Part 5 | Process management

Chapter 1 | Introduction to process management

Why business process management?

In businesses, like in every organization, where many people are working together in different roles, work is distributed between the individual employees and departments in the form of processes. These processes are needed that everyone fulfills their role in the business, in sales, in product development in IP etc. Since the degree of specialization in the workforce is ever increasing this separation of roles within a company and the creation of processes to organize the work between the different departments becomes more and more important. Without good and well-defined processes effective and efficient workflows within a company would not exist. Nevertheless, the processes in a company need constant revision and improvement to lead to good outcomes, to fulfill the needs of the company's customers and to create added value. This improvement is done by business process management.

The Workflow Management Coalition defines business process management as follows: "Business Process Management (BPM) is a discipline involving any combination of modeling, automation, execution, control, measurement and optimization of business activity flows, in support of enterprise goals, spanning systems, employees, customers and partners within and beyond the enterprise boundaries."

The ingredients of a business processes

Since organizations and businesses are often huge and complicated in their setup, we take a first overview about the basic features of a single business process and how it generates added value to the customer, before approaching the big picture. The three constituents of a business process are (see Figure 1):

- Activities
- Events
- And decision points

As an example, an activity in an IP department could be the filing of a patent, registration of a trademark or patent extension. Events are singular incidents which trigger the execution of some activities. So, in the case of the patent filing activity the event triggering the patent filing activity can be the new invention notification by the inventor from the R&D department or the need of a certain legal exclusivity defined by the product manager. The third element are decision points, where the concrete execution of the business process is decided. For example, a decision point in an IP department can be reached, when the product manager suggests a new product and asks, if and how legal exclusivity for that product can be reached through IP. The IP department can then make the decision, that the

targeted exclusivity of the product can be achieved with patents and trademark, so that the process is continued with the filing of the synthetic patents and registration of trademarks. Alternatively, the decision can be that no legal exclusivity for the product can be achieved and the whole product development team needs to redesign the product to reach the exclusivity.

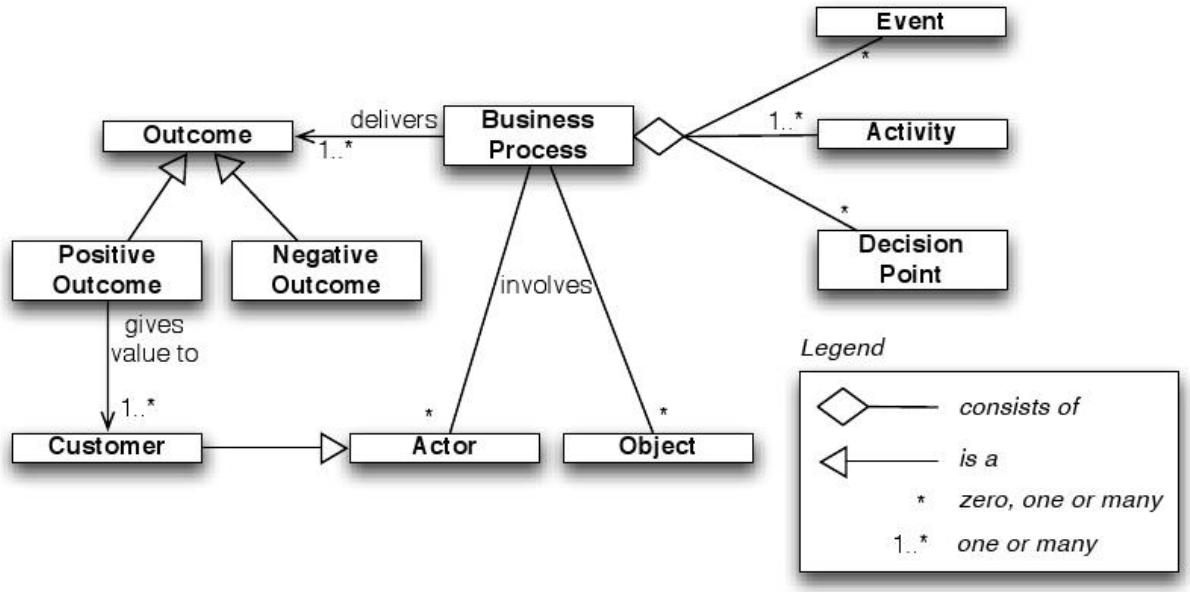

Figure 1: Ingredients of a business process. Source: *Marlon Dumas, Marcello La Rosa, Jan Mendling and Hajo A. Reijers, Fundamentals of Business Process Management, Springer (2012), p. 6*

The next ingredient of a business process are actors and objects. Actors are internal and external individuals or groups involved in a process. In a typical product development process, the internal actors can be the IP department, the R&D department, marketing and user experience (UX), sales etc. External actors could be consultants, lead users, customers, and law firms. All involved groups are necessary to work together to finally create added value through the successfully executed process.

Objects are material and immaterial things involved and needed in processes. Material objects can be for example the developed prototypes in the product development process and immaterial objects are the electronic documentation of the development process or marketing videos created to visualize the customer benefit.

The customer is a very special actor. The customer is in this case not only a customer in the sense of a shopper in a supermarket but any person, who can benefit from the positive outcome of a process. The customer can be both internal and external to the business. The example for two IP processes is shown in figure 2. On the left side the classic patent filing process is depicted. So, the whole process starts with an invention as an event and trigger for the patent filing process. In this case the inventor is the internal customer, the person how will experience a positive outcome of the patent filing process, when the patent is granted. On the left side the direction of the whole patent filing process is turned around. There, the customer is really the customer is the shop, who is buying the product and a

positive outcome of the process is the added value for the customer through the product. The patent filing of the synthetic inventions is in this case the process creating the exclusivity for the customer and through that the added value. This added value determines, if the outcome of the process is positive or negative. The ultimate goal of business process management is to optimize the processes in a way, that the outcomes for the customer are positive.

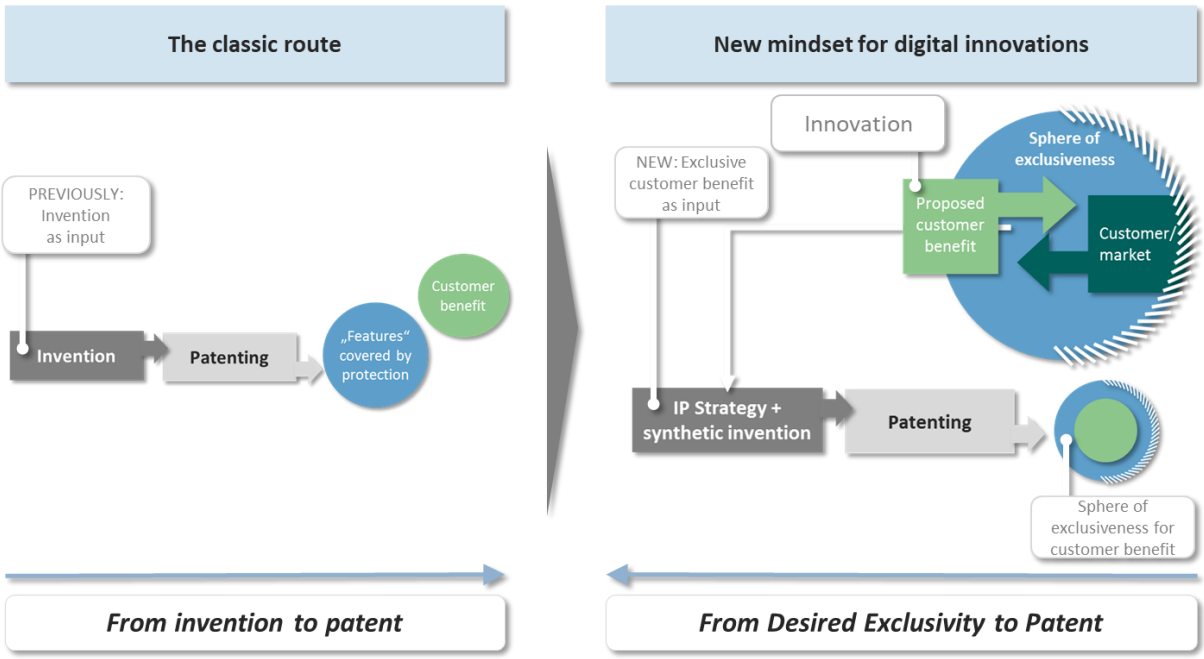

Figure 2: The classic patent filing process with the inventor as customer and the new patent filing process with the customer in the customer role receiving the added value. This added value is the positive outcome of the process. Adapted from: *Alexander J. Wurzer, Theo Grünewald, Wolfgang Berres, Die 360° IP-Strategie – So sichern Sie Ihren Innovationserfolg langfristig, Vahlen (2016)*

The three types of business processes

Processes are implemented in all parts of the firm from sales processes, maintenance processes, product development processes, human resource management processes up to strategic management processes. To better understand the role of these processes in a firm they can be classified into three groups:

- Core or primary processes
- Support processes
- And management processes

Core or primary processes are processes, that directly benefit the paying customers of the products or services of the company. These are the core business parts of the company to make money. They include for example the production processes of the products and services, the marketing and sales processes, and the maintenance processes for sold products and services.

The support processes are internal processes, which are also crucial to the value chain of the company but are not directly valuable to the customer. In these processes the customer, who benefits directly from the positive outcome of the process, is company internal. They support the core processes and lead to a smooth operation of those processes. If they do not work well, also the paying customers will finally notice it either by higher prices or longer delivery times. Supporting activities comprise for example human resources processes, computer-based organization and ordering processes. Those benefit the internal organization not the external customer.

Management processes are not directly part of the value creation in the firm. Nevertheless, all core and supporting processes have to be managed, controlled and optimized, so that the firm works effectively and efficiently. To ensure that each firm operates management processes.

When core and supporting businesses work well together the firm creates value through their value chain within the industry value chain (see Figure 3). IP processes are of course also processes in the firm. But are they core or support processes? This depend on the role of IP in the firm. In the classic model, where the IP department reacts on inventions made by R&D, the IP processes can be seen as a supporting process, which support the core process of product development. When the IP department is directly included in the product development process and its role becomes the creation of legal exclusivities, then the IP process becomes a core process, because it directly creates value to the customer by the created exclusivity.

Integration of IP into the core processes with IP-design: Example Heraeus Amloy

An example of the successful optimization of IP business processes with IP design can be seen at Heraeus Amloy (see Additional Material). Heraeus is a global company specialized in metals and innovative materials from Germany. They operate several Heraeus start-ups which are developing new business models and entering new markets. One of them is Heraeus Amloy focusing on amorphous alloys. Amorphous metals have very special properties such as a high degree as malleability at low temperatures, which makes them very promising for industrial applications.

Heraeus Amloy organized its IP business processes according to the logic of IP-design. So, the IP, R&D, marketing and product management processes are all aligned with each other and the overall business strategy (see Figure 4). This helps to make the processes more agile and eliminates the silos of the different departments. Also, IP-design enables thinking from the perspective of the customer needs and the creation of additional value to the customer, which is crucial for the optimization of the core processes of a firm.

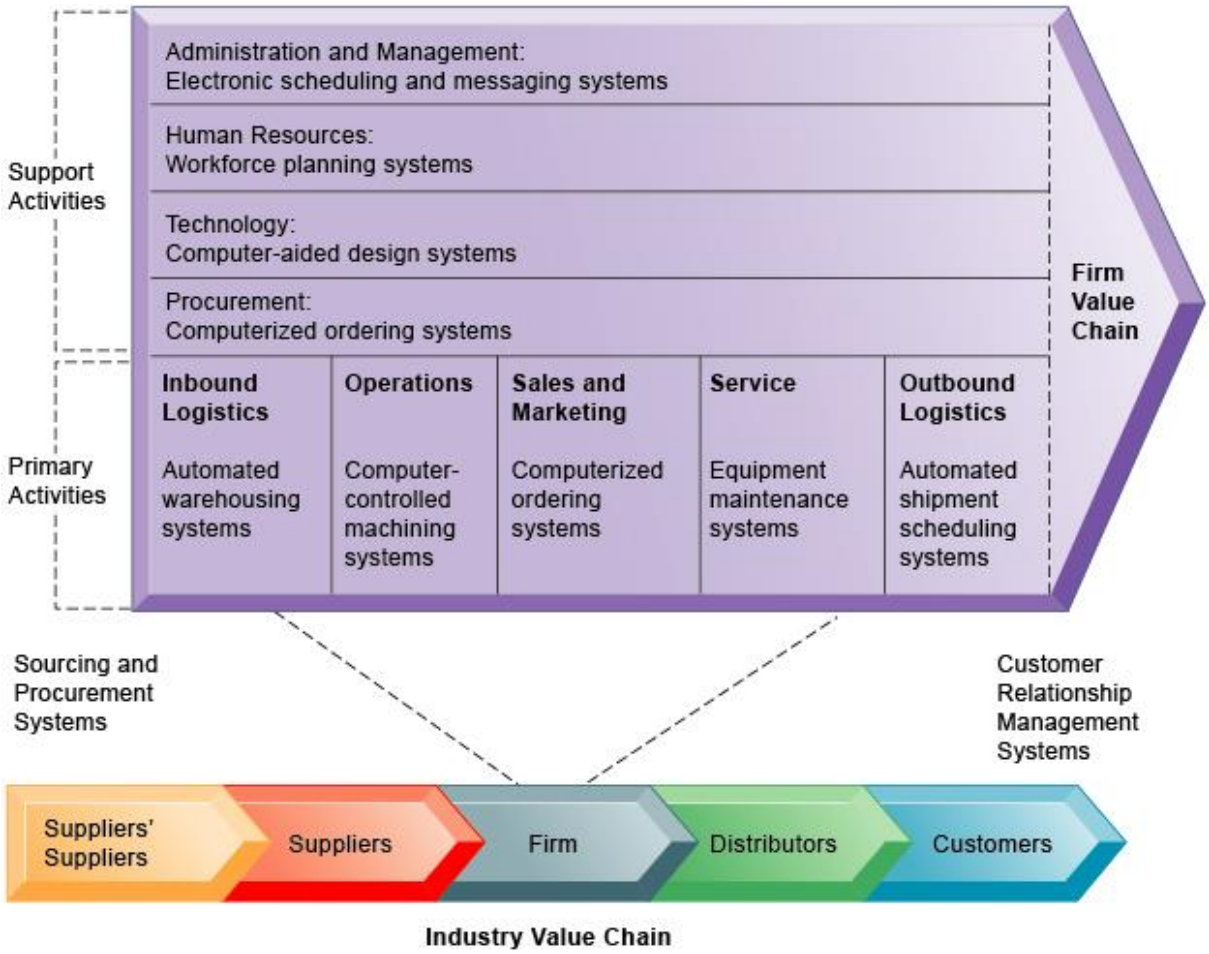

Figure 3: Primary and support processes in a firm within the industry value chain. Source: *https://paginas.fe.up.pt/~als/mis10e/ch3/chpt3-3bullettext.htm*

IP design makes "waiting for inventions" from the R&D department a thing of the past. With IP design, IP is actively developed to meet the needs of business development. The ultimate goal of IP design is to achieve legally enforceable exclusivity for the business model, and this is also reflected in the business processes. IP design provides executives with a toolbox for an efficient way of working. IP design helps Heraeus Amloy to live and breathe the five most important leadership tasks in digital leadership:

- To drive the change within the enterprise
- To make staff performance transparent and enable recognition
- To promote cooperation
- To support staff development
- And to provide orientation

