

Part 4 | Management of technological innovation

Chapter 1 | R&D, technology, and innovation management

What is innovation management?

Innovation management is a discipline which combines two contradicting positions, namely innovation and management. First, innovation is always the creation of something new, be it new products and services, new methods, or new processes. Second, management comprises the processes of planning, organizing, leading, and controlling the work of the members of an organization, and of using organizational resources to reach stated organizational goals and objectives. So, it tries to find a relatively steady solution to run a business optimally and efficiently, which does not have to be changed in every new situation. These two concepts are fundamentally different in their scopes and the challenge is to bring them together to make a company innovative.

Innovation management can be seen as a combination of the management of innovation processes and change management. It organizes the work in a company between different departments to first create and second maintain innovation processes. In this way it comprises both R&D and technology management and the management of the organization and change of the organization to achieve common goals and implement processes for innovation. This means that different methods to generate benefits by innovation are promoted in a company, e.g.:

- Development of new products and services
- Improvement of products and services to go ahead of the competition.
- Improvement of internal processes and organization
- Development of new innovative business models

Difference between innovation management and R&D and technology management

Innovation is not invention. Inventions are made by the R&D department and are subject to R&D management. R&D management therefore covers activities such as basic and fundamental research, technology and product development and prototyping. So, R&D is clearly a part of innovation, but not innovation by itself. Technology management cannot be so clearly distinguished from innovation management as a part of strategic management. It tries to create competitive advantages by the planning, design, optimization, operation and control of technological products, processes, and services. So, technology management is focusing more on the creation of the competitive advantage through technology and innovation management is then concerned with the concrete commercialization of the technological advantage in whole products on the market. They are both linked by R&D management in the way, that it is important for both that new innovative technology is created and improved to create customer benefits.

The four processes of innovation management

Innovation management is about the organization of work in a company to create an innovative environment and foster innovative collaboration between all departments. So, it is not only a task of research and development, but also manufacturing, sales, marketing and IP must be involved, and all departments must bring in their knowledge and expertise to create innovative products fulfilling the customer's needs. To do so, innovation management is mainly comprised of four different processes that should work hand in hand to make companies innovative (see Figure 1):

- Product development
- Capabilities Development
- Business development
- And Strategy Development

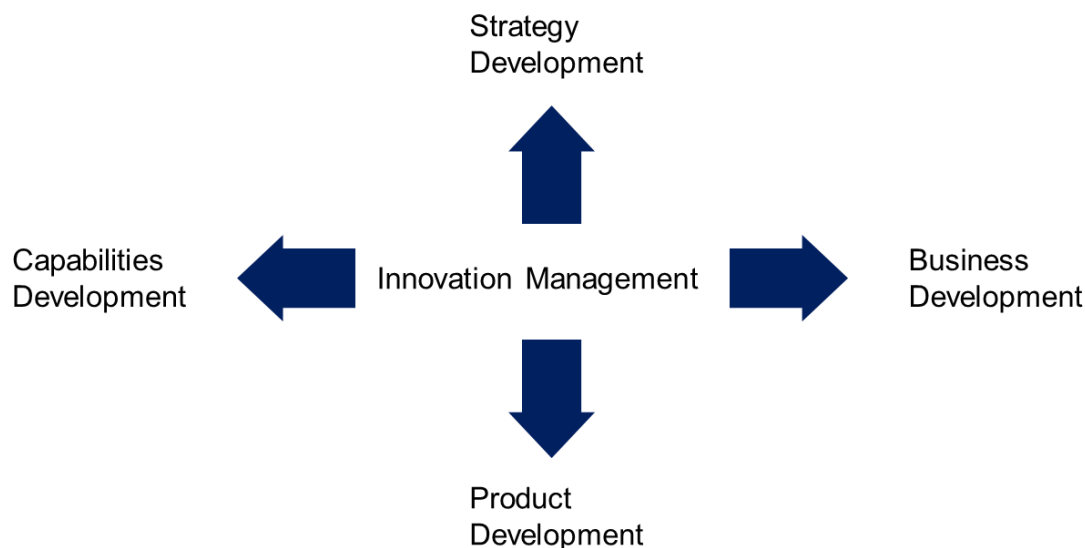


Figure 1: The four dimensions of innovation management: Product development, Capabilities Development, Business development, and Strategy Development.

Product development

Product development is defined as the creation of a new product or service with a new utility, the enhancement of an existing product or a new production process or method. So, it is a process to change the present goods or services or the way of production. To do so it is comprised of the following elements (see Figure 2):

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

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

Also from an IP perspective the IP department must be included early on to guarantee, that the products and services developed can be IP protected, so that the products and services can be sold at all and in the best case are exclusive to the customers, so that the business model is also protected.

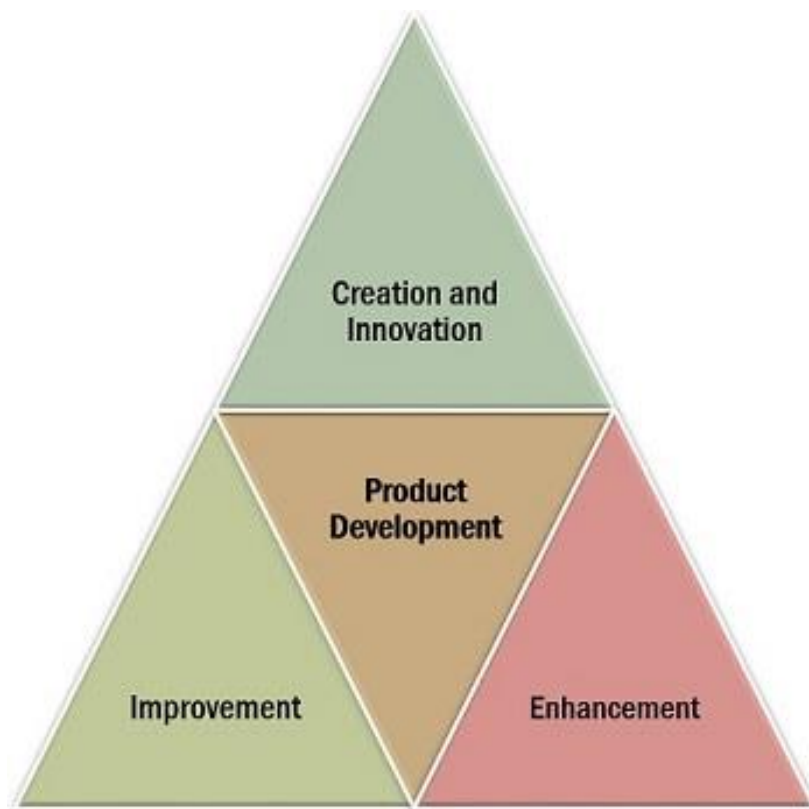


Figure 2: The core elements of product development. Source: <https://theinvestorsbook.com/product-development.html>

Capabilities development

The next step in the innovation management process is capabilities management. Business capabilities describes the enterprise's abilities to operate the day-to-day business as well as to grow, adapt, and acquire a competitive advantage compared to other companies. They can be split up into four groups of capabilities (see Figure 3):

- **Strategic Capabilities:** Strategic capabilities offer the company a competitive advantage through differentiation. For example, for Vorwerk Thermomix with its

integrated cookbook and the IP protected guarantee to success creates an advantage in the kitchen machine market.

- **Core Capabilities:** Core capabilities are capabilities that are inherent to the existence of the company. For example, for Vorwerk the direct sales of their products through their salespeople is a core capability.
- **Context Capabilities:** Context capabilities are essential capabilities that keep operations running in the company and typically become only visible once they fail.
- **Foundational or Commodity Capabilities:** All other capabilities are called foundational or commodity capabilities. They are themselves not vital for the company but help to e.g. lower the cost of operation or maintain a steady operation and thus add value to the company.

The capability development in innovative companies is different from less innovative companies in the way, that the product development team is not separated from the other activities in the company. So, the product development team does not need to develop all new capabilities needed for the product themselves but get assistance from the other departments. So, if new sales channels are needed, the sales department offers resources to develop them and if new technology is needed, the R&D department offers resources, etc. This way the expertise and resources of the whole company are accessible to the innovation process. The whole company develops new valuable, rare, imperfectly imitable, and non-substitutable resources giving them a competitive advantage to competitors (see “VRIN resources” -> IP-Strategy Development: Part 3 Chapter 3). So, in summary the integration of the product development and innovation team into the company structures and the continuous innovation in all areas from sales to manufacturing is vital to create a constant and steady innovation process by the development of new capabilities.

