SME Patent Strategies For IoT-Based Business Models

By Alexander Wurzer, Theo Grünewald, Wolfgang Fischer and Axel Karl

Abstract

The phenomena subsumed under the keywords of "fourth industrial revolution" and "Internet of Things" (IoT) is transforming the industrial landscape. With business models in the B2C and B2B segments adapting to these developments, the role of IP—and in particular that of patents—as a competitive instrument is evolving, too. However, especially small and medium-sized companies (SME) often underestimate this role. Academics and practitioners have jointly developed proven methods and tools to effectively protect digital business models by means of IP under these new framework conditions.

Success factor IP

Having evolved from mechanization by means of water and steam (first industrial revolution) and mass production using conveyor belts (second industrial revolution) to the use of electronics and IT in production automation (third industrial revolution) and Industry 4.0 and IoT, the latest stage of the industrial revolution, has given rise to the following trends:[1]

- Digitization and networking
- Change in value creation networks
- Individualization of customer requirements
- Ubiquitous availability of embedded systems

Sensors and intelligent controls integrated into objects enable machines and systems—but also actual products–to communicate with one another (machine-to-machine (M2M) communication).[2] This independent exchange of information by means of suitable software platforms transforms production units into Cyber-Physical Systems (CPS) and, in its consistent further development based on smart networked objects, is making large parts of the manufacturing process autonomous.[3]

Another important basic concept in the context of the Internet of Things is "ubiquitous computing." This term refers to the profound penetration of everyday life by computing capacity to the extent that it becomes 'invisible.' This development permits the use of Cyber-Physical Systems (CPS) in virtually all environments, starting with the smart factory, the smart grid in energy supply, and smart mobility, through to smart health in the healthcare sector and the smart home.[4] These developments are jointly referred to as "IoT" or CPS-based SmartX solutions.[5]

Intellectual property, and patents in particular is gaining in importance as a strategic instrument within the context of the IoT.[6] In 2016, about 30 percent of patent applications filed at the EPO were directly related to ICT fields.[7] In addition, the EPO estimates that in recent years up to 50 percent of applications in major non-ICT fields such as medical technologies, automotive, or aerospace were computer-implemented inven-

1. Arndt, Neue Produkte und Geschäftsmodelle durch Industrie 4.0 [New products and business models through Industry 4.0], "DIFI—Forum für Innovationsmanagement" [Innovation Management Convention], Produktentwicklung im Rahmen von Industrie 4.0 [Product Development Within the Scope of Industry 4.0], IPEK—Institute of Product Engineering at Karlsruhe Institute of Technology (KIT), Karlsruhe: 24/11/2016; Botthof *et. al.*, Technologische und wirtschaftliche Perspektiven Deutschlands durch die Konvergenz der elektronischen Medien [Technological and Economic Perspectives for Germany as a Result of the Conver-gence of Electronic Media], study by VDI/VDE Innovation + Technik GmbH in cooperation with the Institute for Innovation Management and Entrepreneurship at the University of Potsdam, Berlin: May 2011.

2. Cf. Büllingen/Börnsen, Market organisation and market reality of M2M-communication regarding smart industry and the allocation of IPv6 numbers (Full version only available in German), WIK Discussion Paper No. 400, Bad Honnef 8/2015.

3. Schulte, Industrie 4.0 in Deutschland 2014 [Industry 4.0 in Germany 2014], IDC Executive Brief, Frankfurt: 2014, p.4.

4. Expertenkommission Forschung und Innovation [Experts Commission on Research and Innovation], Die neue Hightech-Strategie—Innovationen für Deutschland [The New High-tech Strategy—Innovations for Germany], Berlin: 2015.

5. Diegner, Plattform Industrie 4.0 [Platform Industry 4.0], Frankfurt/M.: 2014; Botthof *et al.*, Technologische und wirtschaftliche Perspektiven Deutschlands durch die Konvergenz der elektronischen Medien [Technological and Economic Perspectives for Germany Through the Convergence of Electronic Media], Berlin: 2011.

6. Cf. Pike, Virtual Monopoly, London: 2001; Mittelstaedt, Strategisches IP-Management—mehr als nur Paten-te [Strategic IP Management—More Than Just Patents], Wiesbaden: 2009; Frey/Wurzer, IP-Managers in Strategy Development: Integrating IP into Business Models, in: Wurzer, [Ed.], IP-Manager, Cologne/Munich: 2009, pp.101-117.

