

Industry Case Study Series on IP-Management

LUQEL The digitization of water

By Alexander J. Wurzer & Monique Bissen

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Dr. Monique Bissen

Dr. Bissen studied chemical engineering at KIT in Karlsruhe and did her doctorate in the field of water filtration with the topic "Arsen-Spezies im wassergesättigten kontaminierten Untergrund". Her doctoral thesis was awarded the doctoral prize of the German Water Chemistry Society.

Dr. Bissen has been dedicated to water purification and water filtration for over 20 years. After a stay in Switzerland at the water company CHRIST AG (now OVIVO), where she developed processes for ultrapure water systems for the pharmaceutical industry, the electronics and semiconductor industry as well as the metal and electroplating industry in research & development, she joined in 2003 the BWT AG in Mondsee / Austria. BWT offers treatment systems for drinking water, pharmaceutical, biotech, process, heating, boiler, cooling, air conditioning and swimming pool water. Dr. Bissen headed the Research & Development department there and focused on developing products for water filtration at the tapping point, the so-called Point-of-Use. In 2011 she took over the management of the BWT water + more GmbH in Mondsee / Austria.

In June 2016 Dr. Bissen founded the company ICon GmbH & Co. KG in Pforzheim / Germany with the vision to equip people with smart filters and devices for installation at the tapping point, the so-called point-of-use, so that they can enjoy pure, safe and healthy drinking water - worldwide. Dr. Bissen holds numerous patents.

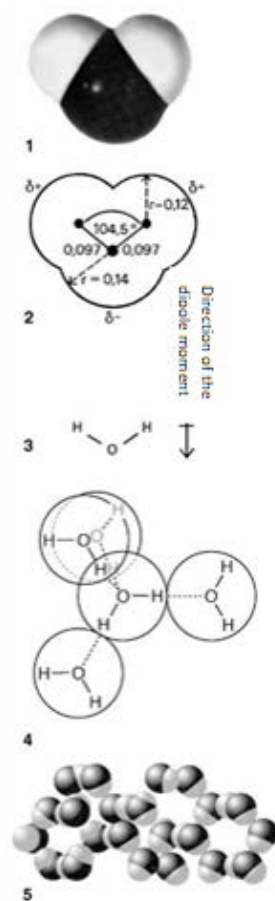
PART I

About Water

Water is an indispensable both as a component of all organic structures and as the primary substance for all chemical reactions in the body. Due to its special chemical and physical properties, water is essential for biological life. The great importance of water lies in the special properties of this liquid as an excellent solvent for a diverse range of substances in a dissolved or semi-dissolved state. Water thus plays a key role in all organisms, because it is vital in biological contexts based purely on metabolic processes. Over 70% of the human body, 92% of the blood, 90% of the brain, 75% of the muscles, and even 22% of the bones consist of water. Most of the water inside body cells is contained in the intracellular space. The human metabolism only works if there is enough water available in the body. Water is not just a solvent and carrier for the absorption, release, and transport of substances, but also a swelling agent. It helps to achieve the swelling state of protein colloids required for life processes. In addition, water is a reaction medium for biochemical processes. In many metabolic reactions such as respiration and digestion, water acts as a source or end product.

Water, whose chemical formula is H_2O , is an odorless and tasteless liquid. The chemical formation of water occurs during the oxidation of hydrogen and hydrogen-containing compounds with oxygen or other oxygen-containing oxidizing agents, the neutralization of acids and bases, and numerous chemical reactions causing the release of water.

It was not until 1781 that H. Cavendish discovered that water was produced by oxygenating hydrogen. In 1783, A.L. de Lavoisier provided evidence of its composition of hydrogen and oxygen in a volume ratio of 2:1 with a strong molecular dipole moment. The dipole character of the water molecule gives water its extraordinary properties: high heat of fusion and evaporation, high heat capacity, volume expansion during solidification (frost wedging), high surface tension (capillarity), high permittivity, and the ability to dissolve polar, especially ionic compounds (solution). This effect is further enhanced by the solvation capacity (solvate) of water, which also results from the dipole nature and has both donor and acceptor properties. Water is thus able to solvate both anions and cations and hydrate them (hydration).



1 Spherical model of the water molecule; 2 Bond structures: angles, distances, radii in nm; 3 Structural formula; 4 Tetrahedral structure of water; 5 Two-dimensional representation of the interactions in liquid water.

Water regulates the cardiovascular function and digestion, is a solvent for salts and minerals, and a transport agent for nutrients and metabolites. In addition, it is of central importance for thermal regulation in the human body. Under normal circumstances, we lose 2-3 liters of water in the course of a day through sweating, breathing, and excretion. This loss must be compensated by the intake of food and beverages, because the body reacts with serious dysfunctions to even the smallest changes in its water balance.

A loss of water of about 0.5% results in a feeling of thirst, which intensifies as the water content of the body continues to decrease. At 2%, our physical and mental performance already decreases; at 5%, our body temperature rises. A water loss of 10% of the body weight causes severe symptoms such as blood thickening, circulatory failure, and confusion. A deficit of more than 20% inevitably leads to death from renal and circulatory failure. Without food, a person can survive for about four weeks (depending on their fat reserves), but without water, they will die of dehydration after about 36 hours.

There are different types of water:

- Saltwater: Over 97% of the water on Earth is saltwater. It contains an average of 35 grams of dissolved mineral salts per liter.
- Freshwater: This is natural water that leaves less than 1 gram of salt residue per liter when evaporated. Around $\frac{3}{4}$ of the freshwater present on Earth is frozen in ice caps at the poles. Fresh water, which is essential for life, is integrated into Earth's great water cycle. It

evaporates when exposed to solar heat, cools down at high altitudes, forms clouds, and falls back down as precipitation. Each raindrop completes this cycle about 35 times a year.

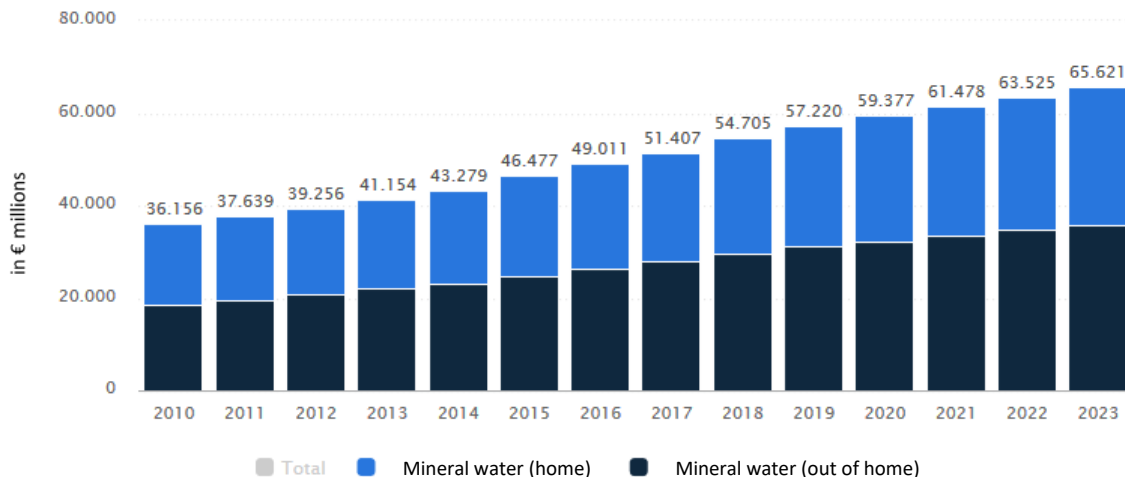
- Surface water: This is what we call all open water reservoirs on Earth, including streams, rivers, ponds, and lakes.
- Groundwater: This is the water from precipitation that seeps into the ground and collects in the gaps, crevices, and pores of the subsoil above impermeable bottom layers. It comes to the surface at springs, but also feeds underground rivers and lakes. Its uppermost horizon is the groundwater table, which varies according to precipitation. Groundwater is the largest supply of liquid fresh water on Earth.
- Drinking water: This is water which is suitable for human nutrition. It is contaminant-free and contains no germs.
- Service water: This is the water used in the production of industrial and commercial goods.
- Wastewater: Contaminated water.

