Industry Case Study Series on IP-Management

Rittal
Smart factory showcase for Industry 4.0

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MIPLM Industry Case Study Series Nr.: ICSS2015-01-324
CEIPI, University Strasbourg in cooperation with
Steinbeis Transfer Institute for Intellectual Property Management
Steinbeis + Akademie, Thalkirchner Str. 2, 80337 Munich

GERMAN INNOVATION AWARD '19 WINNER

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PART I

About Rittal

Rittal is the largest company of the Friedhelm Loh Group (F.L.G.), based in the Hessian town of Haiger and owned by German entrepreneur Friedhelm Loh. Following his apprenticeship and uni-versity education, Loh worked in metal processing before he founded Rudolf Loh Elektrogerätebau in Rittershausen in 1961. The business model was based on the motto: "Control cabinets immediately available ex warehouse". In 1969, Rudolf Loh Elektrogeräteabau was renamed Rittal, an acronym derived from the company's Rittershausen location and the municipality of Dietzhölztal, where Rittal has its headquarters. In 1974, Friedhelm Loh took over as Chairman of the Executive Board. In 1998, Rittal acquired EPLAN Software und Service, an IT company specializing in project planning, mechatronic configuration, management and documentation of automation projects in electrical engineering, cable tree construction, project planning of circuits for fluid engineering systems (e.g. for cooling) and 3D engineering of control cabinets and switchgear. Also in 1998, Rittal acquired Lampertz, a company specializing in IT security systems, Since 2013, the Friedhelm Loh Group has acquired Cideon. Cideon is a specialist for developing SAP and Autodesk interfaces in the areas of CAD/CAE system manufacturing and software development.

These important acquisitions by F.L.G. prove that entrepreneur Friedhelm Loh has recognized the importance of the planning and engineering process along the value chain of control cabinets at an early stage and acquired the necessary competencies for the group. F.L.G. generates a turnover of more than 2.2 billion euros with over 11,500 employees across 12 manufacturing locations world-wide. Not least because of his keen eye for long-term developments and his entrepreneurial vision paired with strategic skills, Friedhelm Loh has earned himself a number of senior honorary offices in leading German industrial associations. He is Vice President of the Federation of German Industries (Bundesverband der Deutschen Industrie) and Honorary President of the Central Association of the Electrical Engineering and Electronics Industry (Zentralverband der Elektrotechnik- und Elektronikindustrie).

Rittal sees itself as a pioneer of the Smart Factory and the concrete implementation of Industrie 4.0 within Germany's industrial landscape. Under the management of CTO Dr. Thomas Steffen, the company develops concepts, standards and solutions for implementing Industrie 4.0. With its central product, the control cabinet system, Rittal sees itself as a pioneer of tomorrow's smart factory. Rittal's objective is to develop futureproof solutions for integrated value chains in control system and switchgear construction by providing integrated engineering tools, standardized systems technology and automated processing machines in order to enable its customers to maximize efficiency in their product development processes. Since processes and productivity are increasingly linked to interfaces, Rittal invests in solutions for the integration of IT into the industrial landscape.

A control cabinet is a housing for electrical and electronic components of industrial systems such as machine tools, plants or manufacturing facilities. In the context of IT data centres, we also speak of racks, where servers, network computers and other components are installed and cooled. In its simplest form, a control cabinet only contains clamps on terminal blocks in order to establish electrical and mechanical connections between the different components of a system in a tidy and organized manner. In this case, it is referred to as a terminal or distribution box. The cabinet protects these components from mechanical and possibly also climatic influences from the environment. The components are protected from dust and water, the internal design is structured and easy to maintain, the cabinet is cooled to prevent overheating and the components are protected against electromagnetic interference. In addition, the cabinet prevents accidental contact with live parts and connections.

Rittal's control cabinet products are part of a system platform which combines products, engineering solutions and services. Control cabinets are usually special solutions serving as switchboards for machines and systems in industrial settings or as computer racks for data centres. Rittal's key competitive advantage is its largely continuous value chain

Figure 1: Typical industrial control cabinets from Rittal.

design from development and engineering through to products and services. This enables optimized power supply, high energy efficiency when it comes to cooling and complete data centre designs. [1]

As far as energy efficiency is concerned, control cabinets play a central role in the operation of systems and data centres. There is a steadily growing demand for IT performance and data centres, for instance. In Germany alone, some 7 billion euros are spent on data centres each year. Improving the energy efficiency of data centres is of particular importance when taking into account that approx. 10 billion kWh of electricity are consumed due to market growth alone. By 2020, the energy consumption of data centres in Germany will be roughly 12 billion kWh. Significant savings can be achieved by cooling electronic components in the most energy-efficient manner possible. With industrial control cabinets, cooling is especially important in order to ensure greatest possible component availability. Rittal's Blue e+ is currently the most efficient cooling device series in the world. These cooling devices are also integrated into Rittal's Industrie 4.0 solutions and the company has received several innovation awards for them.

The electrical industry itself is a comparatively old industry which developed during the second phase of the industrial revolution towards the end of the 19th century. In sim-

Figure 2: Control cabinets as part of the IT infrastructure at a data centre.

[1] *Hahnstein*, IT und IT-Infrastruktur im Kontext von Industrie 4.0, Rittal Whitepaper, Herborn: 2015.

ple terms, electronic engineering distinguishes between power engineering, i.e. power supply, and light-current engineering, which, in its broadest sense, could be referred to as electrical engineering. This includes specialist areas such as plant engineering, automation, batteries, consumer electronics, electric vehicles, electrical energy systems, cables and transformers.[2]

With a turnover of about 180 billion euros, the electrical industry is the second largest industry in Germany after the mechanical engineering and plant engineering industry. It is also among Germany's most successful export industries. Some 12,000 patent applications are generated by this industry each year, making it a key driver for the manufacturing industry. For many historians, the German electrical industry is a paradigm of the industrial revolution. What is more, this sector is considered the greatest industrial performer alongside the chemical and automotive industries. According to John Harold Clapham (1920s), Germany was the leader in virtually every area of application for electricity for many years or even decades. Today, a number of trends are creating a great deal of momentum in the global electrical industry.[3] Driven by the overarching topic of digital transformation, the single most important driver of innovation and source of inspiration, this trend entails opportunities and risks for companies.[4] Different developments are leading to significant change dynamics in the electrical industry. These include ever shorter innovation cycles, for instance, a trend which is not only found in consumer electronics but also extends to industrial solutions. Novelty products and product ranges already account for 40% of the total turnover of companies in the electrical industry – with an upward tendency. In addition, there is a growing trend towards plagiarism and crude imitation of highly innovative solutions. An important trend in the electrical industry is the ever increasing added value contribution it makes to the automotive industry. Driver technologies for electric drives, autonomous driving or connectivity (including mobile entertainment), for instance, fall entirely within the competence spectrum of the electrical industry. Technological advances in the automotive industry stem to an increasing extent from the electrical industry. Another important driver in Germany is the transition towards renewable energies. Due to the systematic phase-out of nuclear power backed in politics, the German industry and society are forced to switch to renewable energies. This also includes future-oriented topics such as smart grid, smart home and smart factory.

