that can be obtained by a customer through a marketing exchange".

In general, a product is a bundle of benefits - physical and psychological - that a marketer wants to offer, or a bundle of expectations that consumers want to be fulfilled. Marketers can satisfy needs of target consumers by products. Product includes both good and service.

Normally, product is taken as a tangible object, such as a pen, television set, bread, book, vehicle, table, etc. But, a tangible product is a package of services or benefits.

Benefits and Solutions

The core benefit is what consumers feel they are getting when they purchase a product. The four levels of a product include: core, tangible, augmented, and promised (see Figure 36). Core, tangible, augmented and promised products feature characteristics (i.e., the total product concept or offer), which include everything a consumer evaluates before making a purchase. These factors can include:

- Price
- Store environment and/or surroundings
- Brand promise/value
- Advertising and marketing activities
- Buyer's past experience
- Accessibility or convenience
- Brand reputation
- Packaging

Figure 36: The four levels of a product. Source: *https://courses.lumenlearning.com/suny-marketing-spring2016/chapter/reading-defining-product/*

We begin with the notion of the core product, which identifies what the consumers feel they are getting when they purchase the product. The core benefits derived when an overweight 45-year-old male purchases a $250 ten-speed bicycle is not transportation–it is the hope for better health and conditioning. In a similar vein, that same individual may install a $16,000 swimming pool in his backyard, not to obtain exercise, but to reflect the status he so desperately desires. Both are legitimate product cores. Because the core product is so individualized, and oftentimes vague, a full-time task of the marketer is to accurately identify the core product for a particular target market.

Once the core product has been indicated, the tangible product becomes important. This tangibility is reflected primarily in its quality level, features, brand name, styling, and packaging. Literally every product contains these components to a greater or lesser degree. Unless the product is one-of-a-kind (e.g. oil painting), the consumer will use at least some of these tangible characteristics to evaluate alternatives and make choices. In addition, the importance of each will vary across products, situations, and individuals. For example, for a 25-year old man, the selection of a particular brand of new automobile (core product = transportation) was based on tangible elements such as styling and brand name (choice = Corvette). In contrast, at age 45, the core product remains the same, but tangible components such as quality level and features become more important (choice = Mercedes).

The next level is the augmented product. Every product is backed up by a host of supporting services. The buyer often expects such services, so they will reject the core-tangible product if these are not available. Examples include restrooms, escalators, and elevators in the case of a department store, and warranties and return policies in the case of a lawn mower. For example, Dow Chemical has earned a reputation as a company that will go the distance to service an account. It means that a Dow sales representative will visit a troubled farmer after-hours in order to solve a serious problem. This extra service is an integral part of the augmented product and a key to their success. In a world with many strong competitors and few unique products, the role of the augmented product is clearly increasing.

The outer ring of the product is referred to as the promised product. Every product has an implied promise. An implied promise is a characteristic that is attached to the product over time. The car industry rates brands by their trade-in value. There is no definite promise that a Mercedes-Benz holds its value better than a BMW. There will always be exceptions. How many parents have installed a swimming pool based on the implied promise that their two teenagers will stay home more or that they will entertain friends more often?

What is a digital product?

Now the question is: What is a digital product and what makes it different to a non-digital product? A digital product is not just an app or a piece of software. A digital product is a product or service which delivers a customer benefit that is enabled by a software. So, practically the customer benefit is delivered through a digital touchpoint. This digital touchpoint can be an app or a platform. It can be web based or mobile. It can be a tablet, smartphone, an augmented reality device like the Microsoft HoloLens or a device using voice recognition like Google Nest.

Figure 37: The Microsoft HoloLens (left) and the Google nest devices (right), Source: *https://www.microsoft.com/en-us/hololens, https://en.wikipedia.org/wiki/Google_Nest_(smart_speakers)#/media/File:Google_Home_with_Home_Hub_and_Home_Mini_on_table.jpg*

An example for such a digital product is the digital and individualized showering experience by Hansgrohe (see Additional Material). In this case an app was used to digitalize a traditional showering experience and to create a digital showering service. So, the sold product is still very physical including a shower, as well as light and sound equipment, but the service delivered, and the related customer benefit of an individualized showering experience is clearly a digital product (see Figure 38).