Mineral water – a billion-dollar market

A battle for the mineral water market is raging around the globe. Food and beverage giants such as Coca-Cola, Danone, and Nestlé are part of the game, and position themselves in order to conquer as much of the billion-dollar mineral water market as possible. Industry experts are already speaking of a “mineral water war”. One of the great battlefields is the USA. In 2016, the consumption of sweetened soft drinks fell to a 31-year low. At the same time, the demand for mineral water sky-rocketed. Europe and Germany are at least secondary battlefields of this war. After all, a record volume of 14.7 billion liters of mineral water was consumed in Germany for the third year in a row in 2017. However, the German market is not an easy playing field for large players such as the French Danone corporation with its Evian and Volvic brands, because it is extremely fragmented. Many regional suppliers compete for consumer goodwill and consumers are rather skeptical about big, global brands. There are nearly 200 mineral springs and over 500 mostly regional mineral waters and health-enhancing waters in Germany. German

mineral water imports accounted for just 1.2 billion liters or a market share of 8 percent in 2017. Industry giants see great potential for growth in this market.

The global mineral water market has been growing steadily for many years. While the average German drank just 12.5 liters per year in 1970, for instance, they consumed 125.2 liters in 2004. By 2018, the annual per-capita consumption of mineral and health-enhancing water had already risen to 189.5 liters. The figure below shows the 2019 market data for the European mineral water market (worth EUR 57,220 million):





Mineral waters can differ significantly in quality. A large-scale mineral water test by German consumer organization Stiftung Warentest in 2017 found that only about one third of the 30 mineral water brands tested were “good”. 18 of the medium carbonated mineral waters tested were rated “satisfactory”. According to Stiftung Warentest, poor test ratings were in particular attributable to undesirable traces from agricultural, industrial, and household wastewaters, but also to flaws in flavor, mainly caused by plastic bottles. The loser of the test was the Naturalis brand sourced from Fonte Guizza in Italy and distributed by the German discount supermarket chain Netto, which only achieved a “pass” rating because it was comparatively high in carcinogenic chromium at 0.5 micrograms per liter. The reference value for drinking water is 0.3 micrograms per liter. According to Stiftung Warentest, five waters additionally contained traces of sweeteners, degradation products of pesticides, and anticorrosives. While these values are still considered “safe for consumption”, it is questionable whether the corresponding products qualify as “natural mineral waters”. In addition, many waters tasted of acetaldehyde, a substance that develops during the production of plastics. According to Stiftung Warentest, this substance can

pass from the bottles into the water and small quantities can already lead to changes in taste.



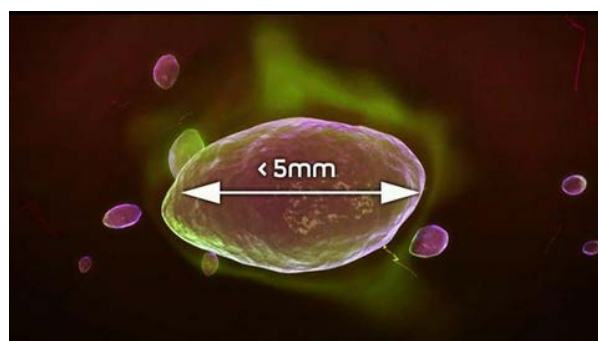
In Germany, there is usually no significant difference between tap water and bottled mineral water. A test conducted in 2016 using various analytical methods found that drinking water also contained traces of chemicals but was generally safe for consumption. Caution is advised in partially or unrenovated historic buildings, since lead pipes were installed in some of them until the 1970s. While building owners are obliged to replace the old pipes when certain thresholds are exceeded, this has by far not happened yet everywhere. There is no place for heavy metals in drinking water.

The most common reason for choosing bottled water over tap water, however, is not related to health but to taste. And indeed, not all waters taste the same. Sodium and chloride give water a salty taste, for example, and high sulphate contents can result in bitter notes. Hard water with high calcium and magnesium contents tends to taste better, while soft water is recommended for tea.

What is interesting from an economic point of view is the fact that there are enormous differences in price between different

bottled water products. Branded mineral waters from northern Germany, for instance, are about four times as expensive as their cheaper counterparts from discount stores or supermarkets. And yet, some cheaper mineral waters are almost identical with higher-priced branded products, which sometimes originate from different sources located in the same place. A test conducted in northern Germany has shown that these price differences cannot usually be justified by the degree of mineralization. Mineral water can originate from different sources in one place. Mineral water springs do not gush out of a rock in the middle of a forest as advertising tends to suggest. Mineral water resources are usually explored by simply drilling into the ground. In the north of Germany, they can predominantly be found in water-bearing sand layers. According to mineral water regulations, only one mineral water can be extracted from each source. The exception: If the name of the spring is printed onto the label 1.5 times as large as the brand name, several mineral waters can be sourced from the same spring. The operator is free to choose the name of the spring at their discretion and register it. The mineral waters examined in the sample originate from different sources and are extracted from different depths, but all within a radius of 1.5 kilometers. The ingredients of the mineral waters tested differ only marginally; the different waters are basically identical. A random blind tasting conducted with passers-by showed that the mineral waters tasted almost the same. The local drinking water is likewise sourced from the same spring. A comparison with the mineral contents of bottled mineral waters from the

same region shows very similar results. The prices of these mineral waters, which are sold under different brand names, and that of the corresponding tap water are very different though. While the mineral water costs around 13 cents per liter at Aldi and the branded water comes in at 59 cents, one liter of drinking water is just 0.4 cents per liter.



A recent problem affecting both tap water and mineral water are microplastics. Scientists have found plastic particles in mineral waters, especially in those which come in PET bottles. The results of such analyses from Germany and the USA are very similar. Microplastic does not just result from the pollution of our oceans, but also from the passage of plastic particles from the packaging to the product. Microplastics are defined as plastic particles with a diameter of up to 5 millimeters. However, there are currently no standardized methods for detecting microplastics and no reliable evidence concerning the effects of microplastics in food and drinks. In the meantime, microplastics resulting from waste residues have also been found in tap water. Analyses show that American households are particularly affected by microplastics in tap water, with more than 90 percent of samples containing microplastics. Samples from

India and Lebanon showed almost the same levels of contamination. The lowest microplastics contents were found in European water samples. Along with French and British samples, German samples showed the lowest levels of contamination. But even in Germany, 72 percent of the tap water samples analyzed contained plastic particles.

