Innovation in Internet of Things

HILTI

Designing an innovation process for Hilti to identify and protect business relevant ideas in the area of Internet of Things.

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Executive Summary

The construction industry is undergoing a significant change driven by the emergence of new technologies. Digitalization is transforming the sector with the Internet of Things (IoT) being one of its core enablers.

As a leading multinational organization that provides cutting-edge tools, technologies, software and services for the global construction sector, Hilti is responding to this change by shifting from a product-oriented focus to become a more solution-oriented company. One essential factor of this transition is the adoption of the IoT technology to provide new solutions to address the customers' needs in the digital future. Thus, Hilti needs to identify and seize opportunities in the field of IoT.

The purpose of this graduation thesis is to enable Hilti to identify new ideas in the area of IoT and protect them with intellectual property rights to enable long-term differentiation. A good overview of the IoT patent landscape will provide clarity to spot new business opportunities systematically. The project aims at developing an innovation process that captures ideas from within the company.

A qualitative user research was conducted uncovering several pain points in the current process. The loss of ideas and the lack of quality of ideas were found to be the biggest challenges that are hindering innovation from happening. The findings were contrasted with literature, which pointed out the importance of the development of an abstract idea to become more concrete, in order to derive value from or protect it.

In an iterative process, a solution was developed that addresses the identified pain points. The outcome is a combination of a sequential and iterative innovation process structured into four phases, including ideation, collection, assessment and protection of ideas. The basic concept of the process is the validation of assumptions, for which a tool was developed that facilitates this and acts as the main touchpoint throughout the process.

The process is visualized in a process blueprint providing detailed information about the different components and interactions. An implementation plan was developed, giving suggestions for the next steps to be taken to operationalize the process.

The project provides a feasible solution for Hilti to identify and protect new ideas in the area of IoT. For the implementation, it is recommended to give much attention to the guidance and training throughout the process to ensure its correct use.

Abbreviations

GPMS	Global Process Management System
IoT	Internet of Things
BU	Business unit
TS	Tool Services
FFE	Fuzzy Front End
IDJM	Idea Journey Map

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Colophon

Master Thesis
Innovation in Internt of Things: Designing an innovation process for Hilti to identify and protect business-relevant ideas in the area of Internet of Things

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1 Introduction

This chapter is divided into three parts. The first part elaborates on the company Hilti, its strategy and current product and service offering. The chapter continues with the introduction of the business unit, where the project was carried out. In the last part of the introduction, the scope of the project is explained, including the problem definition, desired outcome, approach and methodologies that were used throughout the project.

1.1 The company

1.1.1 Hilti

The company where the project was done is the Hilti Corporation. Hilti is a multinational company that provides leading-edge tools, technologies, software and services for the global construction sector. Hilti is a family-owned Lichtenstein business, founded in 1941 by the two brothers Eugen and Martin Hilti, and is since located between the Swiss Alps in the Happy Valley in Schaan, Lichtenstein. It has more than 29,000 employees worldwide, of which 2,000 are located in its headquarters in Schaan, and the others are spread across its marketing organizations in over 120 countries around the globe. Hilti has a worldwide reputation for pioneering products and first-rate service. The company has been steadily growing over the past years, leading to net sales of 5,13 billion Euros in 2018, of which approximately 6 per cent is invested in research and development. Innovation plays an essential role in their company as they create around 30 new products each year.

Hilti differentiates from its competitors in one significant way, which is their direct sales model. The company takes care of the complete process, including research, development, production, marketing, sales, and aftermarket services such as repairs. Hilti has complete transparency into the processes from the research of a new technology until the repair of a tool, that has that very same technology integrated. This closeness to the customer plays an essential role for Hilti, as it provides the basis for continuous innovation based on real customer insights. With around 250,000 individual customer interactions per day, Hilti is not only able to respond to customers' needs by innovative ideas that are developed directly on construction site, but it also creates a strong customer relationship and therefore a strong, trusted brand.