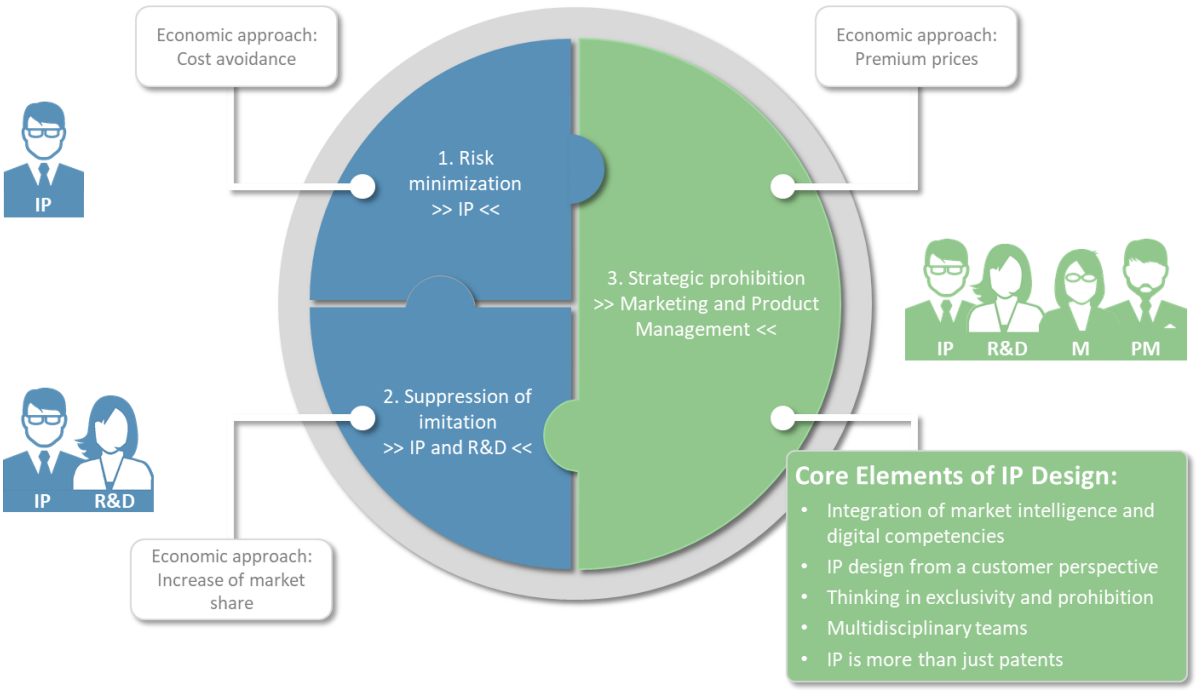

Figure 4: Overview of the IP, R&D, marketing and product management processes and their role in the firm. Adapted from: *Alexander J. Wurzer, Theo Grünewald, Wolfgang Berres, Die 360° IP-Strategie – So sichern Sie Ihren Innovationserfolg langfristig, Vahlen (2016)*

Chapter 2 | The lifecycle of business process management

Methods for business process improvement

Business process management takes care about the improvement and optimization of business processes. To do so, usually a so-called business process management lifecycle is run through in an iterative manner. This follows the idea, that the improvement of processes in a business is a continuous cycle of the planning of improvements, modifying the processes, analyzing the changes and outcomes, and further improvement of the processes. In practice, this continuous improvement cycle is inspired and implemented according to one of two different philosophies, either the Japanese Kaizen approach or the American PDCA approach.

The PDCA approach

The PDCA cycle is named after the four steps which are executed iteratively to improve processes. Those steps are Plan, Do, Check and Act (see Figure 7). Historically, it was developed by Walter A. Shewhart (see Figure 5) in the 1930s and taught by W. Edwards Deming (see Figure 6) and also became known as Shewhart or Deming cycle. The cycle follows the empirical method of hypothesis, experiment, and evaluation, which should all be strictly separated to learn and improve processes.

Figure 5: Walter A. Shewhart. Source: *https://en.wikipedia.org/wiki/Walter_A._Shewhart#/media/File:WalterShewhart.gif*

The first step is the planning phase. Here, the current processes are analyzed by the team and further possibilities for improvement are planned. In this step also the needed resources for the improvement must be analyzed and allocated. Finally, the indicators for the improvement have to be defined, so that in the next steps the process improvement can be evaluated.

The second step is the execution of the process changes. The team tries to implement the planned process changes in small steps into their processes. Here, it is important to observe the effect of the changes and to investigate, if the changes are leading to the expected improvements. This does not necessarily hold true and often changes to the processes have other effects as initially expected. So, it is safest to only make small changes to the processes or only change a small process at once.

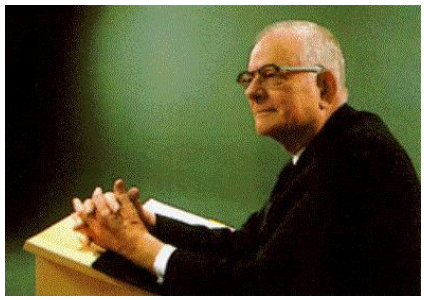

Figure 6: W. Edwards Deming. Source: *https://en.wikipedia.org/wiki/W._Edwards_Deming#/media/File:W._Edwards_Deming.jpg*

The third step is about the checking or studying of the effects of the process changes. So, the results of the execution of the process changes are compared to the

indicators of success defined in the planning stage. This step is important to learn about the successes and failures in the do stage. When something did not work right in practice, this is also an important learning in the process. Failures can be analyzed and new plans for improvement can be made in the next cycle's planning stage.

Finally, the fourth step of the PDCA cycle, the act, starts. To act means here to implement the learnings of the do step in the whole organization. So, all processes of the organization, which can be improved by changes successfully tested during the do step, are improved by the learnings. These new processes are then the standard mode of operation in the business. After the act step the whole PDCA cycle starts from the beginning.

Figure 7: Overview of the processes of the PDCA cycle. Source: *https://www.siteware.co/en/methodologies/how-to-do-pdca-step-by-step/*

The Kaizen approach

The Kaizen approach in the business world was initially established by the Toyota Motor Corporation to improve their assembly lines and other processes after World War 2. This introduction to the business world was inspired by one of the inventors of the PDCA cycle W. Edwards Deming, who was an advisor for Japanese companies at that time. The line workers at the car assembly lines at Toyota are famously expected to completely stop the whole assembly line when an unexpected error occurs (see Figure 8). Such an event sets an iterative improvement cycle in motion, where the assembly line workers and supervisors try to find ways to improve the process.

Figure 8: Assembly line at Toyota Motor Corporation. Source: *https://hbr.org/2016/04/the-toyota-production-system-works-for-relationships-too*

Kaizen follows the Japanese philosophy, that you should both be happy about your own success but also try to improve yourself continuously. So, in the case of an assembly line, the workers should be happy and proud about how many cars they have built, but they should also look for ways how to become even better. This is the cycle of Kaizen. Start with self-criticism to find ways to improve, gain the courage and self-confidence to improve and finally to change and improve the status quo. This cycle triggers the so-called Kairyo, which is the actual continuous improvement cycle (see Figure 9).

In business practice the Kaizen approach focusses on the idea to eliminate wasteful parts in the production process or other processes by the involvement of mindful workers and managers. This means that all people involved have to be inspired to continuously search for self-improvement and not just fulfill orders. So, it is an improvement process not only for processes but also for the working people. This process must not stop at the department level in the single silos but cover all hierarchical levels and business units. Here, it is to

mention, that the improvement by kaizen is only focused on the process improvement and not on product improvement etc.

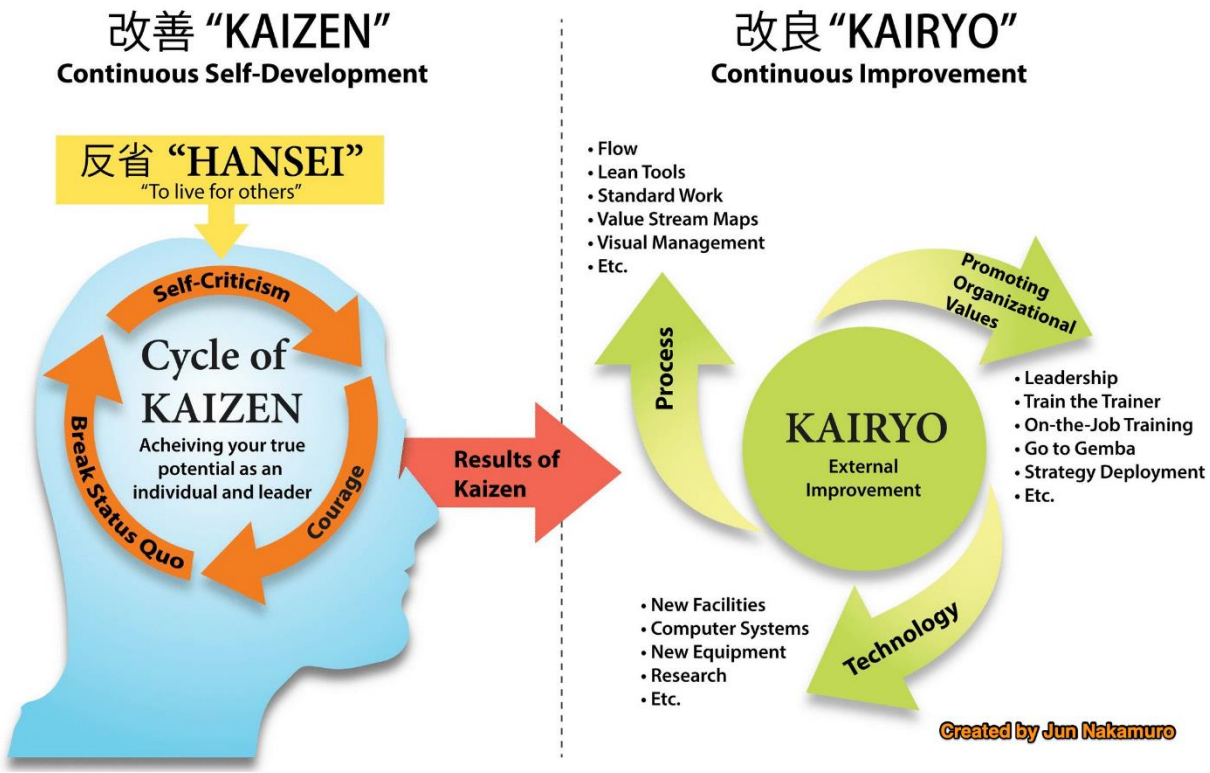

Figure 9: The Kaizen and Kairyo cycles of continuous self-development and continuous improvement. Source: *https://www.linkedin.com/pulse/kaizen-lost-translation-jun-nakamuro-1/*

The business process management life cycle

The business process management life cycle based on the iterative process improvement methods of PDCA or Kaizen is typically designed in 5 phases. These 5 distinct phases of the process management lifecycle are (see Figure 10):

- Design
- Modeling
- Execution
- Monitoring
- And optimization

In the process design stage, the current state of the processes within the company is first analyzed. The existing processes are identified, and the beginning and end of the single processes are defined, so that the improvement of processes can be designed at all. After it is clear, what the status quo of the processes in the company is, the deficits of the identified processes are evaluated by looking at their outcome. Better outcomes of these processes are defined, and new processes are designed based on the overall business strategy and the process strategy, e.g. the IP strategy for IP processes. Then the team decides if a gradual

improvement or a complete redesign of the processes to improve should be done according to the strategy. Also, the processes to be improved are prioritized, so that some processes are not considered in the current cycle, because of their low priority but may be considered in a later cycle. The results of the process analysis and design should then be concretely modeled in the next stage.

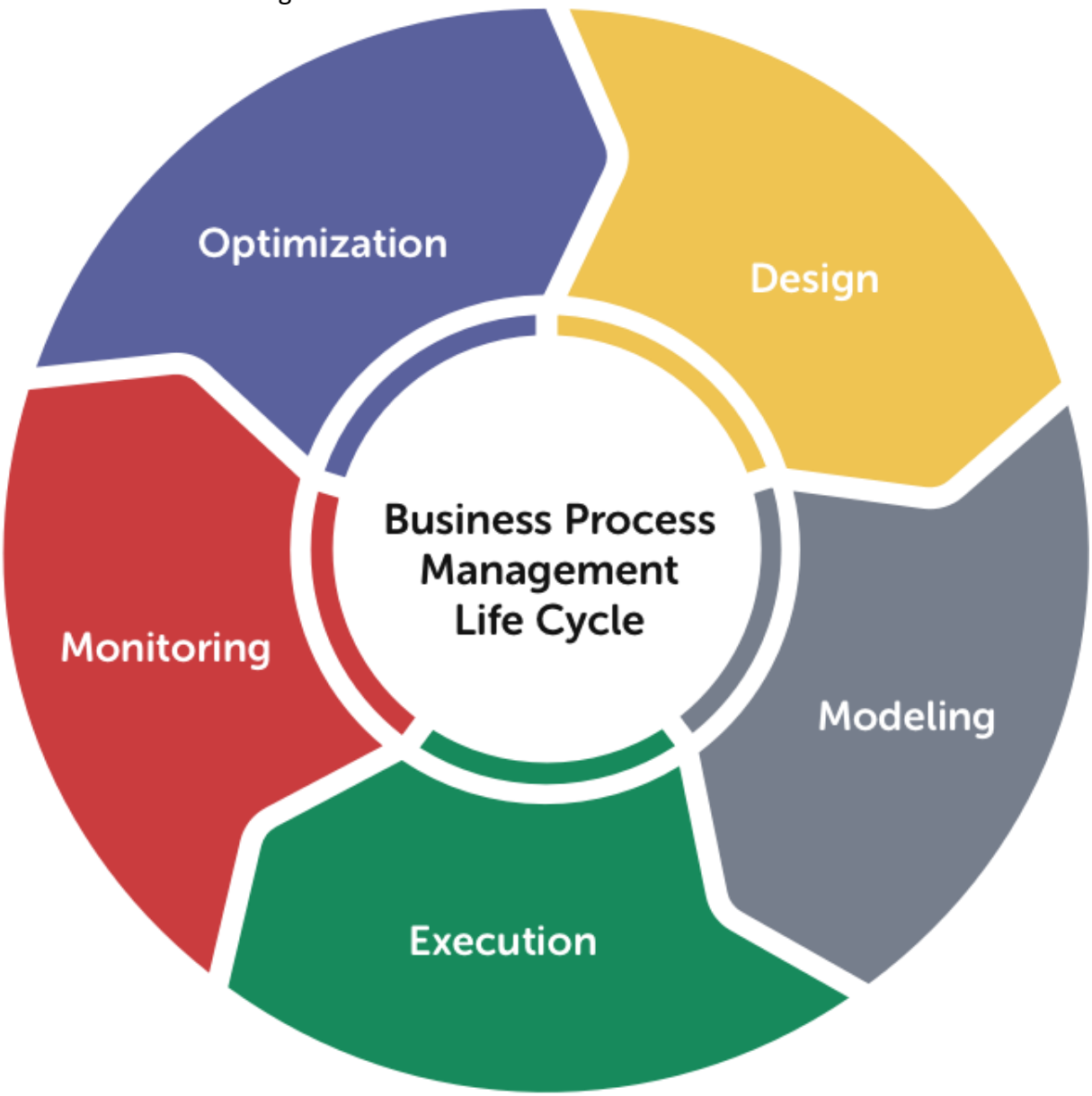

Figure 10: The 5 stages of the business process management life cycle. Source: *https://www.happyfox.com/what-is-business-process-management/*

The modelling stage starts once the process design or redesign is finished and the new processes should be practically modeled. Here, a concrete flow diagram of the process with all relevant actors and objects must be drawn down to define, who has which tasks in the new process to be tested. This is the point, where often a business management software is used for the representation and analysis of the multiple processes.

After the modelling of the new or redesigned processes is finished, they can be executed to learn and improve. This is usually done on a small scale, so with a small group of test users. The test users have to be integrated into the new process testing to a degree, where they should both understand how to adapt the processes and also what is the overarching goal of the new processes. But the new processes do not only need to be communicated to the people directly involved, but all stakeholders in the company affected by the new processes. An important part of the execution of the new processes is also the teaching of the users of the new process, so that they can efficiently and effectively work within the new framework.

Once the new process is practically implemented it must also be monitored to get the relevant information about its performance and to analyze if the outcomes of the process have improved. This can be done based on the key performance indicators (KPIs) defined in the process design stage.

Finally, the processes are optimized based on the learnings from the monitoring stage to achieve the goals of the process improvement. Here, the identified bottlenecks in the processes are corrected either directly or in cases where it is not possible yet, the information is used in the following cycle to improve the processes.

Task allocation in business process management

From an organizational point of view the different tasks in the lifecycle of business process management have to be distributed to the different stakeholders in business process management (see Figure 11). The four different stakeholders are:

- Process manager
- Process owner
- Process analyst
- Process user

The process manager is the head of the whole process improvement program during the business process management lifecycle. The process manager oversees all processes, the identification and definition of processes within the whole process landscape and the documentation of the processes. Also, the alignment with the overall business strategy of all processes is organized by the process manager.