The electrical industry is a key driver of these future-oriented topics and, being a driver of

2 *BMWI* [ed.], Industrie 4.0 und Digitale Wirtschaft, Berlin: 2015

3 *Seidel/Harbeck*, Wachstumschancen durch Industrie 4.0, Computerwoche: 28/02/2014.

4 Cf. *Winterhagen*, Industrie 4.0 blüht auf, Ampere 1 (2016) 13-16.

innovation, it also provides the necessary technologies and components. As computed by the Central Association of the Electrical Engineering and Electronics Industry (Zentralverband der Elektrotechnik- und Elektronikindustrie), annual savings of between 10 and 25% of energy or 7 billion euros can be achieved in Germany through the systematic application of these technologies alone.

The overarching topic in the electrical industry is Industrie 4.0. Not just the electrical industry itself but also all other manufacturing industries require solutions for digital transformation. The industry speaks of a "mammoth project" when trying to name and describe the scope of the challenges involved. This opens up promising business opportunities for the economy, especially with regard to trends such as big data, cyber security and new production technologies such as 3D printing and organic electronics.[5]

Industrie 4.0 is primarily about connecting the digital world of the Internet with the conventional processes, components and services of the manufacturing industrial economy. The focus here is especially on creating horizontal and vertical connections along industrial value chains with a shift in value creation and control from top to bottom. The practical implementation of the basic idea of the Internet of Things has reached a high level of maturity in the past few years and is now being implemented in a wide range of user industries. This digitization in the manufacturing sector is subsumed under the term Industrie 4.0. This digital transformation of production is leading to much more transparent manufacturing, which in turn enables greater flexibility and optimization. Basic parameters such as machine utilization, productivity and individual performance as well as product combinations can thus be improved and implemented by means of cyber-physical systems.

The digital transformation currently taking place in industrialized countries differs substantially from the change processes of previous decades. New services and new business models are being developed on the basis of digitally networked technologies. Products from the electrical industry, from electronics to industrial software, play an important role as enablers in this respect. The development of the digital lead markets within the electrical industry, ranging from energy, living, health and mobility to factory and process automation (Industrie 4.0), is therefore equally dynamic.

The central motivation for the implementation of Industrie 4.0 solutions is to increase productivity as well as flexibility in manufacturing, while at the same time reducing production costs. In addition to making the cus-

5 *Hellinger/Stumpf/Kobsda*, Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0, *Kagermann/Wahlster/Helbig* [eds.], Büro der Forschungsunion bei Stifterverband für die Deutsche Wissenschaft.

tomer benefits transparent, the critical success factors for the industrial sector are to master the challenge of retrofitting existing systems and to effectively integrate solutions into the companies' business processes. The electrical industry is regarded as the driver of every third innovation and views itself as the leading sector when it comes to digitization. However, this industry's role as a provider of digital products is still in its infancy. The electrical industry currently generates just over 20% of its revenue with digital or digitally enhanced products or services.

40% of all transnational patents registered in Germany come from the electrical industry. With key technologies such as digital communication, imaging, micro and nanoelectronics, power electronics and industrial applications (sensors, actuators, machine control systems), significantly more than half of the patents generated by German companies are attributable to the electrical industry. The electrical industry's contribution in terms of computer-implemented inventions (often referred to as software patents) amounts to approximately 60%.

The challenge

Industrie 4.0 in the manufacture and use of control cabinets

Two key technical developments are driving the digitization of the economy. On the one hand, there is the connection of humans and machines through the Internet via existing and new communication technologies, which permits new forms of communication, interaction and work sharing. Virtually unlimited networking capacities generate a wealth of data whose evaluation and use leads to new business models and services with great economic potential. The most important raw material of these new business models is data. On the other hand, this makes it easier to describe and simulate processes with algorithms and to create "digital twins" of the physical world. Apart from improved networking capabilities, the true disruptive potential of digitization can be found in the virtualization of products and processes, which leads to some kind of data economy along the Industrie 4.0 logic, because virtually everything can be described by means of data models and deployed in real time. This technical dimension of digitization is easy to grasp when distinguishing between product and process level on the one hand and the physical and virtual worlds on the other.

For Rittal, this leads to the following options along the value chain for control cabinets:[6]

- Smart integration
  Especially in manufacturing, this includes systems and plants which are controlled within data-driven cyber-physical systems. This is a further development of classical automation technology and robotics, whose possibilities are greatly expanded by internal and intercompany networks. The goal can be self-learning and self-controlling processes in real-time value-added networks, for instance. This also applies to the production of control cabinets at control cabinet manufacturing plants.
- Smart products
  These are physical/material products enabling the monitoring and control of the control cabinet while in use at the customer's premises via sensors and actuators. Manufacturers and users remain connected throughout the entire life cycle. This permits the provision of industrial services with digital business models of their own.
- Smart operations
  This refers to the virtualization of physical processes, i.e. modelling by means of digital twins. As a result, planning and control processes can be optimized because simulations and the search for better solutions are becoming easier. This can be applied to internal processes and interactions with suppliers and customers alike. Extensive data collection systems, advanced evaluation and analysis techniques and software solutions are employed for this purpose. This allows development engineers to identify weaknesses and potentials for development in the control cabinets at an early stage, for example. Algorithms can also be used to predict possible component failure.
- Smart services
  Smart services are comprehensive, digitally supported services for products or systems throughout the entire life cycle, such as predictive maintenance, upgrades, etc. They include a broad range of services from online shops, apps and software solutions through to streaming services and the above-mentioned product-related after-sales services.

Control cabinets consist of a variety of terminals, wires and other passive or active components. Almost all control cabinets are specifically designed for their respective application. This means that the mechanical assembly of the control cabinet by the manufacturer as well as the wiring of the components

[6] Cf. *Bedenbender* et al. (Arbeitsgruppe „Modelle und Standards, ZVEI and work group "Referenzarchitekturen, Standards und Normung, Plattform Industrie 4.0, Beziehung zwischen I4.0-Komponenten – Verbundkomponenten und intelligente Produktion", Bundesministerium für Wirtschaft und Energie (BMWi) [eds.], Zentralverband Elektrotechnik- und Elektronikindustrie e.V.: 2017.

is a lengthy activity which often still requires a great deal of manual labour. However, this step of the value chain, from the planning and design of the cabinet to its industrial application, could benefit from the greatest efficiency gains through digitization and the application of Industrie 4.0 approaches. According to a study conducted by the Institute for Control Technology of Machine Tools and Manufacturing Plants (Institut für Steuerungstechnik der Werkzeugmaschinen und Fertigungseinrichtungen) at the University of Stuttgart, time savings of 35% could be achieved in control cabinet construction by using prefabricated cables based on data sets obtained from control cabinet engineering alone. If the wiring itself was completed on the basis of a structured list of connection data, even up to 50% of manufacturing time could be saved. It is still quite common among control cabinet manufacturers to draft construction and wiring diagrams of control cabinets on paper. Electronic data storage and a comprehensive data platform could release enormous efficiency potentials. This could include the verification of the assembly and wiring of the finished control cabinet based on electronic data (digital twin) prior to the actual assembly, for instance.