There is still some uncertainty as to how microplastics get into our tap water and drinking water. A possible cause is that the plastic particles enter the water via the atmosphere. Tumble dryers or venting systems, for example, release plastic fibers into the air, which eventually end up in precipitation, surface water, and groundwater. In addition to these possible factors, the materials used in our water systems are also thought to be a possible cause for microplastics in our tap water.

Innovation in the mineral water market

65% of mineral waters sold in Germany come in plastic bottles and 24% in glass bottles. At 16%, soda makers account for a relatively small portion of the market. The consumption of mineral water is increasingly regarded as chic and part of our individual lifestyle. The mineral water market is open to innovation. There are products for smokers, for different skin types, for different moods, and with different pH values. Starbucks sells “Ethos Water”, Coca-Cola launched the “Glacéau smartwater” brand that is already well-established in the USA in Germany in May 2018, and there is a luxury water brand from Canada known as “10 Thousand BC”, which supposedly is much more than just ancient rainwater but is advertised as

melted glacial ice from the last ice age. A 0.75-liter bottle costs EUR 16.90. Further mineral water innovations include Fiji and Voss. The former is a product marketed by the Wonderful Company at EUR 2.69 per liter and bottled in Fiji, in the South Pacific, whose environment is said to be particularly clean due to the absence of polluting industries. Ironically, to “get into the hands of top chefs, celebrities, and VIPs”, as proclaimed on the company’s website, the water needs to travel some 16,000 kilometers and thus makes a significant contribution to the global greenhouse effect. Voss bottled water comes from a source in Iveland, a sparsely populated area in southern Norway. A Norwegian TV channel recently made a discovery which is rather unfavorable for the brand: the inhabitants of the village consume the same exclusive water directly from their taps and use it for drinking, washing their cars, and showering. The bottle, whose “breathtaking bottle design, which uniquely conveys the distinction of the water within”, was designed by a former Calvin Klein head designer with the objective of selling the product. The upmarket pricing of these products can be explained by the high costs of product placements and testimonials. In addition, market entry in the premium segment simply requires higher prices. Supposedly, nobody would be interested in the water if it was sold for 35 cents at the kiosk next door. The upmarket price is also what makes the product so attractive to its respective target group.

The price ranges in the mineral water market are fascinating and certainly not down to the quality of the products.

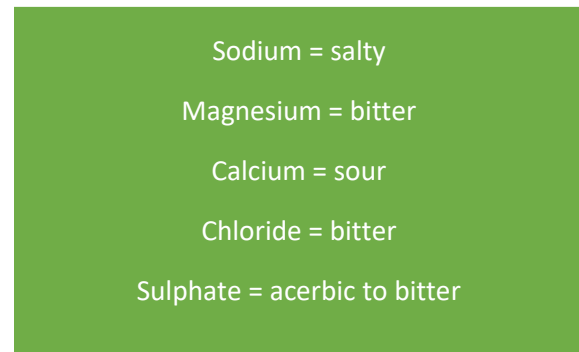
According to the Federal Statistical Office, one liter of tap water in Germany costs on average 0.2 cents while one liter of Evian mineral water costs about EUR 1.69, i.e. 700 times as much. In principle, there are strict legal regulations for the extraction and bottling of mineral water, as well as for tap water. However, a variety of treatment processes are legally permissible for tap water, including chlorination and disinfection.

Water is no longer just a means to an end, but is increasingly becoming a symbol of a healthy and smart lifestyle, beauty, and status. The hype surrounding the product has now reached unprecedented levels and has even led to the emergence of a new profession: the water sommelier. Such water experts typically advise restaurant guests on the more than 40 varieties of water from 18 countries on the menu. Depending on the carbonation and mineralization of different waters, Rieslings, Bordeaux, and other wines can taste entirely different after a sip of water. Each mineral water is unique, and has an individual taste and its own nutritional profile.

Taste variety

Due to its ability to dissolve and carry different substances, water is anything but

tasteless. Each mineral water is characterized by a unique taste profile, which is substantially influenced by its mineral content. The overview below provides a simplified explanation of the effects of individual minerals on taste.



Sodium = salty
Magnesium = bitter
Calcium = sour
Chloride = bitter
Sulphate = acerbic to bitter

In addition, there are a variety of sensory responses to different minerals. Calcium often causes a dry mouthfeel, for example. The taste of magnesium has been described as bitter to sweet by study participants. Hydrogen carbonate binds acid, an effect that becomes evident when mixing juice with sparkling water. When mixing juice with highly carbonated water, it loses almost all of its acidity. A more comprehensive taste analysis can even reveal more complex relationships. Water tastes neutral, for instance, when its mineralization is similar to the composition of the individual's saliva. Since there is no change of stimulus, the taste is described as particularly mild and soft in such cases.

Part II

LUQEL

What the founders of LUQEL have in common is their love of water. Josef Schucker is a successful German entrepreneur who, after selling his company, fulfilled his childhood dream of travelling around the world and found plastic bottles washed up in the most remote places. Water in plastic bottles produces vast and unnecessary amounts of plastic waste around the globe. What is more, these plastic bottles often travel thousands of miles, despite the fact that the quality of tap water is at least equal to that of bottled water in many regions of Europe, including Germany. What is different is the taste. Schucker decided to tackle this issue and met proven water expert Dr. Monique Bissen, who likewise opposes water in plastic bottles. She holds a doctorate in Water Chemistry and has more than 20 years of experience in the field of water treatment. According to her, the combination of water and plastic is detrimental to our health. She complains about the fact that even in water purification systems, which people use to avoid plastic bottles, there is so much plastic that the water inside them is constantly exposed to plastic. Dr. Bissen knows that tap water in Germany is of excellent quality. But she also knows about the contaminants in tap water, even if current regulations consider it clean. For certain contaminants, such as microplastics, there are no thresholds yet. So far, there has even been a lack of consensus on a standardized test method, not least because of the diverging interests of industry and consumers. The only thing that

is certain is that microplastic has been found in domestic taps.



Dr. Bissen is convinced that there needs to be a shift away from drinking standardized water in plastic bottles towards consuming water that meets individual needs. Her vision is one of absolutely pure and completely customized water for every consumer. The new water needs different packaging and must adapt to people's lives. It further requires a completely new, plastic-free way of purifying it, and Dr. Monique Bissen is convinced of her abilities to provide it. The engineer, who holds a PhD and whose work has been awarded the Dissertation Prize of the Water Chemistry Society, has been working as an expert for water treatment with leading industry players for more than 20 years. She develops products, holds patents, and continues to push for innovation in an industry which is widely known as resistant to innovation.

After some initial exploratory talks between the two entrepreneurs, both perfectionists agreed that they attached great importance to quality and that they both wanted to

improve the way we consume water around the globe together. After countless experiments and nights of brainstorming, they were rewarded with great success – their first water recipes tasted fantastic. Sometime later, the first technical drawing of the LUQEL Water Station was put down on paper. At the heart of this technology are a filtration process using reverse osmosis and a unique, patented liquid mineral ion dosing technology combined with a multi-stage filtration system allowing every user to draw their favorite personalized water in pristine quality at the press of a touchscreen.

After setting up a company, the team grew very quickly. In early 2018, there were 30 employees. By early 2019, there were more than 70 staff members, including technicians, engineers, logistics specialists, water sommeliers, and other specialists with plenty of experience in their respective fields of expertise. They are all filled with the same enthusiasm and want to help revolutionize the way we drink water. They all have a clear vision of what LUQEL is about: water as individual as you are.