A process owner is the responsible person for a single process. In the context of the improvement of processes the process owner is responsible for the organization, i.e. modelling, and the monitoring of the new process. As the head of the process a process owner is also involved in the definition of the performance indicators of the process, the KPIs, which are defined in the design stage, and responsible for guiding the process users through the execution of the process.

The process analysts are the specialists regarding the improvement of processes and identify improvement possibilities in identified processes. They take care of the design and especially

redesign steps and also help the process manager to monitor the outcomes. They are the link between the process owner and the process users.

The process users are executing the single activities of the process, both routine and novel activities. They are guided by the process owner in their daily business to ensure a smooth operation of all daily and novel activities and they document the whole process.

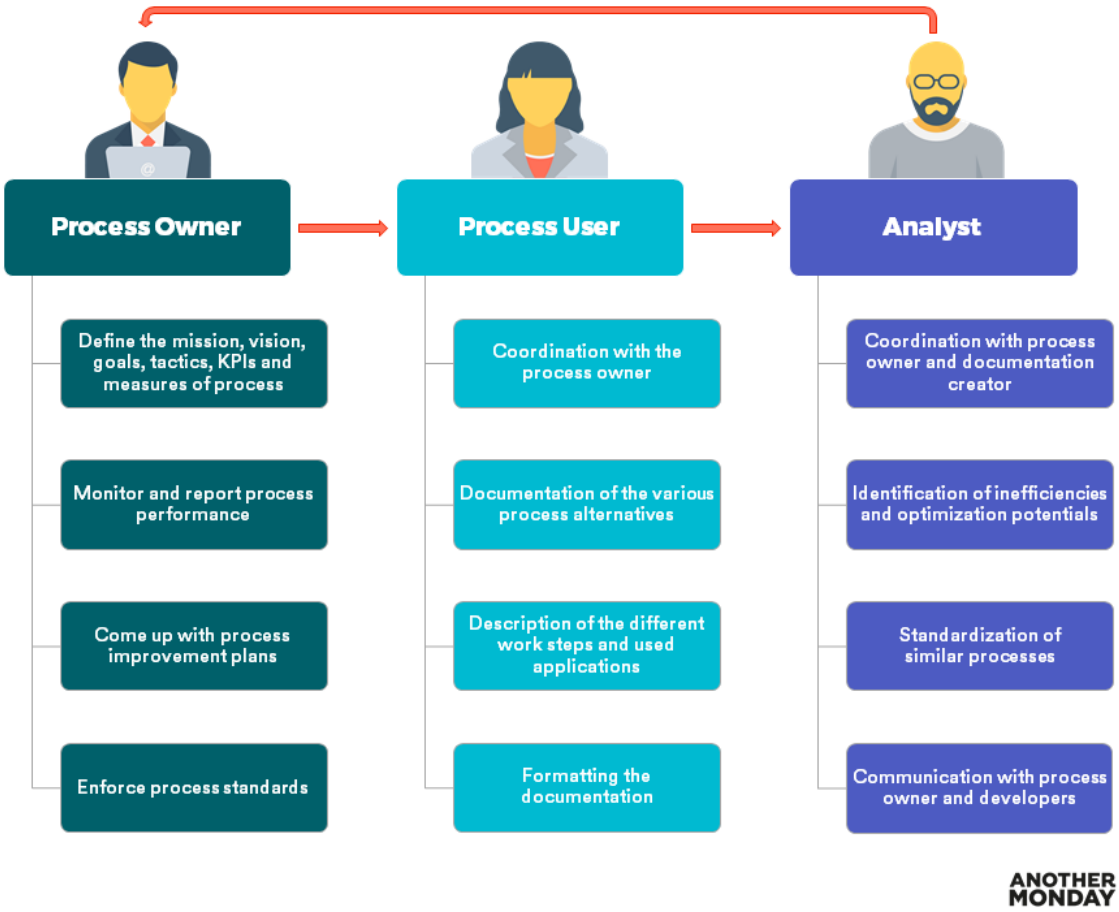

Figure 11: Role of the stakeholders of business process management. Source: *https://blog.anothermonday.com/process-documentation-done-right*

Quality in IP Management

The improvement of business processes considers all processes in a company including IP processes in IP management. The state of the art to improve IP processes is documented in the German standard "DIN 77006:2020-06 Intellectual property management systems - Requirements" published in June 2020. This standard is the supplement for IP management to the DIN EN ISO 9001:2015-11 standard and embedded in the high-level structure of management standards. Considering the improvement of IP processes, it follows the logic of the PDCA cycle (see Figure 12).

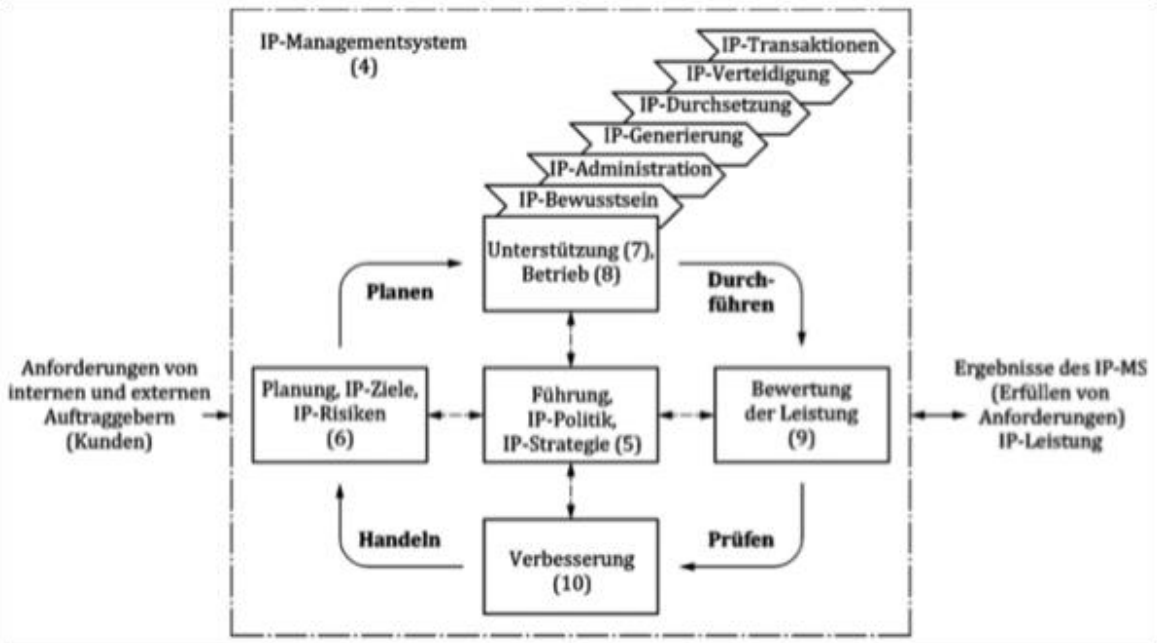

Figure 12: The PDCA cycle in IP management in the DIN 77006:2020-06. Source: *DIN 77006:2020-06 Intellectual property management systems – Requirements, Beuth*

The standard DIN 77006 requires the use of the PDCA cycle in IP management in the following way. The central part of IP management is the leadership, IP policy and IP strategy, which is the guideline for all other IP related actions and processes. Then the PDCA cycle starts with the planning and identification of IP goals and IP risks based on the requirements of internal and external customers. The next step is the support and operation of other functions of the company, then the evaluation of the performance of IP is checked and finally continuously improved.

Chapter 3 | Process maps and process landscapes

The process architecture of a company

In a company the different processes can be modelled and written down in the so-called process architecture. The process architecture can be understood in a horizontal and in a vertical dimension. In the vertical direction the different hierarchical levels of the processes are depicted in a process pyramid (see Figure 13). On the highest level of the pyramid the process landscape is modelled. The process landscape gives an overview over the processes on a business level. The process landscape has the lowest level of detail in the modelling of the processes, but also covers all main processes relevant in the company. It also shows the links between individual processes. The processes in the process landscape can then be broken down into smaller parts, the process maps, on the intermediate level. The process maps are a finer representation of the processes in the process landscape but are still not resolving the individual steps of the processes. The individual steps are then represented on the lowest level of the process architecture in the detailed process models. The different levels in the process architecture are linked with each other and represent exactly the same processes just with a different resolution. On the horizontal level process maps should represent the inputs and outputs of a process and the individual steps in between. This can be done with various visualization methods.

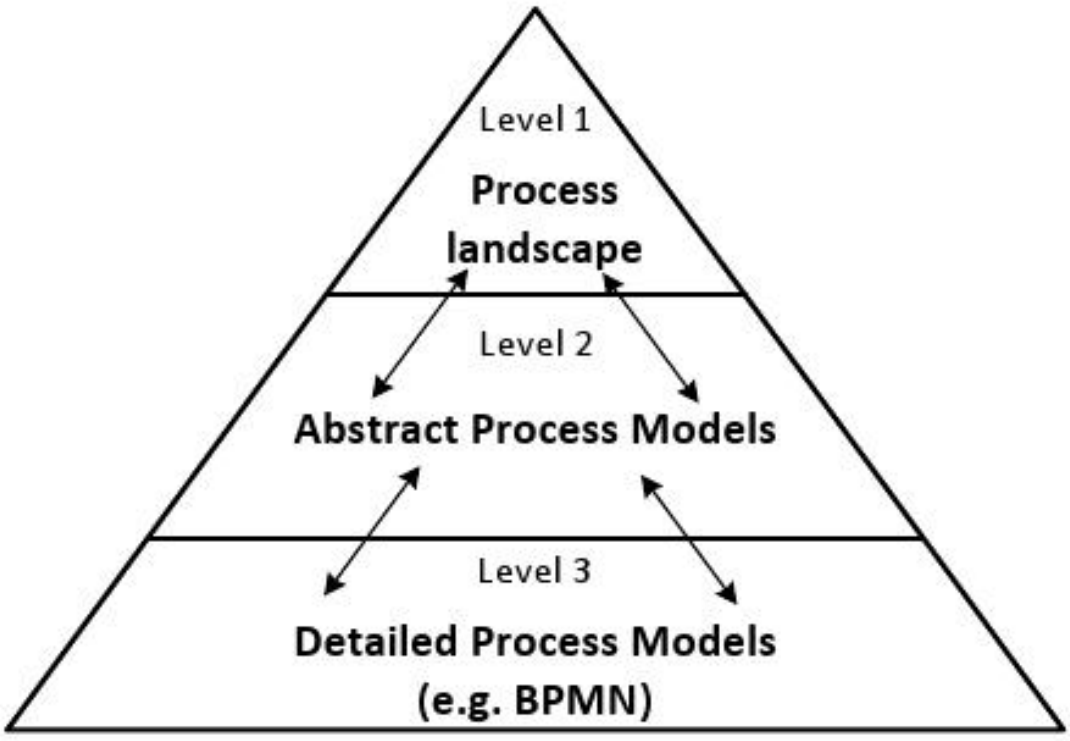

Figure 13: The process architecture of a company. Source: *Marlon Dumas, Marcello La Rosa, Jan Mendling and Hajo A. Reijers, Fundamentals of Business Process Management, Springer (2012), p. 42*

Flowcharts

Flowcharts are the simplest and also easiest accessible and understandable diagrams to map a process. A flowchart is the sequential representation of a process from beginning to end. The single steps of the process are written down as boxes and linked with arrows indicating the direction of the process. Activities are visualized as rectangular boxes, event are visualized as boxes with rounded corners, and decision points are visualized as diamond shapes (see Figure 14).

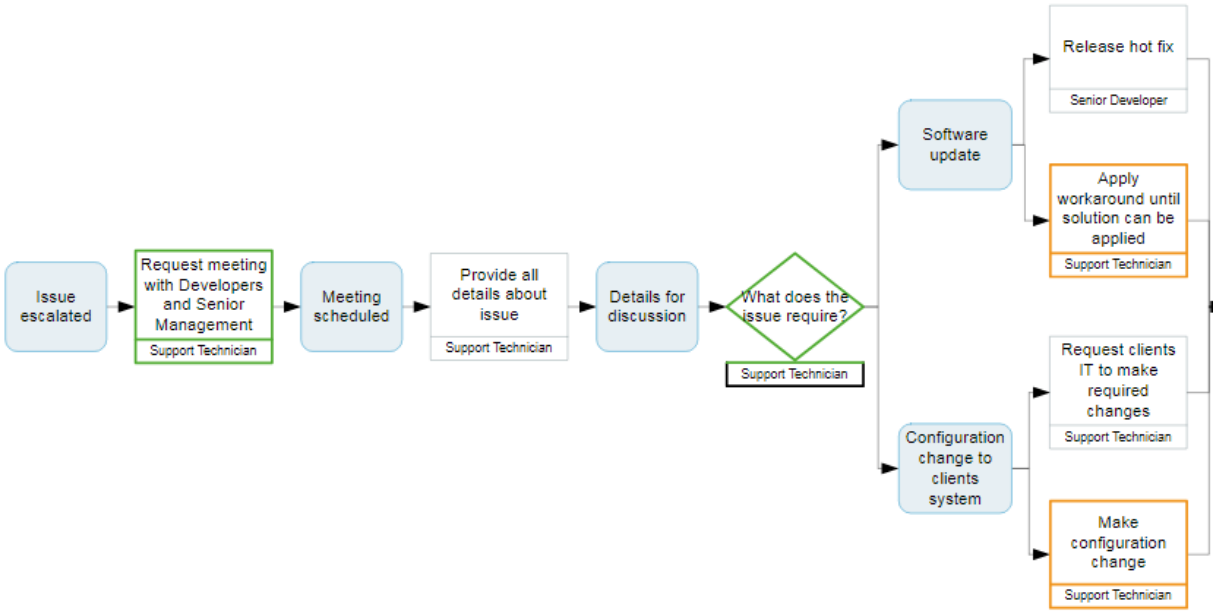

Figure 14: Flowchart for an IT business project. Source: *https://www.processexcellencenetwork.com/business-process-management-bpm/articles/the-pex-guide-to-bpm*

The swim lane diagram

Swim lane diagrams are extensions of flowchart, where the responsibility for individual jobs is indicated by the introduction of columns, the so-called swim lanes (see Figure 15). It contains like a traditional flowchart all the activities, events, and decision points. The activities, events and decision points are then placed in the lines of the individuals or organizational parts responsible for it. The swim lanes also have a direction, so that the order to execute the tasks by the individuals is indicated by their position in the swim lane diagram. Swim lane diagrams help with this approach to identify bottlenecks in single departments and improve the cooperation between different departments or people. Swim lanes make redundancies and organizational inefficiencies visible and are easy to analyze.