Figure 38: Components of the digital shower by Hansgrohe. Source: *MIPLM industry Case study Hansgrohe.*

Practically, the product and IP design team of Hansgrohe analyzed the showering behavior of different people and identified multiple showering personas, like the indulgence showerer, the grooming showerer, the quick showerer, etc. To fulfill those individual customer needs, Hansgrohe brought the RainTunes showering system to the market, which is capable to individualize the showering experience with additional sound, lighting, and fragrance. RainTunes is controlled by an app, which offers the user a multitude of showering scenarios, created for typical situations like the morning shower, the wellness shower, and the good night shower.

Product development

Product development is defined as the creation of a new product or service with a new utility, the enhancement of an existing product or a new production process or method. So, it is a process to change the present goods or services or the way of production. To do so it is comprised of the following elements (see Figure 39):

- Creation and Innovation: This creates new inventions and generations of a new products which provide new consumer benefits through products and services.
- Improvement: This increases the customer benefits of the existing products.
- Enhancement: This improves the existing production processes, methods, techniques, and systems in the company to improve the customer experience and make products and services cheaper.

Here, it is important that all departments in the company work together in the product development process. This is necessary, since R&D, sales and manufacturing have different expertise about the production, shipping and sales processes and can contribute with their knowledge to improve the quality of the products and services and fulfill the customer needs.

Also from an IP perspective the IP department must be included early on to guarantee, that the products and services developed can be IP protected, that the products

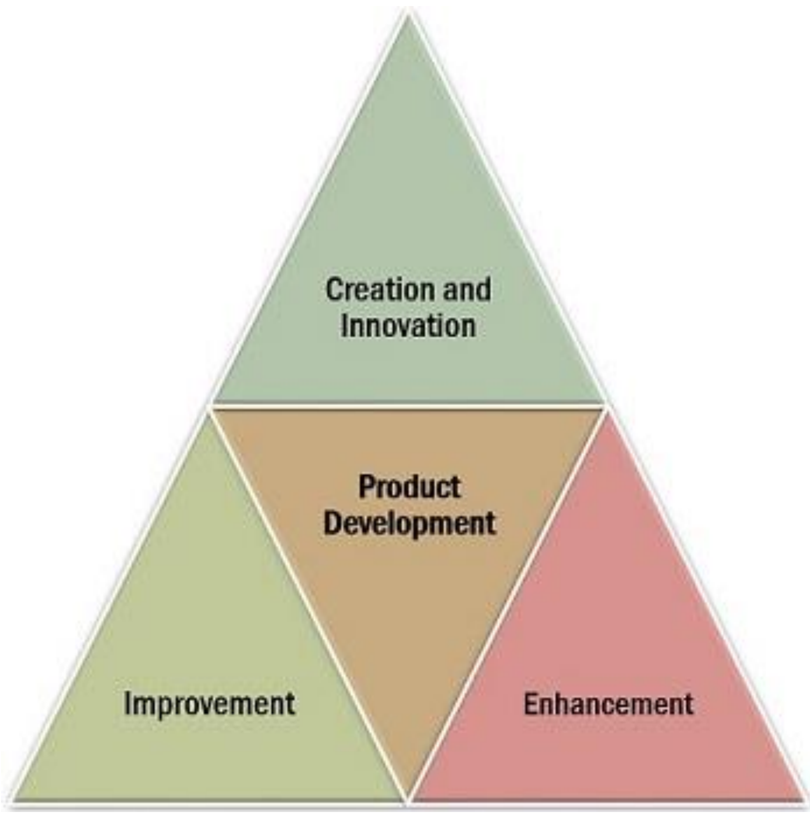

Figure 39: The core elements of product development. Source: *https://theinvestorsbook.com/product-development.html*

and services can be sold at all and in the best case are exclusive to the customers, and that the business model is also protected.

The standard method of product development is the so-called stage-gate process invented in the 1980s by Robert G. Cooper (see "Stage-gate process and the integration of IP" -> Integrated IP and Innovation management: Part 6). The Stage-gate process is a multistage process, where typically five stages of product development are iterated after another with gates in between, where the quality of the project is assessed and a decision-making team decides if the project should be continued or aborted (see Figure 40).