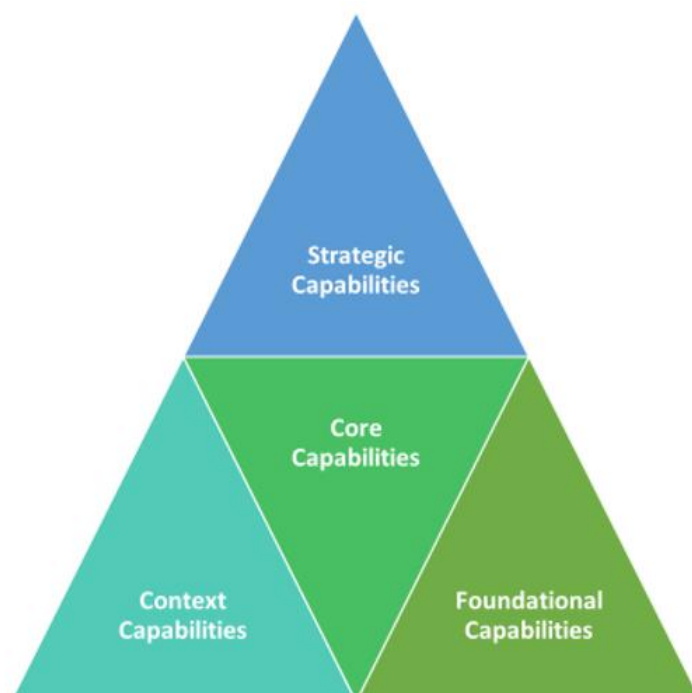


Figure 3: The four types of capabilities in a company. Source: <https://www.capstera.com/company-capabilities/>

Business development

Scott Pollack defined business development as: “Business development is the creation of long-term value for an organization from customers, markets, and relationships.” So, in terms of innovation management it is important, that the single business units are positive to adopt innovations and new products and services. In general, businesses could decide to stick with the traditional ways and create a short-term revenue with the old products or they could invest in and adopt new products and integrate them in the business development processes.

In innovative companies business development managers are more positive to look out for new opportunities in new markets and align the business development with product development. They are developing new business models for innovative products and are looking for all types of innovation, incremental and disruptive.

Strategy development

Finally, innovation in a company still can be killed off by a lack of innovation focus in the overall business strategy. This is a problem since especially in large technological companies the large number of separated business units needed to develop the specific products for different customer needs leads to a separation of developments. Nevertheless, the customers are expecting that the products of a company are all compatible and working well together. This can only be done with a platform solution for all products of the company, but no single business unit is big enough to start the platform on its own and only the top management can start this necessary innovation activity.

In innovative companies the top strategic management is always informed about the innovation activities in the different business units and aligns their innovation activities e.g. by their support of the development of innovative platform solutions, where the products and services of the different business units are all available and connected with each other. So, the top management in innovative companies fosters the product and capabilities development and makes the resources available to continuously improve those activities, e.g. by setting up platform solutions (see “Digitalization of services and products” -> Integrated IP and innovation management: Part 3 Chapter 6).

Chapter 2 | Timing of entry strategies

The time of entry on the s-curve

An important aspect in a successful innovation strategy is the right timing of the market entry of the product or service. Here, early, and late entries have both advantages and disadvantages. So, a premature entry can be as devastating as a too late entry, where the market is already occupied by earlier competitors. The different advantages and disadvantages can be derived from the theoretical concept of the s-curve (see „The s-curve concept” -> Integrated IP and innovation management: Part 2 Chapter 2).

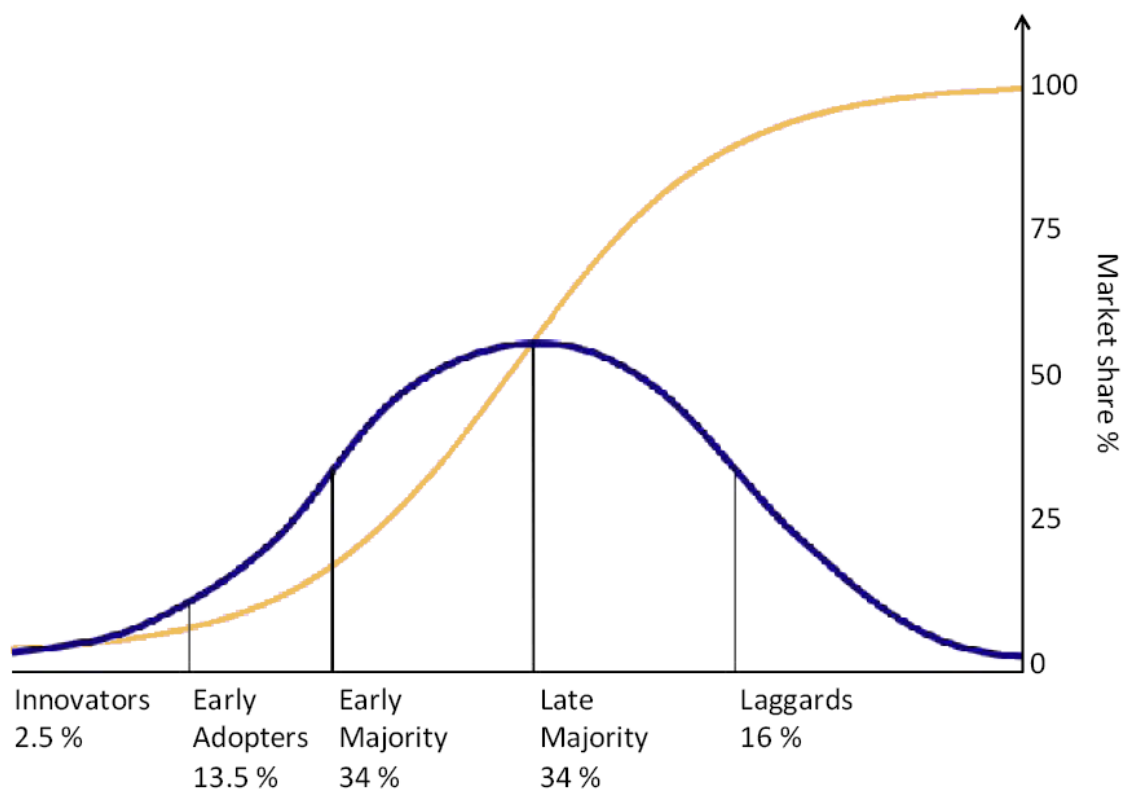


Figure 4: The successive adoption of new technology (shown in blue) by a new user group will increase its market share (yellow) until saturation level. Source: *Wikipedia, Adapted from Rogers, E. (1962) Diffusion of innovations. Free Press, London, NY, USA.*

First movers and late movers

Figure 4 describes the adoption rate of an innovation in a new market with its market share. So, a company can opt to either introduce an absolutely new technology to the market or it can follow the innovators and delay the market entry to a point, where the product and the market are already matured. The different times of market entry are usually characterized in the following three categories:

- First movers: Those are the first businesses of substantial size which enter the market with a new product or service. They try to increase their market share as long as the competition is still weak. In the representation of the s-curve, they target the innovators and early adopters.
- Early Followers: Those are businesses which enter the market only a short time after the first movers. These companies are initially targeting the early adopters and the early majority.
- Late movers: Those businesses chose a later state of entry when technology is already more matured and established. They are aiming at the mass market with the majority of customers.

Examples for first movers, early followers and late movers in the personal computer industry are for example the Altair 8800 by MITS released in 1974 (first mover, see Figure 5) the Apple I released in 1976 (early follower, see Figure 6) and the IBM PC released in 1981 (late mover, see Figure 7).



Figure 5: The Altair 8800 by MITS. Source: <https://github.com/gorskima/altair8800>



Figure 6: The Apple I. Source: Jimmy Grewal, <https://youtu.be/A1kupEMjmF4>



Figure 7: The IBM PC. Source: <https://www.computerhistory.org/revolution/personal-computers/17/301>

First mover advantage

In general, choosing the time of market entry as an early mover or later mover are both strategies that can lead to success. Nevertheless, there are systemic advantages observed for early movers. The research in first mover advantages was started by Marvin Lieberman and David Montgomery in 1988, who discovered three major advantages for first movers. Those are:

- Technology leadership
- Control of resources
- And buyer switching costs

Technology leadership means, that the products or services of the first mover are superior to the followers through their early entry. This can have multiple reasons, e.g. the first mover has more experience in producing their products and services and is already higher on the technology learning curve. This can have a positive effect on the quality of the sold products, so that they fulfill the customer needs to a higher degree. It can also lead to cheaper production costs and lower prizes for the customers. With some products like the iPhone also the first mover can use the mechanism of dominant design ("Dominant design" -> Integrated IP and innovation management: Part 3 Chapter 3), so that they set the industry standard and convince the customers, that their product or service is the standard and its functionality must be fulfilled by all competitors. This advantage can even be increased when the technology and design are protected with IP.

A related advantage, which should be mentioned here, is the brand loyalty gained by the first mover. The later entries are always struggling with the assumptions, that they are just copying the original product. So, early movers can always opt for a strong brand to gain a competitive advantage over the competition.

The control of resources by first movers means, that the first mover has without competitors the chance to get the best spots in the still empty market environment. This can be key locations for shops, distribution channels and customer relationships.

Buyer switching costs arise, when the customers of the first mover want to change to a competitor. In that case they have learn how to use the competitors' products and customers want to avoid the investment into these skills, so they stick with the products of the first mover they are already used to.

First mover disadvantage

Being the first mover does not only have advantages. So, some of the characteristics of being the first in a new market and launching a new product or service can be troublesome for a company. Disadvantages of first movers or advantages of late movers are:

- High investment costs of the first mover

- Higher technological and financial risk of the first mover
- Higher viability of products from late movers

The early movers have the disadvantage of substantially higher investment costs in their technological development since they start to develop their products directly from scratch. The later movers always have the advantage to reverse engineer the products and to develop cheaper production methods compared to the early mover. The late mover does not need to go through all the failed testing phases of the early mover and can learn from the already working product.

The technological and financial risks of the early mover are also substantially higher. The late mover can always watch, which products fail and only invest into the working solutions accepted by the market. They also have the advantage, that they know the pricing of the competitors and can learn from the customers willingness to pay, so that they will produce and sell more fitting products on the market.