State-of-the-art manufacturing plants and production machines have an increasing number of control cabinets with a growing number different components. Within the scope of foreseeable developments in Industrie 4.0 approaches, future machines and systems will likely be increasingly networked and become smarter and smarter. This is going to lead to ever increasing expectations from the logics and components of control cabinets, and consequently to greater demands on engineering and production.[7]

A possible solution could be to divide circuit diagrams and design drawings into modular and functional units. These units would then have to be constructed and tested in accordance with their respective functions only once and could subsequently be reused during the engineering stage. Such approaches are already known from logical component and integrated circuit engineering, for instance. The key to further efficiency gains is 3D construction, which has long been the method of choice in architecture, general construction as well as mechanical and plant engineering. Over 90% of all control cabinet manufacturing projects, however, are still carried out using two-dimensional engineering data. This regularly leads to problems during the manufacture of control cabinets, since spatial collision testing is not possible with 2D data. As a result, control cabinet engineers only recognize such collisions during actual installation, forcing them to improvise and rework their constructions. Efficiency

[7] *Pyper*, Industrie 4.0 im Schaltschrankbau, keNext 06/10/2016.

gains can also be achieved for individual adaptations such as the punching of breakthroughs or the attachment of cable ducts when 3D data are readily available during production. Further Industrie 4.0 topics for efficiency improvement include automatic wiring by means of machines and three-dimensional thermal planning of control cabinets including cooling simulation.[8]

Part II

IP strategy for the digital value chain in switchgear and control system production

For the Friedhelm Loh Group, the focus of its strategic considerations when it comes to IP is on remaining competitive and protecting the F.L.G. value chain from collisions with third-party rights. In addition to imitation protection, the aim is to be able to develop and defend USPs of greatest possible relevance to the customer due to an integrated and digital value chain.

The figure below shows the industrial value chain for a control cabinet. With its group companies Rittal, Kiesling, EPLAN and Cideon, F.L.G. is positioned at crucial points of the control cabinet value chain, ranging from planning to production.

The aim is to use digitization in order to achieve greatest possible exclusivity for relevant customer benefits through value chain integration. The industrial value chain is defined by all stages of the manufacturing process, including all upstream and downstream activities. These stages dictate the requirements for vertical and horizontal integration:

- Consistent digitization of engineering across the entire value chain
- Horizontal intercompany integration along value creation networks
- Vertical integration of systems, e.g. with ERP systems, via sensors and actuators

[8] *Rinortner*, Welche Chancen die Digitalisierung für Hersteller und Kunden bietet, Interview with *Dr. Thomas Steffen*, R&D Director at Rittal, Elektronik Praxis, 21/03/2017

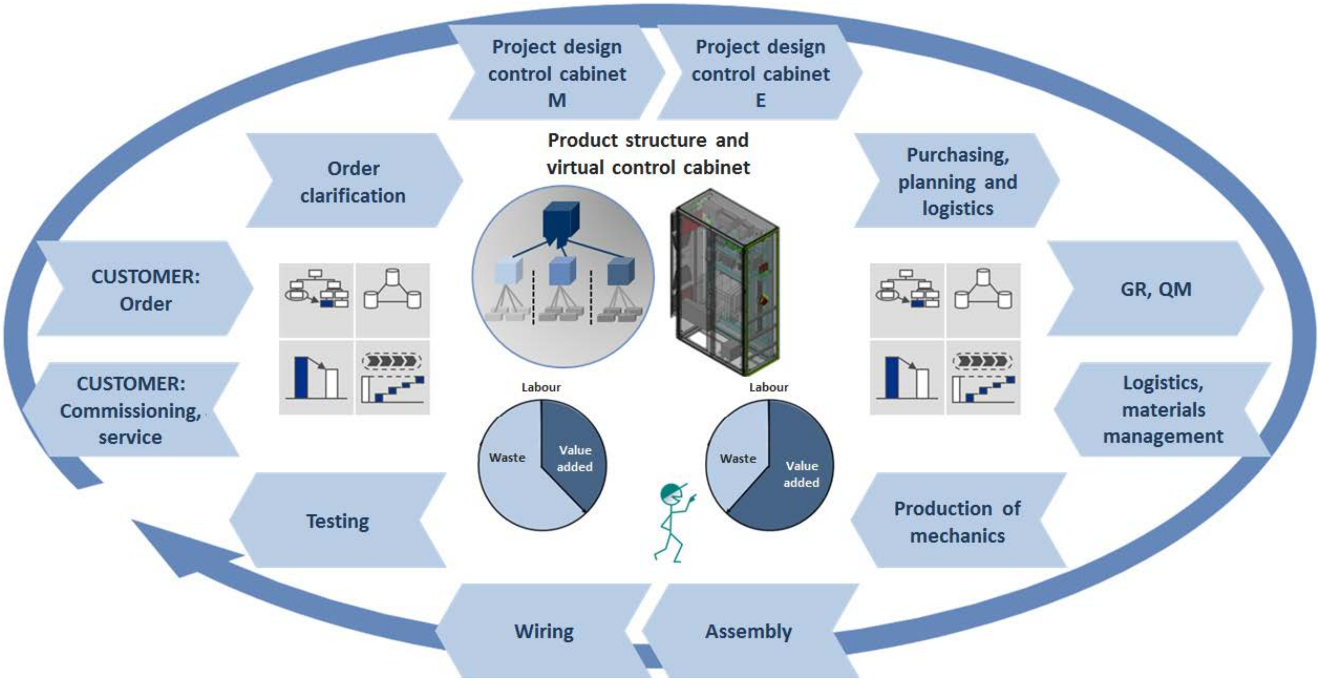

Figure 3: Schematic representation of the industrial value chain in control cabinet manufacturing.

At engineering level, EPLAN provides a platform technology enabling the centralized provision and administration of data related to planning and production. This platform allows data continuity from pre-planning to production without having to change systems. EPLAN provides comprehensive product data for all components, enables electrical planning by means of variant technology and facilitates the structural planning of control cabinets in 3D. As a result, downstream manufacturing problems can already be taken into account and eliminated at the planning stage.

CIDEON closes the interface gap between the administrative ERP software and the PLM system, e.g. by automating BOMs.

Rittal offers modular cabinet systems with comprehensive compatible system accessories, including power distribution, climatization and IT infrastructure systems. This not only ensures maximum flexibility and availability, but also safe power distribution, standard-compliant solutions and efficient climate control.

Workshop automation solutions for control cabinet manufacturing are provided, including all aspects from processing to assembly and wiring. The Perforex Machining Centre can be used for processing flat parts and housings, the Secarex Cutting Centre cuts cable ducts and support rails. In addition, there is an automatic terminal strip machine for the automatic assembly and cutting of terminal strips. And finally, the Averex Wiring Centre can be used for the efficient wiring of mount mounting plates.