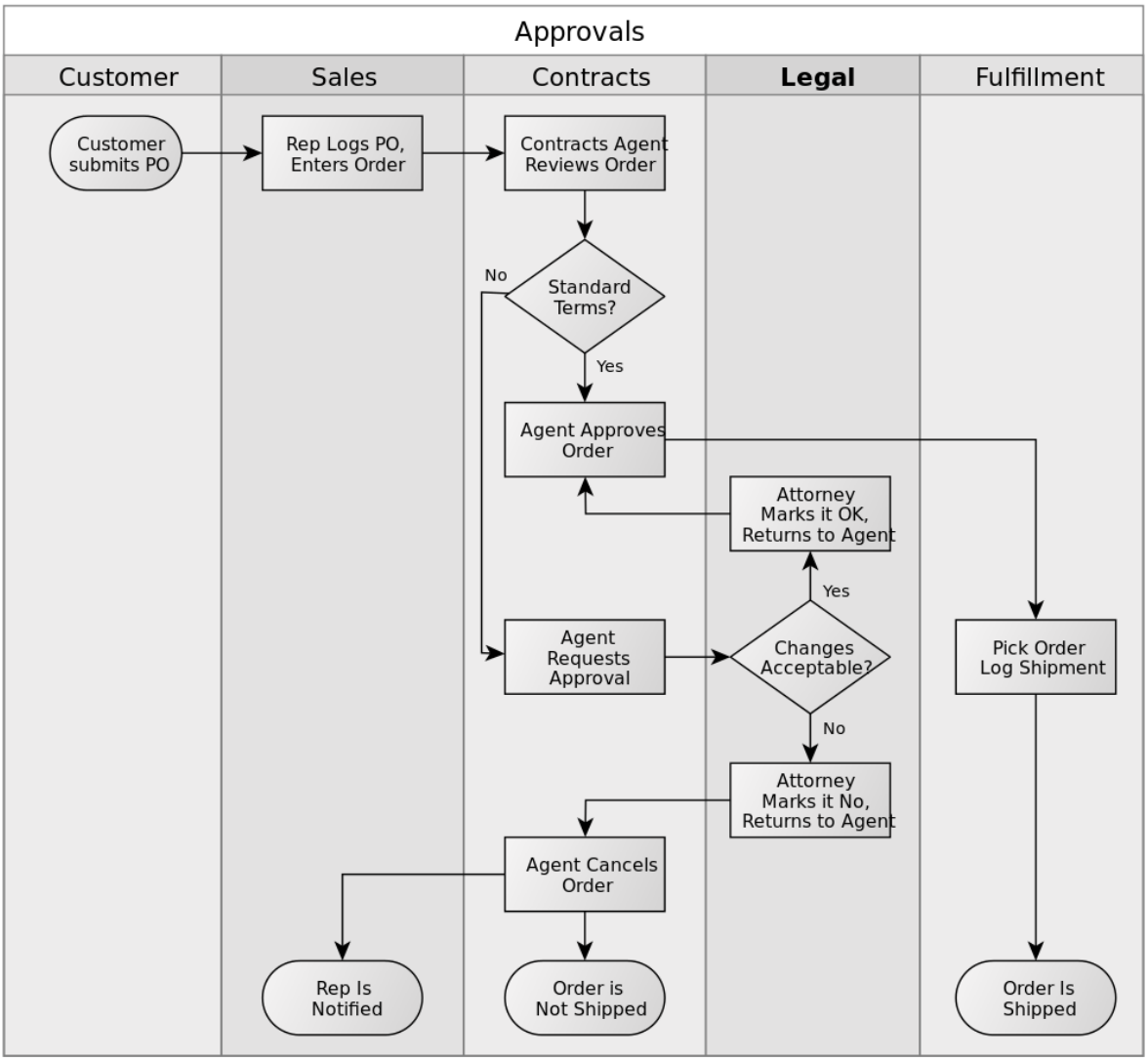

Figure 15: Swimlane diagram. Source: *https://en.wikipedia.org/wiki/Swim_lane#/media/File:Approvals.svg*

The swim lane approach can also be used in other ways, for example with the design thinking method and IP design to better structure and examine a user scenario. This can be done with the AEIOU method developed by Rick E. Robinson. AEIOU stands for:

- Activities
- Environment
- Interaction
- Objects
- And user

With the methods of AEIOU a concrete scenario can be ideated and structured (see Figure 16). First the activities in the scenario are ideated within a cognitive walkthrough. So basically, it should be answered what happens to the customer using the product and in which steps. Then the environment, interactions, objects, and user are ideated, and the

individual steps are visualized in the swim lanes. In further steps the needed IP can be derived from the AEIOU visualization.

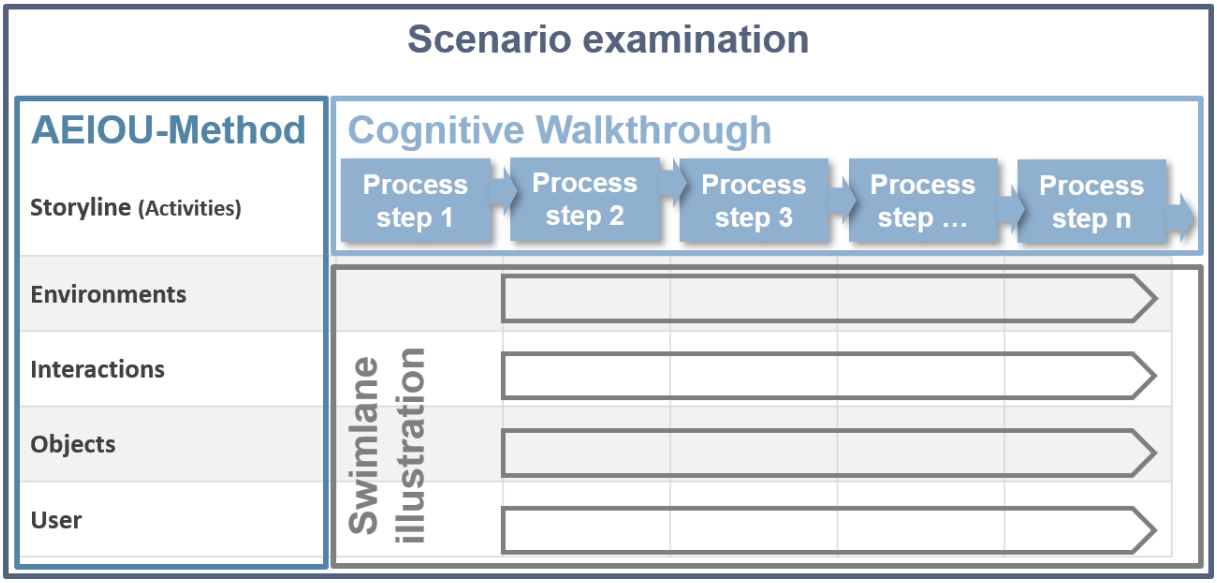

Figure 16: Visualization of the scenario examination with the AEIOU method. The Activities are written down in a cognitive walkthrough with the individual process steps from the left to the right. The environment, interactions, objects, and user are separated into swim lanes and their contributions and interactions are added to the swim lane diagram.

Business Process Model and Notation (BPMN)

The business process model and notation (BPMN) was developed by the business process management initiative and maintained by the object management group (OMG). The OMG is a standard developing consortium mostly for the computer industry. The BPMN is ratified as ISO 19510 standard.

The BPMN notation consists of the following building blocks (see Figure 17):

- Flow objects: events (circles), activities (rectangles with rounded corners), and gateways (diamonds)
- Connecting objects: sequence flow (filled arrows), message flow (dotted arrows), and associations (dotted line)
- Swim lanes: pools (graphic container) and lanes (sub-partition of the pool)
- Artifacts: data objects, groups, and annotations

In more detail, the events, when something happens, can be separated in start, intermediate and end events. The start event is denoted with a circle with a thin line, the end event is denoted with a circle with a thick line and the intermediate events are denoted with a circle with a double border line. The rectangles for activities, where some kind of work must be done, are separated into tasks, sub-processes, transactions and call activity. A task is the smallest unity of an activity and is denoted with a single rectangle with rounded corners. A sub-process contains additional details of business processes and is denoted as a rectangle

with rounded corners and a plus sign on its bottom line. This plus sign can be clicked to expand the details. Transactions are subprocesses, which cannot be split up into single tasks, so all tasks must succeed to meet an objective. They are denoted with a double bordered rectangle with rounded corners. Finally, when a global process is reused, this is denoted as a call activity with a bold bordered rectangle with rounded corners.

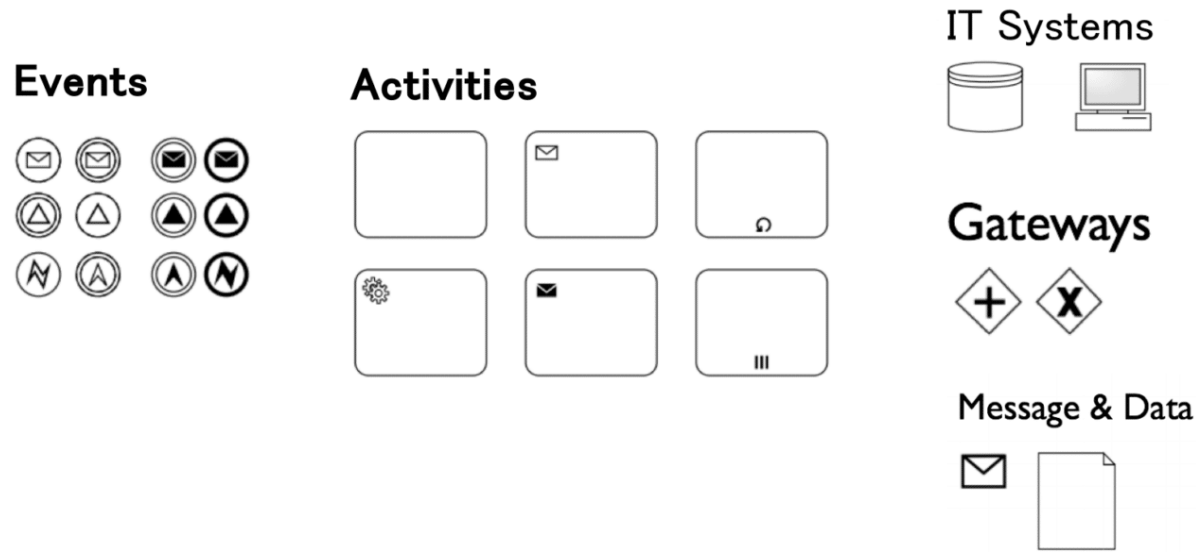

Figure 17: Notation in the BPMN. Source: *https://lanalabs.com/en/glossary/bpmn/*

Gateways are the connections between events and activities and denoted with diamonds. They also determine the pathways taken depending on the conditions indicated. The conditions can be for example, exclusive (indicated with an X), where only one pathway can be taken, parallel (indicated with a plus), where pathways are combined, inclusive (indicated with a circle), where all following pathways are evaluated, etc.

The connections can be a sequence flow, message flow or association. The sequence flow shows the direction of the flow in an arrow with a solid line. A small slash at the beginning of the arrows indicates the default flow, when conditional flows are available. The message flow indicates message flows from outside of the organizational boundary and is denoted as an arrow with a dotted line. A dotted line indicates associations of artifacts to flows. Artifacts can be data objects, groups, and annotations, which add more information to the model.

Diagrams can also contain pools and lanes. Pools are representing the actors of the process in an organization and are separated into lanes, which organize the activities by assigning them to the individual actors with their different roles. An example of a map for the ordering process of an iPhone is shown in Figure 18.

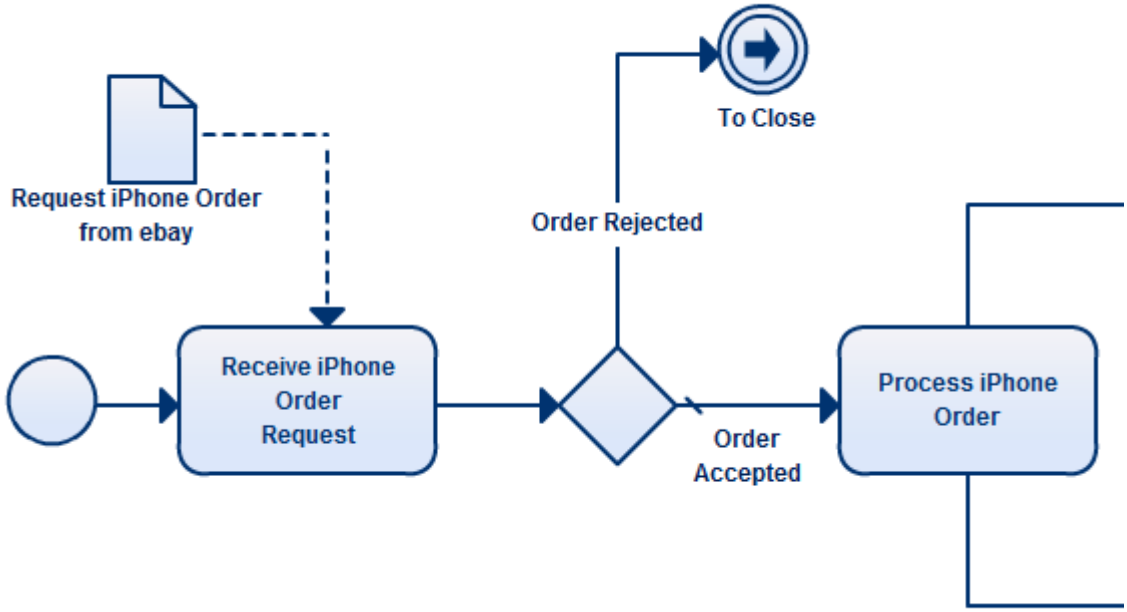

Figure 18:A simple process in BPMN notation. Source: *https://creately.com/blog/announcements/business-process-modeling-tool/*

UML diagrams

The Unified Modelling language (UML) was originally designed for software engineers as a general-purpose modelling language. It was adopted by OMG and in the international standard ISO/IEC 19505-2:2012. UML is especially helpful for software engineers to work together in larger projects and maintain code together. It supports them to achieve the targeted functionality for the end-customer while staying within the budget. This is achieved by organizing the activities of the software development team, specifying what should be developed, guiding the team and the individual developers through the activities, and helping to monitor the project.

UML visualizes software system architectures in different diagram types (see Figure 19). Those can be structure diagrams (class diagram, component diagram (see Figure 20), deployment diagram, object diagram, package diagram, profile diagram and composite structure diagram) and behavioral diagrams (use case diagram, activity diagram, state machine diagram, sequence diagram, communication diagram, interaction overview diagram and timing diagram). The single components and the activities are then written down and visualized with the standard set of UML symbols, e.g. for components diagrams (see Figure 21).

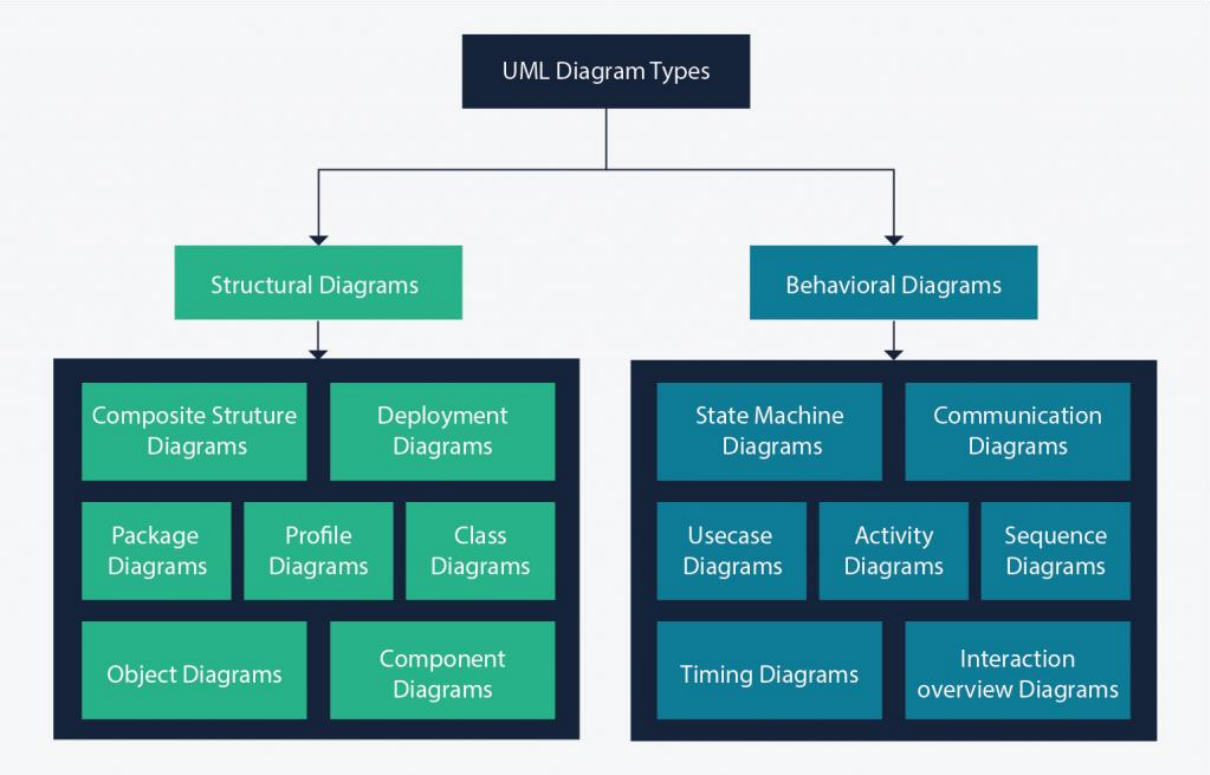

Figure 19: Structural and behavioral diagrams in UML. Source: *https://creately.com/blog/diagrams/uml-diagram-types-examples/*