1.1.2 Product and service portfolio

Hilti has a diverse product and service offering covering many business areas of the construction sector, which makes Hilti a strong player in its market. Apart from the recognizable red power tools, which are Hilti's figurehead on any construction site, the company offers a wide range of products, services and software. It helps Hilti to act as a holistic solution provider for the building industry.
The portfolio is divided into nine business areas which are anchor systems, electric tools & accessories, direct fastening & screw fastening, firestop systems, diamond coring & cutting, tool services, measuring systems, construction services, and installation systems (Hilti , 2019).

"Hilti. Outperform. Outlast." This slogan represents the mindset of the company, which is translated into the products by creating high quality and durable products that last for a lifetime. Premium quality and excellent service to provide the best solutions for the customer is deeply anchored in Hilti's DNA (Hilti, 2018). However, offering tools that do the job better than its competitors, while requiring lower maintenance also comes at a price. Hilti is therefore seen as a premium brand in the construction industry as their products cost significantly more than competitors' products.

1.1.3 Culture and strategy

The superior quality is critical for the success of Hilti. This is shown not only in the products but also in the culture and mindset of the employees. Providing first-class products, software and services for the customer has always been the ultimate goal of the company. *"We passionately create enthusiastic customers and build a better future."* These are the words that are currently in the heads of Hilti's employees, which is the common goal to achieve by the year 2020. In order to achieve this goal, the overall strategy of Hilti is shifting from a product-oriented company to a more solution-oriented organization that provides more holistic solutions for the customer.

In recent years, Hilti has recognized the trend of digitalization and the importance of being part of the transformation towards the digital construction site. The company is making massive investments in digitalization in order to provide its cutting-edge solutions for the customers – also in the digital future. The digital solutions are both for company internal and external purposes. Internally, digitalization happens in HR, finance, logistic, training and manufacturing to gradually introduce the "Industry 4.0". For the customer, Hilti provides digital design and modelling for building planning, construction process and facility management, but also solutions for digital communication with customers.

1.1.4 Business Unit Tool Services

Within the topic of digitalization, Hilti has realized the potential of making use of new technologies, such as Internet of Things (IoT) in a way that adds value to the business. The company is already exploring the opportunities of IoT, which enables them to create new products, services and provide new solutions for its customers. Hilti currently has several products on the market that include IoT. To emphasize the importance of this topic and put a clear focus on the introduction of IoT at Hilti, a new business area was dedicated to this. In April 2018 the Business Unit Tool Services (BU TS) was born.

The focus of the BU TS is to provide services that enhance productivity while minimizing administrative efforts. This translates into different services and integrated software

solutions, such as fleet management, asset management, repair and maintenance services, and apps that continuously provide the customer with relevant tool information. The current portfolio and the role of the BU TS will be explained in more detail in Chapter *3.4 IoT* .

As the BU TS is rather new and the topic of IoT yet unexplored, Hilti saw the need to further look into the opportunities that such technology can offer, what new solutions can be developed and how they can add value, both for the customer and Hilti. This was the reason to initiate this project. The master thesis was done at the development department at the Business Unit Tool Services.

1.2 The project

This section will give insights into the problem definition, the desired outcome, as it was defined by the BU TS, the approach and the different methodologies that were used throughout the project. As a starting of the project, the problem and the desired outcome were defined based on the initial project brief (Appendix A) and the expectations of the Head of Development of the Business Unit Tool Services, who commissioned the project.

1.2.1 Problem definition

IoT solutions consist of several different components including hardware, software and services, which requires the knowledge and capabilities from different areas such as research, development, marketing and the different business units. Thus, innovation in IoT goes beyond the traditional product or service development process as it touches on the different areas of a company. Conventional company internal structures and processes need to be rethought, and a holistic and structured approach is needed in order to create innovative solutions for the Internet of Things.

With the creation of the Business Unit Tool Services in April 2018, Hilti is breaking new ground in the area of IoT. In order to maintain a leading position in the market, the company needs to keep up and stay ahead of its competitors by adequately exploring the potential of this new technology. The BU TS needs to be able to identify new business opportunities in the area of IoT early on. At the moment, the identification of new business opportunities in the field of IoT happened in an unstructured way as there were not systematically tracked and potentially lost.