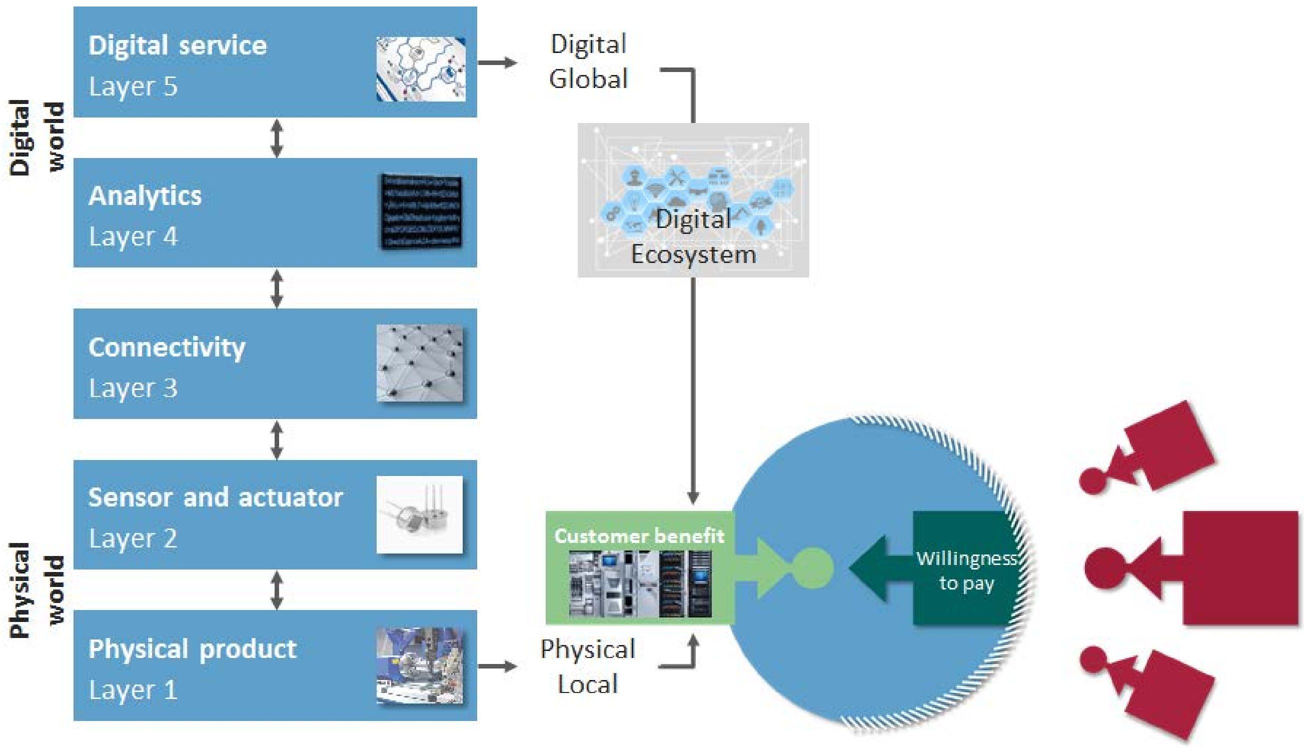

Figure 4: Schematic representation of the protection of digital Industrie 4.0 business models.

The decisive factor for efficiency along the entire value chain is integrated data handling from data provision (e.g. via individual components as "digital items") and product specifications as "virtual models of the control cabinet" to data interfaces and outputs for all process steps in manufacturing, commissioning, operation and maintenance.[9]

In order to design an IP strategy for the digital value chain in switchgear and control system production, it is useful to identify the different layers involved in Industrie 4.0 approaches. At the lowest level, there is the actual physical product: in Rittal's case, the finished control cabinet to be used at the customer's premises including all components. The layer above includes the sensors and actuators making the control cabinet electronically interoperable with the virtual world. The next layer consists of networking capabilities and therefore the possibility of collecting, transferring and storing data and controlling the control cabinet remotely. These data as well as data from other sources can subsequently be analyzed and the insights gained can be used in service provision. Typical applications include condition monitoring and the possibility of pre-emptive maintenance.

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9 Cf. *Sattler*, Schutz von maschinengenerierten Daten, in: *Sassenber/Faber*, Rechtshandbuch Industrie 4.0 und Internet of Things, Beck, Munich: 2017; pp. 27 ff. for the difficulties involved in the legal handling of machine-generated data.

Together, these layers result in a value proposition for which the customer is willing to pay a certain price. These central considerations provide the starting point for developing prohibitive rights in such a way that they prevent the competition from offering benefits which are perceived by the customer as being of equivalent value.[10] This results in a sphere of exclusivity in the eyes of the customer, which allows Rittal to integrate its value proposition into its value chain.

As described above, freedom to operate is an important strategic goal for F.L.G.'s companies. Preventing infringements of third-party rights is a particular challenge for digitized business models.[11]

This becomes obvious when separating the evaluation of the probability of occurrence and the potential loss amount in a risk assessment. As a systems manufacturer, Rittal is accustomed to keeping a high number of individual components in stock and keeping them available for customers. The system accessories comprise thousands of parts and components. If a patent infringement occurs in this mechanical world, the potential damage is limited to individual components. As a rule, such components can be redesigned or the infringement can be remedied by paying a small licence fee. With digital business models, however, this situation is completely different. If a patent infringement relates to the digital twin, for instance, the entire value chain and potentially large parts of production can be affected.

But the perspectives for the mechanical and the digital world differ not only when it comes to potential losses, but also in terms of the probability of occurrence. While in the mechanical world of the physical product, the intensity of patent activities and the speed of innovation are comparatively moderate, the opposite is true for analytics and digital services. These domains are characterized by highly dynamic innovative activities of typically Internet-focused companies such as Amazon, Google, Samsung, Huawei or Apple.[12] Patent activities are far more intense than in the physical world, patent enforcement is more aggressive and the requirements from digital process patents and data models are typically much more complex than in the case of mechanical solutions. The digital transformation of business models

10 Cf. *Wurzer*, IP-Management im Mittelstand, in: Mittelstand-Motor und Zukunft der deutschen Wirtschaft, *Fahrenschon/Kirchhoff/Simmert* [eds.], Springer Fachmedien, Wiesbaden: 2015, pp. 161-169.

11 Cf. *Wurzer*, Aktuelles aus der IP-Ökonomie, Mitteilungen der Deutschen Patentanwälte 5 (2013) 221-225.

12 Cf. the opinion of Yann Ménière, Chief Economist at the European Patent Office (EPO), that approx. 1/3 of all patent applications at the EPO are attributable to the category of "digital patents"; based on an internal study conducted by the EPO and presented at the "Intellectual Property and Digitalization" conference, CEIPI/BETA, University of Strasbourg, 04/05/2015: http://ipforbusiness.org/understanding-the-new-role-of-ip-management-within-the-digital-transformation-in-industry-and-commerce