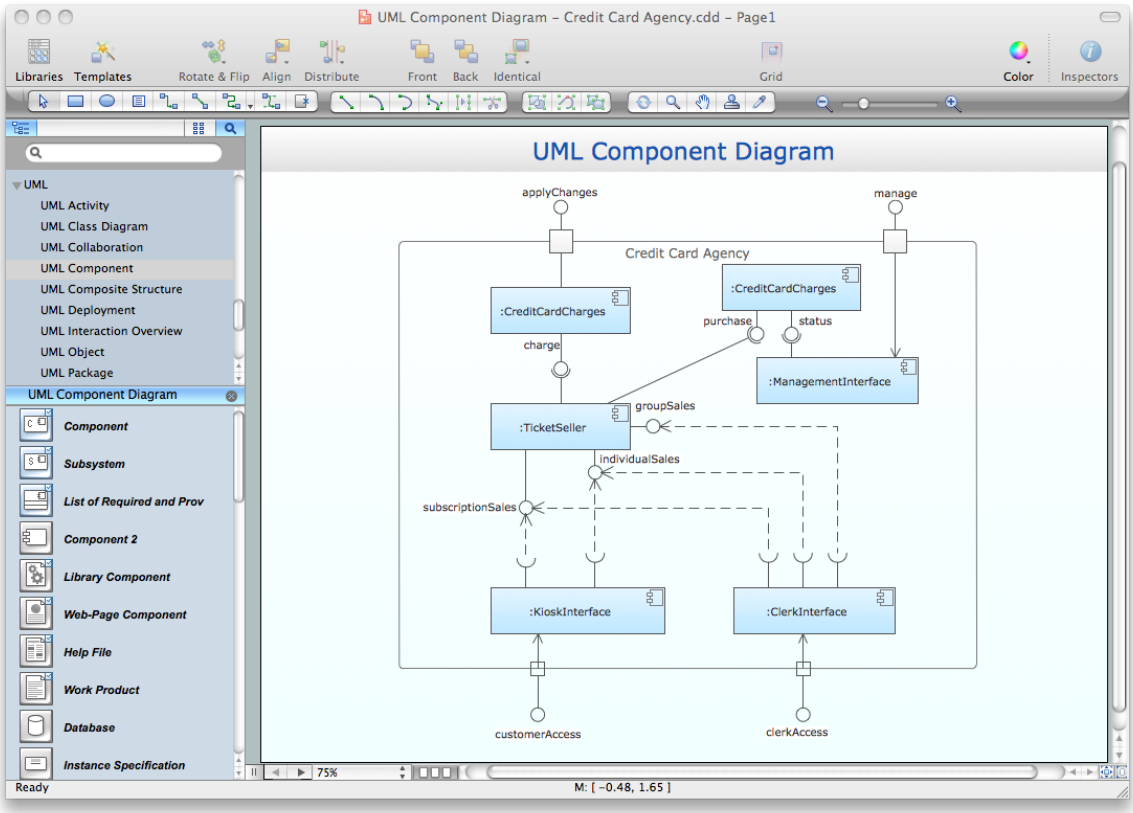

Figure 20: Sketch of a UML component diagram. Source: *https://www.conceptdraw.com/How-To-Guide/design-elements-uml-diagram*

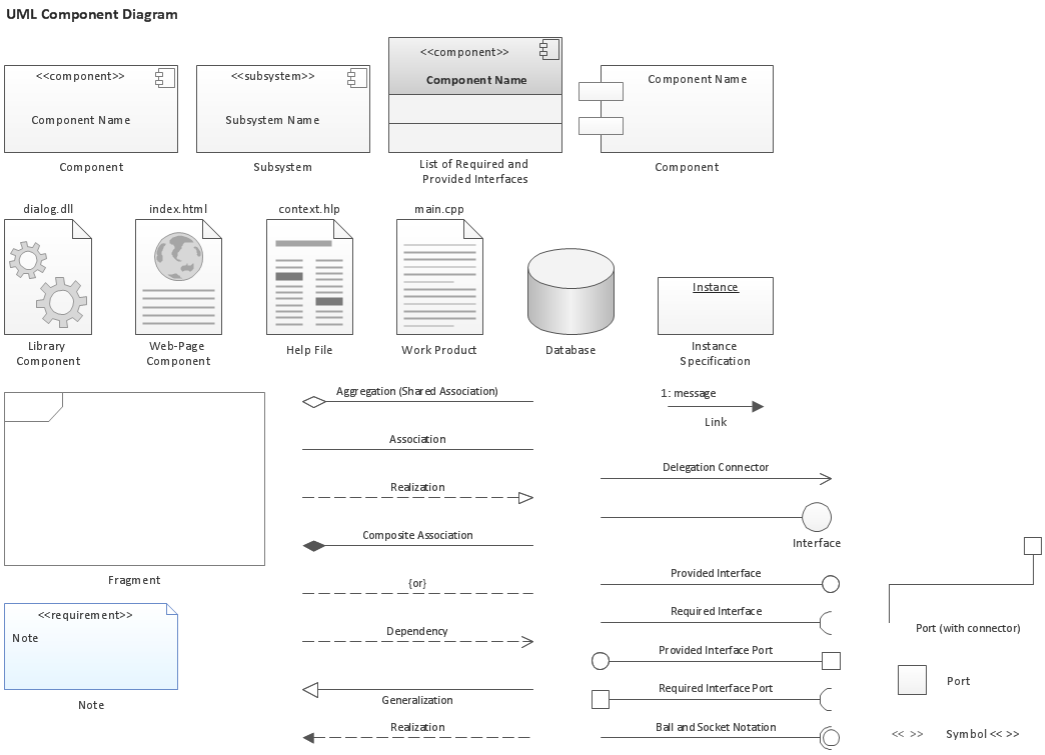

Figure 21: Elements of Component diagrams in UML. Source: *https://www.conceptdraw.com/How-To-Guide/design-elements-uml-diagram*

Value stream mapping

Value stream mapping is a mapping method oriented on the principles of the lean management method trying to reduce wasteful parts in an organization. It is part of the so-called lean six sigma methods. It can be used to analyze, design, and manage the flows of material and information in an organization. It focuses on the improvement of a single value stream, which is analyzed and then improved. Therefore, two different maps are drawn depicting the status quo of the process and the improved process for the value stream (see Figure 22). The map is drawn with the information flow on the top of the diagram, the production flow in the middle of the diagram and the time ladder on the bottom of the diagram, which makes them different to the flowchart diagrams and adds layers of information.

The information flow on the top of the diagram shows how the information of process-related data flows and how it is transmitted between e.g. the supplier, customer, and release manager. The product flow section covers the whole product development process. For example, this covers the request of new product features by the supplier and the single process activities till the launch of the new product. The individual activities in the production flow are broken down to single tasks with the team, the setup and cycle times of the task assigned to it. The time ladder at the bottom indicates the time needed for the individual tasks. The lower parts of the ladder show the working hours of the team members executing the tasks and the upper parts show the time between the process stages.

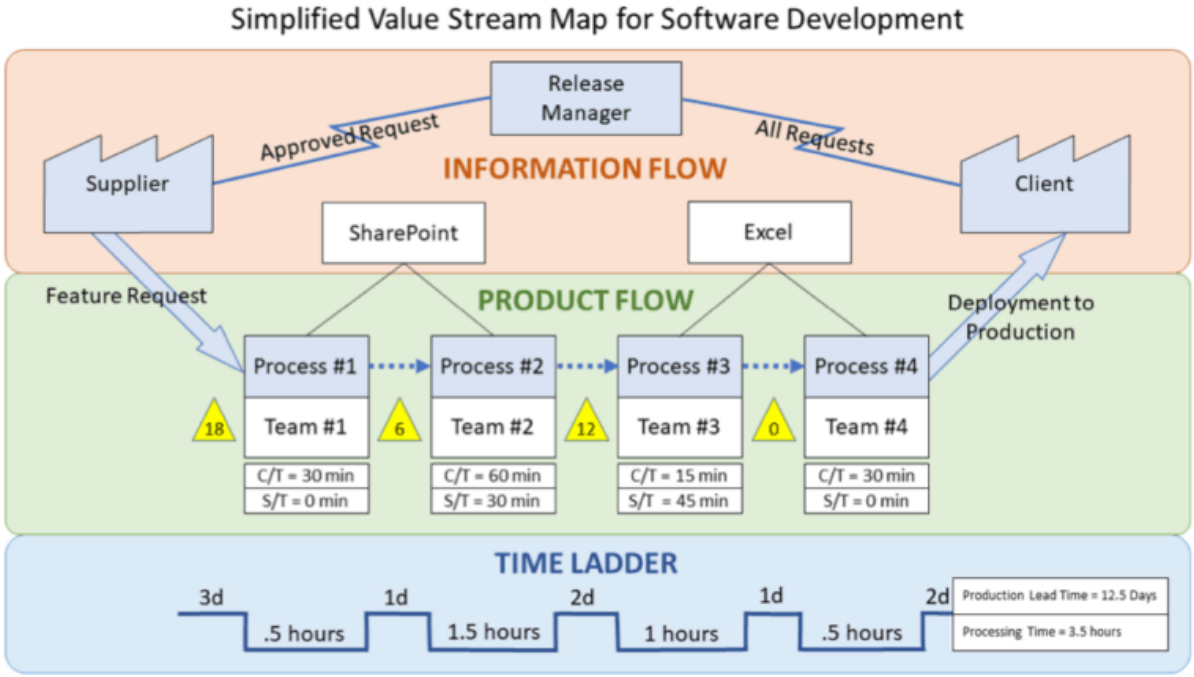

Figure 22: Example of a value stream map. Source: *https://www.plutora.com/blog/value-stream-mapping*

Chapter 4 | IP Process maps

The process map of the IP department

Companies are individual like humans. Each company is organized in a different way, so it is also complicated to write down the process map of an IP department, which holds true for every company. A very general map for the integration of the IP department is given in Figure 23. On the highest level of the map, the board member, who oversees the IP department and other departments, is located. This can be a CIO, CFO, CTO or also another member of the management depending on the structure and size of the company. On the sides the other departments are located, which to some degree interact with the IP department. Finally, in the center the IP department with its groups of processes is located. Those processes comprise strategy related processes, R&D related processes, management related processes, infringement related processes, and patent procedures.

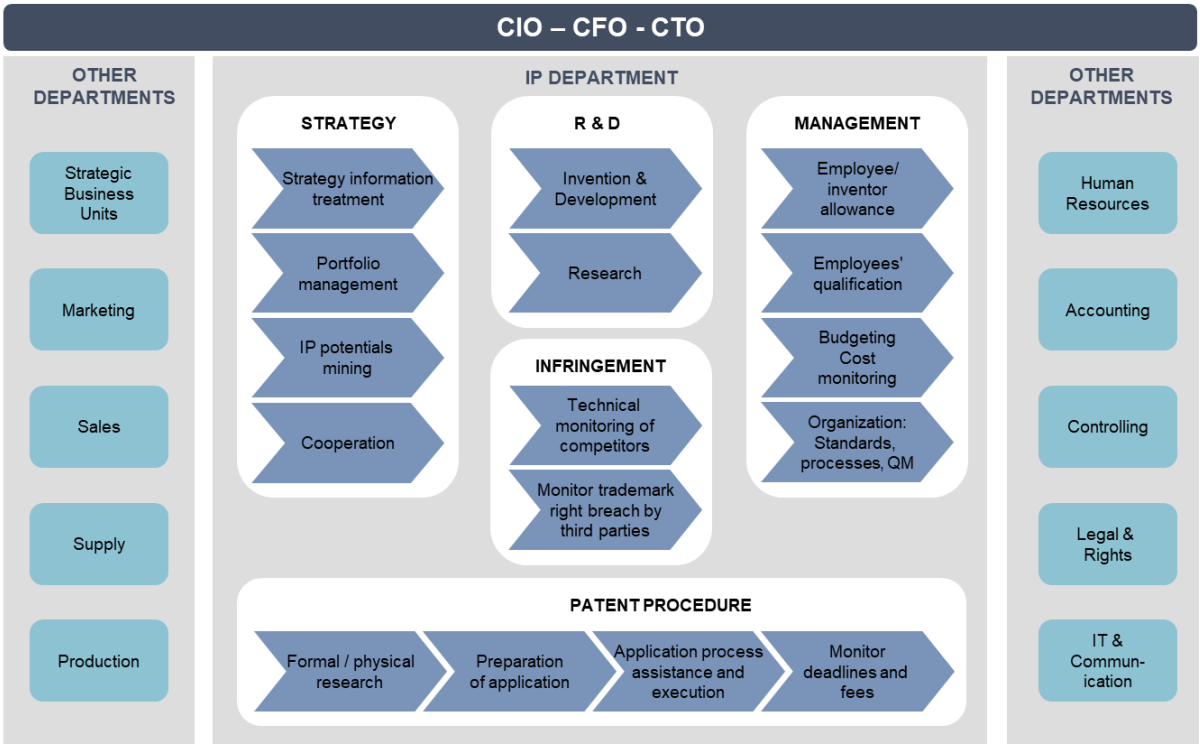

Figure 23: Schematic process map of the IP department within a company.

The core processes of IP management

Following the logic of business process management, the IP processes in a company can be identified in the process architecture and written down into IP process maps. Those maps start with a relatively course description of the handled processes but can also go down to the level of explicit workflow descriptions. In modern IP management 9 core processes can be identified (see Figure 24):

- IP Strategy Development
- Generation of IP
- IP administration
- IP risk management
- IP enforcement
- IP related defense
- IP transactions
- IP reporting
- And IP Awareness Raising

Figure 24: The 9 core processes of IP management.

Those processes are interconnected in a way, that the outcomes of the previous process might trigger the start of the next process, but processes might also start periodically. The role of the IP Strategy Development process is to describe IP-related goals and ways to achieve them in accordance with the business model. The generation process of IP consists of the systematic and goal-oriented design of IP or development of an IP portfolio to meet the IP requirements along the defined IP strategy. The role of the IP administration process is to provide a reasonable overview of the IP inventory and ensuring the legal status of the IP required for economic use. The IP risk management process takes care about the identification and assessment of risk situations from own and 3rd party IP. Also, appropriate measures regarding the identified IP risks are defined. The IP enforcement process has the role to identify and handle (potential) IPR infringements adequately. The IP related defense processes are about the response to IP-based attacks by 3rd parties and the lawful handling of disputes. In the IP transaction processes the acquisition and exploitation of IP and related legal positions, including the design of licensing relationships, are treated. The IP reporting process handles the creation of transparency on IP investments, shows the resource allocation and enables the optimization of the IP portfolio. Finally, the IP awareness raising process aims to create an appropriate understanding of the economic impact of IP in the business model among all stakeholders.

Subprocess maps: The Generation of IP

Each of the 9 processes can be broken down onto smaller more detailed process levels within the process architecture. One example for a process map for the generation of IP can be found in Figure 25. Here, two separate process chains for patents and trademarks have to be distinguished. However, both process chains aim to systematically design IP or to develop an IP portfolio to meet the IP requirements along the defined IP strategy.

The initial process is always the identification of either IP-related business model elements or core elements of communication along the defined business strategy. In the case of trademark generation this leads directly to the shaping of elements to protect the identified core elements of communication. In the case of patent generation, first invention disclosures have to be processes to detect customer relevant features in the second step. Those features may be IP protected according to the IP strategy to exclusify the customer benefits. The following steps are again the same for patents and trademarks. Based on the outcome of the previous processes a decision about the IPR application of the patents and trademarks must be made. If the decision is positive, the patent or trademark application must be prepared and accompanied. The IP generation process ends when the patent is granted or the trademark registered, respectively.