7. EPO Annual report 2016. ICT sectors such as computer technology, digital communication, telecommunication or audio-visual technology are grouped in the technical field "electrical engineering," which accounted for 29 percent of applications at the EPO in 2016.

tions (CII) that also qualify as "digital patents."[8] This is due to the following:

- New, digital business models regularly exceed the scope of traditional value creation stages.[9]
- New patent-relevant and patent-active competitors from the ICT industry are venturing into value creation structures, sales markets and customer relationships outside the ICT industry.
- Due to the central importance of M2M communication and the associated data handling across value creation stages,[10] patent positions from the ICT sector are increasingly turning into vital gatekeepers.[11]
- Increased risks of patent infringement through cross-product or cross-production digital platforms.[12] Product customization by means of such platforms can jeopardize entire business models.
- IoT-based business processes require interoperability, which, in turn, must be secured by means of unique IP positions.
- Interoperability is often based on communication standards. Companies need their own competencies for licensing and standard use.[13]

It is therefore only logical that the targeted use of IP is considered a key success factor in competing for solutions and new business models in times of digital transformation.[14] However, there is a characteristic reluctance to implement IoT-specific IP strategies.[15] Especially in the area of computer-implemented inventions and IoT-relevant solutions, European SMEs often feel that they lack sufficient competence or do not have capacities when it comes to IP. The same applies to the handling of relevant IP for communication standards.[16]

While large, multinational corporations are more flexible in transforming their business models and have vast budgets in order to rapidly create adapted IP portfolios, SMEs traditionally employ business models with a rather narrow focus and a great level of detail. Compared to corporations, their options for producing and using IP are often limited to the existing portfolios they have developed over time—not least because of limited financial and human resources.

However, a change of perspective from the physical to the digital/virtual world also offers tremendous opportunities for businesses. Entire industries are currently undergoing radical change in this respect. Old market leaders will have to adapt themselves

■ Prof. Dr. Alexander J. Wurzer, Prof. Associé at Centre d'Etudes Internationales de la Propriété Intellectuelle (CEIPI), Université Strasbourg,
Munich, Germany
E-mail: alexander.wurzer@ceipi.edu

■ Wolfgang Fischer, Wurzer & Kollegen GmbH, Senior IP Project Manager,
Munich, Germany
E-mail: wolfgang.fischer@wurzer-kollegen.de

■ Theo Grünewald, Wurzer & Kollegen GmbH, Senior IP Project Manager,
Munich, Germany
E-mail: theo.gruenewald@wurzer-kollegen.de

■ Axel Karl, Maiwald Patentanwalts GmbH,
Patent Attorney,
Munich, Germany
E-mail: karl@maiwald.eu

8. Within the context of the European Patent Convention, inventions based on software implementation are known as computer-implemented inventions (CII). An analysis of large representative samples of European patent applications in automotive, aeronautics and medical technologies showed that the share of CII has passed the 50 percent mark in recent years. Ménière, The EPO Approach to Industry 4.0 and the Internet of Things, Conference: Understanding the new role of IP management within the digital transformation in industry and commerce, 3rd panel: Patentability of technical software solutions and the exploitation model for digital innovation, Strasbourg: 04/05/2015: *www.ipforbusiness.org*.

9. Emmerich *et al.*, Geschäftsmodell-Innovation durch Industrie 4.0 [Business model innovation through In-dustry 4.0], Dr. Wieselhuber & Partner, Fraunhofer IPA, Study, Munich 2015; Wurzer/Grünewald, Aktuelles aus der IP-Ökonomie: industrie 4.0 [Current Developments in the IP Economy: Industry 4.0], Mitt. 5 (2017) 205-211; Kagermann, Chancen von Industrie 4.0 nutzen [Seizing the Opportunities Provided by In-dustry 4.0], in: Vogel-Heuser/Bauernhansl/Hompel [Eds.], Handbuch Industrie 4.0 [Industry 4.0 Manual], Vol. 4, 2nd edition, Berlin: 2017.

10. Sattler, Schutz von maschinengenerierten Daten [Protection of Machine-generated Data], in Sassen-berg/Sattler [Eds.], Rechtshandbuch Industrie 4.0 und Internet of Things [Legal Guidelines for Industry 4.0 and the Internet of Things], Munich: 2017; pp.27 ff.

11. Heilmann/Eickemeyer/Kleibrink, Industrie 4.0 in internationalen Vergleich [An International Comparison of Industry 4.0], Düsseldorf: 2016, p. 13; Konrad/Zloczsti, Normung und Innovation sind keine Gegensätze [Standardization and Innovation Are No Paradox], DIW Wochenbericht [Weekly report of the German Institute for Economic Research] 77/40 (2010) 10-15.

12. Kornmeier, IP und Industrie 4.0 [IP and Industry 4.0], presentation at the Industrial IP Day, Tag der gewerblichen Schutzrechte [Industrial IP Day], Informationszentrum Patente [Patent Information Centre], Stuttgart: 05/07/2016.