Finally, the late mover has the advantage to sell more viable products on the market, since they observed the failure and success of the different product features and they can produce fully viable products on the market. This was not possible for the early mover who is only able to sell minimal viable products, which are often seen as being in a testing phase.

First mover advantages and disadvantages in the PDA market

The roles in the market of early and late movers can for example be observed in the market of Personal Digital Assistants (PDAs). PDAs were developed beginning in the 1980s as small handheld computer devices with multifunctionality similar to modern tablets or smartphones. The first commercially available PDA was the PSION "Organizer I" in 1984. It was basically an improved version of a pocket calculator, which could calculate but also had a data base, where short texts could be saved and read similar to an electronic dictionary. Its successor also had a time planner to schedule meetings and an alarm function and could be connected to other devices, e.g. printer and barcode scanner.

In the 90s the functionality evolved, and the design of the PDA changed from a pocket calculator by the standard implementation of a keyboard. In this time also the big companies introduced their products, e.g. the Newton by Apple (see Figure 8) and the IBM Simon. Nevertheless, most of these first movers struggled, because the users did not know how to use the product and they lacked enabling technologies (batteries, modems, etc.). One example was the problem to recognize the handwriting of the user by the Newton, but also the PocketPC by Microsoft struggled because of its low battery power.

The most successful late mover in the PDA market was Palm with its PalmPilot (see Figure). The palm inventors had a background as handwriting recognition experts and decided to enter the PDA market with their expertise. One million sales in the first year showed, that the use of this enabling technology in the PDA was a critical success factor against competitive products. Also, the cheaper price compared to competitive products and a

better definition of the functionality of the product might have drawn the customer's attention to the PDAs by palm.



Figure 8: The Newton by Apple. Source: <https://www.computerworld.ch/business/ios/apples-newton-urahne-iphone-1331830.html>

The early follower

An intermediate position between the early and late movers have the early followers. Those try to reach a balance between the advantages and disadvantages of the early and late movers. So, they do not bear all the risks of the first market entry and can already learn from the early mover, without looking like a copycat of the first movers product, because their brand is not yet well established and some customers who struggle with the first mover's products can be persuaded to change to an early follower's products, when the functionality is superior.

Also, the early followers can base their market launch on an already establishing market. While the first mover must create the market themselves and persuade customers to choose a completely new



Figure 9: The PalmPilot. Source: <http://interface-experience.org/objects/palm-pilot-professional/>

product, which can be very cost intensive. The early follower can target the early developing market directly with their products, without the costs of the first mover and at a time, where the market is not saturated by late movers.

Chapter 3 | Should I lead or follow?

How to identify the fitting entry strategy?

For the identification of the right entry strategy it is crucial to have understood the advantages and disadvantages of first and late movers. But for the identification of the right strategy it is also important to analyze, which product and service features, market conditions and other internal and external factors play a role for the success of early or late entries. For the choice of an early or late entry time it is important to analyze:

- Customer preferences
- Requirements of enabling technologies
- Complementary goods
- The type of innovation
- The pace of adaption in the industry
- Availability of capital
- Availability of resources
- Uncertainty and market confusion

Analysis of customer preferences

Customer or consumer preferences are defined as the subjective individual tastes of various bundles of goods measured by utility. Utility is in this case defined as the satisfaction with the product or service. This is a crucial concept for management, when choosing the market launch of products, because the willingness to pay depends next to the customer needs on the customer preferences for products and services. Aspects that are important influencing factors of customer preference are for example how convenient a product or service can be purchased; how easy the user interface can be used and how accessible a new technology is. But also factors like, e.g. the novelty of a product plays a role, where some customers prefer a novel product and others want to stick with the same old products, and the choice of the right communication channel matter (see Figure 10). So, customer preferences are not always easy to determine for a company.

From a first mover perspective it is important, that not only the customer needs but also the customer preferences are fulfilled. So, a premature market launch may not be rewarded by the customers but also a late entry can be wrong, when the customer preference for new products was underestimated, so that possible profits are missed out by the company. An example for this was the launch of the PlayStation 2, where analysts believed that there is no market for having a game console with CD and DVD features and underestimated the customer preferences. In contrast, the PlayStation 2 showed to be the bestselling video game console of all times.

Consumers' preferred communications channel vs what businesses are planning to offer

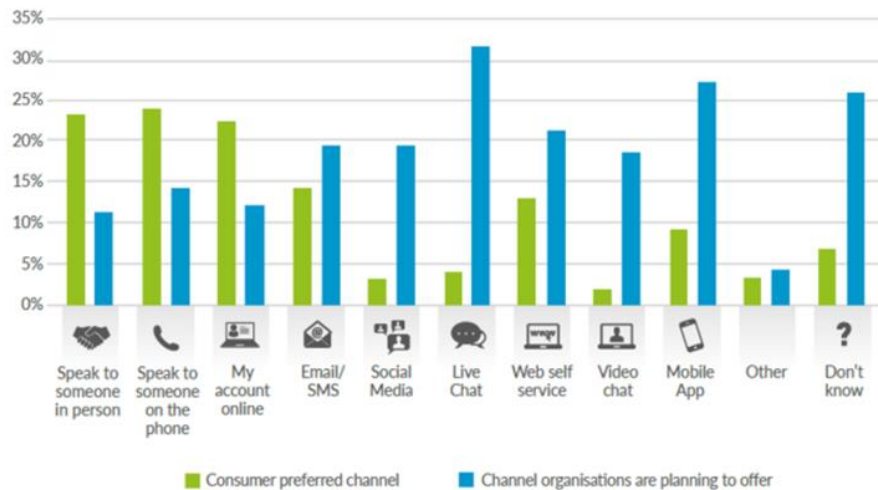


Figure 10: Consumers' preferred communication channels. Source: <https://customerthink.com/how-to-deliver-superb-omnichannel-cx-in-a-digital-world-according-to-24000-consumers-globally/>

Requirements of enabling technologies

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

When choosing an entry strategy, it must be analyzed, if the products need enabling technologies and if they are matured enough, that the customers experience a large enough benefit from the innovation. If the enabling technologies are not matured yet, the launch of the product should be delayed, and a late entry strategy should be chosen.

Examples for enabling technologies in industry 4.0 can be found in Figure 11. A practical case is the use of augmented reality glasses at Thyssenkrupp with its HoloLinc (see Figure 12). With the HoloLens technology by Microsoft a digitalized sales process was developed to improve efficiency and the customer experience in the stairlift business. From the first on-site visit at the buyer's home to the installation of a stairlift it took over two months but with the new sales process this time could be reduced to two weeks. HoloLinc shortens the delivery time because the salesperson can measure the entire stairwell with the augmented reality glasses on-site with just one visit and make the homeowner an offer. They can even use the on-site data to calculate the optimal stairlift solution and visualize it on a tablet when the salesperson is at the customer's home.

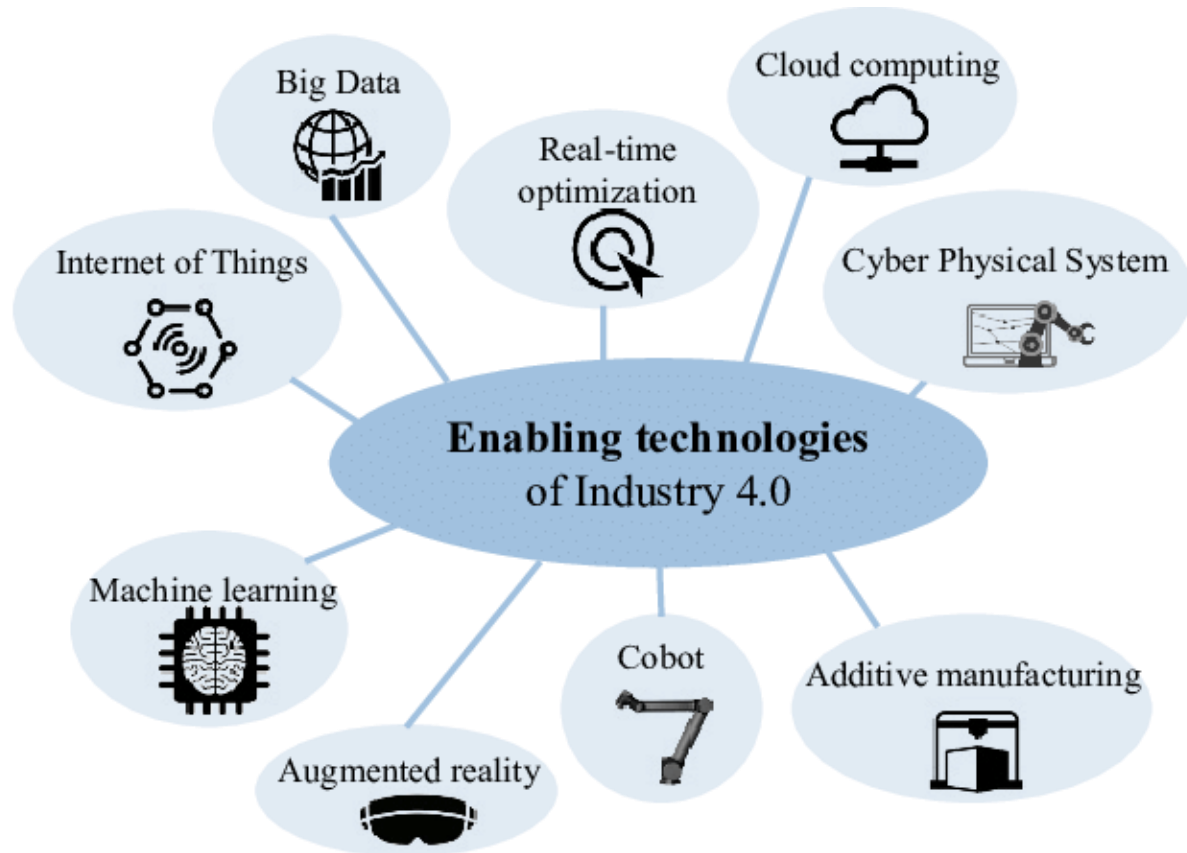


Figure 11: Enabling technologies of industry 4.0. Source: Bortolini, Marco & Ferrari, Emilio & Gamberi, Mauro & Pilati, Francesco & Faccio, Maurizio. (2017). Assembly system design in the Industry 4.0 era: a general framework. IFAC-PapersOnLine. 50. 5700-5705. 10.1016/j.ifacol.2017.08.1121.