1.2.2 Desired outcome

The desired outcome of the project was an innovation process that provides a structured approach to identify and protect business-relevant ideas in the area of IoT early on. The goal was to collect the ideas that already exist within Hilti but also to combine the knowledge from different departments in order to create new ideas. This would strengthen the knowledge about IoT within Hilti and enable a continuous flow of innovation for new IoT solutions.

Further, the aim of the process was not only to identify ideas for new business opportunities but to protect their intellectual property (IP). Thus, ensuring differentiation over time. The output of the innovation process is therefore twofold: Firstly, intellectual property such as patent applications, and secondly, to generate ideas to launch innovative products, services and software, which can be seen as the tangible outcome of a patent.

1.2.3 Structure & approach

This section outlines the approach, which refers to the sequence of events in chronological order and gives insights into the activities that were carried out throughout the project phases. Then, the structure of the report is explained, which is organised into different chapters based on relevant topics of the project.

The project follows the double diamond process model, which was developed by the British Design Council in 2005 (Design Council, 2007). The model was slightly adapted to the needs of the project, which is shown in Figure 1. Additionally, elements from The Lean Startup Method by Eric Ries (Ries, 2011) were used for the second part of the project, the solution development phase.

The first half of the project focused on finding the right problem and the second half on finding the right solution. The project was approached in four main phases: initial research, user research, problem framing, and solution development.

The goal of the initial research was to acquire the background knowledge that was needed to carry out this project. It consisted of an internal research (Chapter 3), focusing on the company, as well as a more contextual research (2 Context analysis), which aimed at understanding the IoT technology and the context of the construction industry.

In the second phase, the user research (Chapter 4), the focus was put on the current situation of the innovation process inside the business unit tool services. The research also looks into the innovation processes applied in other business units. In-depth interviews were conducted in order to understand and map out the as-is situation of the innovation process. An analysis of the obtained data was conducted to depict pain points in the current situation.

The results from the user research analysis were contrasted with relevant literature about innovation.

In the third phase, the problem framing (Chapter 5), the initial problem statement was analysed. Literature was used to clarify the elements that the problem statement entails. The identified pain points were addressed, the desired outcome redefined, and the solution outlined.

In the fourth phase, the solution development is described (Chapter 6). In several iterations, the solution was ideated, prototyped and tested. In a continuous validation process through feedback interviews, practical testing and workshops, the solution was developed. The final outcome is presented in chapter 7.

The final phase aims at the implementation of the solution (Chapter 8). An implementation plan was developed, including a strategy, stakeholders, and the required organizational change. At the end of the phase, the next steps are defined.

1.2.4 Methodologies

This section explains the different methodologies that were used throughout the project in order to increase the validity of the research. The methodologies were: desk research & trend analysis, literature study, internal interview, customer journey mapping, and internal workshops.

Literature study
In the first phase of the project, the primary source of information was obtained through desk research and trend analysis. The focus of the research was on the Internet of Things and current trends and developments in the construction industry. Further, literature was used in the second phase to explore the topic of innovation and innovation processes. Besides, internal documents were used for the analysis of the company.

Internal interviews
The most important source of information was internal interviews. Throughout the whole project, over twenty interviews with different company internal stakeholders were conducted. The interviews can be divided into two main rounds: an initial round of helped to understand the current situation and depict pain points in the process, which built the basis of the project. The second round of