LUQEL puts the individual and their uniqueness at the heart of everything it does, thus heralding a break with learned habits. After all, the ways in which we consume drinking water is as individual as we are. Behaviors can be learned, and the current status of water consumption is relatively new and has been influenced by different framework conditions and market-related motifs. The ‘bottling’ of spring water dates back to about 500 years ago. In the 17th century, mineral water was reserved for aristocrats and the rich bourgeoisie. Physicians and chemists subsequently

discovered the healing properties of the mineral profiles of different waters, which marked the beginning of the era in which mineral water was predominantly used for medicinal purposes. It was mainly prescribed to patients suffering from chronic illness and it was an expensive good which only the wealthy could afford. Even in the 19th century, mineral water was still considered a medicinal product. This era saw the emergence of many spas which offered drinking treatments with healing springs and health-enhancing water. It was not until about 50 years ago that mineral water became an everyday product for mass consumption, Seeing a dramatic increase in annual per capita consumption from about 12 liters to 190 liters since the 1970s.

Hydronar filter technology



The logic of LUQEL is based on the objective of delivering water that is as pure as it gets. To this end, a complex, multi-stage filter system with the patented Hydronar filter technology is used. A coarse filter is installed at the mains water connection to prevent impurities from domestic water pipes from entering the system. With the aid of a pump, the water is then fed through the sediment filter. Small

particles such as sand, microplastics, and rust are removed at this stage. Sediment filters reliably remove coarse contaminants such as sand, rust particles, and turbidity from the water. The diameter of the filter pores varies between 1 micron and 80 microns (1 micron = 0.001 millimeters). Smaller molecules such as H₂O (water), Na⁺ (sodium) and Cl⁻ (chloride) ions, as well as other minerals can just about pass through these pores. Sediment filtration is an important precursor for finer filtering methods such as membrane-based reverse osmosis. The filters must be changed after some time as the substances filtered out of the water form deposits in the filter material.

Activated carbon filters are used in order to remove foreign bodies smaller than 1 micron. Activated carbon filtration is used in water purification technology to reliably remove foreign bodies such as chlorine, a disinfectant, from tap water. Various organic substances are bound by the unique pore structure of the activated charcoal. Even in the cosmetics and health sectors, carbon is used as a filter material. But when it comes to hormones, antibiotics, bacteria, arsenic, uranium, and heavy metals, this all-rounder reaches its limits. Lead and chromium, for example, cannot be filtered from air or water by using activated carbon, nor can nitrate. Other filtering methods are used for this purpose, which use activated carbon as a pre-filter. The surface of four grams of activated carbon corresponds approximately to that of a soccer field. What enables the outstanding performance of activated carbon without taking up a lot of space are its many pores, i.e. tubular cavities whose large inner surface make it an ideal

filter. Drinking water purification by means of activated carbon uses the principle of adsorption: Pollutant molecules from contaminated liquids are absorbed and bound by the pores of the activated carbon. These pores vary in size, resulting in a gradual decrease of the concentration of foreign bodies.



Reverse osmosis is used as a final filtration step to remove substances consisting of finer-grained particles such as [nitrate](#) or pesticides. Reverse osmosis even fully eliminates molecular residues of glyphosate and drugs. Reverse osmosis is a type of membrane filtration. Artificial semipermeable membranes are manufactured for drinking water treatment. These reverse osmosis filters separate contaminated water from readily purified water containing no residues of foreign matter. To filter out foreign bodies, pressures of 4 to 10 bars are applied to the contaminated water, allowing only the water molecules to pass through the membrane.

Reverse osmosis leaves us with filtered water which is so pure that it is virtually completely demineralized. This is where the Water Station comes into play, which

remineralizes the purified water in accordance with individual needs.

Water mineralization

Pure H₂O contains no minerals. The mineralization of water results in a solution of these important substances and ensures their bioavailability by making them available to the body via the bloodstream. Minerals can be absorbed particularly effectively by the human body when available in their ionized form. They serve as building materials for the skeleton, and are important components of enzymes and hormones. Biologically active substances such as hemoglobin are likewise composed of electrolytes.

In nature, the mineralization of water occurs as it flows through different layers of rock from the source to the spring. The layers involved influence the degree of mineralization. Natural mineral water contains different mineral concentrations, depending on its origins. For people with specific needs, such as infants, athletes, or pregnant women, the concentration of certain minerals is crucial. Different mineral waters can contain high concentrations of minerals such as sodium or low concentrations of minerals such as magnesium. For this reason, it is important to know our own daily requirements and to select our mineral water accordingly. Our mineral needs and therefore the choice of the right water are as unique as we are.

Minerals fulfill various functions in the body, serve as building blocks, and influence chemical processes. Among other things, they strengthen our

bones, stimulate metabolic processes, serve as building blocks of enzymes and hormones, and ensure the correct transmission of nerve impulses. In addition, they also affect the taste of water, as mentioned above.

Is there such a thing as too many minerals? Healthy individuals can easily cope with mineral concentrations which are slightly too high. Caution is advised, however, for persons who belong to a high-risk group. Infants or patients with an impaired kidney function generally benefit from water with a low mineral content. Patients with high blood pressure should watch the sodium content as the mineral can increase their blood pressure.

Greater attention should be paid to the nitrite content of mineral water. Nitrite is released from nitrate as a by-product of bacterial activity. It is toxic and suspected of being potentially carcinogenic, which is why it has no place in drinking water. The German Drinking Water Ordinance defines a limit of 0.50 milligrams per liter at the mains water connection and of 0.10 milligrams per liter at the waterworks outlet. In the case of bottled mineral water, consumers can find out the nitrite content from the bottle label.



In the Water Station, mineralization takes place via a glass unit in order to prevent contamination from plastics. Each individual type of mineral ion comes from a glass vial which is introduced in the upper dosing shaft of the water station. The patented dosing technology releases minute quantities of each type of mineral ion into the water as specified in the corresponding recipe. This results in dissolved minerals with an enhanced bioavailability due to their chemical interaction with the water. The water is mineralized using sodium hydrogen carbonate, calcium chloride, potassium hydrogen carbonate, magnesium sulphate, and magnesium chloride. In addition to the specific taste of the water, the mineral composition also influences the perceivable aroma spectrum of tea, coffee, as well as whiskey or wine.

Apart from the mineralization, users can also control the water temperature and the level of carbonization via the touch display. In other words, the unit enables the seamless preparation of still or lightly sparkling water. The water is prepared inside the Water Station on the spot and is therefore always fresh and tailored to the specific application.

Water handling

LUQEL water is not just for immediate consumption, but can also be used for preparing hot drinks, for example. There are various recipe suggestions specifying the ideal temperature and taking into account the individual properties of different types of coffee or tea.



One of the most important considerations is freshness to keep the water hygienic and germ-free. The Water Station is designed in such a way that no water is stored inside the unit to prevent any contamination. There is no storage tank and the unit is connected directly to the mains supply. Every glass of water is delivered freshly filtered and processed. Water-bearing components are cleaned and disinfected daily with water heated to 75 degrees. There is even a special formula for water that is safe for infants. In order to prevent any contamination with microplastics or changes in the taste profile after filtration, no water-bearing components inside the Water Station are exposed to plastic. Since the unit is not just designed for hospitality or corporate environments, but also for use in private households, additional attention was paid to a particularly silent operation.