The phases of the stage-gate process are:

- The ideation phase: In this pre-phase new product ideas are discovered and ideated. Those ideas have to be approved by the management team at the next gate.
- Stage 1: Scoping: In this phase the scope of the ideas is defined. To do so, an analysis of the market environment with readily available material is conducted to specify the key concepts and estimate the feasibility and profitability of the project. Also, a SWOT analysis can be conducted to identify the strengths, weaknesses, opportunities, and threats regarding the project (see "SWOT analysis" -> IP strategy Development: Part 7 Chapter 2).
- Stage 2: Build business case: In this phase the concept and business case are concretized. An in-depth analysis of the technical feasibility and market needs is made and also the costs, risk and feasibility of the project is assessed and defined within an outlined project plan.
- Stage 3: Development: In the development phase the first prototypes are constructed and tested both in the lab environment and with real customers.
- Stage 4. Testing and validation: In this stage the prototype is continuously tested and improved with user feedback to develop a whole product including most of the final features of the product to be launched. Also, the marketing plan is developed.
- Stage 5: Launch: In this last stage the product is finally launched, and the marketing activities start.

Between those stages lie gates which are the decision-making points to determine the quality of the project and to decide if the project should be aborted or if more should be invested into the project. Those decisions are taken based on the quality of the execution of the activities in the previous stage, the alignment with the overall business rationale, the alignment with the action plan and the reasonability to invest the needed resources to carry on with the project. Due to the abortion of projects at the multiple gates the number of ideas decreases from phase to phase and only the few best ideas lead to products which are eventually launched in the market.

Digital product development

The main difference in digital product development stems from the key feature of digital products, namely that they use digital touchpoints to deliver the customer benefit. This

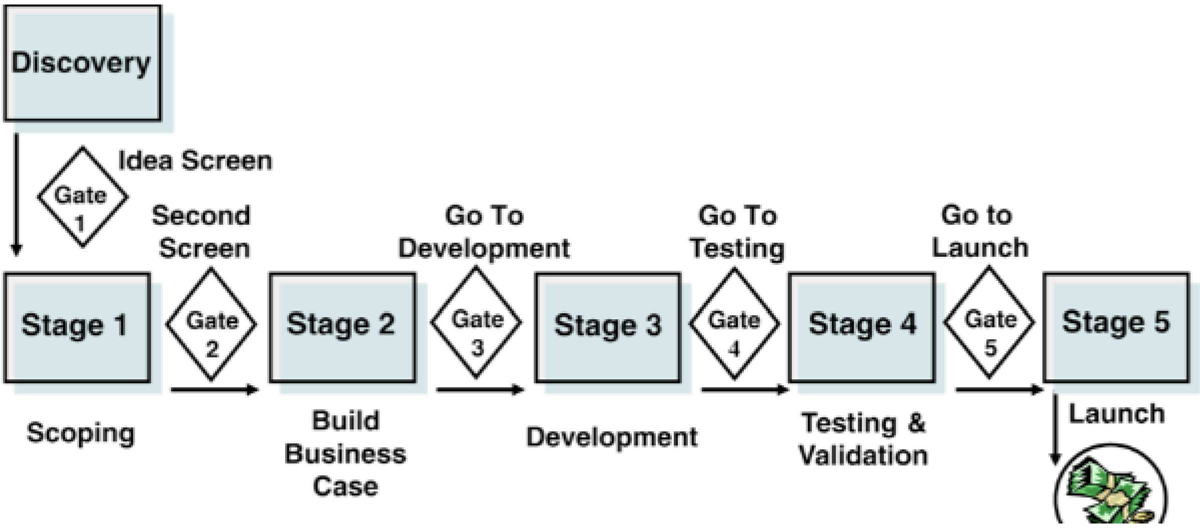

Figure 40: The 5 stages of the stage-gate process. Source: *Cooper R.G. Perspective: The Stage-Gate® Idea-to-Launch Process-Update, What's New, and NexGen Systems*. Journal of Product Innovation Management, 2008, 25, 213-232.*

makes the interaction with the customer a lot closer compared to non-digital products. So, customers want to interact more with the seller of the product or service and also demand a more individualized service from the seller.

This challenge to offer tailored digital products to customers can be achieved in many ways. One way is the use of data analytics and machine learning or AI tools to develop digital products and services. At the development stage theses tools can be used to analyze the market environment and model product or customer behavior. This way future market trends can be foreseen and also individualization and personalization of products and services can be developed in a predictive way. But also, after the market launch the user behavior and interaction with the launched product can be monitored and analyzed to further constantly improve the product even after the launch.