Complementary goods

An important part of choosing the right entry strategy is not only the availability of enabling but also complementary goods (see “The role of complementary assets and exploitation for IP values” -> IP-Valuation (I): Part 4 Chapter 5). A complementary good is defined as a good which is necessary for using another good. This means that the value and utility of a good depends on the complementary goods available. Therefore, to choose the right entry strategy one must analyze the availability of the complementary goods and also their quality.

One example for this is the backward compatibility of gaming consoles. Backward compatibility is a property of a



Figure 12: Planning of a staircase with the HoloLinc. Source: <https://engineered.thyssenkrupp.com/en/hololinc-the-mixed-reality-revolution-on-the-staircase/>

system that allows interoperability with an older system usually used in computer technology. This was also an important feature of the Sony PlayStation 2 which was backward compatible with games for its direct predecessor the PlayStation. At the launch of the PlayStation 2 only few games developed for it were available and the backward compatibility was crucial to find buyers for the new product. So, the installed base grew until developers created enough new console games. Without the backward compatibility the market launch would have been too early.

Type of innovation

Not every entry strategy is suitable for each type of innovation. So, for incremental, radical, and disruptive innovations, different entry strategies must be used. In this time of digitalization with ever faster innovation one type of innovation must be mentioned especially, disruptive innovation. For disruptive innovation, the first mover advantage is especially important. New entrants to the market are constantly changing the market environment and there is no time to lose. Those disruptive innovations are often strongly linked to the enabling innovations of industry 4.0 (see Figure 11). For example, machine learning and big data analysis can leapfrog existing technologies in many application areas and chances are high for a successful disruption by the first movers.

The pace of adaption in the industry

An important factor to choose the entry time is a good analysis of the speed of the learning curve and the presence of network externalities. Network externalities are effects which a product or service has on a user depending on the number of users of the same or compatible products and services. Positive network externalities are effects, where the utility of the product or service increases the function with the number of other users. One example can be the number of connections in a telecommunication network, where the utility of the network grows fast for each user due to network externalities (see Figure 13).

An entry strategy for services with strong network externalities can be to offer the first users a free service for limited time and monetize the services once the network is strong enough. One example for this can be seen in the platform Skywise by Airbus (see Figure 14). The Skywise data platform was launched in the summer of 2017 and collected millions of data during the operation of over 8,000 aircraft also from the competitor Boeing. Skywise is a basis for developing, building, and operating new aircraft, and maintenance companies and suppliers are increasingly

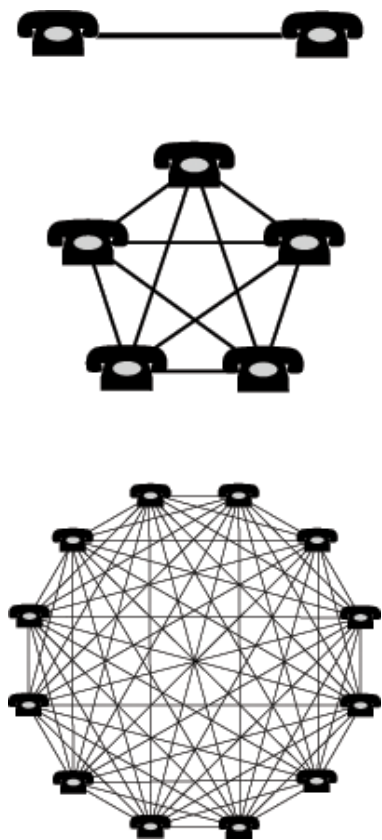


Figure 13: Network externalities in telecommunication networks. Source: https://de.wikipedia.org/wiki/Netzwerkeffekt#/media/Datei:Network_effect.png

integrated into the platform. So, Skywise has become the most important data hub for commercial aviation.

In 2019 the network became strong enough that Airbus wanted to monetize the data and its investments. Maintenance companies are expected to pay money for the access to the data from the data platform in the future. From Airbus' point of view, previous free services based on Airbus' intellectual property will have to be economically rewarded in the future. So, an entry strategy for a first mover in platforms can be the offering of a limited free service, until the network externalities make the platform valuable enough to monetize it.



Figure 14: Components of the Airbus Skywise platform. Source: <https://skywise.airbus.com/>

Availability of capital

An important point in choosing the entry strategy is the availability of capital. Typically, startups are trying to be first entrants and to get themselves a lucrative place in the market, especially in disruptive markets. Nevertheless, they have a lot less capital available compared to their incumbent competitors and a too early entry strategy can lead to their failure. E.g., many early movers in the PDA industry failed because they run out of money while late movers like Palm succeeded with their products.

Availability of resources

Also, a point to mention is the question, if a company has all the resources needed at the time of the product launch, that are needed for success. A negative example for the too early launch of a product is the Sega Saturn. The gaming console by Sega was launched in a surprise move earlier than the announced release data. This early move surprised then both game developers and retailers. The independent and third-party game developers were angry because they had no time to publish their own games that fast and suspected Sega to force customers to buy their own software with that move. The retailers who were surprised and not included in the product launch went even one step further and supported the sales of competitors products. This included also big retailers like Wal-Mart, so that Sega had a huge problem with its distribution channels and the console was finally a flop.

Uncertainty and market confusion

Finally, an important point to choose an entry strategy is the analysis of uncertainty and market confusion. Market confusion means, that the customers are not sure, which or if they should buy a product. There can be multiple sources, e.g. the technology is not functional enough yet and the users just have not found a way how to use products and services in a useful way or there are too many different brands on the market and they do not know which one to choose. In that case standardization can help to reduce the confusion, because the products of different companies become compatible with each other and consumers do not need to wait until one the technology of one of the competitors becomes a market standard. This increases the confidence in the customers. So, when there are many competitors it is a good strategy to stay out of the first market confusion and learn from the failure of the competitors or to team up with competitors to set up a cooptation (see "Standards and Format Wars" -> Integrated IP and innovation management: Part 3 Chapter 4).

Chapter 4 | Product management

What is product management?

For the management of innovation, it becomes increasingly important to have efficient product management processes. For this purpose, startups and big corporations are often creating the role of a product manager. So, the question is, what is the role of a product manager in an organization or what is product management.

The role of the product manager is the role of a mediator between different parts of an organization, like marketing managers, project managers and other stakeholders, e.g. the IP department (see Figure 15). It is a fully interdisciplinary job combining the duties of product planning, designing, and bringing the products to the market. So, the product manager must have a good understanding of technology, business tasks and customers. The product manager must also define which exclusivities are needed for the product and which kind of IP is needed for the product. The main tasks of a product manager can be broken down to:

- Understanding customer experience
- Developing a vision
- Prioritizing processes and activities
- Developing product pricing and positioning strategies
- Negotiating with stakeholders
- Building a roadmap
- Arranging product testing groups
- Driving the product launch
- Participating in the promotion plan development
- Building and maintaining product awareness

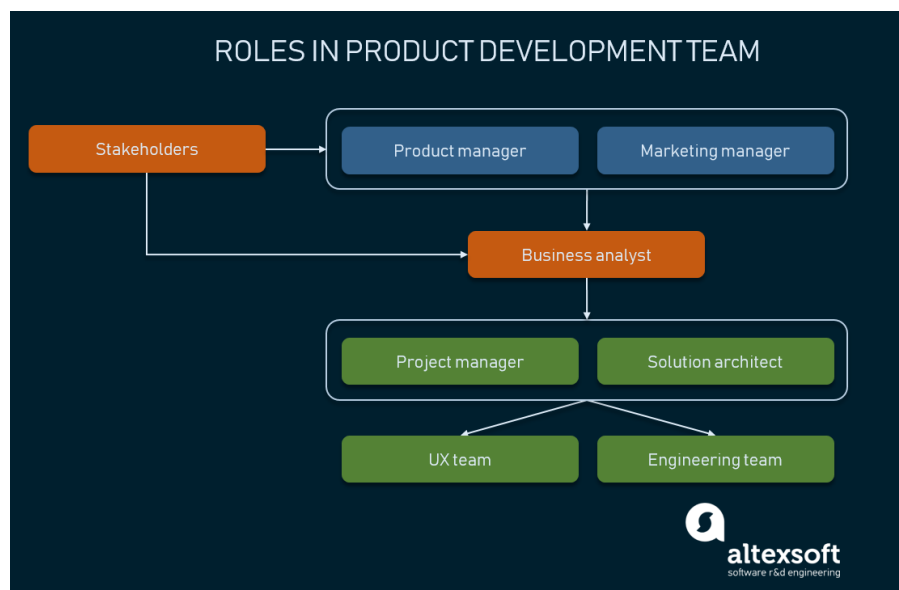


Figure 15: Sketch of the different role in the product development team. Source: <https://www.altexsoft.com/blog/business/product-management-main-stages-and-product-manager-role/>

Understanding this, we can conclude that the product manager has a coordinating and communicating role between the different groups involved in the product development process. Its role is not a product developer and technician or marketer, but a coordinator. So, it is a strategic function in the organization asking for the big picture of the product and not for tactical questions. Those questions lie often in the responsibilities of the project managers (see Figure 16).