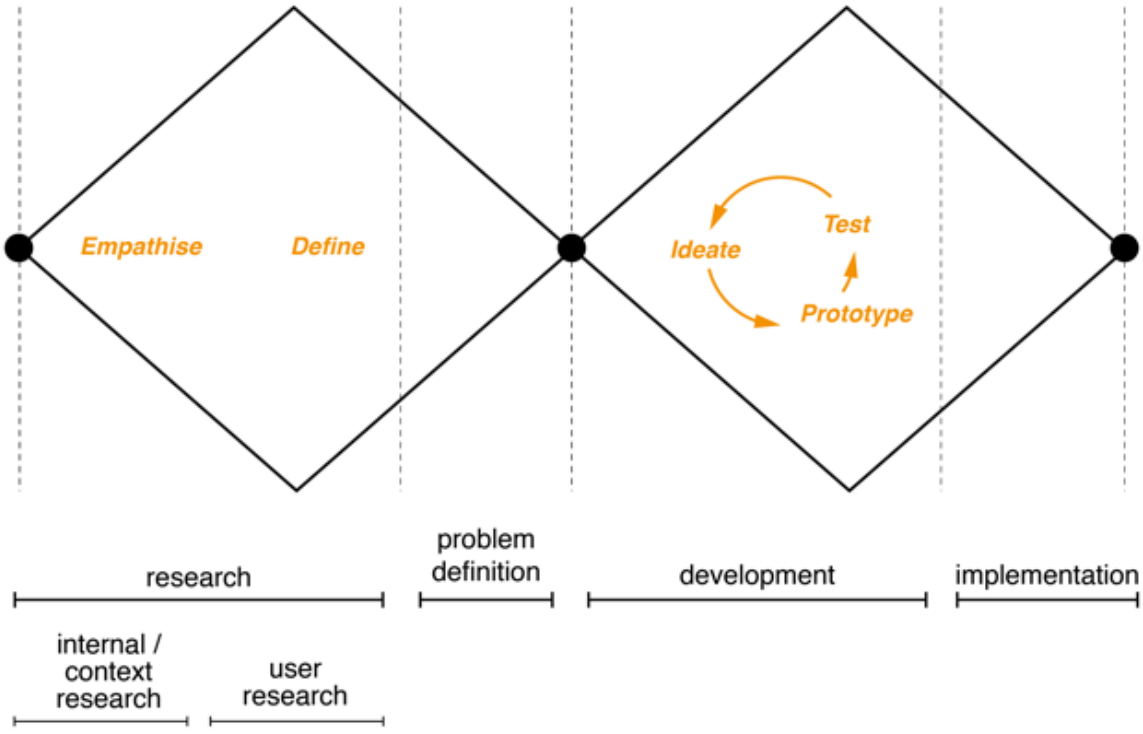

Figure 1: Structure of the project based on the adapted Double Diamond Process Model

interviews was conducted throughout the solution development phase. These interviews were used to get additional insights to firstly, stimulate the ideation process and secondly, to receive feedback during the testing phase of the solution. Last but not least, informal meetings, lunch appointments, and coffee corner talks contributed much valuable information to the project.

Customer journey mapping
For the first round of interviews, the customer journey mapping method was used, as this method helps to map out a sequence of events. The method was slightly adapted to the needs of the project since the goal was not to understand the customer's journey but the process that an idea goes through. A journey map was designed and used as a boundary object during the interviews. This way, the process could be mapped out and pain points associated with the individual steps in the process.

Workshops
There were two workshops organized in order to test and validate parts of the proposed solution. The first workshop took place in the first iteration of the solution development. The goal was to test the process with participants to validate the proposed solution. The second workshop was the final validation of the final solution.

Experience exchange
During the ideation phase of the solution an experience exchange with BMW was organized to gain insights how other companies manage the same challenges. It provided insights about what worked well and what did not.

2 Context analysis

As a starting point for this project, the context was explored to get an understanding of the industry and the technology that were central elements of the project that was carried out. A literature study was conducted, first looking into the topic of the Internet of Things and secondly, diving into the digitalization of the construction industry with an emphasis on IoT in the construction sector. The primary source of information was literature on IoT and market reports on the current trends and developments in the construction industry.

The understanding of IoT was essential to gain solid background knowledge about the technology, in order to design an innovation process that delivers IoT solutions. The objective of the second part of the context research was to get an overview of the bigger picture where this project was done and to get a feeling for the environment of the company. The outcome of this research was relevant in order to understand what IoT solutions already exist in the market and how they are currently applied in the building industry.