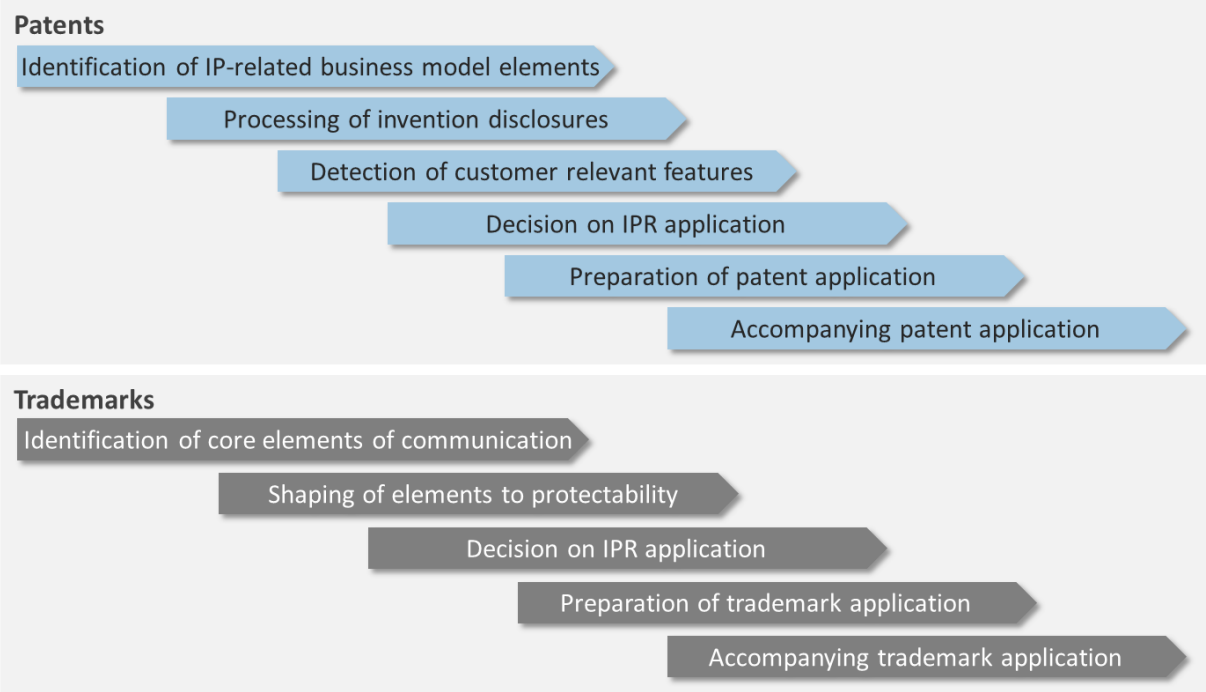

Figure 25: The IP generation process for patents and trademarks.

Flowchart of the patent maintenance process

On the lowest level of the process architecture, the processes must be written down in e.g. a flowchart or a swim lane diagram. A practical IP example for such a diagram is written down for the patent maintenance process within IP administration in Figure 26.

From this diagram, all actors, events, and decision points in the process can be understood and the execution of the process can be comprehended. The whole process is triggered once a year. Initially, the IP administrator updates the relevant information, carries out an evaluation and reports to the product management, which patents may be dropped based on the evaluation. The product manager is then included into the process and gets asked about an opinion if the patents should be dropped or not. Based on that opinion the IP

manager creates a decision template, which is submitted to the steering committee to make a decision. At this point three decision pathways are possible. First, the patent should be maintained. Second, the patent family should be restricted. Third, the patent should be dropped completely. In the first and second case, the maintenance process leads to the payment process of the maintenance fee, which is not depicted here. In the third case, the dropping of the patent leads to the end of the process.

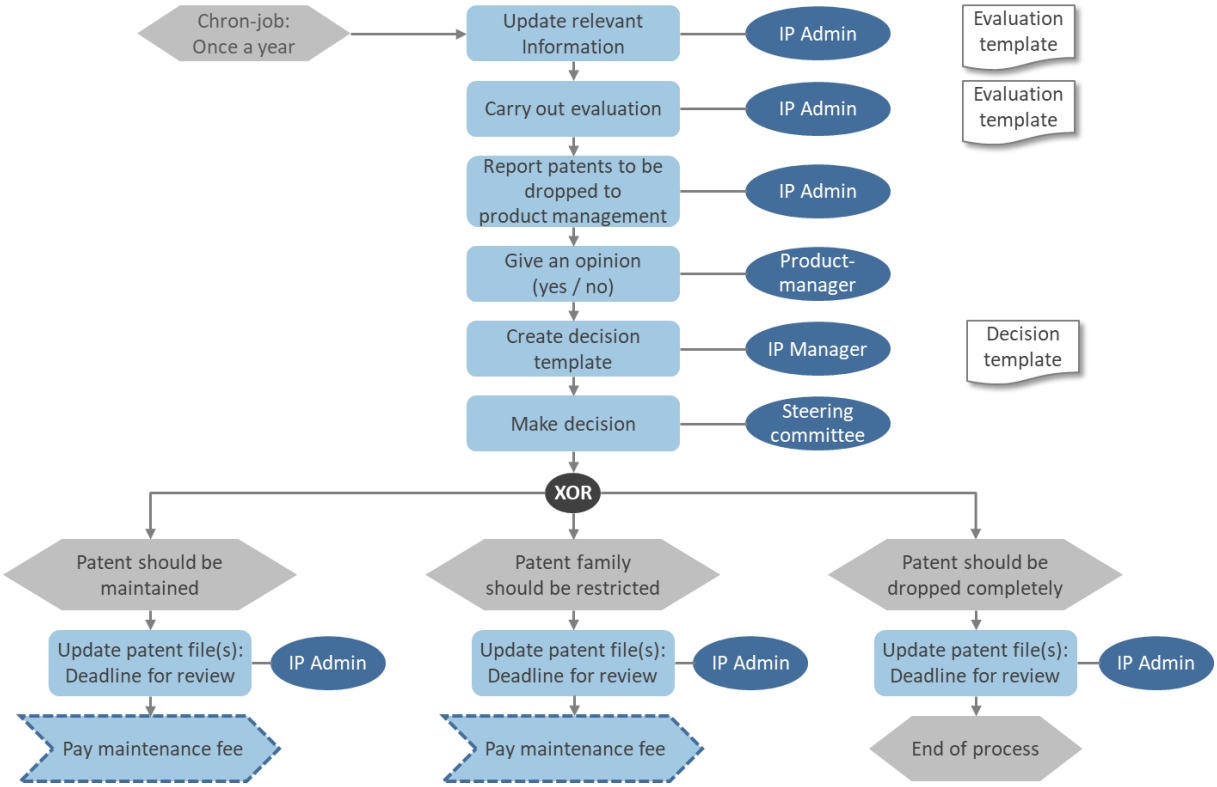

Figure 26: Flowchart of the patent maintenance process.

Interfaces between the innovation process and IP management processes

In modern IP management it is important, that the IP department is not working as a silo but is fully integrated in the innovation and product development processes to support the strategic goals of the company and to create a legal exclusivity for the developed products and services (see Figure 27). That means, that from a process architectural point of view innovation processes and IP processes are connected. They can trigger each other, and process information generated by each other. Examples for IP management processes related to the overall innovation process can be seen in Figure 28. For example, in the ideation phase of the innovation project the IP department might be included with an IP related evaluation of innovation fields, which is an independent process connected with the innovation process. Similar, in the product planning process the IP strategy development process can support the product planning. The identification of customer relevant technical features can support the development and product design process and many other IP related processes can be integrated into the innovation process chain.

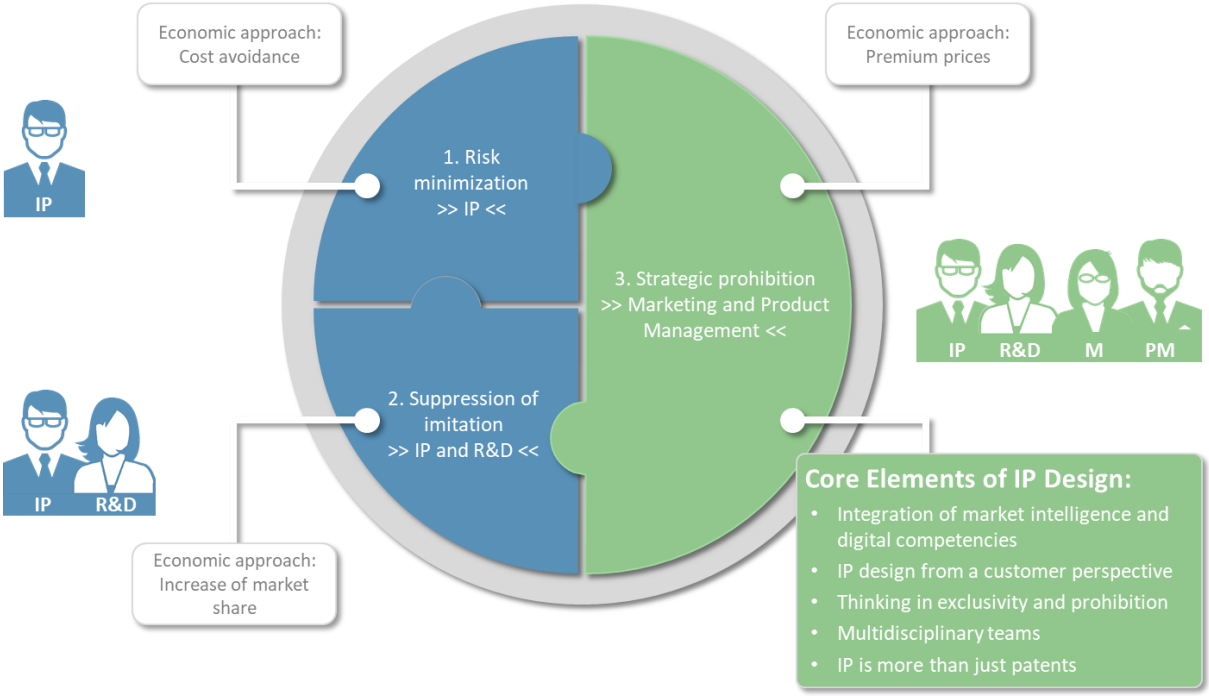

Figure 27: Integration of IP into the product development and innovation processes with IP-design. Adapted from: *Alexander J. Wurzer, Theo Grünewald, Wolfgang Berres, Die 360° IP-Strategie – So sichern Sie Ihren Innovationserfolg langfristig, Vahlen (2016)*

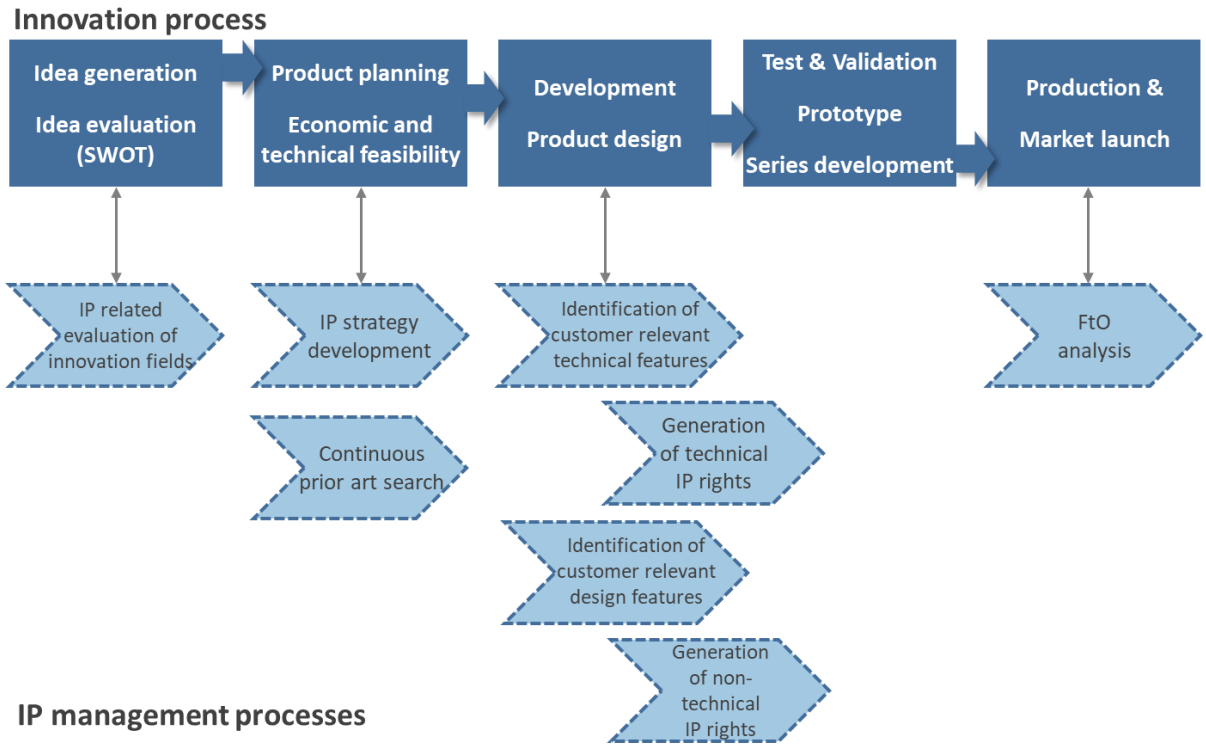

Figure 28: Integration of IP management processes in the innovation process.

Chapter 5 | Process documentation and description

The documentation of business processes

The documentation of business processes is an important tool in the context of the improvement of business processes. Compared to business process management it has not the purpose to improve the processes but to inform all stakeholders about how and why the processes in the company are performed. This is crucial, since even within the same department, people tend to do their work in their personal style and team members who formally make the same job make it slightly different. They use a different process. So, a documentation of the really executed business processes is gathering necessary information for any improvement of processes by process management. Business process documentation also helps companies to conserve the knowledge of the processes. For example, when an important employee leaves, their knowledge is not lost by the company, but well documented and the successor can learn to fill the position adequately. This way, process documentation can be used as a training tool for new employees.

When process documentation is performed, most of the job is drawing down process maps, like described in Chapter 3. But process documentation is more than just process mapping. In process documentation all documents, which explain the documented process are added to the map. This can be references, notes, software, forms, and other documents and records. This is necessary to communicate to all stakeholders not only how, but also why a process is performed. Only this way, a newly trained employee will fully understand how to perform the process and the business process managers will get an idea how to improve the processes. A simple work instruction is not enough.

To better understand this, take the example of a process map for the IP design process. In this process map continuous meetings of the IP department with the product management, marketing and sales and R&D department are written down. It also says that in these meetings the customer needs and customer perspective should be discussed from various perspectives. But what is not written down in the process map is, that a corporate culture is necessary recognizing the creative contributions of the team members and putting the result above the planning. The methodology itself is less important than the achieved exclusivity of the business model and customer experience. Therefore, documentation needs to be more than mapping.

The needed information in process documentation

Now the question is, which information should be written down in process documentation additionally to just drawing a map to give the new employees enough information to do their job. Additionally, it should be asked, which information is necessary in the process documentation to understand what a process should do and how it could be possible to improve it. The list of points that need to be addressed in process documentation comprises:

- Purpose and scope of the process
- Boundaries of the process
- Input and output of the process
- The process flow
- Exceptions to the process flow
- Process organization
- Process indicators

The starting point of process documentation is to define the concrete purpose and scope of the process. So, here it is defined, why the process is executed at all, which is the necessary information for the process improvement, but also information for the employees to better understand their own work. Also, in this step the scope of the process is defined, which is needed to have a clear boundary of the process and understand, what is not in the scope of the individual process. For example, the job of the IP department in the IP design process is the creation of the legal exclusivity of the product. This is in the scope of the process. The determination which exclusivity should be generated is not in the scope of this process, but in the scope of the product development process, where the IP department is involved in a consulting function.

Related to the scope are the boundaries of the process. Those are the start and end points of the process, which are usually triggering other processes also from other departments. Here, it must be clarified and communicated, what triggers the start of a process, when a process ends, and what happens after the ending of a process. E.g. when the determination of the needed exclusivity ends a part of the product development process, this triggers the IP process for the creation of legal exclusivities.

When the boundaries are defined, the inputs and outputs at these boundaries need to be defined and documented. For the process input, it must be determined, what is needed for the process. This includes all types of necessary assets both tangible assets and also immaterial assets to execute the process. For the IP department this could be e.g. software for IP analysis or information gathered by other processes. Also, the trigger for the process must be defined here, so that it is clear, which other process or event can lead to the start of the process, who provides the information that the process should be triggered to the process owner, and who provides the information and material needed as process input.

The requirements for the process output are similar. Here, it is also important to define the results of the whole process. So, why is the process executed at all? Each process has a purpose in the company and in the process landscape of the company, so that the output of each process must lead to e.g. value creation in the company or the provision of information for another process. That output definition is also relevant, when the process should be improved, since it shows how good the process performance is. The process performance is also indicated by the process indicators.