13. Wurzer/Grünewald (2017) op. cit.

14. Wee/Kelly/Cattell/Breunig, Industry 4.0 How to navigate digitization of the manufacturing sector, McKinsey Digital, Munich: 2015.

15. Wurzer/Grünewald (2017) op. cit.; Grünewald/Wurzer, Empirische Studie: Patentposition in der Indu-strie 4.0—Verliert die deutsche Industrie den Anschluss? [Empirical Study: Patent Position in Industry 4.0—Is the German Industry Lagging Behind?], Innovation Management Support, 1 (2016) 45-57.

16. Wurzer/Grünewald (2017) op. cit.

and their business models or clear the way for new, more innovative competitors.

IP strategies which are stringently designed to meet the new framework conditions therefore also offer smaller companies an opportunity to transform markets. An approach jointly developed by academics and businesses and already successfully in use across industries aims for the targeted development of such IP strategies. New strategic concepts and tools help companies to face the challenges of digital transformation in IP management and to develop appropriate IP strategies.[17]

The methodology presented below, along with examples of industrial implementation, provides an overview of such approaches drawing from various case studies.[18]

The Business Model as a Starting Point for IP Strategy

A business model describes the specific way in which a company seeks to be successful in the market, *e.g.* by means of an innovation.[19] The key elements are as follows: the value creation architecture and the key resources on the cost side of things, and the customer benefit leveraging the customer's willingness to pay, as well as the ability to maintain this value proposition in the long term on the revenue side.

Business model analysis is generally based on the premise of competitive differentiation.[20] This involves the targeted prevention of customers from comparing competing products and services purely based on price. In competitive differentiation, unique selling propositions (USPs) perceived as relevant by the customer are positioned against the competition in such a way that a specific customer benefit is as unique and incomparable as possible in the eyes of the customer. If a company successfully manages to prevent the competition from offering a similar customer benefit, it is in an exclusive position to leverage the customer's willingness to pay.

Micrel Medical Devices, a family-owned SME founded in Greece in 1980, is a prime example for this. Its first product, an ambulatory syringe pump, allowed patients suffering from thalassaemia, a rare blood disease that is prevalent among people of Mediterranean descent, to be treated at home rather than in hospital. Following that success, Micrel developed a full range of ambulatory volumetric and syringe infusion pumps for home and hospital care—all with the aim of making treatment more comfortable for patients. Ever since, a key development focus of Micrel has therefore been on miniaturization in order to permit greater mobility for patients. To achieve a new dimension in miniaturization, Micrel took the 100-year-old concept of rotary peristaltic pumps and improved it. So far, rotary pumps have not been used in medical devices because of problems such as high friction and power consumption as well as poor accuracy. However, their great advantage is that they can be constructed with a very small footprint. Micrel has recently patented the solution to the problems associated with this technology. Achieving a very good linearity of flow, reducing power consumption and increasing accuracy levels, Micrel's solution meets users' demands.

Another of Micrel's development focuses is drug safety. As pharmaceutical companies are moving towards "personalized" medicine, this topic is becoming more and more important. Apart from pharmaceutical companies, companies dealing with pharmaceutical packaging are also going to move in this direction, offering pre-filled bags with ready-made drugs and disposable pumps. It is therefore essential to match the right drug with the right pump and the right patient. To this end, Micrel has patented specific RFID and barcode labelling solutions for drug, people and device identification, which are associated with other technologies to avoid medication error.[21] This way the patented developments of miniaturizing the pump and medication security complemented each other very well in the context of ambulant treatment, and allowed Micrel a strong differentiation in the market of medical technology, which is usually dominated by a few big and financially strong multi-national corporations.

The fundamental principle of an IP strategy in competitive differentiation also relies on exclusivity positions which customers willing to pay for the corresponding benefits perceive as relevant to their decision making, and which can be defended and enforced against the competition. This basic model must be adapted in order to work in the context of digital business models.

In a similar way to the reference model for network communication between computers, the so-called Open System Interconnection model (OSI model), of the International Organization for Standardization (ISO), digital business models are also conceived along different layers.[22] As shown in the figure be-