2.1 The Internet of Things: Connecting everything

The vision of a digitally connected world is not just a futuristic thought anymore but has become a reality. The Internet of Things (IoT) is a technology or a combination of technologies that allows physical objects or "things" to be connected to the internet. That means that not only one's personal computer and the smartphone will be connected to the internet, but also a fridge, a car, a toothbrush, an underground piping system or even a tree. The Internet of Things has found its way not only into the consumer market but also in the industry increasing productivity in supply chain management or by enabling smart factories. There is a rapid growth of the IoT, which is expected to connect 20 billion things to the internet by the year 2020 (Gartner, 2017).

2.1.1 What is the Internet of Things?

To this day, there is no one clear definition of IoT but rather different approaches to explain it. While some definitions focus more on the holistic aspect of IoT as a being a global network infrastructure that combines the physical and the digital world (Vermesan & Friess, 2014) (Miorandi, Sicari, De Pellegrini, & Chlamtac, 2012), other explanations tend to focus more on the fact that physical objects (things) are able to communicate and sense or interact with each other thanks to embedded technology (Gartner, 2017) (Atzori, Iera, & Morabito, 2010). Despite the different approaches that try to explain the complex concept of this technology, there are several elements that they all have in common, such as a physical thing, sensors, electronics, connectivity and data analysis — creating a network of things that are able to communicate with each other and create an application for the user. This shows that there is a common understanding of the technology; however, depending on the interests of an organization or stakeholder, the focus of IoT might differ.

2.1.2 How IoT works

IoT merges the physical with the digital world, meaning that there are both physical and digital elements to it, which together build an IoT ecosystem (Figure 2). The centre of the IoT ecosystem is an internet network that connects the different physical and digital elements. The physical objects, IoT devices, are equipped with sensors and electronics. The sensors that are embedded in the objects can sense the physical world and translate them into digital data. The electronics contain connectivity options, which enables to send the data from the object via a gateway to the cloud. In the cloud, the data is stored, analysed and processed. In the end, the data can either be visualized or used for command, to trigger actuation. This data can be used for different purposes, such as retrieving information or remotely controlling a device (Gartner, 2017). This way, an application or service for the customer can be provided.

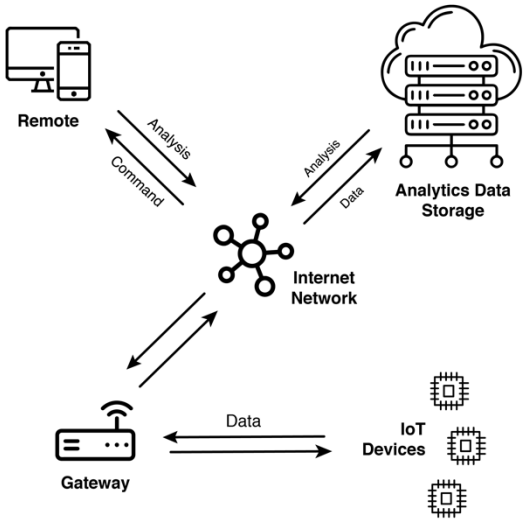

Figure 2: The Internet of Things ecosystem

2.1.3 Opportunities & challenges of value creation in IoT

Equipping physical objects with sensors and electronics and giving them virtual identities brings many new opportunities (Vermesan & Friess, 2014). Thinking of all the objects, we are surrounded in our everyday life; it becomes clear that there are endless opportunities by connecting them all to the internet. Equipping the front door of one's home with a smart lock that is connected to the internet, for example, enables someone to remotely open the door to let the delivery guy leave a package inside the house. There is some value creation by connecting physical things with the digital world. Thus, many businesses are currently exploring the opportunities of IoT how it can create value for them. The challenge, however, is to understand if and how an added value can be derived from connecting a physical object with the internet. Despite their willingness to become a digital business, many companies struggle to make use of the technology and successfully exploit the potential for their business (Gartner, 2017).