The next step is the drafting of the process map, which shows the actual process flow. Here, all individual steps of the process are described and it is documented how they are

performed, by which person they are performed and all gateways and events, where different pathways are possible, are shown. This map also includes the start and end points of the process and the flow of information via inputs and outputs. For the process documentation it is important, that not only the ideal process map is drawn, but that also the exceptions to the process flow are written down. This means, that especially in large and complicated processes often unintended events can happen, which are not part of the process map. Those events and the way it was dealt with them must be part of the process documentation to finally improve the processes.

Finally, the process organization must be documented well. The process organization includes the different involved team members and their roles in the process. Here, it must be documented, who is the process manager, process owner, process analyst and process user. Also, it must be drawn down in the process map, who has which job in the execution of the process.

A last step is the documentation of the process indicators. The process indicators are crucial for the improvement of the processes, since they are indicating how well a process was executed and where room for improvement can be identified. Process indicators are often connected to the output with the question, if the process achieved, what it should achieve. But also, the quality of the executed activities can be a process indicator independently of the final output. Those two approaches can also be combined.

Example: The invention submission process

A practical example for process documentation is the invention submission process. Here, the multiple subprocesses, actors, needed inputs and aspired outputs must be described and well documented. For the mapping of the invention submission process a pure flowchart or similar map is enough (see Figure 29). For the process documentation also, all other details should be well documented.

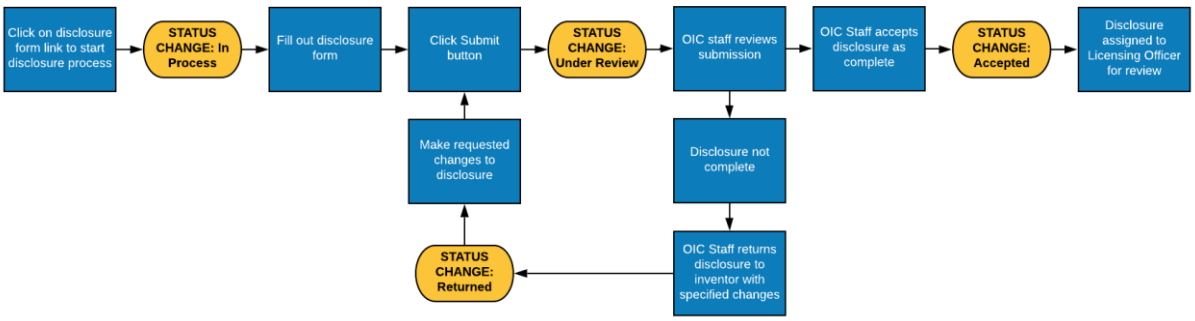

Figure 29: Example of a flowchart of the invention submission process. Source: *https://blink.ucsd.edu/research/conducting-research/edisclosure/index.html*

This can be done for example in a spreadsheet including all necessary data (see Figure30). On the top of the spreadsheet, the process, the process owner, and the process team must be defined. Also, the purpose and scope of the process must be defined. The individual

subprocesses are then documented in the spreadsheet from left to right. From left to right first the supplier and the input of the process are defined. The supplier of the process in the first subprocess of the invention submission is the inventor, who can be either internal or external. This inventor provides either written or oral input, namely the idea of the invention. The next step is the description of the activity in the process. In the example this is the interview with the inventor based on the invention disclosure. Then the output, i.e. result, and the internal or external customer of the process are defined. Here, the output of the first subprocess is the first draft of an invention disclosure and the customer is a member of the IP process team.

Process: 2.4 Invention submission
Processowner: Piero Visani, Ulf Marquardt
Processteam: Beat Mollet, Patrick Couzens, Sarah Dixon

AC: Accountable / Responsible
OTC: Obligation to co-operate
RR: Reporting required
DM: Decision maker

Purpose and goal:

Scope:

S	I	P	O	C

Pos.	Supplier	Input	Sub-Processes: Activities	Output	Customer	Parties involved: AC	OTC	RR	DM	References (R), Notes (N), Software (S), Form (F), Documents and Records (D)	Weakness; Opportunities
A.	Standard-Process: Sub-processes 1, 2, 3, 4, 6 and 7										
1.	Capturing (optional)										
1.1	(internal or external) Inventor	written / oral Idea	Interviewing the inventor based on disclosure	1st draft IDF	TIP	TIP	Inventors	none	none	R: N: S: F: electronic IDF D:	If external IDF will be logged in by the TIP-Managers
1.2	Database	1st draft IDF	Giving a Ref-No. and capture date of draft IDF	Official-No. IDF, record	TIP, Inventor, database	Tip or inventor				D: automatic	
1.3	Inventor	Country of origin invention	Capture country of origin of invention	Record	Database	TIP	Inventors				
1.4	Database	1st draft IDF	Generate deadlines for acceptence for relevant countries of origin only	Deadlines	Database	TIP					
1.5	HR Database	Inventors details	Capture inventors details on IDF	Record	Database	HR / Assistance team	Inventors				Problem: Automatic link to the database
2.	Filtering (optional)										
2.1	Database	1st draft IDF	Filter whether idea or invention	Go Nogo recording to system "why"	TIP, Inventor	TIP				D: reason for NoGo	PA (opt.)
2.2	Database	1st draft IDF	Filter on quality points (search, data, clarify)	Request to search to inventor	Inventor	TIP	Inventors			N: request for improve	
2.3	Database	1st draft IDF	Initial filter for business relevance	Go Nogo recording reason to system "why"	Inventor, PAC	TIP	PAC (NRC)			D: reason for NoGo	

Figure 30: Spreadsheet for multiple IP subprocesses for invention submission.

Next, the functions of the different actors in the process are defined. One function must be the accountable or responsible person (AC) for the process. This means, that he or she must either execute the activity or supervise somebody to execute the activity and bear the responsibility in the case of non-compliance. This function is the only function which has to be defined for every process. The next function is the obligation to cooperate (OTC), which means that the involved persons are eligible and obliged to contribute to reach the goal of the activity. The third function includes the requirement of reporting (RR). This means that an assigned person must report the information on the taken decisions and results of the decisions. Finally, the role of the decision maker (DM) can be assigned. The person assigned as decision maker is responsible for making a legally binding decision and takes the responsibility for that decision. In the first step of the invention submission process, the accountable person is a member of the IP team and the inventor has the role to cooperate within the process. Reporting or final decisions are not made, so that these functions are not required.

In the next column to the right the necessary material is written down. This can be references, notes, software, forms, and other documents and records. In this case the first electronic draft of the invention disclosure form is the only document needed for the subprocess. Finally, the weaknesses and opportunities are written down. Here is also place for exceptions to the process flow and improvement suggestions for process management. In the invention submission process e.g. the IP team managers must log in external invention disclosure forms.

The process documentation also must take into account the full process architecture of the company. So, the processes must be documented from the main process level down to subprocesses and single activities with clear job instructions (see Figure 31).

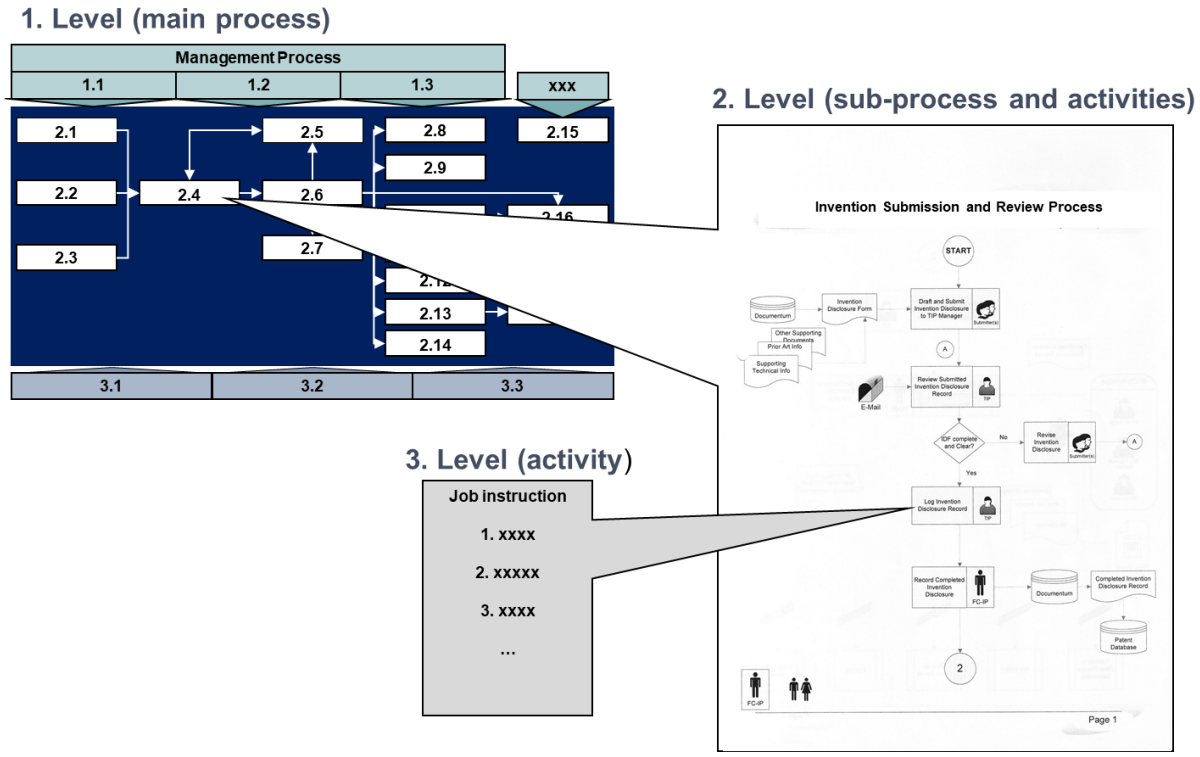

Figure 31: Process architecture from main processes to individual activities.

Chapter 6 | Performance management and improvement

How to measure the performance of business processes?

Figure 32: Robert S. Kaplan and David P. Norton. Source: *https://thinkers50.com/biographies/Robert-Kaplan-David-Norton/*

For the improvement of processes, a continuous monitoring of the processes is needed and also performance indicators of the processes must be defined to identify weaknesses and targets for improvement. Practically, there are many ways to assess the performance of business processes. A very popular method is the balanced scorecard by Robert S. Kaplan and David P. Norton (see Figure 32), which includes both financial and non-financial performance measures. Balanced means here, that not only financial measures like the return on investment (ROI) are used for the performance determination like it was usual until the 1990s, but also non-financial measures were added. The balanced scorecard is an easily accessible tool for the company to communicate the strategic goals and objectives of the company to the employees and define key performance indicators (KPIs) to measure the performance. With the defined KPIs the employees can understand which measurable outcome is expected from them.

The measures in the balanced scorecard are combined from 4 different perspectives, namely the financial, the customer, the process, and the organizational capacity perspective (see Figure 33).

The financial perspective asks mainly the question, how does the company look like from the shareholders point of view. So, the financial performance is measured e.g. by profit, cost, revenue. Financial objectives of the company are then the increase of profit and revenue or the decrease of costs. These objectives can be easily measured, but concrete actions to reach these objectives are hard to determine.

The customer perspective looks at the way, how the customers see the company. The objectives include measures of the customer satisfaction and opinion of the company. This can include the satisfaction with the price and quality of the products and services, the rate of repurchase and the number of customer complaints.

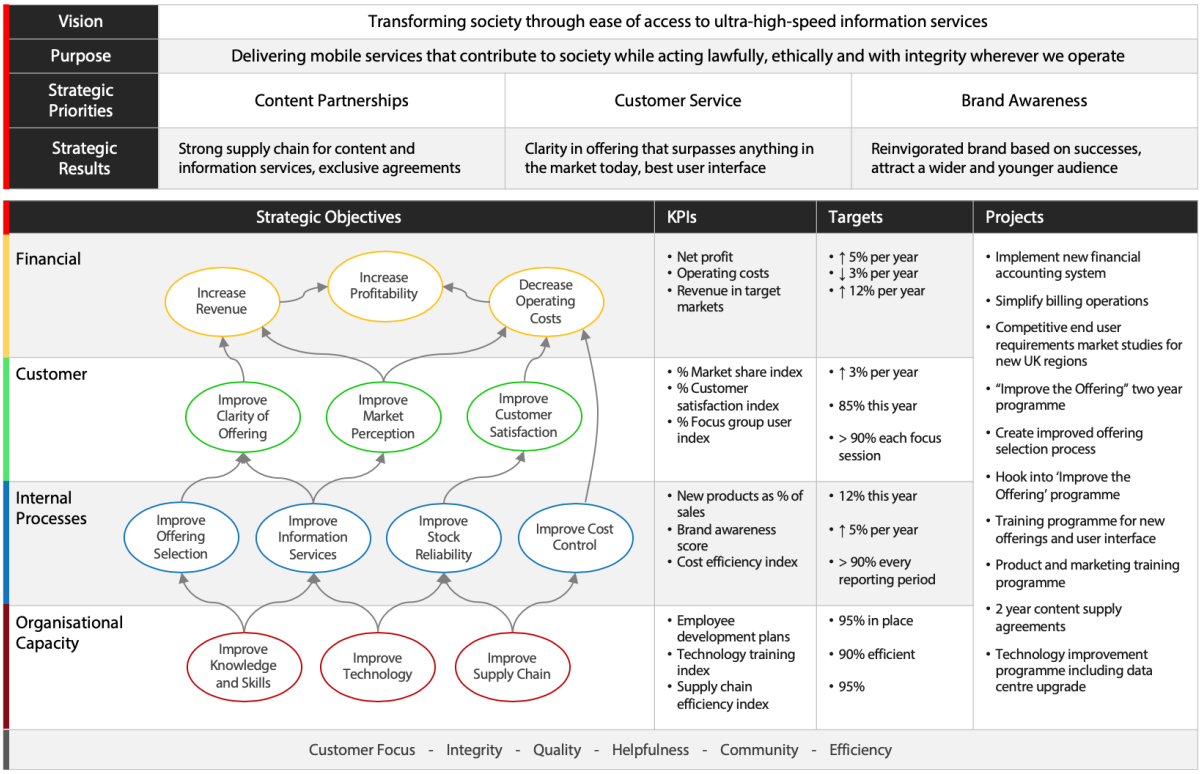

Figure 33: Example of a balanced scorecard. Source: *https://www.intrafocus.com/balanced-scorecard/*

The process perspective looks at the internal processes in the company. Process measures can be lead times or the cost of logistics. Objectives can be the reduction of bottlenecks and process gaps as well as the reduction of wasteful parts in the company's processes.

Finally, the perspective of the organizational capacity or the learning and growth perspective must be addressed. This perspective asks, how the internal employees see the company and how well it is prepared for the future. E.g. how valuable are the employee's skills and how are they improving them? How good is the image of the company as an employer? But also, how good is the infrastructure and technology of the company and how may it be improved, e.g. through product innovations?

Taking these four perspectives together the strategic management of the company can better identify the critical factors reducing the company's performance. This includes metrics which can be used for the improvement of processes. Nevertheless, the balanced scorecard only looks at the whole company and subprocesses and single activities cannot be resolved and improved with this approach.

The four dimensions of processes performance indicators – The devil's quadrangle

When we are not looking at the performance of processes on the business level, but on the individual process level, we need a different set of indicators. The typical key performance indicators (KPIs) for processes can be separated into four broader dimensions, namely time, cost, quality, and flexibility. The performance indicators can also be drawn in the four-

dimensional devil's quadrangle to get an overview over the performance of the different indicators and use them as a starting point for process improvement (see Figure 34).