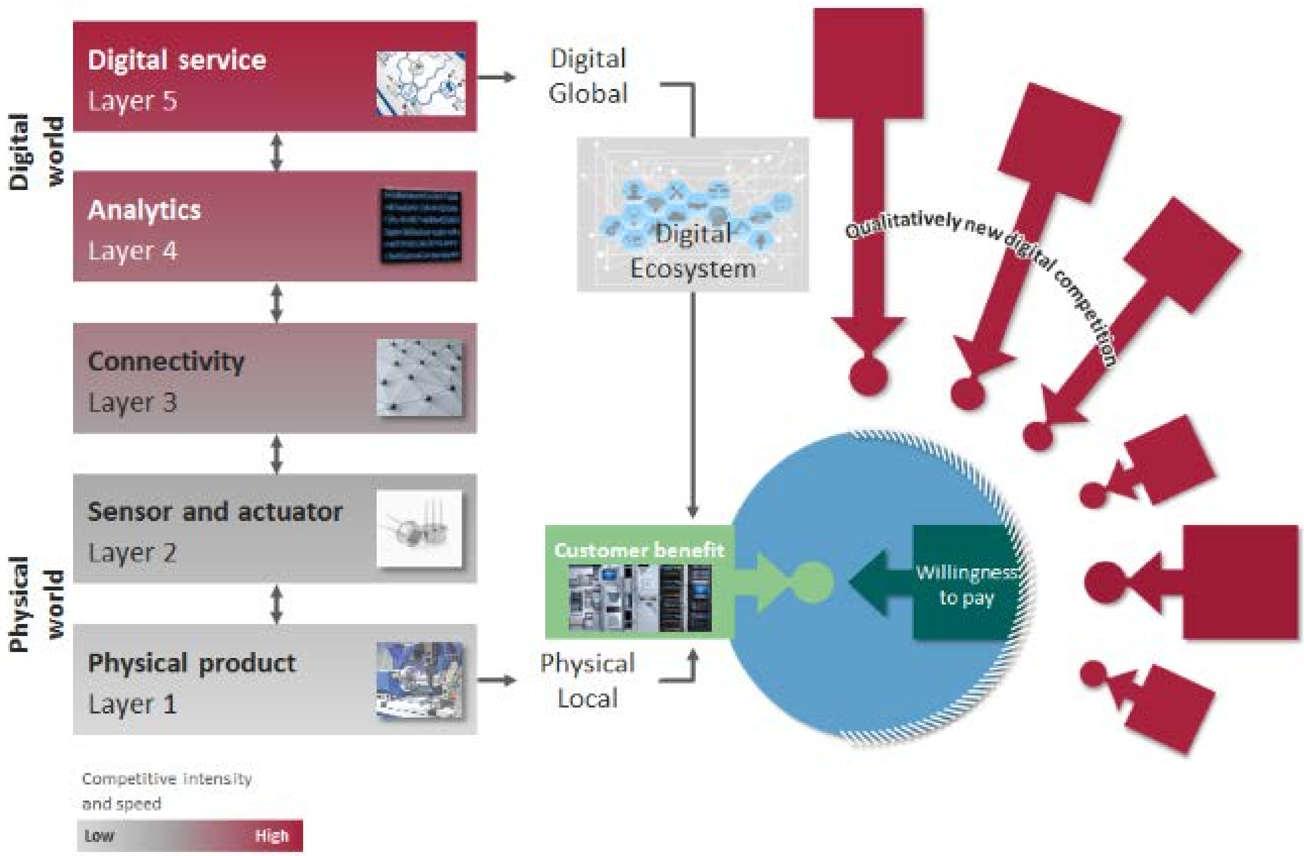

Figure 5: A different competitive situation for digital business models.

therefore requires significantly greater efforts when it comes to maintaining the freedom to operate and managing the risk of potential patent infringements.

The 360° IP strategy for the digital value chain in switchgear and control system production relies on the three IP design competencies which must be applied to the innovation project and the associated business model in an appropriate time sequence (see Figure 6). These three competences are: informing, anticipating and generating.

When managing IP within the scope of digital business models, it is important to understand that the underlying scenarios evolve continuously. In contrast to business models in the physical world (Layer 1 in Figures 4 and 5), digital business models evolve rapidly and in an evolutionary manner along changing customer requirements, competitive activities and, in particular, technical possibilities (Layers 2-5 in Figures 4 and 5). This dynamic reality of digital business models is taken into account in the problem-space/solution-space logic of the IP design process. If, after a first project run, Rittal has succeeded in establishing the necessary exclusivity along its value chain, the competitive environment, customer requirements and technical possibilities must be reanalyzed and the IP portfolio must be adjusted to changes in the underlying circumstances.

of little value unless it is used in the right context and leads to an understanding of the market and the competitive situation. This is

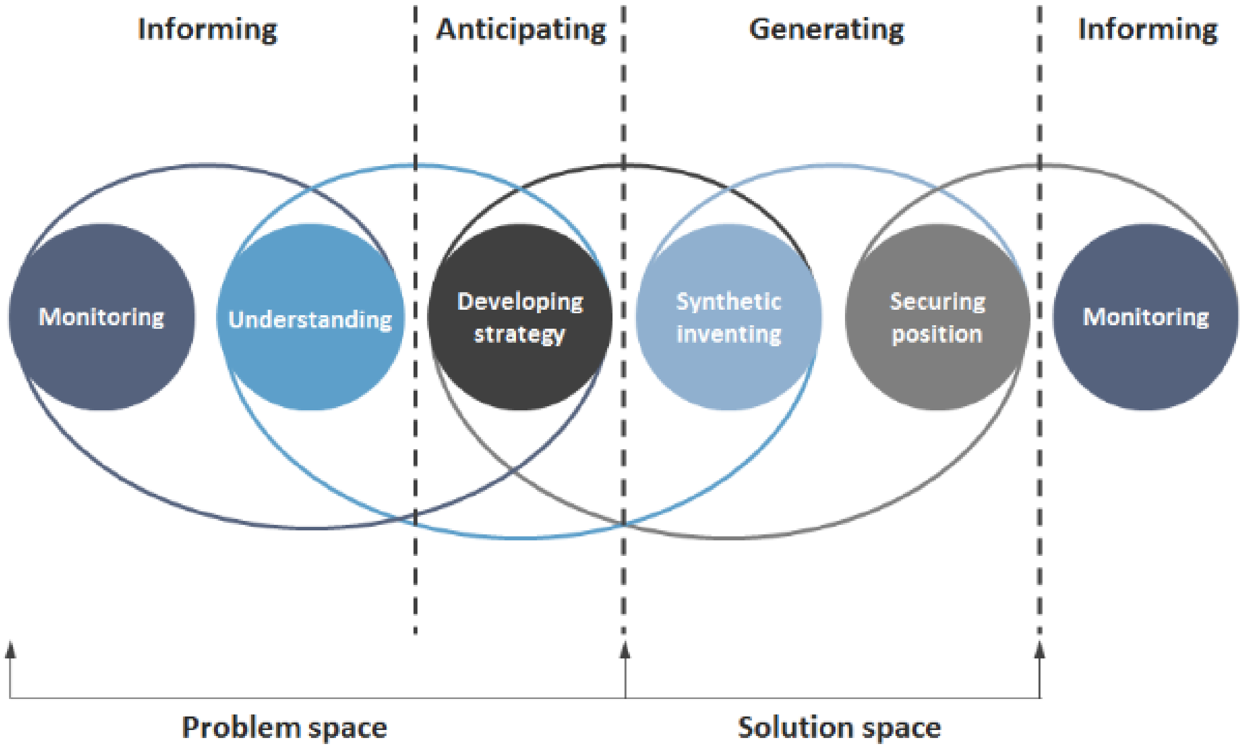

Figure 6: Schematic representation of the IP design process.[13]

The competency of informing includes, in particular, the ability to monitor the prior art and the competitive environment for relevant and desired market positions. This kind of competition monitoring goes far beyond the traditional approach of observing disclosure documents of direct market competitors as described in the patent literature. It therefore requires an alternative setup to the traditional approach. The aim is not just to find the right information, but rather to draw the right conclusions from it, i.e. to gain a profound understanding. Information per se is the core task of Intellectual Property – Function Deployment (IP-FD). [14]

An understanding of our own business model as well as the competitive and market situation (see schematic representation in Figure 3) leads to a strategic vision for the future of the company. Having "anticipated" an integrated future digital value chain for switchgear and control system production for Rittal, a 360° IP strategy can be defined. This IP strategy approach must include the

[13] Cf. *Wurzer/Kürbis*, MIPLM Industry Case Study "W.O.M.", Strasbourg: 2017.