17. Wurzer/Grünewald/Berres, Die 360° IP-Strategie [The 360° IP Strategy], Vahlen, Munich: 2016; pp.50 ff.

18. MILPLM Case Study Series, available from *www.ipforbusiness.org*

19. Wurzer/Köllner, Wertorientiertes Patent-Design [Value-oriented Patent Design], Mitt. 8-9 (2015) 350-351.

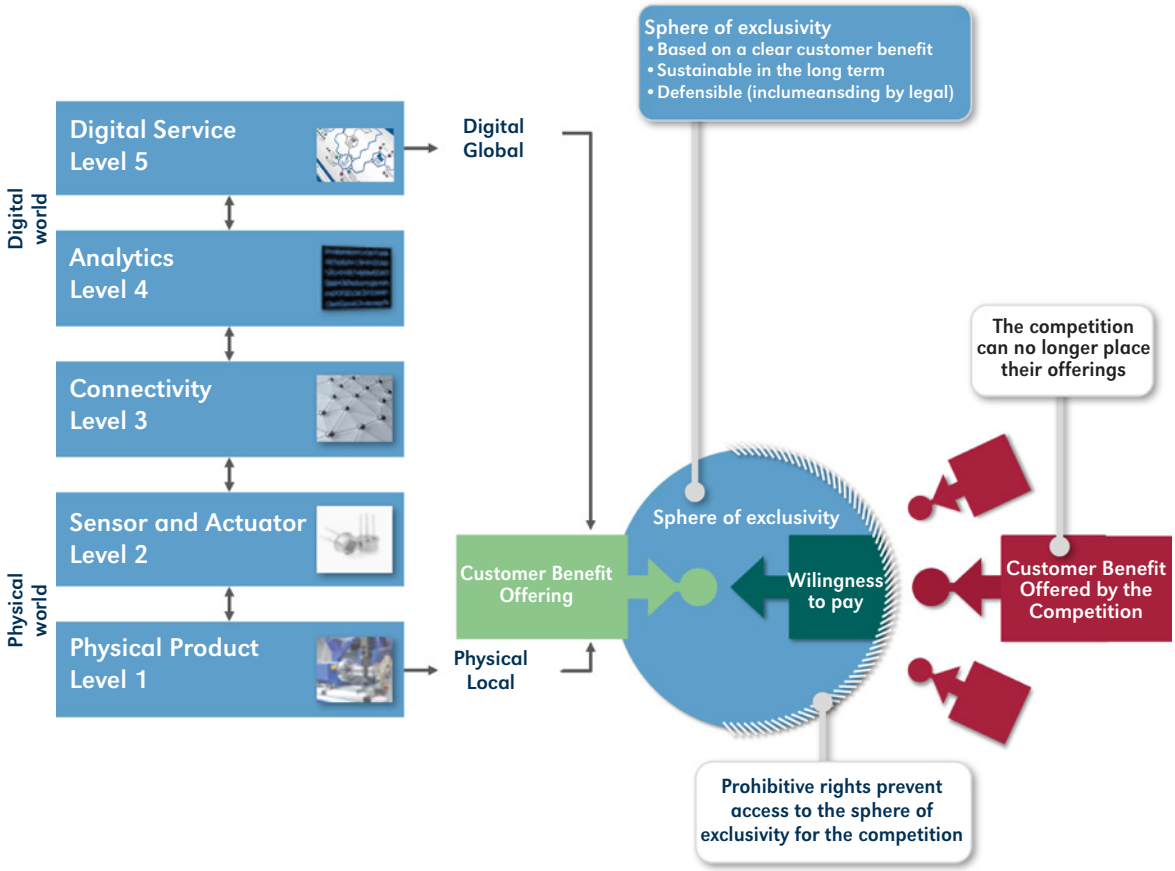
20. Wurzer/Grünewald/Berres, op cit., pp.4 ff.

21. *See* case study about Micrel Medical Devices, Smart infusion pumps for treating patients at home, in this issue.

22. *https://www.elektronik-kompendium.de/sites/kom/0301201.htm*.

Figure 1. Schematic Representation of IoT Layer Model

Schematic representation of the IoT layer model as a basis for generating customer benefits and designing prohibitive rights in order to create a sphere of exclusivity around the customer benefit offered.[24]



low, these different layers interact with each other in order to generate customer benefits by applying the business model.[23]

When developing an IP strategy for digital business models, it is useful to look at the mechanisms of and interactions between the various layers of IoT approaches. The lowest level consists of the physical product, *e.g.* a production plant or a device to be operated by the customer. The layer above includes the sensors and actuators making the plant or device 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 plant or device remotely. These data as well as data from other sources can subsequently be analysed and the insights gained can be used in providing products and services. The fundamental principle described here is not limited to B2C or B2B markets.[25]

The use of IoT elements does not necessarily have to result in novelties in the original sense of the term. Both the individual elements and the underlying solutions applied are usually known. In terms of the technological elements and underlying solutions used, the prohibitive rights developed within the scope of IoT strategies can be characterized as recombinant rather than revolutionary. Actual novelty is achieved by deriving technological necessities from the business model and, in the case of digital business models, by analysing the individual layers and their interactions. This systematically leads to a "periodic system of ideas"[26] and enables a structured analysis of digital business models, based on which relevant solutions can be protected by means of patents.