This already highlights another difference between traditional product development and digital product development. Digital products are typically launched early to the market and then receive regular updates for their services (see Figure 41). A typical method to implement such a product development process is the lean startup method by Eric Ries (see "Principles of disruptive technologies" -> Integrated IP and Innovation management: Part 2 Chapter 4).

The early launched version of a product or service is often called a minimal viable product (MVP). This minimal viable product is a product, which has all necessary product features to launch it to the market and satisfy the early adopters. Also, the MVP should be ready enough so that after the market launch, it can be improved by the customer feedback in the next improvement cycles. These improvement cycles are then the next steps to fully develop a fully satisfying product for the customers.

Design Research within the Digital Product Life Cycle
Your guide to assessing research opportunities and choosing the right research methods for your project

Life cycle phase	Goals and missions to generate ideas	Goals and missions to evaluate ideas
1 New product definition	**Understand gaps in the market** **Identify audience targets** **Identify audience needs** What's changing in the space? What does this change mean?	**Refine the value proposition** **Identify resource requirements** **Build a case to move forward (or not)** What problems does this idea solve, and for whom? Should we pursue it?
2 First release (MVP)	**Focus the functionality** **Promote the differentiators** **Define the personality** How will it be differentiated? How will people find out about it?	**Gain confidence in the product** **Understand customer perceptions** **Identify / resolve blockers** Does the design do what it should?
3 Minor release updates (1.x)	**Be responsive to feedback** **Improve analytics** **Make incremental enhancements** Who is actually using the product? What are people saying? What's the data saying?	**Gain confidence in the release** **Understand customer perceptions** **Stay under the radar** Is feedback being acknowledged? Did anything break?
4 Major release updates (X.0)	**Evolve to remain competitive** **Adapt to new behaviors** **Deliver the core value in new ways** What's at stake? How should we react to change?	**Gain confidence in direction** **Evaluate customer perceptions** **Identify / resolve blockers** Does the new design do what it should?
5 Product retirement	**Model the consequences** **Plan for migration** **Manage risk** How disruptive will this be? How should we break the news?	**Build confidence in retirement tactics** **Know the pain points** **Set expectations, prep support team** Who will be upset? Are we prepared?

MOMENT

Figure 41: Stages of the digital product life cycle. Source: *https://medium.com/design-intelligence/a-method-for-every-mission-4e453aa8d9e4*

Here, another important aspect of digital product development is highlighted. Digital product development does not use an iterative development approach, which is called waterfall model, but a so-called agile development approach (see Figure 42). The agile model fosters a team-based and iterative approach with more flexibility and a continuous improvement in the development process. This is also possible because previous stages of the product development process can always be repeated when it is necessary. So, when a prototype is found to not deliver the needed customer benefit the team can return to an earlier stage and develop new ideas. This repetition of stages can also be formalized within so-called sprints. During these sprints, all stages of the agile development are run through with the aim to provide a working product at the end. At the end of each sprint, all stakeholders in the product development process are reviewing the development and checking if the project is still aligned which the customer needs and company goals. Finally, the functionality of the product is then tested with the customers and a new sprint for the improvement may be planned or if the product is good enough it may be released to the market. An advantage of this agile method is also the constant feedback within the team, where everyone is informed about the current state of the project and the goals.