[14] Cf. Wurzer/Becker, MIPLM Industry Case Study "Abus" Strasbourg: 2015.

tasks required for a differentiation strategy:[15] managing risks, suppressing imitation, designing a market position and communicating the USP.

IP generation is primarily based on the process of synthetic inventing.[16] The invention cores in the innovation description are based on three central elements:

- The business model, i.e. the "why?"[17]
- The application situations/user scenarios, i.e. the "how?" (see Figures 5 to 8)
- The product and service, i.e. the "what?"[18] (see Figures 1 and 2)

Rittal employs scenario analysis, which is generically described as a tool in Figure 7, in order to perform a precise analysis of the value chain and the individual sequences comprised in the larger steps (see Figure 3).

Adopting a dynamic perspective is crucial for the IP design method of the application scenario. While descriptions of technical systems often rely on static visualizations, application scenarios deliberately refer to time sequences (storyline with activities). In the case of cyber-physical systems, it is important to distinguish between the physical world and the virtual world. Precisely because of this distinction and the systematic description of interactions, approaches to inventions and

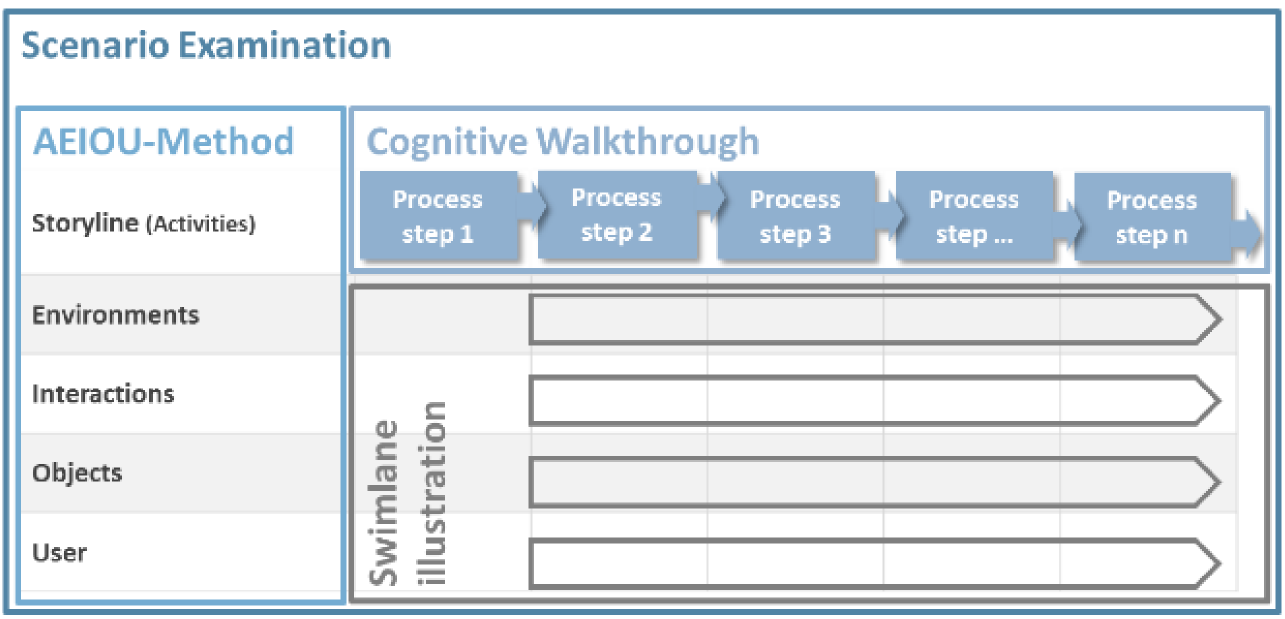

Figure 7: An integrative IP design method to support synthetic inventing based on application scenarios.

15 Cf. *Wurzer/Kraus*, MIPLM Industry Case Study "Arri", Strasbourg: 2014.

16 *Wurzer/Köllner*, Wertorientiertes Patent-Design, Mitteilungen der Deutschen Patentanwälte 8-9 (2015) 350-355.