The product manager focuses on tasks like setting the product vision, developing strategic plans, creating product roadmaps, and making the communication with stakeholder, while the project manager takes care about the planning of single tasks, timelines, resources and the monitoring and communication of the progress.

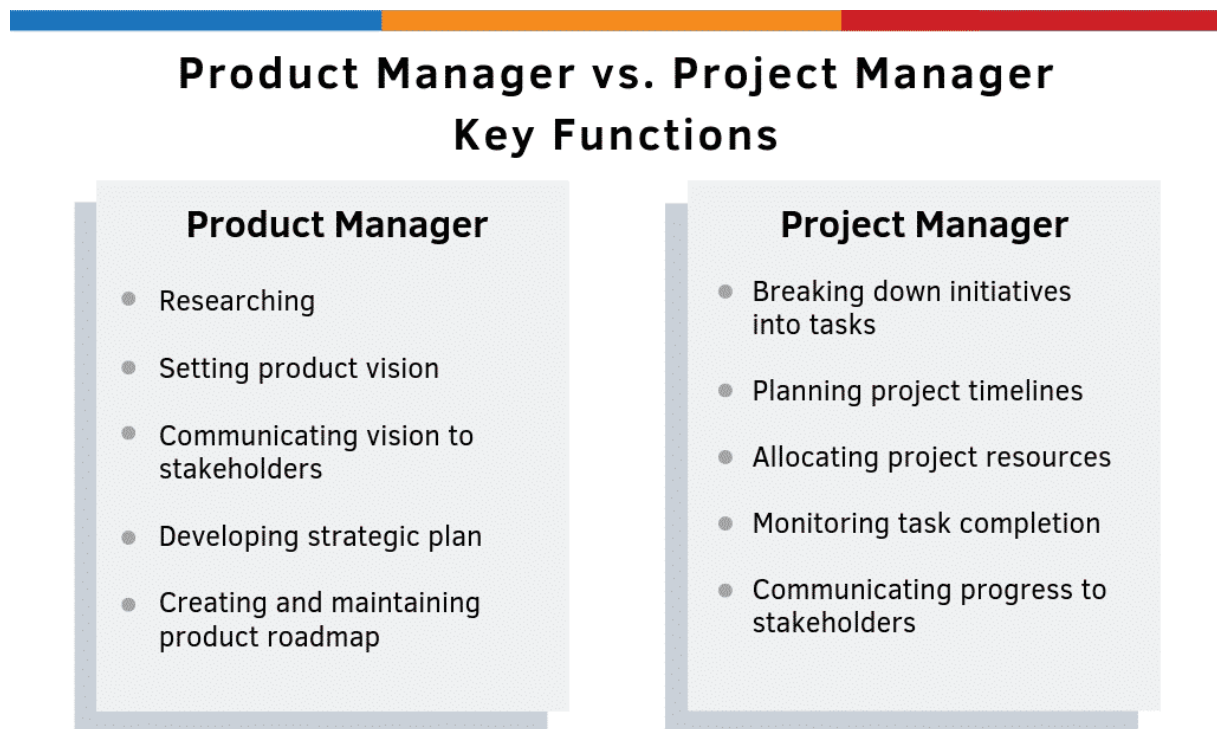


Figure 16: Different main duties of product and project managers. Source: <https://www.productplan.com/what-is-product-management/>

How does practical product management look like?

Product management can in practice be separated into five steps. Those steps should not be seen as a strict working instruction, because the job of the product manager is not the execution of single steps but very communicative and agile. Therefore, the steps should be executed iteratively when needed and communication with the different stakeholders and departments are vital to success. The five main steps are:

- Setting a vision
- Developing a product strategy

- Developing an IP strategy
- Creation of a product roadmap
- And execution and testing

Setting a vision

The first step in the product management process is to define a vision for the product. This can be done for example with the template suggested by Geoffrey Moore for elevator pitches in his book “crossing the chasm” (see Figure 17). The important point in this process is, that it is a teamwork process. So, the job of the product manager is here the job of an idea manager. The product manager must not come up with the ideas all by him or herself. It is about collecting the different ideas from the single departments and creating a vision out of them. So, for example the sales department can give valuable information about customer feedback and inform about the customer needs, the R&D department can make suggestions about new breakthrough technologies leading to new innovative product development options, etc. Idea management is at this point breaking the silos of the different departments and making the product development process a team effort.

The idea generation process can practically be performed in many different ways and many tools and methods to set up the idea generation processes are available today. It can be structured methods like the introduction of lead users or the use of design thinking processes (see “Predicting technology change” -> Integrated IP and innovation management: Part 2 Chapter 5), but also the invitation to single brainstorming session to come up with the best product visions from all departments of the company.

For (target customer)

Who (statement of need or opportunity)

The (product name) **is a** (product category)

That (key benefit, reason to buy)

Unlike (primary competitive alternative)

Our product (statement of primary differentiation)

Figure 17: Product vision template adapted from Geoffrey Moore’s crossing the chasm. Source: <https://www.prodpad.com/blog/product-vision-template/>

Developing a product strategy

When developing a product strategy, first the product strategy must be aligned with the overall business strategy to fulfill the goals of the business. Second, it must be

communicated and coordinated with the other departments (marketing, design & UX, R&D and IP). This is necessarily the step before the roadmap can be written down, since it has the purpose to communicate the questions, why a product is planned at all, which must be answered by the strategy. The product strategy development process can be seen as the central part of the three hierarchical levels, business objectives, product strategy and tactics, which comprise the product management process (see Figure 18).

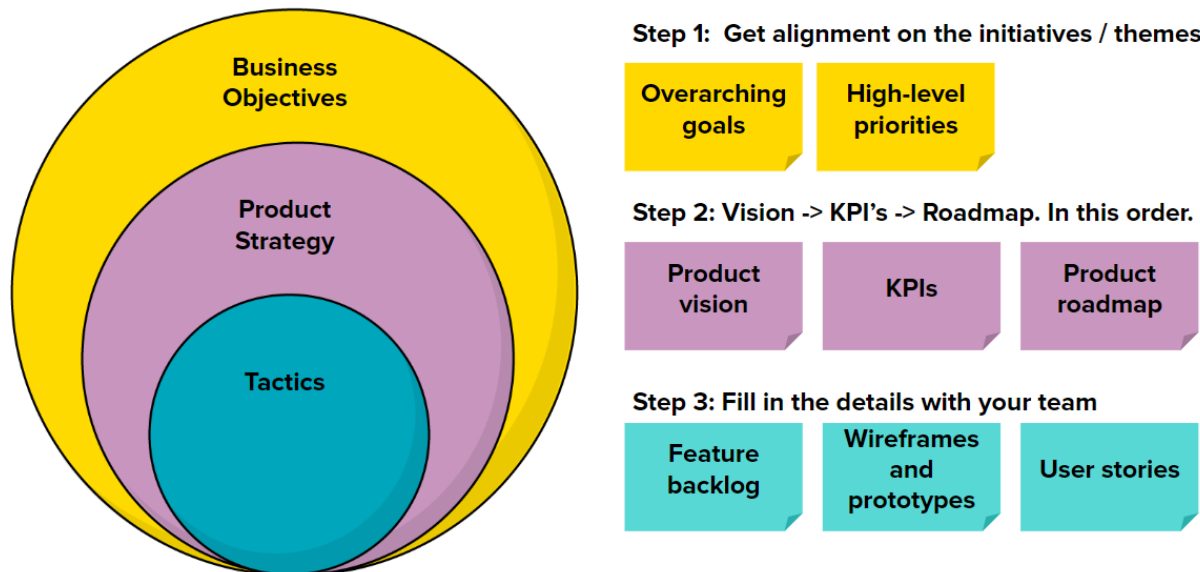


Figure 18: The hierarchy of product management in software development: from the business objectives over product management to tactics. Source: <https://productcoalition.com/how-to-create-kick-ass-product-roadmaps-spoiler-alert-there-are-3-types-of-roadmaps-a1018d147603>

The tasks on the different hierarchical levels are discussed by the product manager with the different groups in the company. First, business objectives have to be discussed with the top management, so that the product development is aligned with the overall goals and business strategy of the whole company. This should of course be the first process done even before a clear product vision is defined.

In the second hierarchical step, the business strategy is then communicated to the different stakeholders and departments with the aim to develop a product strategy. In this process, the final product vision and product strategy can be developed from the ideas of the different departments and the prioritization of the ideas is then aligned with the business objectives and communicated with the top management, so that a roadmap with the defined key performance indicators (KPIs) can be concretely written down later. In the last step during road mapping the tactics are written down, which means that the single tasks are broken down to working instructions with the help of the project managers, so that they can be easily executed.