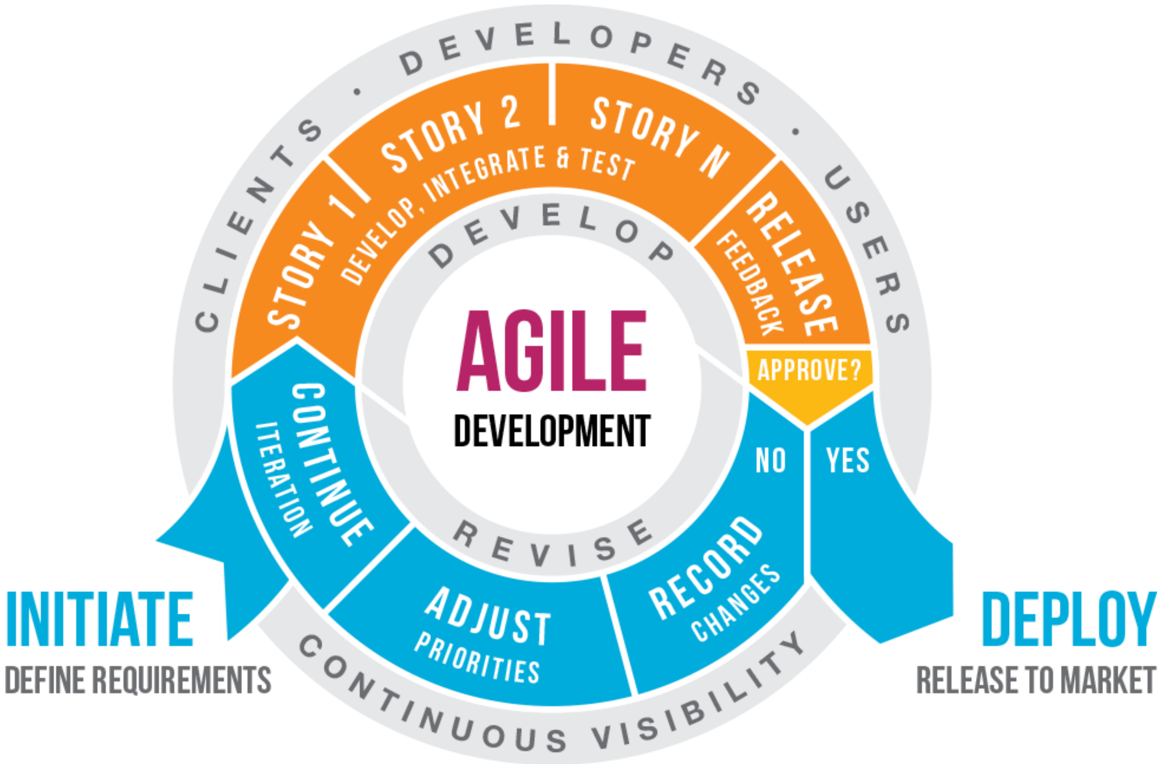

Figure 42: Agile Product development. Source: *https://www.devteam.space/blog/the-10-best-agile-project-management-tools/*

Integration of IP into the digital product development process

In a meaningful product development process also, IP must be integrated. This is especially true for a digital product development process, where the risk of patent infringement increases due to new competitors from other and digital industries. This is a result from the recombinant use of technology in digital business models. In more detail, the inventors of the Business Model Navigators (see Figure 43) from University of St. Gallen found out, that 90% of new business models are just recombinations of 55 business model elements. Those elements are often already used in other industries and due to the digital transformation and the breaking of industry boundaries the application of those elements becomes possible in new industries. From an IP perspective it is now important to analyze the patent situation associated with the used business model elements. Here, typically new competitors with a digital patent portfolio exist and for each new digital business model it is crucial to check that the developed products and services are free from third party IP rights.