23. Fleisch/Weinberger/Wortmann, Geschäftsmodelle im Internet der Dinge [Business Models in The Internet of Things], Zeitschrift für betriebswirtschaftliche Forschung [Journal of Business Research] 12 (1015) 444-464.

24. Adapted from Wurzer/Grünewald/Berres, op. cit., p. 42.

25. Elste, Digitalisierung im Vertrieb [Digitization in Sales], Wiesbaden 2016.

26. Küppers, Wissen statt Moral [*Knowledge vs Morality*], Cologne: 2010, pp.172 f.

The SAILS Approach for Business Model Analysis and IP Strategy Development

The SAILS approach was originally developed as a road-mapping tool for analysing disruptive threats to a company's business model.[27] SAILS is an acronym and stands for the initials of the individual methodological building blocks: (S) Standards, (A) Architectures, (I) Integration, (L) Linkages, (S) Substitutions. The SAILS approach is based on the underlying idea of empirical observation of technological developments and change mechanisms. These can be traced back to the five general, abstract and generic principles mentioned above. The special charm of this approach is that it can basically be applied to any technology and industry.

- **Standards**

Interoperability is a key success factor for IoT business models. The exchange of data or energy, for example, takes place via standards. Objects which are capable of using the same standard are classified as compatible. Famous examples include communication systems such as Field Bus or LTE. Depending on the reach of a standard, we speak of a proprietary (company-specific) or industrial standard. Regardless of whether they are de facto or formally protected, performance and implementation specifications define parts of the industrial superstructure, which typically exceeds the immediate sphere of influence of an individual company.[28] Standards are therefore an important strategic tool for the implementation of IoT business models. Patent protection can be achieved for various aspects of standards, including interfaces, transmission types, the processing of data for controlling device reactions, etc. Complex standards can be composed of hundreds of individual patent applications.[29]

As IoT solutions typically rely on an exchange and processing of data, interoperability between the different components is key factor for proper functioning of IoT solutions. Inter-operability is achieved through technology standards defining compatible Interfaces, data transmission protocols and data formats. Typical standard definitions, such as WLAN, Bluetooth, LTE etc., are usually developed by a cooperation of different vendors or research institutes. The related key features and processes are backed with patents. Thus, an implementation of a standard technology automatically leads to a usage of third party IP.

Due to a common interest in a wide application of those standards, licenses are offered at fair, reasonable and non-discriminatory conditions (FRAND). SMEs should therefore identify relevant standards used in their products and value creation chain and apply for licenses. If no sufficiently qualified internal resources are available, SMEs can engage external service providers to support the identification of relevant standard technologies and acquisition of the necessary licenses. In recent times especially certain Non-Practicing Entities (NPEs), known as patent trolls, start approaching SMEs with missing standards licenses, which may cause high cost for legal disputes and therefore creates a high risk to the current and future business of the company.

- **Architecture**

The SAILS logic uses the term "architecture" in its general sense, *i.e.* the planned design and development of systems. It therefore speaks of a "value creation architecture"[30] when referring to more complex value creation structures than Porter's value chain.[31] Changes in architecture must be analysed at different system levels: subsystems, systems or super systems. When speaking of IoT and CPS-based SmartX solutions such as the above-mentioned smart factory, smart product or smart home, the ubiquitous smartness leads to alterations in value creation structures[32] and traditional

27. Vojak/Chambers, Road-Mapping Disruptive Technical Threats and Opportunities in Complex, Technology-Based Subsystems: The SAILS Methodology, Technological Forecasting and Social Change 71 (2004) 121-139; Kind/Hartmann/Bovenschulte, Die Visual-Roadmapping-Methode für die Trendanalyse [The Visual Road-mapping Method for Trend Analysis], Roadmapping und Visualisierung von Expertenwissen [Road-mapping and Visualization of Expert Knowledge], Working Paper of the Institute of Innovation and Technology at VDI/VDE-IT GmhH, No. 4, Berlin: February 2011.

28. Blind/Thumm, Interrelation between patenting and standardization strategies: empirical evidence and pol-icy implications, Research Policy 33/10 (2004) 1583-1598; Picht, Strategisches Verhalten bei der Nutzung von Patenten in Standardisierungsverfahren aus der Sicht des europäischen Kartellrechts [Strategic Behaviour for Using Patents in Standardization Processes From the Perspective of European Competition Law], Heidelberg: 2013; pp.167 ff.

29. The number of patents essential for the LTE standard (fourth generation of mobile communication: 4G) is estimated at 1,941, cf. Stasik, Royalty Rates And Licensing Strategies For Essential Patents On LTE (4G) Tele-communication Standards, *les Nouvelles* 9 (2010) 116 and reference to data from ETSI 2010.