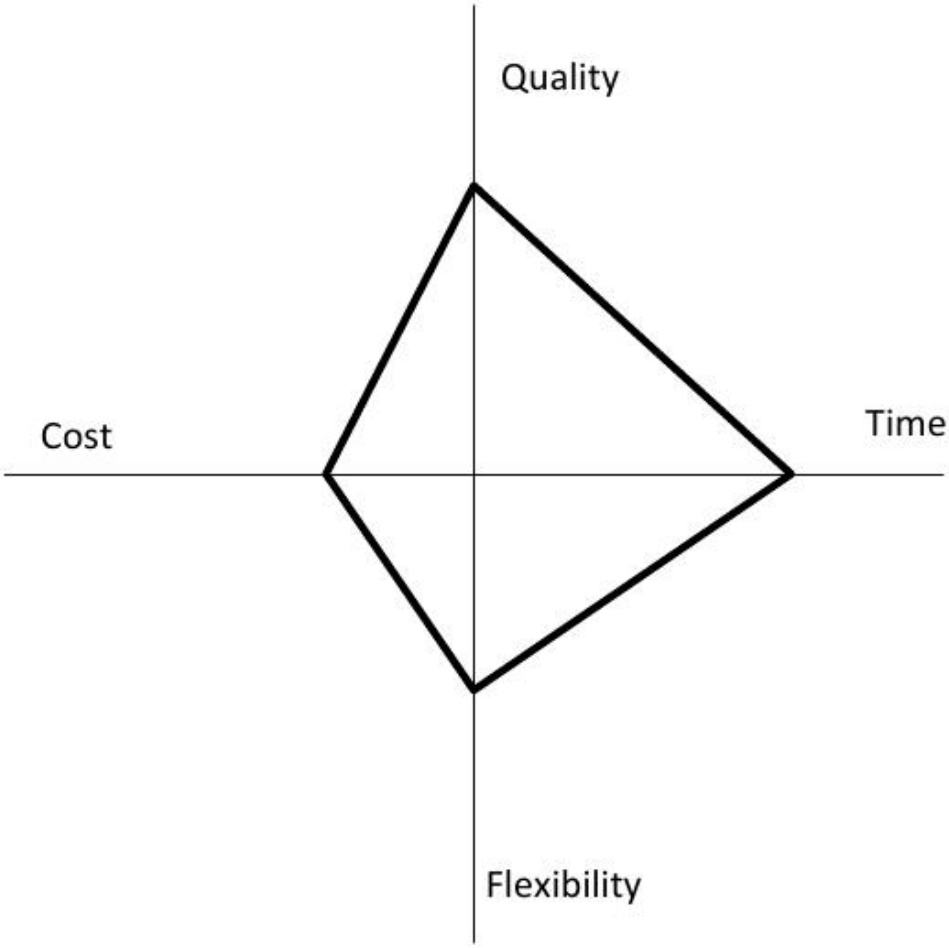

Figure 34: The devil's quadrangle with the four dimensions time, cost, quality, and flexibility. Source: *Marlon Dumas, Marcello La Rosa, Jan Mendling and Hajo A. Reijers, Fundamentals of Business Process Management, Springer (2012), p.259*

The first dimension of KPIs is the time dimension. Indicators in this dimension can usually be easily assessed and measured. Here, many different aspects of a process can be optimized, e.g. the maximum time a process takes, the average time a process takes or the variation of that times. For example, in the IP generation process the maximum process time might be the most critical indicator, since it can delay the whole innovation process, and the maximum process time should be reduced by process redesign. Also, delays between the end of one process and the triggering of the next process may be considered and a more effective communication between the process owners of different processes may be integrated. This leads to a better information flow between the different processes.

The second KPI dimension are costs. Those comprise the costs for the employees and all tools and objects needed in the process. Also, other financial indicators can be analyzed like

profit and revenue. In the IP department the typical way to improve the costs of a process is the automatization of processes. This can be done with software designed for specialized tasks. Of course, this also leads to new costs, i.e. the costs of the software and costs related to training.

The KPIs in the quality dimension comprise both internal and external quality indicators. So, indicators referring to the customer's and the process user's satisfaction are in this category, respectively. In the innovation process, internal satisfaction with a process can mean, that the IP, marketing and R&D department are happy with the information, which the get from the innovation process manager, so that they can effectively execute their subprocesses. External satisfaction with the IP process can be the customer satisfaction with the final product and especially with the customer benefit through the exclusivity of the product or service.

The last dimension for KPIs is the flexibility of processes. These indicators show, how effectively and fast a company can adapt processes, when internal or external forces require a change of processes. For example, a disruptive startup will at some point reach a significant size in the new market and may change its innovation strategy from disruptive to sustainable innovation. This can make a flexible redesign of the internal innovation processes necessary and not every company has the capabilities to make this effectively.

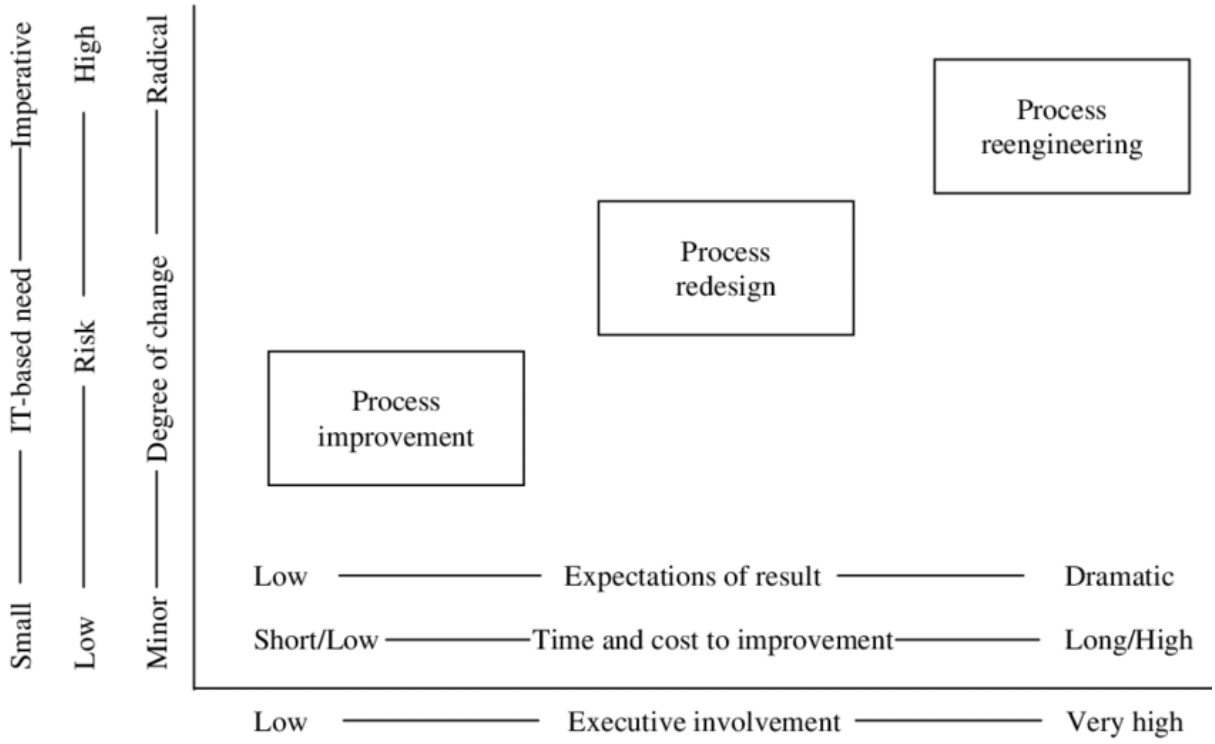

Figure 35: The different degrees of process improvement. Source: *Macdonald, J. (1995), "Together TQM and BPR are winners", The TQM Magazine, Vol. 7 No. 3, pp. 21-5.*

Improving processes

After a company has defined the key performance indicators for its processes, it may find bottlenecks or other weaknesses in the processes and wants to improve that processes. The processes can be changed to different degrees (see Figure 35), from minor changes to radical changes, from low to high risk, with less or more integration of IT, from low to high involvement of management, and from short time and cost involvement to a large time and cost involvement.

For only gradual improvements on a subprocess level, there are multiple ways how to improve a process by changing activities of the process. The 8 general ways to change a process are (see Figure 36):

- Improve: The performance of a single activity in the process is improved.
- Eliminate: A single activity in the process was wasteful and could be completely eliminated in the process.
- Add: A new activity can be added to the process.
- Change order: The order of two activities in the process is exchanged.
- Summarize: Two activities are combined to one activity within the process.
- Parallel: Two activities are executed parallel.
- Speed Up: The execution of all activities is sped up.
- Automatize: The execution of all activities in the process is automized.

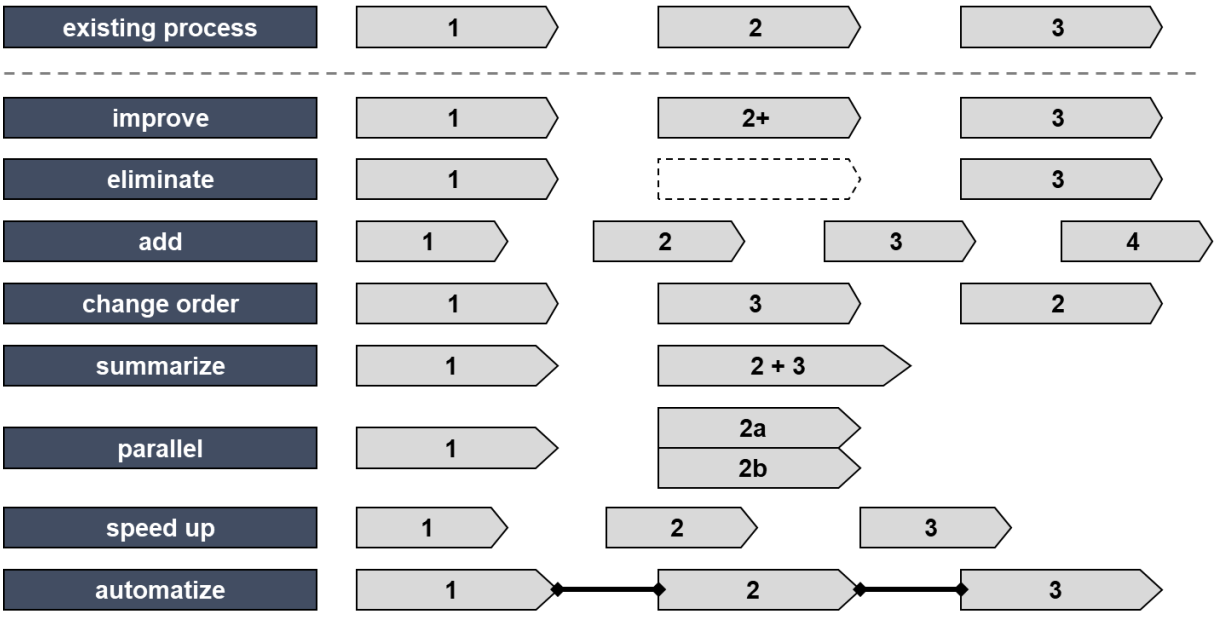

Figure 36: The 8 ways how to change a process.

An example for process improvement from the IP area can be the use of AI in Freedom-to-Operate (FTO) search processes, especially for digital business models. To reduce the risk of an infringement an FTO analysis has to be performed for such businesses. Part of such an FTO analysis, is a patent search to find out more about what is already protected by third

parties. So, patent search is essential and with the quality of the patent search the FTO analysis stands and falls. The number of patent applications has risen sharply in recent years, so it is becoming more and more difficult for a searcher to deliver an adequate result in the mass of patents. An automated search by an AI would be very beneficial. The implementation of automated search tool can decrease the search time, with it the search costs and increase the quality of the process. It improves at least three of the four key performance indicator dimensions. More about the "Potentials of AI-based third-party rights analyses for digital business models" can be found in the MIPLM research project by Roland Bittner, Siemens (see Additional material).

Business process reengineering

Often the change of a single subprocess is not enough, but key processes of the company must by changed. In this case the practice of business process reengineering can be used. But why is business process reengineering needed in a company, when the processes it uses worked fine in the past? There can be internal and external reasons, why business processes, which worked effectively are not good anymore. The internal reason can be the growth of the company and changes of the business model. This means, that processes evolved during the lifetime of the company and activities which were necessary in the past are not needed anymore and are now wasteful. Those activities should be removed from the processes. External reasons can be changed customer preferences and new entries in the market. Those companies can make better offers to the customers, so that the old processes are not giving the customers what they want and should also be reengineered.

Historically, business process reengineering was invented in the 1990s to improve the business processes based on the emerging possibilities of IT. The introduction of new IT systems made it possible to completely reengineer for example order processes. The classic example is the reengineering of the order process at Ford Motor company (see Figure 37). In the traditional process involving paperwork, the accounting department needed to match 14 documents till the order process was completed. The introduction of a central database reduced the number of needed items to 3: the part number, the unit of measure, and the supplier code. This process redesign led to improved accuracy of the documents and an increase of efficiency, so that finally 3 out of 4 employees of the accounting department became redundant.

Practically, business process reengineering uses a holistic approach taking into account the organization's strategic goals, the customer needs, the core processes of the company and the possibilities of IT to change and improve the processes in the company. The inventor of business process reengineering Michael Hammer proposed seven key principles for business process reengineering. Those are:

- Organize around outcomes, not tasks.
- Identify all the processes in an organization and prioritize them in order of redesign urgency.

- Integrate information processing work into the real work that produces the information.
- Treat geographically dispersed resources as though they were centralized.
- Link parallel activities in the workflow instead of just integrating their results.
- Put the decision point where the work is performed and build control into the process.
- Capture information once and at the source.

Additionally, to the seven principles, Thomas H. Davenport defined five concrete steps for business process reengineering. Those are:

- Develop the business vision and process objectives.
- Identify the processes to be redesigned.
- Understand and measure the existing processes.
- Identify IT levers.
- Design and build a prototype of the new process.

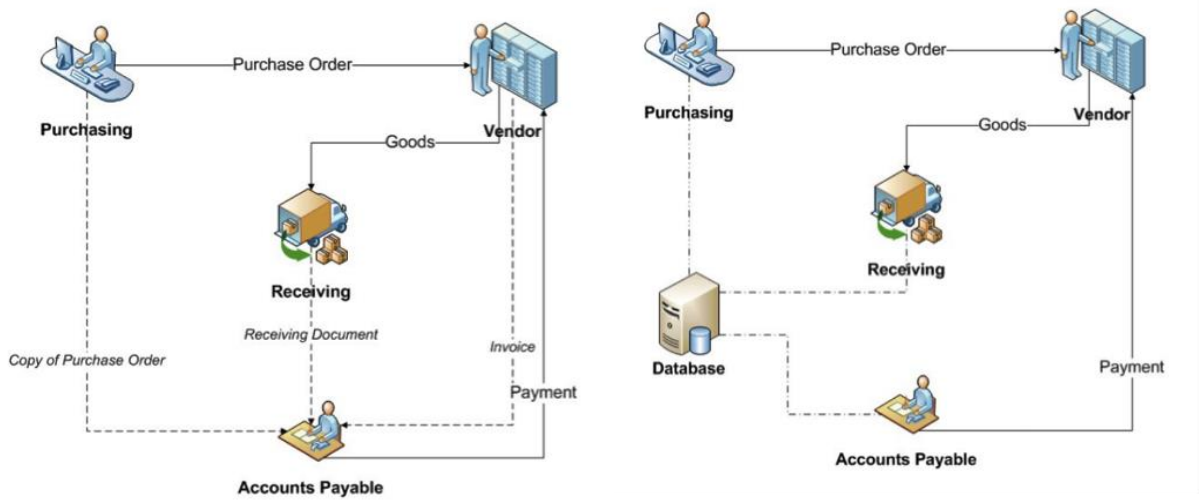

Figure 37: The original order process (left) and reengineered order process at Ford. Source: *https://bprford.wordpress.com/2014/03/12/business-process-reengineering-fords-accounts-payable-case-study/*

Business process reengineering became massively unpopular in the mid-90s as it became a synonym with massive layoff in big companies, which was also a result of the neglection of people and company culture in business process reengineering. But also, problems with the integration of IT in companies led to the failure of many projects and also the breaking of the silos within companies was often complicated. All this made business process management irrelevant soon.

Nevertheless, with the emergence of digital transformation the need to radically reengineer processes becomes more relevant again. This can be seen exemplary in the 3 levels of digitization, digitalization and digital transformation which are now driving the economy (see "Digitalization of services and products" -> Integrated IP and Innovation management: Part 3

Chapter 6). In digitization processes are improved with digital tools, e.g. an email is sent instead of a letter. This does not change the process at all. Compared to that, in digitalization and digital transformation, the business processes are fundamentally changed and improved by digital technologies. This improvement can be accompanied with business process reengineering.