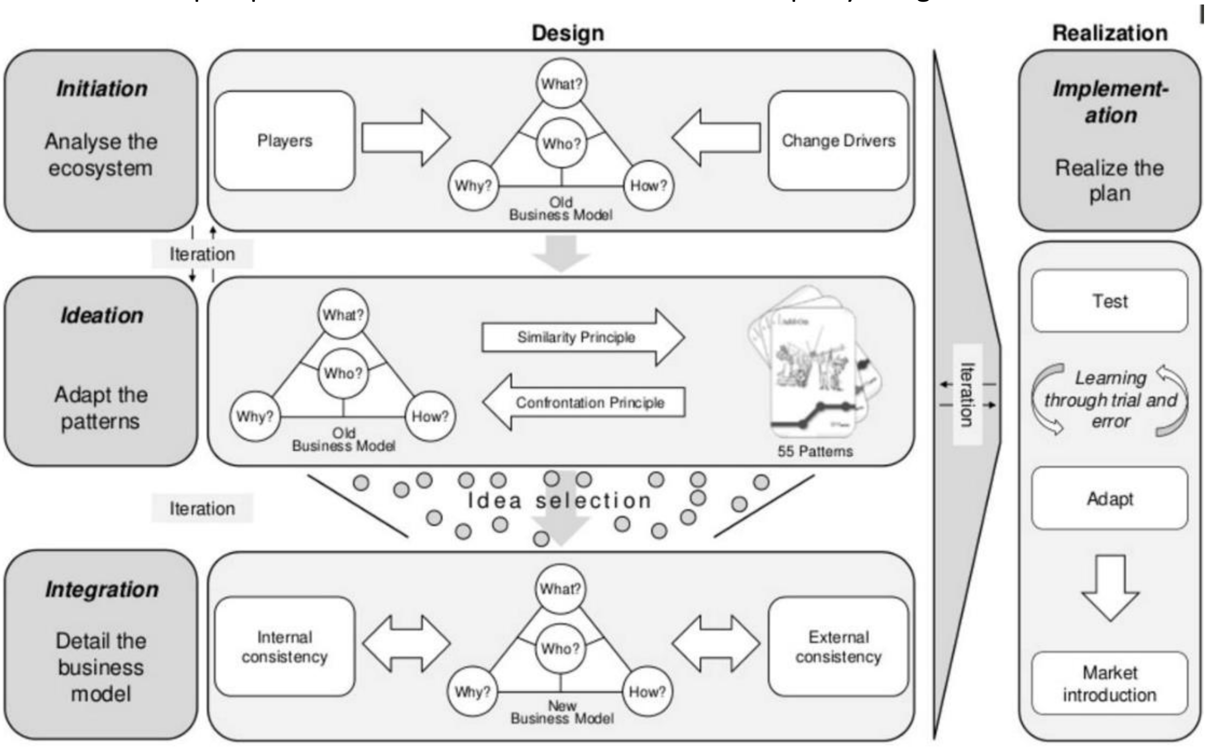

Figure 43: The business model navigator. Source: *Oliver Gassmann, Karolin Frankenberger, Michaela Csik, The Business Model Navigator: 55 Models That Will Revolutionise Your Business, FT Publishing International (2014)*

An example can be seen in an infringement case where IBM sued AirBnB on digital use cases like "presenting advertising in an interactive service" (see Figure 44 and US7072849B1) and "improved navigation using bookmarks". These technologies were patented by IBM many years ago, some of their priorities go back to the late 1980s. This shows how long the tradition and practice in digital patents is within the big tech companies. These technologies were developed as a part of "Prodigy", a service IBM described in court filings as a "forerunner to today's internet". Prodigy was an online service from 1985 to 2001 which offered access to a range of networked services like news, weather, online-shopping, bulletin boards, games, and banking.

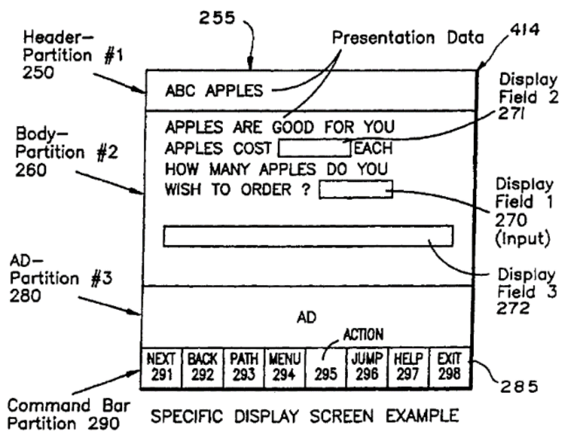

Figure 44: US7072849B1 Source: *https://patents.google.com/patent/US7072849B1/en*

The technologies, which were developed in that time, are still highly relevant and integrated in current and prominent use case and IBM has had significant success in the past in asserting its patents against other platforms. IBM used the same patent as part of a dispute with coupon site Groupon, which in 2018 agreed to pay $57m to end a bruising two-year court battle. The patent was also part of a suit filed in 2013 against Twitter, a then-emerging social network, which also struck a deal, licensing disputed patents from IBM, and also acquiring 900 more — at a total cost of $36m.

Integration of IP - the Freedom of action process

For the improvement of innovation projects IP must be integrated into the innovation process and the stage-gate process at all stages. This can be done with the freedom of action (FOA) process which helps to secure the freedom to operate (FTO) through all stages of the innovation process and the stage-gate process from the generation of ideas to the launch (see Figure 45). The core idea of the FOA is to avoid the infringement of third-party IP rights by reacting on the changes in the innovation process during the different process stages.