30. Cf. Bach/Brehm/Buchholz/Petry, Wertschöpfungsorientierte Organisation: Architekturen—Prozesse—Struk-turen [Value-oriented Organization: Architectures—Processes—Structures], Wiesbaden: 2012; Gass-mann/Friesike/Cisk, Change a Running System—Konstruktionsmethodik für Geschäftsmodellinnovationen, in: Gassmann/Sutter [Eds.], Praxiswissen Innovationsmanagement: von der Idee zum Markterfolg [Innova-tion Management in Practice: From the Idea to Market Success], Munich: 2011, pp. 197-214.

31. Porter, Competitive Advantage: Creating and Sustaining Superior Performance, 1st edition, NYC: 1998.

32. Wischmann/Wangler/Botthof, Autonomik für Industrie 4.0 [Autonomics for Industry 4.0], iit-Berlin, BMWi [Ed.], Berlin: 2015; Bauer/Schlund/Ganschar, Industrie 4.0—Volkswirtschaftliches Potenzial für Deutschland, Bitkom-Studie, Berlin: 2014.

separations and hierarchies of systems.[33] As demonstrated by the smart home example, for instance, there has been a heated debate on where the control centre for this domestic control, regulation and communication intelligence should be located—in the TV unit, in the kitchen, in the PC or in the control unit for the heating system—and who should have access to the corresponding data, and for what purpose.[34]

- **Integration**

This term subsumes all forms of combining elements and functions in order to design new systems of enhanced functionality, as well as disintegration, *i.e.* the deliberate separation of elements from elements previously combined within a system, and the reintegration of separated parts.[35] Thinking in terms of integration is typically applied to IoT business models to overcome various barriers of the existing value creation architecture. Thinking in terms of integration can be directed against suppliers (backward integration), against customers (forward integration) or against former unrelated industries and competitors (lateral integration). The IoT layer model is primarily about the integration of levels 2 and 3—including computing capacity—into the physical level. The layer model therefore provides an explanation of the increasing ubiquitousness of computing capacity from a technology perspective. The sensors, actuators and computing capacity integrated across a full spectrum of products and systems, subsequently permit the creation of new customer benefits on levels 4 and 5, including the development of business models adapted for these means.[36]

- **Linking**

The full capacity for the creation of customer benefits is usually not achieved before the different levels of the IoT layer model are skilfully linked. Links can exist on all system levels or between individual levels. These links can be communication paths but also integrations for value creation. An example for the creation of such links is the production of spectacle lenses. An example encompassing several value creation stages is that of switchgear and control system production described below.

33. Botthof *et al.*, Technologische und wirtschaftliche Perspektiven Deutschlands durch die Konvergenz der elektronischen Medien [Technological and Economic Perspectives of Germany Through the Convergence of Electronic Media], VDI-VDE Innovation+Technik, Institut für Gründung und Innovation Universität Potsdam [Institute of Innovation and Technology of the University of Potsdam], Berlin: 2011.

34. Cf. Sattler, op. cit., on the protection of machine-generated data.

35. Vojak/Chambers, op. cit. p.126.

36. Bischoff et al., Erschließung der Potenziale der Anwendung von Industrie 4.0 im Mittelstand [Unlocking the Potentials of Applying Industry 4.0 in SMEs], BMWi [Eds.], Berlin: 2015, pp.75 ff.

- **Substitution**

Substitution is one of the core aspects of Porter's classic strategic approaches[37] as well as an integral component of market-oriented IP-based prohibition strategies.[38] The methods of substitution are diverse and can be applied to IoT-based business models at various levels, as well across levels. Functions, components, products, hardware for software, and indeed entire types of devices can be substituted, as well as value creation and work steps from manual data collection to machine operation, and entire business models. Substitution can be step by step or radical, for example stepwise from product sale to operator models.[39] Materials, stocks and motion sequences, for instance, can be replaced by real-time production.[40] Also think of the functional integration by today's smartphones and the substitution of entire device classes that comes along with it.

Once the basic approaches for protecting the digital business model have been identified, the fine-tuning for the development of prohibitive rights as part of the IP design process begins.

IP Design in Cyber-Physical Systems

In order to protect digital business models, it is necessary to identify those components which must be protected against imitation, as well as those components which are of particular importance for a company's market position, and therefore enable and merit protection.[41] Relevant methods have been developed in order to analyse cyber-physical systems and to actively derive prohibitive rights from such analysis.[42]

In analogy to the design thinking process, the static perspective of business model and system descriptions must be abandoned in order to find the central components relevant for detailed analysis and synthetic inventing within a CPS. A dynamic perspective on scenarios is crucial in IP design. The principles of scenario analysis are shown in Figure 2.

37. Cf. Porter op. cit.

38. Wurzer/Grünewald/Reinhardt, Valuation of Patents, Alphen aan den Rijn: 2012, pp.37 ff., *see* also the literature referenced there. (2015) p.15.