One of the reasons for this struggle is the nature of value creation, which differs from many firms' conventional ways. Especially for product-focused companies, the introduction of IoT poses a challenge as the value proposition entails more than just the physical product. The value creation can happen on all the different layers of the IoT application such as the real thing, the sensors, connectivity, data analysis or the service for the customer as shown in Figure 3 (Wortmann, Weinberger, & Fleisch, 2015). Thus, IoT solutions are a combination of physical products and digital services. Therefore, the value creation can happen both in the physical or in the digital world, and the business models for IoT solutions need to be rethought. It is no longer merely the physical product that solves a problem for the customer and creates an added value. The availability of data is a crucial element that makes an IoT solution valuable.

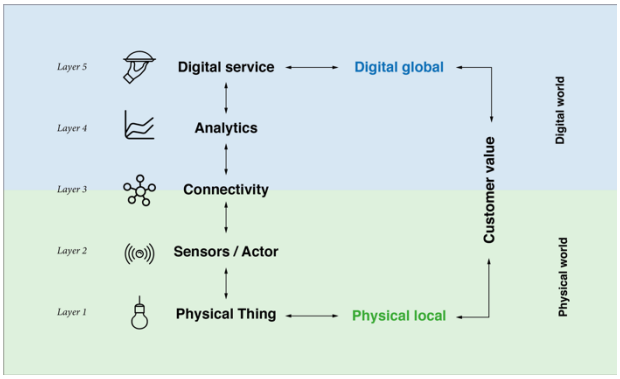

Figure 3: Value-creation Layers in an Internet of Things Application (Wortmann, Weinberger, & Fleisch, 2015).

In some cases, the physical product is simply an embodiment of the sensors that are needed to generate the required data in order to provide the service for the customer. A fitness bracelet without a display, for example, has very limited functions for the user considering the device itself. The only way for instant feedback for the user is through the vibration of the bracelet. However, the device contains several sensors that captures data from the real world such as motion, location and acceleration. With this data, a service can be created, such as giving recommendations about the user's physical activity or detecting sleeping patterns. The interaction of the user with the application works with a digital interface such as a smartphone, where the data can be visualized. In this case, there is no real value of the physical object, the bracelet; it could even be perceived as negative value as the user *must* wear the device in order to make use of the service. The data analysis and digital service are the important layers in this example. The value creation happens entirely on one end of the spectrum, in the digital world.

On the other hand, there are cases where the physical thing remains the main creator of value, such as a washing machine that can be connected to the internet and controlled with a smartphone. The main job of a washing machine is to clean clothes. Embedding sensors and connectivity into the washing machine does not necessarily change the outer appearance of the device, nor does it significantly impact its weight. Moreover, the user has the choice to use the product like a regular washing machine without connectivity. Additionally, when connected to the internet, additional features are available for the user such as notifications about the termination of a wash, the remote initiation of a new wash or retrieving information about water and electricity usage. One might buy a washing machine, especially because of these features. However, the device itself does its job just as well without being connected to the internet. In this example, the additional features add a value; nevertheless, the main value creation remains with the physical product and not the digital service.

The two examples show that there is a full spectrum of possible value creation throughout the IoT layers. For the fitness bracelet, the digital service is in the foreground, and the physical product is solely a means to collect the necessary data to enable the service. Thus, a completely new product has to be created in order to achieve this as without the data, the service would not work. In the washing machine example, the product has already existed similarly before. The added features are rather an extension to the existing product than the core value proposition. The absence of data does not make the product redundant. If, however, the washing machine is not owned by the user but by the producer, and the user receives the device for free and pays per kilogram and washing cycles, the data becomes a crucial element of the IoT solution. Changing the business model for the same product can create an entirely new value. Instead of adding connectivity features to an existing product, whose main value creation is in the physical world, the availability of data can cause a change in the business model that makes the connection to the internet of the physical product indispensable. This depicts that the business models for IoT solutions can change significantly. Companies need to understand this fundamental change in value creation and adapt their business models in order to exploit the potential of the IoT for their business thoroughly.