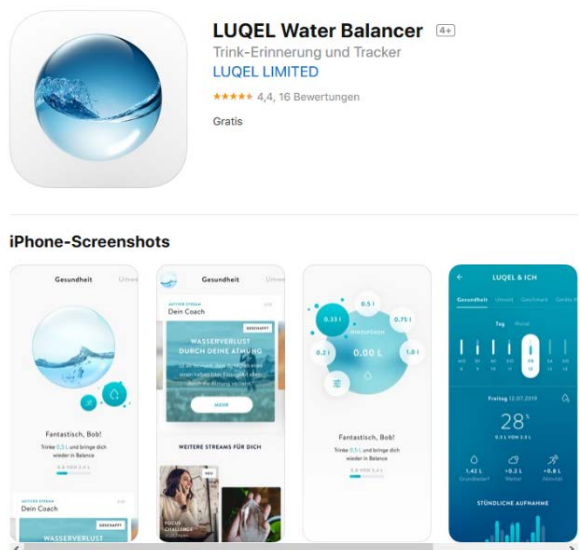
The business architecture comprises all information about how the business is organized. This includes the organizational units of LUQEL as well as their tasks, and the dependencies between organizational units. With regard to the IT system hierarchy, a distinction is made between project processes and operational processes.

All information, data, data flows, interactions of information, and the corresponding source and target systems are stored in the Information architecture. These include the enterprise resource model, class diagram, and formal UML information flow diagrams that represent the information flow from one application (system) to another (e.g., data is exported from one system to Excel, then edited, and imported into another system to derive a particular recipe from knowledge about taste preferences).

The application Infrastructure is about the interaction of technologies, systems, and applications. The LUQEL app is based on a Java applet, for example, where Java is provided on a Tomcat server that runs on an Apache server. The corresponding front end is optimized for Firefox with Javascript and

communicates with the server via JSON/XML. In addition, there is a Firefox plugin that is configured in XUL and contributes further data from a second server to enrich the existing data. The relationships between these systems are visualized in the application architecture. An example of an application architecture is shown in the figure on the left.

The infrastructure architecture represents



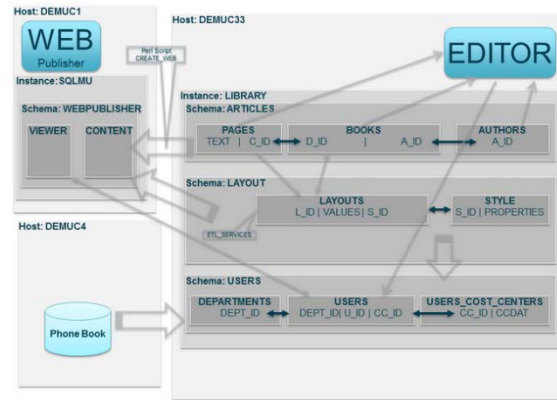
the actual information retrieval structure, including the available servers, the exact storage locations on each drive, and which

firewalls or access types require access to the information.

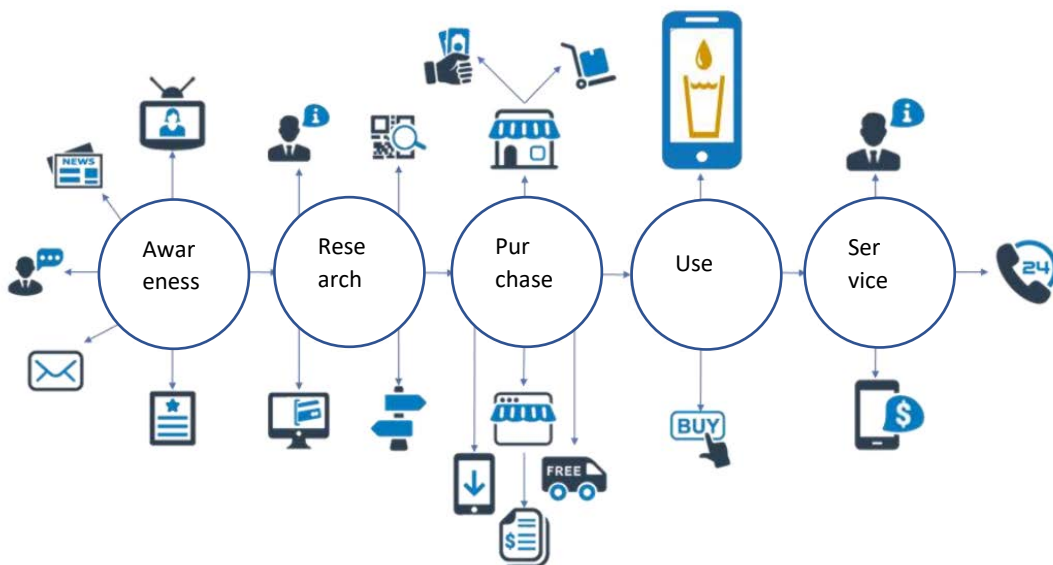
The functionality of the app as well as the system integration between the app, the Smart Bottle, and the Water Station is crucial for a consistent customer and user experience.

Apps (short for “application software”) mean that the computer system (desktop, laptop, smartphone, tablet, smart TV, or any other relatively smart device) can run without this program. The functionality of the device is enhanced by the app. Apps can be understood as means of customizing end devices and, unlike the operating system, are aimed at specific user groups. The exact content of such an app and its role within a corresponding business model are an entirely different and fairly open question.

“App” as a term became established with the introduction of Apple’s App Store. Therefore, many people associate the term with applications on mobile devices, especially on smartphones and tablets. However, a more general understanding of



the term is required since the launch of Windows 10, where apps run like other applications. Apps are also used to functionally extend other programs such as browsers. One of the key differences compared to “traditional” software is the fact that apps do not necessarily have to be fully installed on a local computer. Apps are always “additional programs” which are not essential for the actual operation of the device. From the system platform operators’ point of view (Android, IOS), apps also have the express purpose of extending the



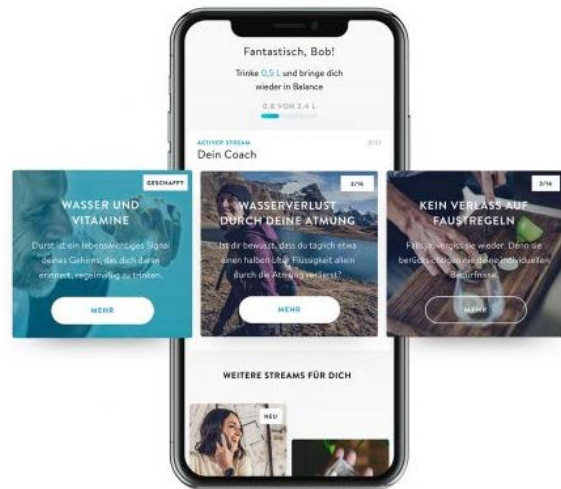
functions of devices based on system applications and can be offered “on demand”.

In contrast to “traditional” software, where the sale of software licenses is the ultimate goal of the underlying business model, this IT-oriented definition and characterization provides no clear or predetermined role for an app within a business model.