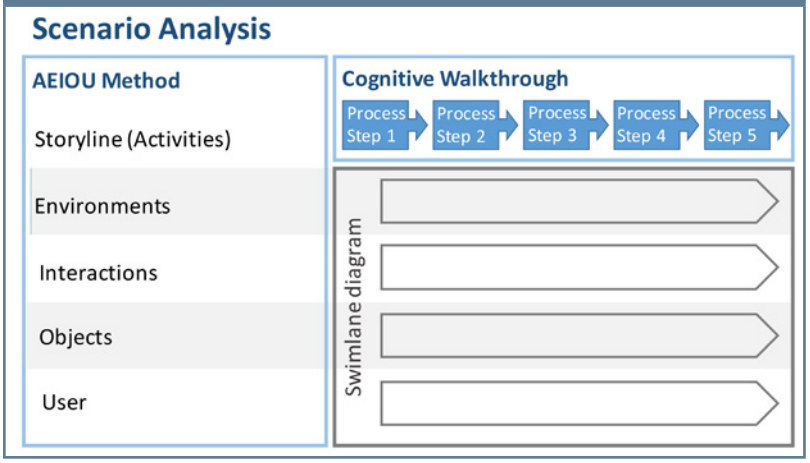
39. Emmerich *et al.*, Geschäftsmodell-Innovation durch Industrie 4.0 [Business Model Innovation Through Industry 4.0], Dr. Wieselhuber & Partner, Fraunhofer Institute for Manufacturing Engineering and Automation, Munich: 2015, p.25.

40. Wolter *et al.*, Industrie 4.0 und die Folgen für Arbeitsmarkt und Wirtschaft [Industry 4.0 and the Conse-quences for the Labour Market and the Economy], IAB research report 8

41. Cf. Wurzer/Grünewald/Berres op. cit., pp.51 ff. for the distinction between the different strategic tasks of IP in the context of a differentiation strategy.

42. The most important considerations regarding the on-demand design of prohibitive rights are summarized in Wurzer/Köllner op. cit., as well as in Wurzer/Grünewald/Berres op. cit. pp.143 ff.

Figure 2. An Integrative IP Design Method For Structuring Synthetic Inventing In Application Scenarios.



Scenario analysis is applied to usage or application scenarios, for example, in order to describe a sequence in time (Figure 2—storyline with activities). In the case of CPS solutions, it is important to distinguish between the sequences taking place in the physical world and those in the virtual world. Precisely this distinction and systematic description of the interactions between these two worlds lead to potential inventions and thus to exclusivity potentials.

The entire CPS is analysed along the value chain in order to precisely extract the decisive positions at which it is important to develop proprietary exclusivity positions for the implementation of a digital business model. Figure 3 shows an excerpt from the analysis along a cyber-physical business process in switchgear and control system production.

These analyses provide indications of points at which non-trivial technological challenges and solutions can be found which form the basis for the subsequent elaboration of the company's own exclusivity positions derived from patents.

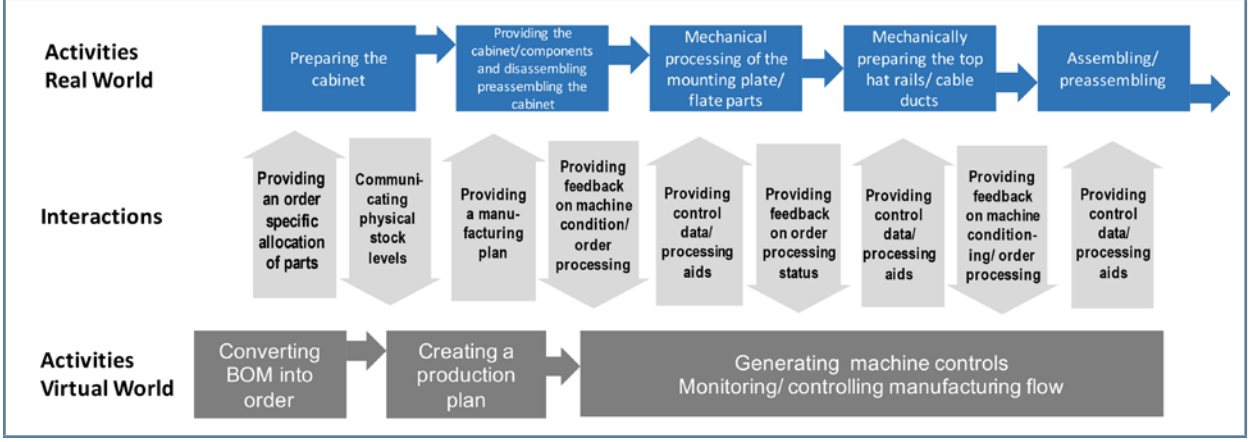
An analysis of the points within the value chain at which data are created, documented, processed and machines are controlled on the basis of these data is required in order to further substantiate the problem-solution approaches found. A simplified excerpt from the analysis of a value chain in electric control cabinet manufacturing is shown in Figure 4.