17 Cf. *Wurzer/Schneider*, MIPLM Industry Case Study "Schneider", Strasbourg: 2017.

18 Cf. Wurzer/*Schäffner*, MIPLM Industry Case Study "Vorwerk (I)", Strasbourg: 2016.

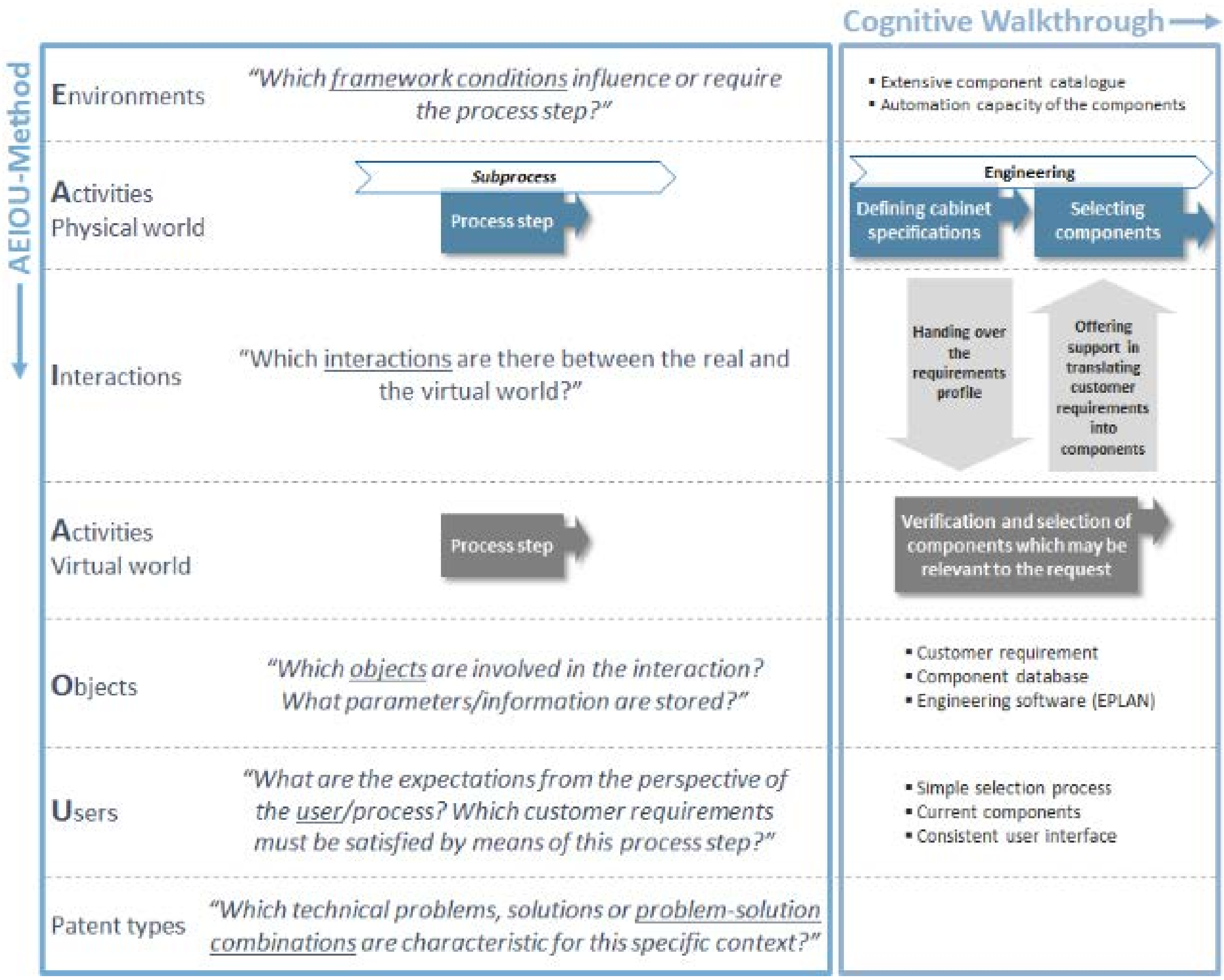

Figure 8: Example of a use case structure for cyber-physical systems.

therefore exclusivity potentials can be derived, for instance, along the value chain of Rittal and F.L.G. It is also important that the description encompasses the entire reality space that is relevant to the application scenario. In addition to the environment, activities and interactions, this also includes the objects involved in the action or subject to influence or interaction as well as the users. Figure 6 shows the structure of a use case for a cyber-physical system.

In order to precisely determine the crucial points at which Rittal must develop its own exclusivity positions within the scope of the business model and the 360° IP strategy, the entire cyber-physical system was analyzed along the industrial value chain and across the various partner companies. Figure 9 shows an exemplary excerpt from the analysis along a cyber-physical business process.

These analyses provided first 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. An analysis of the

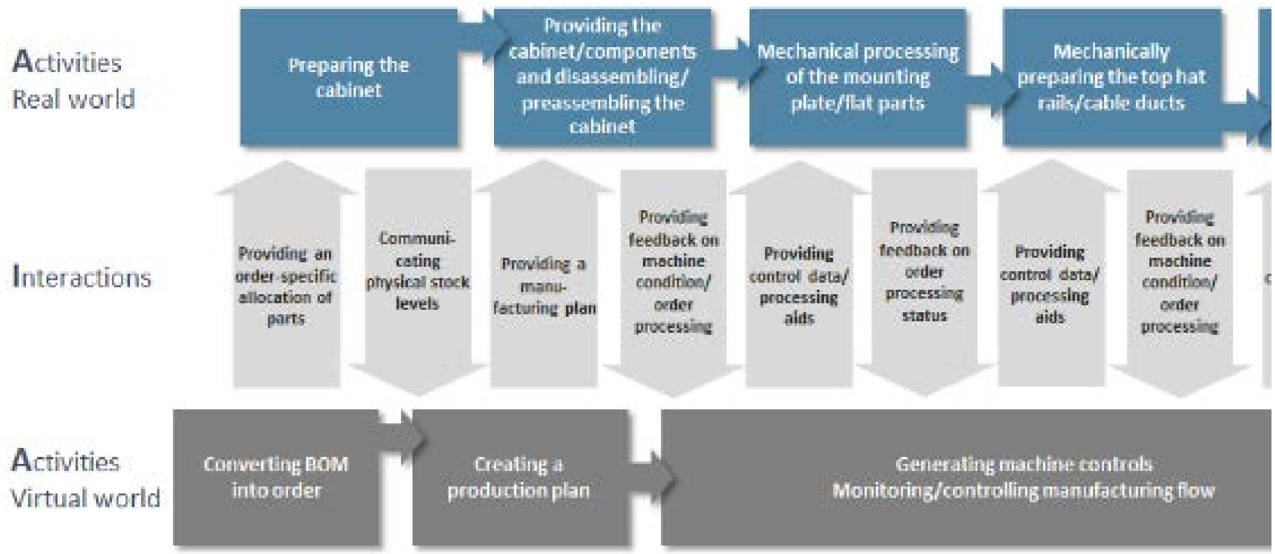

Figure 9: Schematic representation of the coordination of cyber-physical systems for the identification of relevant invention environments along a digitally transformed assembly process.

points within the value chain at which data are created, documented, processed and machines are controlled on the basis of these data is required in order to further substantiate the problem-solution approaches found. A simplified exemplary excerpt from such an analysis is shown in Figure 10.

Relevant patent types for these value chain stages can be found in the following IPC classes:

- G06Q: Data processing systems or methods, specially adapted for administrative, commercial, financial, managerial, supervisory of forecasting purposes…
- G06F: Electrical digital data processing (incl. handling with the meaning of processing or transporting data and incl. data processing equipment with the meaning of an electric digital data processor classifiable under group G06f 7/00..)
- G06B: Control or regulating systems in general; functional elements of such systems; monitoring or testing arrangements for such systems or elements.
- G05F Systems for regulating electric or magnetic variables.

The identified invention environments must then be translated into technologies, bearing in mind their intended benefit within the value chain and the intended customer benefit. In other words, the delivery must be translated into technological challenges and solutions. Potentially successful invention environments in terms of their contribution to the business model and potential patentability and enforceability, must be identified and evaluated. The invention core is isolated from these invention environments by discarding comparable or disruptive solutions described in the patent literature. This results in a patent portfolio which is closely aligned