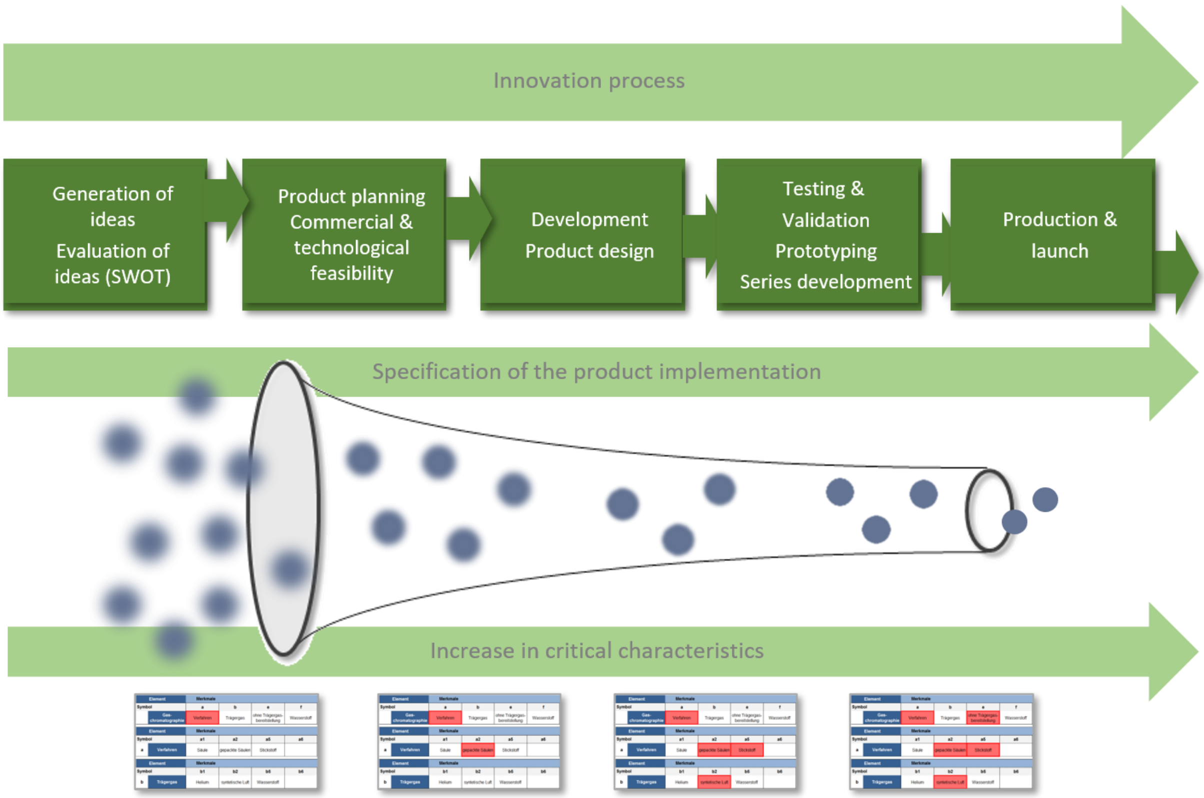

Figure 45: Integration and contribution of IP in the innovation process. Adapted from: *Alexander J. Wurzer, Theo Grünewald, Wolfgang Berres, Die 360° IP-Strategie – So sichern Sie Ihren Innovationserfolg langfristig, Vahlen (2016)*

In classical innovation processes concrete technical solutions become developed during the product development phase and FTO analyses are performed to analyze if third party IP rights exist, which prevent a market launch of the developed product. If such third-party IP rights are found, the respective product components must be modified or in the worst case the whole project must be cancelled. This shows that an FTO analysis at this late process stage can lead to unnecessary development costs, which could be avoided with an inclusion of IP at an earlier stage.

The alternative is the FOA process, which is already integrated in the idea generation phase. Here, the product development team is provided with information regarding possible infringement risks and possible unique selling propositions (USP). So, the FOA is both trying to avoid risks and to reach targeted exclusivity of the product. During the innovation process the product becomes more and more specific and the FOA process must follow this concretization of the product. This may cause a drastic decrease of the needed IP rights to ensure exclusivity during the product development process, since the potential number of critical components of the product which must be protected might decrease once the product features are defined very narrow. Nevertheless, this also means, that the analysis in the later stages should be more precise compared to the earlier stages, where only a broad overview of the state of the art is necessary to identify areas, where exclusivity through IP rights may be reached.

The integration of IP into the innovation process should be done with a focus on the effectiveness and efficiency of the FOA process. This is necessary, since innovation projects are complicated, expensive and the scope of the process, including possible infringement risks, constantly changes. For this purpose, binding rules along the innovation process must be defined outside the IP department, especially for the following areas:

- Definition of IP goals
- Responsibilities
- Process quality
- Structure of the strategic levels
- Risk management
- Level of formalization
- Budgeting