To support the strategy development process not only internal ideas but also external analysis of the market environment should be considered. This can be done by market research but also an early implementation of outside experts like with the inclusion of lead users or the methods of the design thinking process can support the process (see "Predicting

technology change" -> Integrated IP and innovation management: Part 2 Chapter 5). This helps the whole interdisciplinary team with members from R&D, design and user experience (UX), marketing and sales and IP to better understand the customer needs and define a strategy incorporating the experience from all departments and the outside. Finally, with the strategy and based on the product vision clear product features and KPIs may be defined and broken down in a roadmap.

Developing an IP strategy

The role of IP within the product development process is its creative use to develop exclusivity for features, customer benefits and other aspects to create profits from the innovation. IP management leads to higher returns through innovation instead of just filing patents for inventions. When IP is integrated in marketing and product management, the legally enforceable exclusivities can be communicated and can create a sustainable brand loyalty.

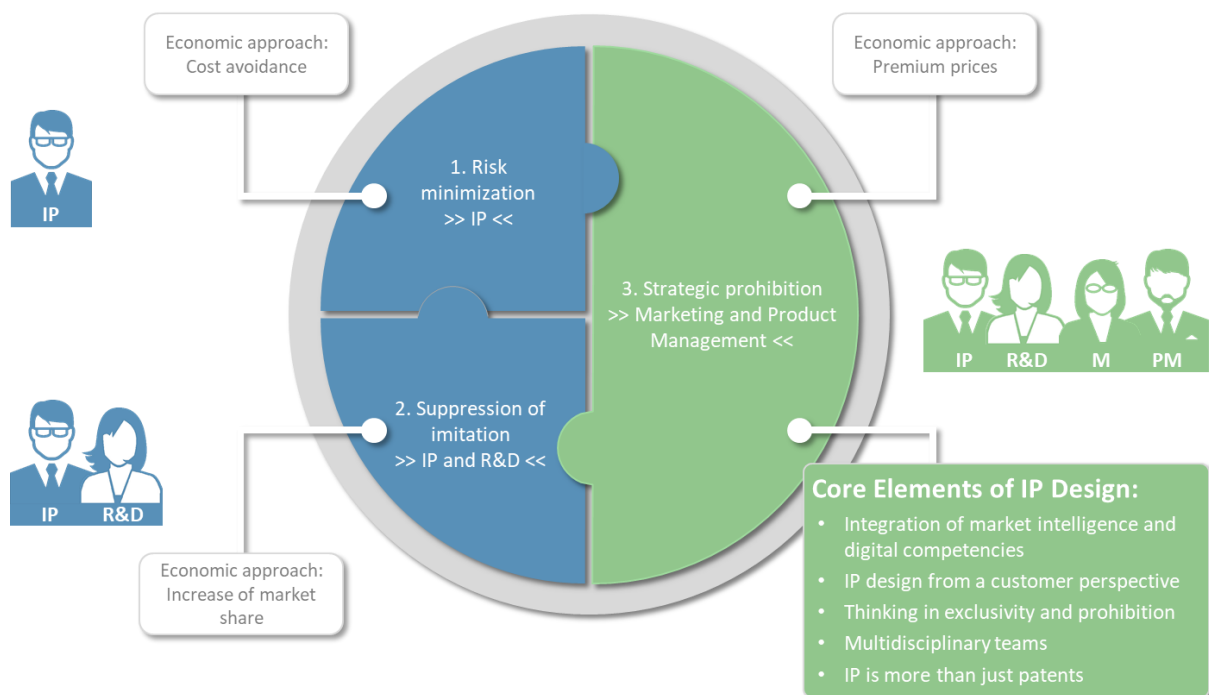


Figure 19: Integration of the IP manager in the product development process. The role of IP is not only to minimize IP risks and suppress imitation together with R&D. IP also should be used to create exclusivities with the help of strategic positioning in coordination with marketing and product management. Adapted from: Alexander J. Wurzer, Theo Grünewald, Wolfgang Berres, *Die 360° IP-Strategie – So sichern Sie Ihren Innovationserfolg langfristig*, Vahlen (2016)

To achieve this goal the product management and the IP management must go hand in hand from the beginning of the product development process (see Figure 19). The product manager needs to communicate to the IP manager what kind of exclusivity is needed and should be communicated to the customer with the help of marketing. The IP manager on the other hand must develop an IP strategy and communicate to the product manager, if and how legally enforceable exclusivity can be reached or not. Without this communication

products and services could be developed which cannot be adequately IP protected or even worse business models could be developed which cannot be operated at all because of third party IP rights. To prevent this the integration of IP in product development should already start on day one of the product development process.

Creation of a product roadmap

The link between the product and IP strategy development process and the creation of a product road map is the prioritization of ideas, which should then be used in the concrete road mapping process. Here, the ideas can for example be selected into ideas, which can be implemented immediately, such which may be implemented in the near future, and moonshots which may be implemented in the distant future. Characteristics of those moonshots are, that they require a high level of development, while the ideas still cover a broad scope and are very flexible. The implementable ideas on the other side are very specific in their areas of focus and application, and the design and technical specifications are already well defined. It is important to mention that all selected ideas are already approved by the team in the idea generation process and the job here is only to determine, if they should be used now or put on the shelf for the use at a later time. This decision should be based on the developed strategies.

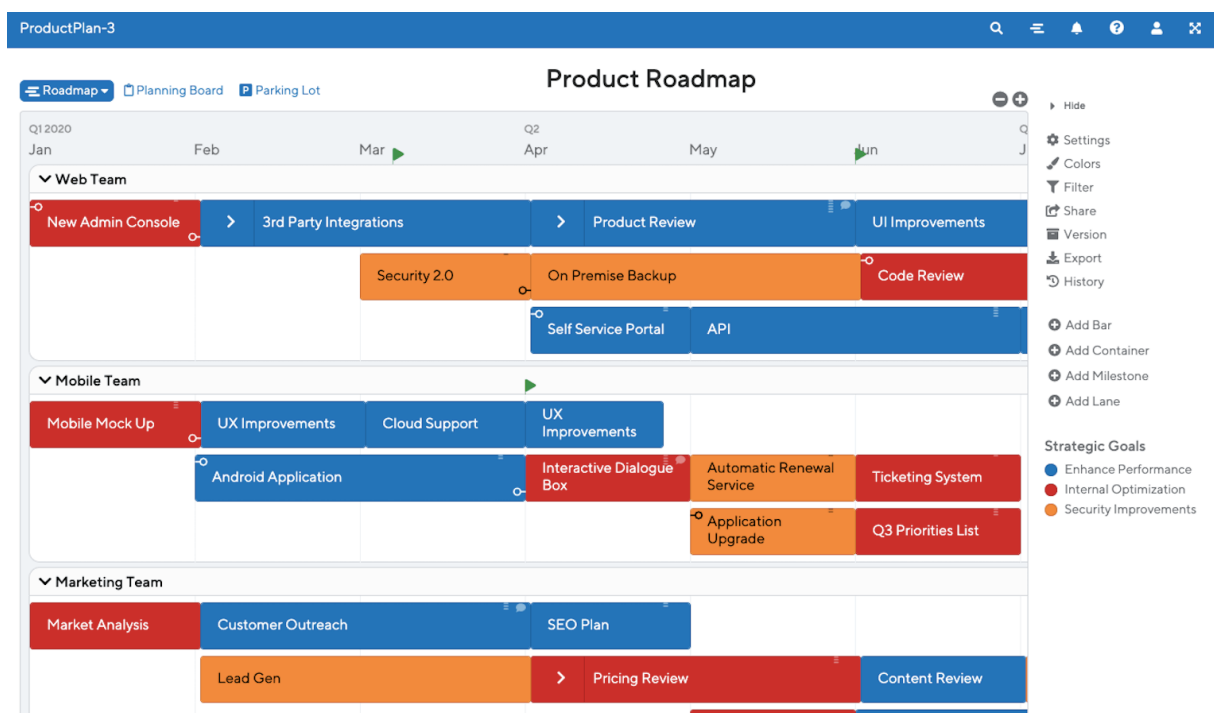


Figure 20: Example of a product roadmap. Source: <https://www.productplan.com/what-is-product-management/>

Once the ideas are prioritized the heart of the product management process, the product road mapping process, can be started. Here, the plan and agenda for the whole organization are defined in a single roadmap (see Figure 20). The chosen and prioritized visions are written down in a concrete plan with timetables and job descriptions. So, the product

roadmap is the main public communication channel of the product manager with the different departments and teams. It serves as an open and transparent tool to bring everyone on board. This is important since the product manager is a communicator and coordinator, who has to bring everyone together and cannot lead through authority (see Figure 21).