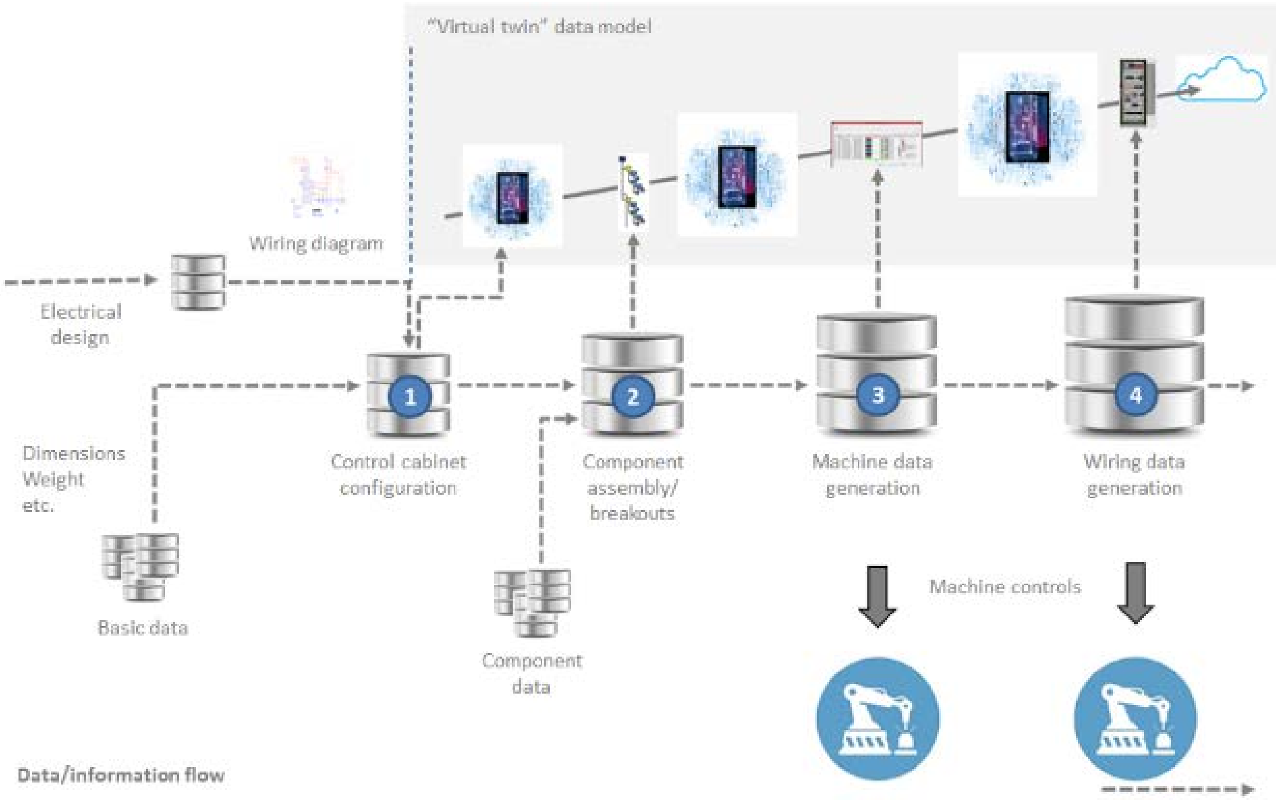

Figure 10: Schematic representation of a data and information flow analysis performed in order to identify of patent-relevant problem/solution combinations in the concrete implementation of the concrete implementation of the value chain for control cabinets.

with the basic requirements of the IP strategy for F.L.G: prevention of collisions with third-party rights, imitation protection as well as development and protection of customer-relevant USPs in alignment with F.L.G.'s integrated and digitized value chain.

PART III

Summary and benefits for Rittal

The value chain of the Friedhelm Loh Group in the area of switchgear and control system production and the corresponding digital transformation are a showcase for the smart factory as an implementation of the basic idea of Industrie 4.0. Consistent digitization and virtualization enable the continuous expansion and improvement of automation as well as increased flexibility at batch size 1. This represents a major efficiency gain at all levels of the value chain, especially in the assembly of switchgear and control systems. The digitization of the value chain is an enormous challenge as far as IP is concerned. On the one hand, freedom to operate must be ensured for a digital business model despite significantly higher innovation and patenting dynamics. On the other, the central points must be identified in order to ensure the concrete implementation of Rittal's value chain. Based on this, the implementation factors enabling Rittal to offer industry-wide USPs must be se-cured. Using the IP design methodology, the digitization of the value chain was analyzed, the critical points were identified and an exclusivity position for the future-oriented topic of Industrie 4.0 was secured for Rittal.

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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, laywers 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 Penin,
University of Strasbourg, BETA

Prof. Nicolas Petit
University of Liege

Prof. Alexander Peukert,
Goethe University, Frankfurt/Main

Prof. Jens Schovsbo,
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Prof. Martin Senftleben
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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
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Heinz Polsterer,
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Open Innovention Network

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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
Plinkington
PSA Peugeot Citroen
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SAP SE
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ST-Ericsson
Tarkett GDL
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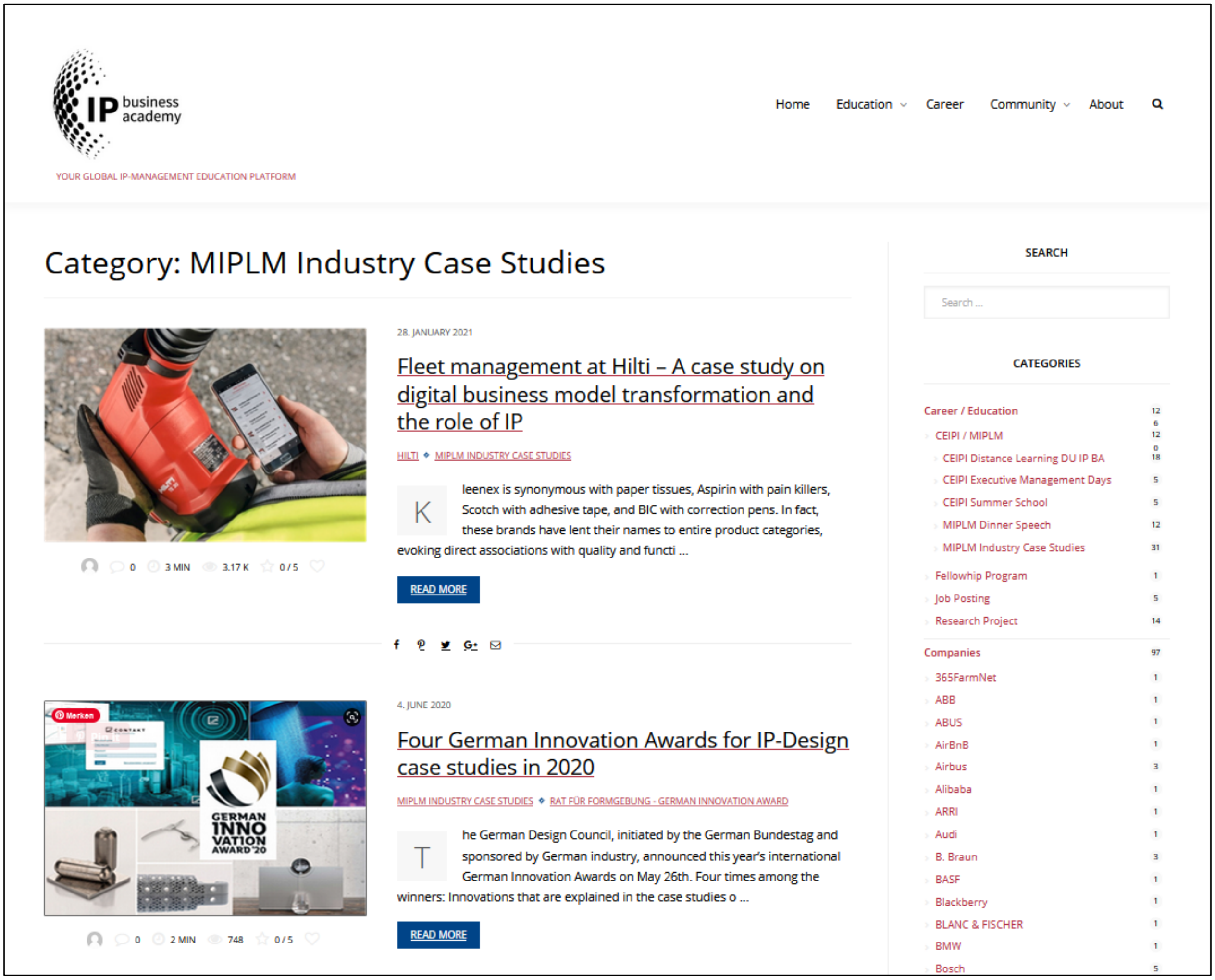

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