The identified invention environments (as specified by IPC classes, for instance) 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.[43] 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, and must subsequently be developed into patent applications. This ultimately leads to a patent portfolio which is closely aligned with the basic requirements for the IP strategy for the company's digital IoT business model.

Conclusion

The developments related to IoT solutions described above are due to the fact that companies are looking for new products and services which provide added

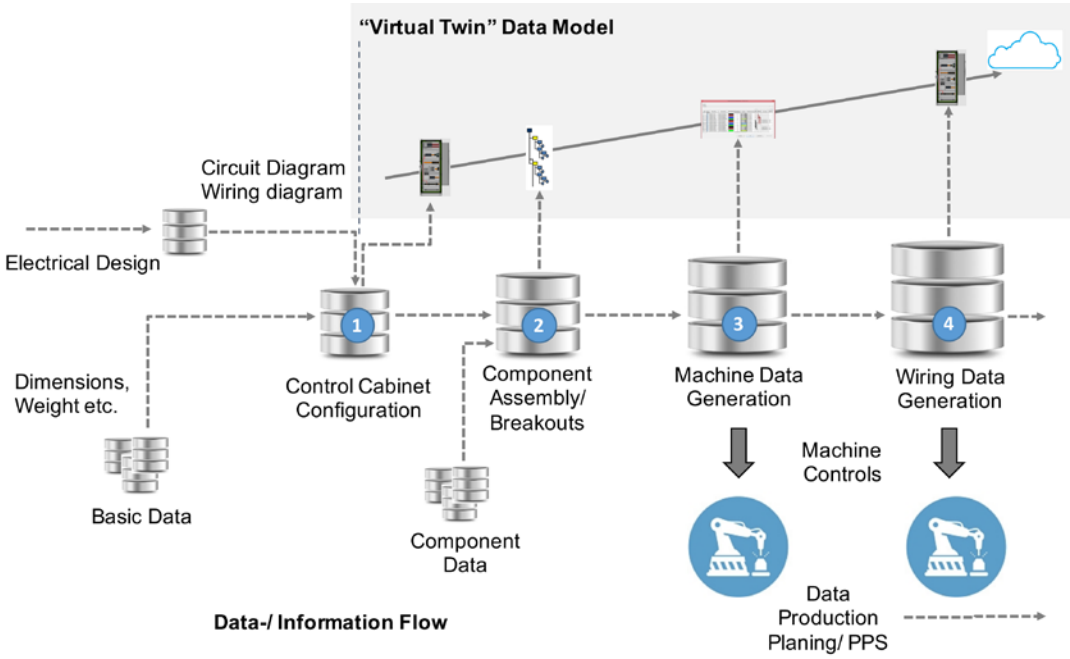
Figure 3. Schematic Representation Of The Coordination Of A Cyber-Physical System



43. Wurzer/Köllner, op. cit.

Figure 4. Schematic Representation Of A Data And Information Flow Analysis

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



value for their customers. The activities presented here result from the need for legally enforceable added value positions and the protection of digital business models. The data generated within the scope of these business models can help to improve development activities, accelerate innovation and enforce premium prices through added value. Due to the exclusivity of value added positions achieved through IP, the price premium is therefore also ultimately protected by IP. Key success factors for the approach presented above include thinking in terms of business models and understanding added value. Beyond technological considerations, the interdisciplinary approach of IP design permits the integration of a market perspective into the design of enforceable added value positions which allow us to leverage the customer's willingness to pay. To this end, IP must be integrated into the business model development process at an early stage and its effects must be anticipated. The case studies document the significant relevance of IP for the commercial success of IoT-based business models.

Summary

- The changes subsumed under the term Internet of Things are driven by a sustainable transformation through digital technologies.
- This transformation not only affects customer requirements and customer relationships, products and value propositions, but also established value creation structures, competitive situations and business models, which are changing at a rapid pace.
- As a consequence of these developments, the role of IP—and especially that of patents—as a competitive instrument in IoT business models is changing, too.
- The IoT layer model shows a basic pattern of technological levels IoT business models are composed of.
- The SAILS method is a tried and tested practical aid for describing the necessary exclusivities in order to identify the required proprietary IP positions in future solution spaces for a company's business models from an early stage.
- Targeted IP positions can be designed with the help of methods from industrial design and design thinking in combination with synthetic inventing. ■

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