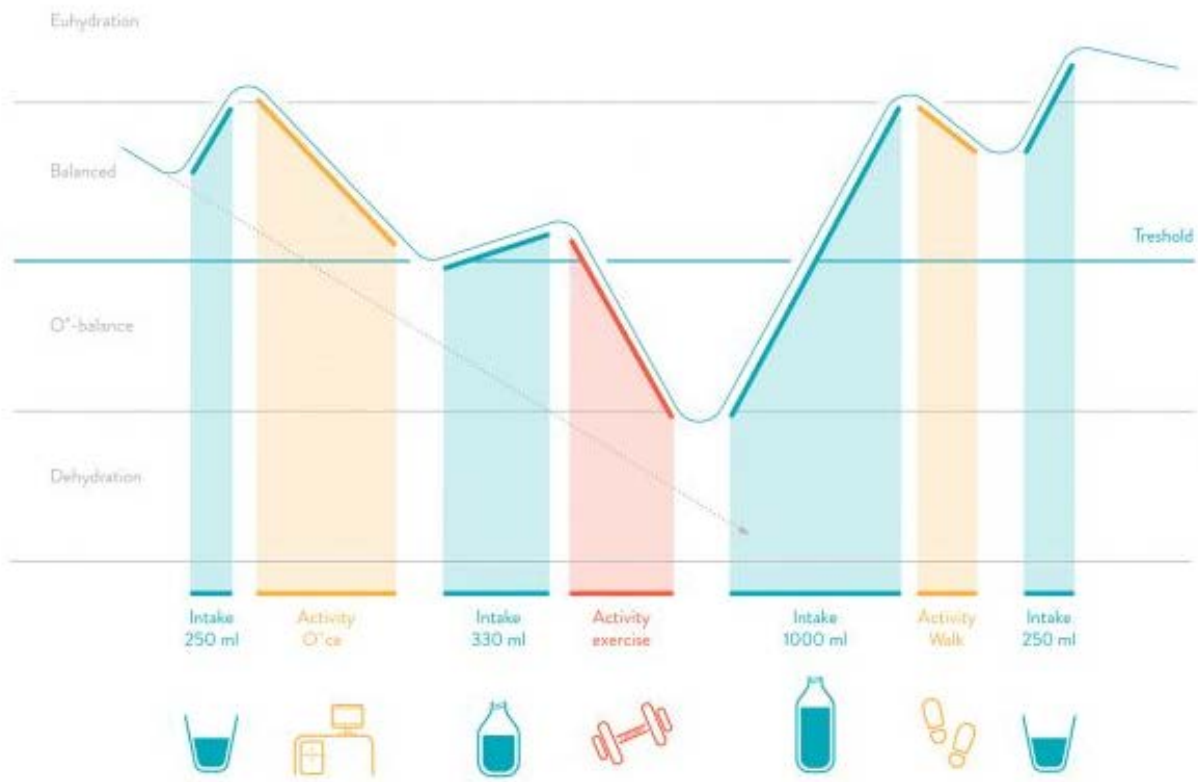
In LUQEL’s case, the purpose of the Water Balancer app is to support customers in their everyday lives. The interplay of water and activity tracking, local weather data and a science-based algorithm ensures that customers receive precisely tailored drinking recommendations, reminders, and practical tips on how to drink water the enjoyable way. A free coaching program also helps customers develop better drinking routines.

Apps are usually offered free of charge and aim to provide access to an eco-system, platform, etc., where varied services, contents, and other monetarization options are made available to users. Hardware and software are often integrated and operable via the smart device. In the simplest case, the device is operated via the app and communicates via WiFi or Bluetooth. Such devices can include car phones, Sonos speakers, a Thermomix device, or the water station, for example. The end device is used as a relatively smart operating terminal. But the app can also provide content which is completely independent of the respective terminal device or does not relate to a physical device.

LUQEL also uses deliberate interactions with reality outside the respective smart



device as in the case of Shazam or the Hololens application from ThyssenKrupp (which also includes an additional augmented reality component). In other words, the sensor technology of the smart device is used to collect data and send it to the cloud via the app to control processes there. This is how customized water can be put into practice.



To sum it all up, an app structure for IP protection can be defined as follows. The following core questions remain to be clarified:

- Which components of the Smart Device will be used (screen, keyboard, speakers, sensors (gyro, audio, brightness, camera), etc.)?
- What portions of data processing and connectivity are performed by the app on the smart device – e.g. on-screen features, augmented reality, output and analysis of sound, voice, etc., linking with other data available on the device (time, location, or other data (e.g. health apps), or data from other devices linked to the smart device, such as

fitness trackers, smart watches, board systems in cars, etc.)?

- What portions of data processing and connectivity are performed via data connections of the smart device – e.g. via the cloud (Spotify, Sonos, weather apps), which are often content-driven but also use computing power in the cloud (voice assistants) or are operated remotely via the cloud (alarm function in Sonos)?

Please find below a selection of typical use cases that can be realized through the combination of app, Smart Bottle, and Water Station:

Use case "Wake up & First Water"



Use case "Reminder"



Use case "Quality Indicator"



Use case "New Recipes"



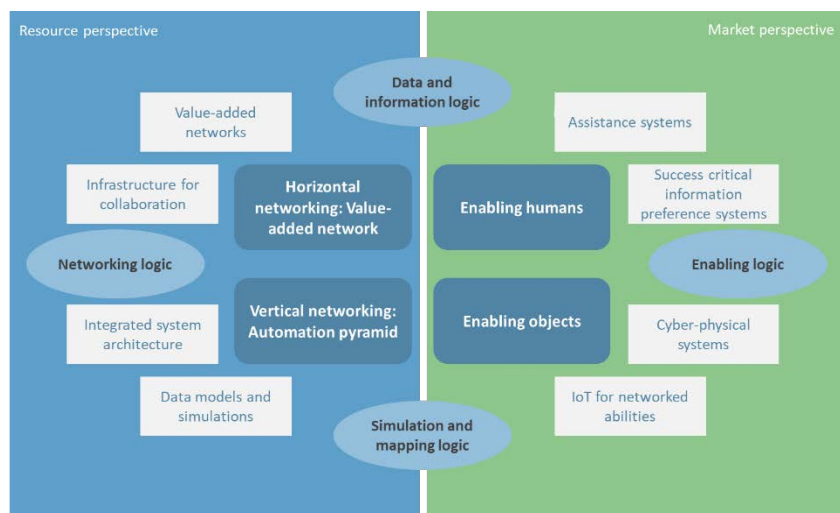
Optimization of digital business models and use of IP

When it comes to protecting digital business models by means of IP, most notably through patents, it is important to understand how the use of digital technologies affects the business model and how the technologies are implemented in each specific case. The figure below shows the potential applications of digital technologies along the resource and market perspectives of business models. The application of the four digital logics