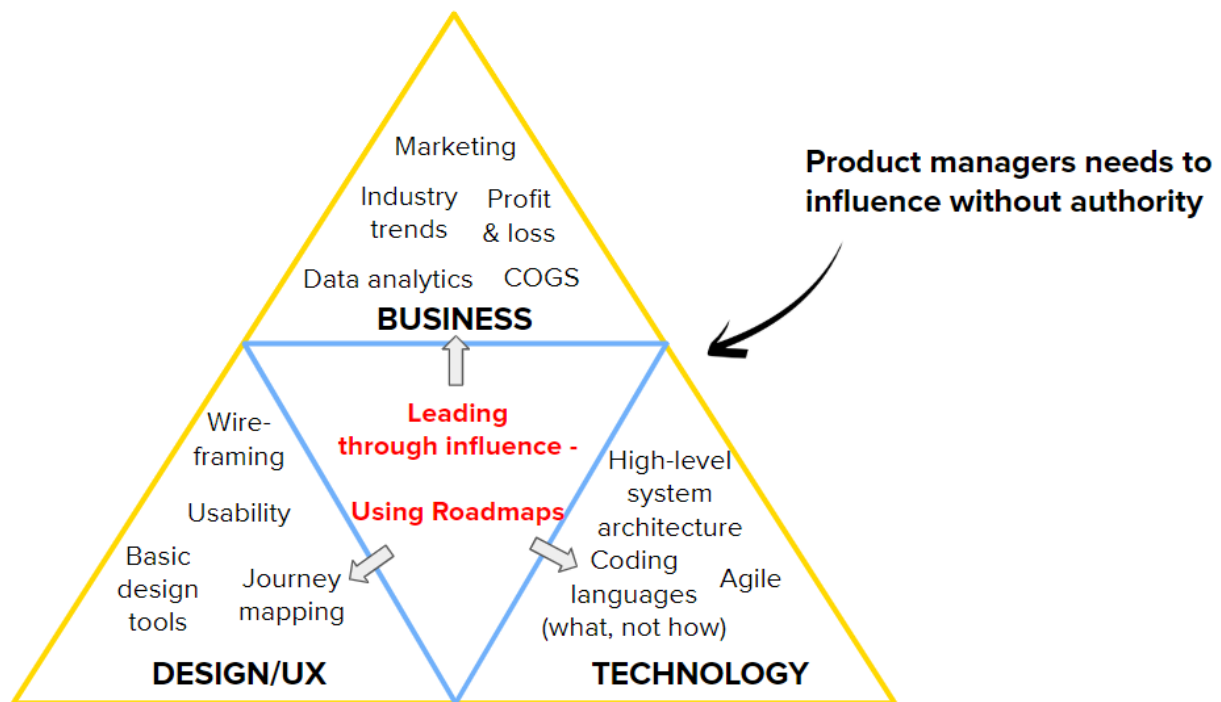


Figure 21: The roadmap is a communication tool of the product manager to bring all departments on board without authority. Source: <https://productcoalition.com/how-to-create-kick-ass-product-roadmaps-spoiler-alert-there-are-3-types-of-roadmaps-a1018d147603>

Execution and testing

Once the roadmap is well defined and the jobs are distributed the roadmap becomes executed and the products are iteratively tested. Here, it is to mention, that also in the earlier steps the idea generation, the road mapping, the distribution and splitting of task should be constantly reviewed in an agile process.

The execution and testing stages usually go hand in hand. So, execution means first the product development itself. Here, the new needed technologies are developed, but also the prototypes are tested. The role of the product manager is here to support and communicate with both the R&D team and the UX team, which is responsible for the user experience (UX), that the customer needs are met from both the technological and the design point of view. So, already in this execution and development stage the testing plays a huge role and is part of the product manager's job.

In a next stage the product should be tested with real potential customers. This can be done in many ways. The company can invite customer advisory groups, run focus group sessions

or question & answer sessions. In the area of software development testing is often done with giving the product to beta testers for free or creating competitions, who find the most bugs in the code, so that the quality of the product is enhanced. The job of the product manager is to choose the fitting and most promising ways to test and improve the products and communicate the results until the decision for the market launch is met.

After market launch the testing of the product continues in further testing cycles. A good example for this comes from the agile world of continuous integration in software development. In old software development the whole software bundle was built until release and then finally integrated, which was very time inefficient. The more agile approach is now continuous integration, which means that multiple developers can work with the same code and constantly improve and test it, while working on the same project. This way, the product can be released earlier, and the testing and integration of the product happens along the way.

Chapter 5 | The innovation funnel

Empirical data of the new product development process

To better understand the new product development processes in companies Greg A. Stevens and James Burley conducted an analysis how ideas are finally leading to successful product launches in companies. The results were published in the 1997 paper "3,000 Raw Ideas = 1 Commercial Success!", where they found out, that during the idea refinery process in a company it needed 3000 raw ideas to come up with only 1 successful product launch (see Figure 22). In more detail from the 3000 raw ideas only 300 are considered as useful enough to shortlist them for a second project stage and 125 end up as small projects. Those small projects lead often to a patent, but only 9 are continued further in large projects. Finally, four projects are taken close to a launch, 1.7 are finally launched and one launch is successful. This narrowing down of raw ideas until the product launch of the most promising ideas resonates in the concept of the innovation funnel.

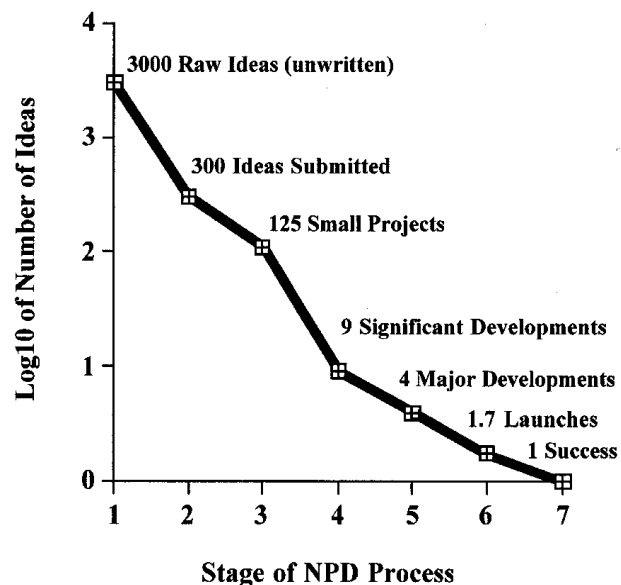


Figure 1.—This "universal industrial success curve" illustrates the number of "substantially new" product ideas surviving between each stage of the new product development (NPD) process.

Figure 22: Stages of the new product development process (NPD) versus the number of ideas. Source: Stevens, Greg & Burley, James. (1997). 3,000 Raw Ideas = 1 Commercial Success! *Research Technology Management*. 40. 16-27. 10.1080/08956308.1997.11671126.

What is the innovation funnel?

The innovation development process is traditionally described by the concept of the innovation funnel (see Figure 23). In short, the function of the innovation funnel is first to generate as many ideas as possible and refine their selection by discarding the less viable and less feasible ideas step by step. In this way only the most viable ideas creating the most useful products and services for the customers should survive. This means, that the products can be manufactured cheaper, have higher functionality, or meet customers' needs better than the discarded ideas.

The funnel has three levels from the wide left opening, where the masses of new ideas enter, to the narrow end on the right, where only the most promising ideas survived the refinery process. Those three levels are:

- Idea development
- Concept development
- And Concept-to-launch

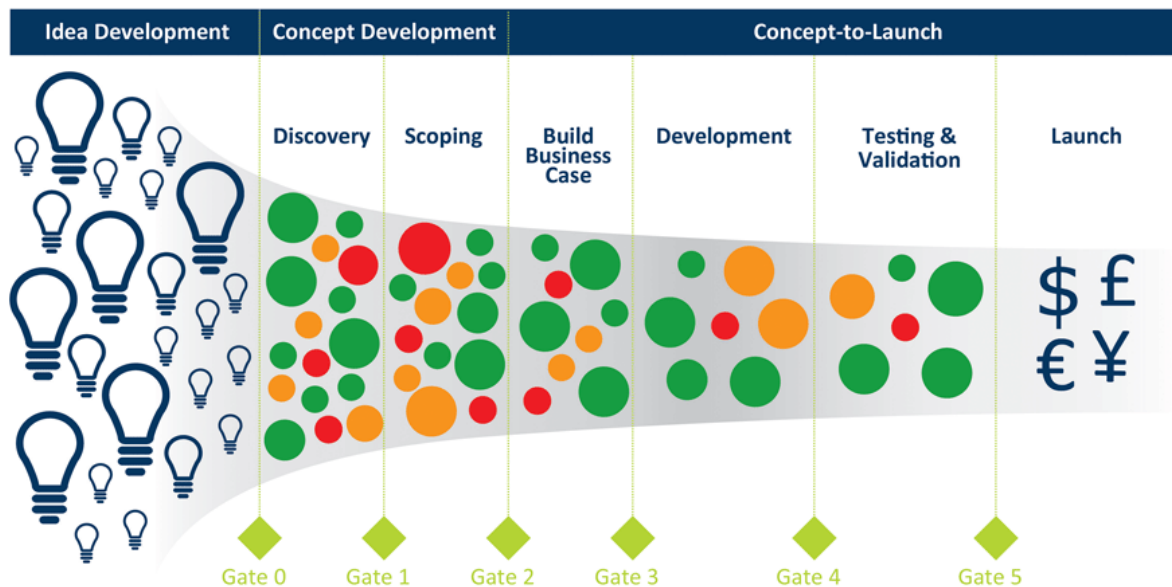


Figure 23: The innovation funnel including the gates of the stage-gate process. Source: <https://www.sopheon.com/de/ideen-und-konzeptentwicklung/#single/0>

Idea development

The first stage of the innovation funnel process is the idea generation. Here, as many as possible ideas should be generated in the process since weak ideas are discarded in the refinery steps of the funnel later on. Before coming up with the first ideas, it is important to define the goals of the project to have a clear scope which ideas should be collected. After that the idea generation within the multidisciplinary team within the company and with the help of external sources and advisors can start.