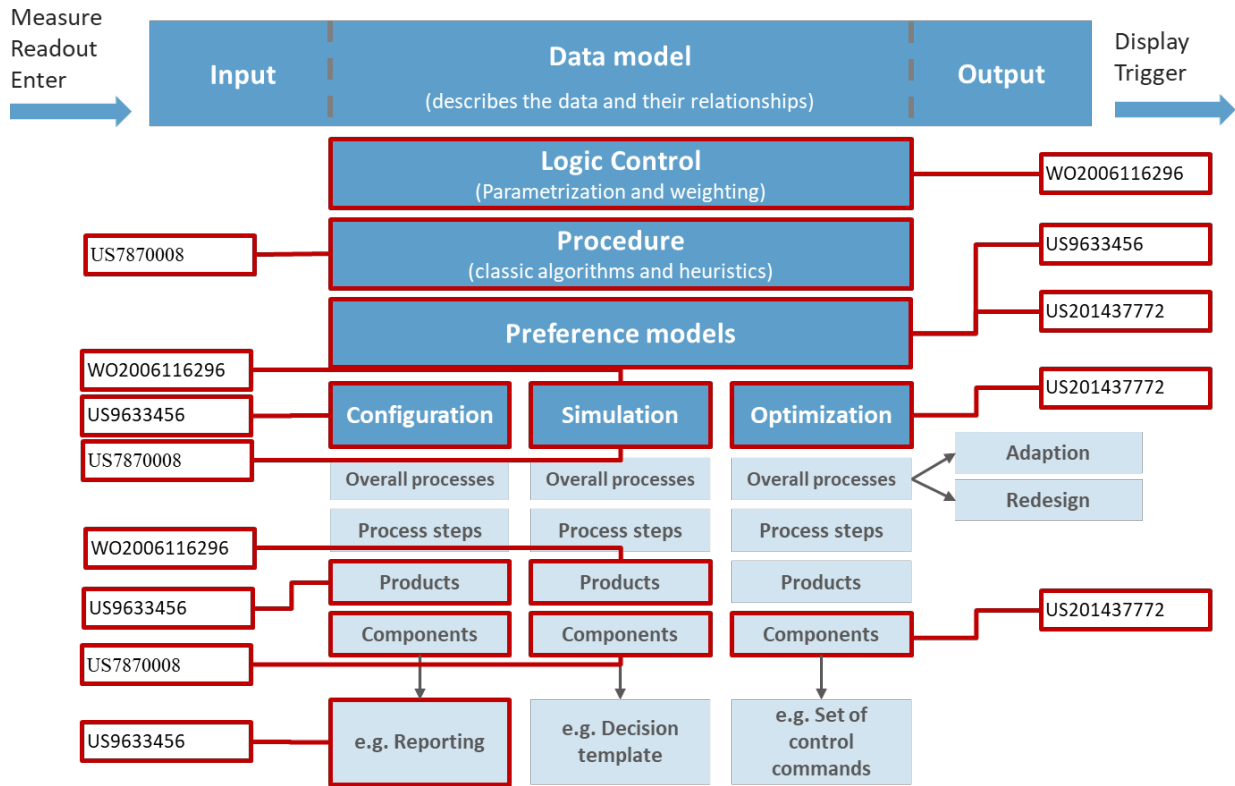
- networking logic,
- enabling logic,
- data and information logic, as well as
- simulation and mapping logic,

leads to cost reduction potentials as well as earnings potentials on the market side. These logics are linked to technological approaches such as the Industrial Internet of Things or cyber-physical systems. What is decisive for the patent position to be used in a specific case is the economic effect achieved by the use of the technology in the business model. If the technology in question has a cost effect, such as time reduction or energy savings, then a resource-oriented IP approach will be chosen and an attempt will be made to create a so-called VRIN (valuable, rare, imperfect imitable, non-substitutable) resource by means of prohibition rights. If, on the other hand, the technology in

question has a revenue effect, such as increased flexibility or the creation of new decors, then a market-oriented IP approach will be chosen in order to try to influence Porter's typical market forces (competitive rivalry, bargaining power of customers, bargaining power of suppliers, threat of new entrants, threat of substitutes, impact of complementors) by means of superior patent positions.



This systematic approach leads to a taxonomy of applicable digital patents. This taxonomy is based on empirical learnings from the protection of digital business models. The structure is highly abstracted and extensive, and must be adapted to the implemented technologies in line with the digital logics applied. The figure below shows the patent types that can be used for the development of business models and the analyses of eco-systems of LUQEL. Patent types refer to typical elements of business models whose technical implementation is described in the patent literature.



PART III

Summary: Success factors and benefits for LUQEL

LUQEL's strategic focus is on the enjoyment of drinking water. There is a growth market for clean, healthy, and great-tasting water, which is not affected by economic cycles, as evidenced by the enormous increase in mineral water sales in recent years. The main challenge in this market is to change existing drinking habits. However, a comparison of long-term trends shows that such usage habits can both be learned and changed by individual market participants. Due to changes in consumption patterns and the strong position of the food retail industry, the beverage market is highly competitive, which has led to strong price and cost pressure. LUQEL shakes up the traditional logic of bottled mineral water in the retail sector. It also breaks the focus on certain mineral waters by permitting a customized taste experience of water. In addition, it enables customization in line with individual environmental and physiological conditions. The systematic use of IP design as a management tool helps 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 helps companies to identify and protect viable future-proof strategies. The tool-based IP design methodology supports the strategic goal of operational excellence, including the digitization of internal processes, especially with start-ups. In particular, it promotes individual creative contributions of employees, thus increasing their motivation and commitment.

Contact

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What is the MIPLM?

The 21st century marks a new era as our economies increasingly rely on knowledge-based production processes and services. Consequently, the institutions responsible for education and research in the field of intellectual property law in Europe must provide appropriate training for staff from the respective professional environments to acquire or reinforce their ability to initiate, control, protect, exploit and increase the value of intangible assets. The knowledge-based economy integrates research and development activities, innovation, industrialization and the marketing of products and services including intangible assets and completely revolutionizes enterprise management. It creates new professions specialized in dealing with intangible assets: this branch of law attracts consultants and intellectual property experts from among managers, jurists and lawyers. Indeed, every innovation process generated by new economic activities assumes the intervention of the law, the installation of tools and structures for developing or planning in order to control the intangible assets and to optimize their valorization. It has therefore been the duty of CEIPI, University of Strasbourg, as a leading center for Intellectual Property Studies in Europe, to propose a master program on "IP Law and Management" (MIPLM) since 2005, which complements the existing training course for engineers, scientists and lawyers. This "European" master program features a continuous training scheme aimed at experts in the field of intellectual property. It provides a genuine education program based on an investigation carried out in large enterprises in Europe. The teaching staff comprises academics and experts from various countries, renowned for their work and competence in dealing with the impact of intellectual property on the policy of enterprises.



M. Yann Basire
Director General of CEIPI.

Intellectual property has become a crucial factor and driving force in the knowledge-based economy. The economic development and the competitiveness of companies increasingly depend on the generation and exploitation of knowledge. Intellectual property can convert investment in corporate knowledge creation into economic benefits. Thus IP-based appropriation strategies form the basis for creating wealth and competitive advantages for companies from their R&D and innovation activities. The development and implementation of sustainable strategies for IP exploitation require a concerted integration of the disciplines involved in order to achieve an interdisciplinary perspective on IP. In a knowledge-based economy, companies can only achieve a competitive edge by combining the economic, legal and technological sciences. IP management within such a holistic approach provides optimized appropriation strategies and thus essentially contributes to the creation of wealth within a company. Accordingly, IP management needs skilled managers who can combine the economics of intangible assets in an intellectualized environment with multidisciplinary knowledge in order to maximize the benefits of IP. A new type of competencies, skills and underlying knowledge enters the arena of management and management education. The increasing impact of intellectualized wealth creation by investment in knowledge, R&D and innovation followed by its exploitation and IP-based appropriation calls for seminal new education concepts. The CEIPI program "Master of IP Law and Management" offers such a new type of management education. It follows an intrinsically multidisciplinary approach to meet the challenges and requirements of the knowledge-based economy. This master program combines legal, economic and management sciences and includes lectures from leading scholars in the field of IP law and management. Its ultimate objective is to qualify experienced IP professionals for acting as practically skilled IP managers with a sound knowledge of the principles of wealth creation in our knowledge-based economy.



Alexander J. Wurzer

Director of Studies, CEIPI | Adjunct Professor

Director of the Steinbeis Transfer Institute Intellectual Property Management

Concepts of the Studies Intellectual property and economics in the present context are two disciplines that exist in parallel.

Experts are found in each discipline, but with a lack of mutual understanding and training. Both "worlds" are nowadays bridged by experts, called IP managers, who link both disciplines through knowledge and experience. The CEIPI studies pursue a holistic approach and engage experts for the developing market of an IP economy. They are experts for basic economic management processes with specific assets. Management is understood in the broad sense of an overall company management and accordingly divided into six general functions:

- 1. Strategy
- 2. Decision
- 3. Implementation
- 4. Organization
- 5. Leadership
- 6. Business Development

On the basis of this differentiation skills should be allocated to management functions, and relevant knowledge to the functions and skills. The teaching concept focuses on both areas, skills and knowledge, as relevant to business with intellectual property.

Skills can be allocated to the specific management functions as relevant to the practical work within IP management. The skills are thus determined by the daily challenges and tasks an IP manager encounters.

For example, the "Decision" function includes skills such as "valuation and portfolio analysis techniques", and "Organization" as a function requires skills to manage IP exploitation and licensing including economic aspects as well as contractual design and international trade regulations with IP assets.

Special knowledge of economy and law is required in order to implement and deploy these skills in business. This includes knowledge of economic basics such as function of markets and internal and external influence factors. Additional management knowledge is also included such as value-added and value-chain concepts.

The legal knowledge includes contractual and competition law, and special attention will be paid to European and international IP and trade law, e. g. litigation, licensing, dispute resolution. Following this concept, IP law and management can be combined in clusters formed of specific skills and knowledge defined within each management function.

The lectures have a high international standard; the lecturers possess a high reputation and long experience in the teaching subject with academic and practical backgrounds.

The top-level experts come from the fields of law, economics and technology. The experts and the students work closely together during the seminar periods. Exchange of experience and, as a consequence, networking are common follow-ups.

Participants & their Benefits This European master's program was designed especially for European patent attorneys, lawyers and other experienced IP professionals.

Its ultimate objective is to qualify experienced IP professionals to act as IP managers with the practical skills and knowledge to deal with the new challenges of wealth creation and profit generation. Participants acquire first and foremost a new understanding of how intellectual property works in business models and are conveyed the necessary skills to achieve the systematic alignment of IP management and business objectives.

The course provides an international networking platform for IP managers and in addition enables participants to build long-lasting relationships and to further develop relevant topics within the field of IP management. Being part of this international alumni network also offers new job opportunities and publication possibilities.



Past lecturers and academics

Prof. Jacques de Werra,
University of Geneva

Prof. Estelle Derclaye,
University of Nottingham

Prof. Christoph Geiger,
University of Strasbourg

Prof. Jonathan Griffiths,
School of Law, Queen Mary,
University of London

Dr. Henning Grosse Ruse-Kahn,
Faculty of Law, University of
Cambridge

Prof. Christian Ohly,
University of Bayreuth

Prof. Christian Osterrith,
University of Constance

Prof. Yann, Ménière,
CERNA, École des mines de
Paris

Prof. Cees Mulder,
University of Maastricht

Prof. Julien Pein,
University of Strasbourg, BETA

Prof. Nicolas Petit,
University of Liege

Prof. Alexander Peukert,
Goethe University,
Frankfurt/Main

Prof. Jens Schovsbo,
University of Copenhagen

Prof. Martin Senftleben,
University of Amsterdam

Prof. Bruno van Pottelsberghe,
Solvay Business School

Prof. Guido Westkamp,
Queen Mary University London

Prof. Alexander Wurzer,
Steinbeis University Berlin

Prof. Estelle Derclaye,
University of Nottingham

Prof. Ulf Petrusson,
Göteborg University

Past lecturers and speakers, practitioners and institutions

Arian Duijvestijn,
SVP BG Lighting Philips

Kees Schüller,
Nestlé S.A.

Thierry Sueur,
Air Liquide

Heinz Polsterer,
T-Mobile International

Dr. Fabirama Niang,
Total Group

Philipp Hammans,
Jenoptik AG

Dr. Lorenz Kaiser,
Fraunhofer-Gesellschaft

Leo Longauer,
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Nikolaus Thum,
European Patent Office

Bojan Pretnar,
World Intellectual Property
Organization

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Köllner & Partner Patentanwälte

Dr. Dorit Weikert,
KPMG

Keith Bergelt,
Open Innovention Network

Selected companies

3M Europe S.A.

ABB Corporate Research Center

ABB Motors and Generators

AGC France SAS

Agfa Graphics

Air Liquide

Airbus Defence and Space

Akzo Nobel NV

BASF Construction Chemicals

Boehringer Ingelheim Pharma

British Telecom

Clyde Bergemann Power Group

Danisco/Dupont

DSM Nederland

Fresenius Medical Care

Groupe Danone

Jenoptik

Kenwood

Nestec Ltd

Novartis AG

Philips

Pilkington

PSA Peugeot Citroen

Rittal

Sanofi/Aventis

SAP SE

Schlumberger Etude&Production

ST-Ericsson

Tarkett GDL

Total S.A.

UBS AG

Unilever

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The screenshot shows the IP Business Academy website interface. At the top left is the logo for IP business academy, with the tagline "YOUR GLOBAL IP-MANAGEMENT EDUCATION PLATFORM". The top navigation bar includes links for Home, Education, Career, Community, and About, along with a search icon. The main content area is titled "Category: MIPLM Industry Case Studies".

The first article, dated 28 JANUARY 2021, is titled "Fleet management at Hilti – A case study on digital business model transformation and the role of IP". It features an image of a person using a smartphone with a Hilti power tool in the background. The article text begins with "Kleenex is synonymous with paper tissues, Aspirin with pain killers, Scotch with adhesive tape, and BIC with correction pens. In fact, these brands have lent their names to entire product categories, evoking direct associations with quality and functi ...". A "READ MORE" button is visible below the text.

The second article, dated 4 JUNE 2020, is titled "Four German Innovation Awards for IP-Design case studies in 2020". It features an image of a laptop displaying a website and a "GERMAN INNOVATION AWARD 2020" logo. The article text begins with "The German Design Council, initiated by the German Bundestag and sponsored by German industry, announced this year's international German Innovation Awards on May 26th. Four times among the winners: Innovations that are explained in the case studies o ...". A "READ MORE" button is visible below the text.

On the right side of the page, there is a "SEARCH" section with a search input field. Below it is a "CATEGORIES" section with a list of categories and their respective counts:

Category	Count
Career / Education	12
CEIPI / MIPLM	6
CEIPI Distance Learning DU IP BA	12
CEIPI Executive Management Days	0
CEIPI Summer School	18
MIPLM Dinner Speech	5
MIPLM Industry Case Studies	12
Fellowship Program	31
Job Posting	1
Research Project	5
14	
Companies	97
365FarmNet	1
ABB	1
ABUS	1
AirBnB	1
Airbus	3
Alibaba	1
ARRI	1
Audi	1
B. Braun	1
BASF	3
Blackberry	1
BLANC & FISCHER	1
BMW	1
Bosch	1
5	

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