Concept development

The second step in the innovation funnel is the concept development stage. Here, the first ideas become discarded in the idea screening process. For the idea screening process it is important, that the screening team is composed of members from the different departments, so not only the engineers, but also marketing and sales people and IP people are involved to decide, which ideas are most promising, and also senior enough members must be in the screening team, who can talk to management about the suggested ideas and confirm that the finally chosen ideas are aligned with the overall business strategy of the company.

Concept to launch

In the final stage the ideas are driven to market readiness. This means, that the first practical development and testing of the ideas is carried out and also that the ideas are finally aligned a last time with the overall business strategy. This is important since during the development and testing process the initial scope can get out of sight. Finally, the product can be launched in the market.

Criticism of the innovation funnel

The innovation funnel is a very popular and straight forward approach to innovation. But there is also a lot of criticism about it. The most obvious criticism is, that it is very inefficient, so 3000 ideas need to be created to get only one successful product, which binds many resources first in the idea generation process and second in the idea refinery process. The second criticism is that the refinery process is not selecting the best ideas, but the ideas, which appeal most to the reviewers. The reviewer can here be seen as gatekeepers, who only let pass the least controversial and least ambitious ideas and do not really know what the customers want. So, radical innovative ideas are dropping out during the refinery process and many poor or not viable ideas survive the funnel, which then lead to market failures.

Alternatives to the innovation funnel

The first process in the innovation funnel, which may be changed for better is the idea generation and refinement process. In the innovation funnel the ideas are all created before entering the funnel and then immediately discarded, when they do not fully fulfil the objectives and scope. In this process also ideas are discarded, which may be only slightly modified to fit the final innovation question. This can be avoided with creative thinking methods, where the modification of initial ideas in the funnel is possible, so that refined ideas are allowed to progress through the funnel. Also, criteria like the feasibility or profitability of the ideas are not applied to exclude ideas at this early stage, so that also more radical ideas can survive the early stages of ideation.

Many different methods for idea generation are available on the market. Here, we focus on the SCAMPER method (see Figure 24). It is a method designed by Bob Eberle for brainstorming sessions to enhance critical thinking processes. SCAMPER stands for:

- Substitute
- Combine
- Adapt
- Modify
- Put to another use
- Eliminate
- Reverse

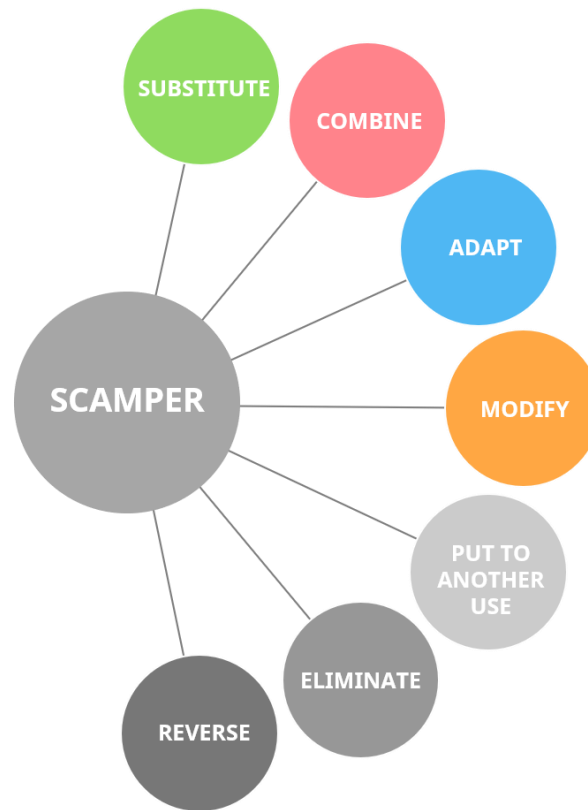


Figure 24: The 7 steps of the SCAMPER method by Bob Eberle. Source: <https://www.viima.com/blog/idea-generation>

The multiple steps all have the purpose to view the problem from different angles and get new thoughts. The substitute step asks, how the product or service aimed for could be substituted with other products or services, so that other solutions appear, and the scope of the project can be adapted. The combine approach asks, if there is a way to combine different ideas to a common idea and improve it in that way. The adapt method asks the thinker, if small adaptations to the existing ideas could improve the products substantially. The modify approach is similar to the adapt approach, but asks the innovator to change the expected environment, e.g. the expected market size or consumer base, to come up with a different analysis of the idea. The put to another use method asks the innovator, if and how the innovation could be used in another context to come up with new ideas. The eliminate method asks the inventor, if the idea and innovation could be reduced and some parts could be removed to improve the product by focusing on few major features. The reverse process asks, if the order of the production process is optimal or if a reversed order of production steps could improve the quality or reduce the costs of the final product. With this methods group working sessions further improve their innovative ideas and converge them to the most promising ideas.

The most promising ideas are then selected and tested in iterative cycles with prototyping and further improvement of the ideas. Here, the scope to reach a promising final project should always be kept in mind. So, in the testing phase it is crucial to define beforehand the goal that should be reached. When this goal is reached, a convincing product pitch for the

innovative product should be prepared and presented in front of the decision makers, so that the most promising ideas enter the project stage.

The second phase that should be improved is the project phase. In the innovation funnel, only few ideas reach the project phase and the ideas cannot be modified. So, when a project fails because minor problem, it often gets killed in the innovation funnel. A better approach is to still keep the single ideas flexible within the project. The whole project development process is changed from finding the best solution to learning from the different solutions and application possibilities through intensive testing.

The different innovation projects are then carried out on small scale and budget to learn and improve the ideas together with customers and experts under realistic conditions. This process is again an iterative process to learn from failure. The ideas are not immediately discarded when they fail but the lessons learned are used further down the innovation process. So, again the whole process becomes more agile, more iterative, and more practical. The ideas are at every stage tested and improved, instead of discarded based on an expert group opinion like in the original innovation funnel, which uses a waterfall project management method, where all steps are carried out one after another.

IP design

In a meaningful product development process also intellectual property (IP) must be integrated into this agile innovation process. This can be done with the method on IP design (see Figure 25). IP design is a methodology to use design thinking approaches for creating IP on demand. Based on a deep understanding of customer needs, benefits and decisions, IP is created to drive customer decisions, to protect and exclusify customer benefits and user experiences. It is an iterative and agile methodology which does not use the classical waterfall project management model. A more detailed description of IP-design will be presented in "IP road mapping and IP design" -> Integrated IP and Innovation Management: Part 7.

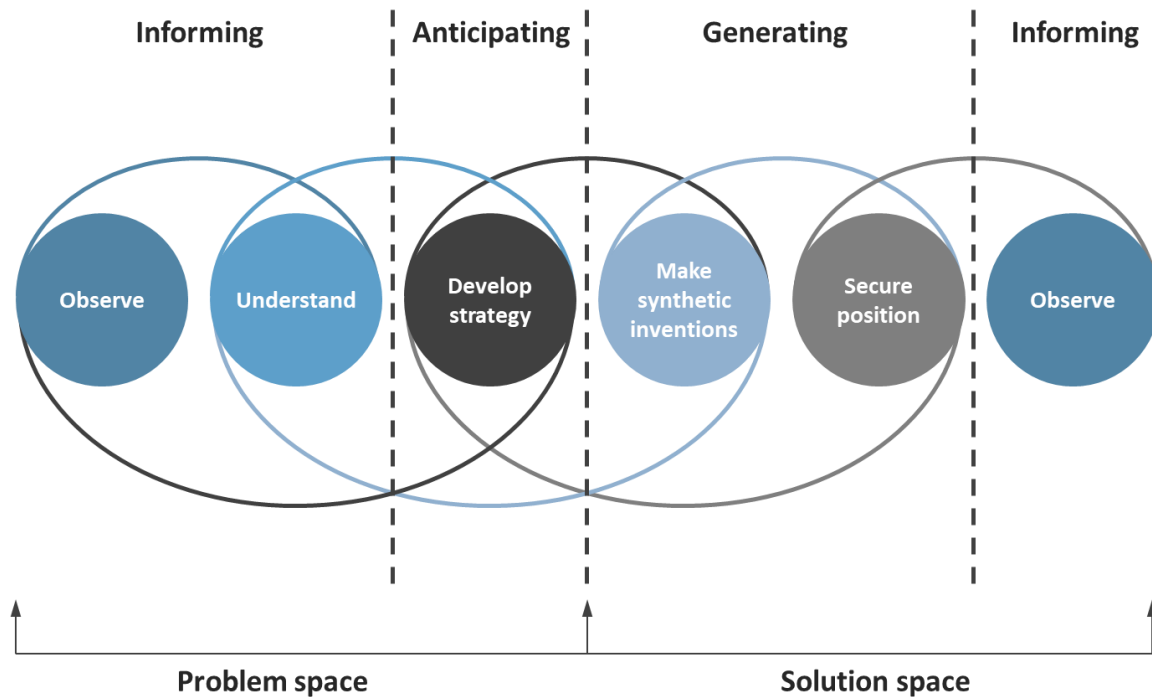


Figure 25: The IP-design process with the three phases of informing, anticipating, and generating. The informing process can be split into “observe” and “understand” and the generating process consists of “Make synthetic inventions” and “secure position”. Adapted from: *HPI School of Design Thinking / Qudosoft*