2.1.4 Innovating for the IoT

The aim of successfully monetizing and designing business models for the IoT comes with challenges. The challenges concern the complex nature of IoT that comes with a network of connected things. A network involves a large amount of very different physical things that are connected,

which makes it challenging to design standardized interfaces to connect them to the internet. However, not only on a product level but also on a human level, there is a lack of structure in the IoT ecosystem leading to unclear defined stakeholder roles and value creation logic. From a technical perspective, there are challenges regarding the vast amount of new technologies for the IoT, including sensors, connectivity options and embedded electronics that are emerging on the market every day. Many of them are immature technologies which force developers to experiment with them as the potential benefits and risks of a particular technology remain unknown (Rajahonka, Leminen, & Westerlund, 2014). Thus, designing connected products as well as new business models comes with high complexity and uncertainty on various levels. There is not one product with clearly defined stakeholders in focus but a network of connected products and a network of stakeholders that are involved. There are many variables in an IoT ecosystem that can change at any moment in time. The emergence of new technology, for example, might suddenly enable a new use case that makes a whole business model viable. The sudden availability of specific data might be the crucial element to create a new service for the customer.
Further, the combination of the physical and digital world, that IoT solutions entail involves the development of hardware, software and services. All these changes and challenges create new conditions for the development of IoT solutions. Conditions that entail high complexity and high uncertainty due to a large number of constantly changing variables.

In order to embrace these new conditions, processes for the development of IoT solutions need to change. Traditional linear product development processes are not made to address the challenges of complexity and uncertainty. To adapt to the changes, much flexibility is required in the design and development process, which is why iterative innovation processes are more appropriate to address those challenges (Bilgeri, Brillinger, & Tesch, 2017). In addition to an iterative innovation process, a more holistic approach is required in order to orchestrate the development of large networks of connected devices and ecosystems of stakeholders involved in IoT solutions.

2.2 Digitalization of the construction industry: A new way to build the future

The engineering and construction (E&C) industry is a very slow progressing industry that has not experienced a lot of disruptive innovations throughout time. Most of the work is still done by manual labour. To this day, the process of building houses consists to a large extent of low-tech man labour. Bricks are laid one by one on top of each other in a way that has not changed much in the last 100 years. Further, the daily business relies a lot on ‘pen on paper documents', despite the digital era we live in. While other industries like IT, media or finance have experienced major changes in the last decades and have widely adopted new technologies, the building industry has mainly remained the same (Ramaswamy, Khanna, & Prashant, 2016). Nevertheless, in recent years, the laggard industry is undergoing some remarkable changes (Schober, 2016). Digitalization has arrived in the E&C sector, and more and more building companies are adopting new technologies to increase productivity.

2.2.1 Digitalization in the construction sector

The digitalization of the brick and mortar business and the fact that sooner or later the construction industry will be disrupted by emerging technologies is not a secret. This is an unstoppable trend, and construction companies and any firms that provide products and services for the building sector need to embrace it rather sooner than later in order not to be left behind. The German consultancy Roland Gerber mentions four key aspects for the digital transformation to happen. Namely, the automated collection and analysis of digital data, the use of new technologies to create autonomous, self-organizing systems, the connection and synchronization of separate activities and the digital access to the internet and internal networks. These aspects come into play at every stage of the value chain in the E&C industry, thus leading to the enormous potential for digitization (Schober, 2016). Many technology companies and start-ups have put their focus on this topic in order to provide innovative solutions that support digitization in order to increase productivity. This led to a double of investment in construction technology over the past decade leading to a total of $18 billion (Ribeirinho, Mullin, Blanco, Pandya, & Parsons, 2018).

The applications of new technologies in the construction sector have taken many shapes and can be found throughout all three phases of the building process: design, build and operate. According to McKinsey & Company, there will be five major trends that will shape the construction sector in the future (Figure 4). The trends go from higher-definition surveying and geolocation, next-generation 5D building information modelling (BIM), to digital collaboration and mobility, and future-proof design and construction. Last but not least, one of the big five to be expected to dominate the E&C sector is IoT and advanced analytics (Sridhar, Agarwal, & Chandrasekaran, 2016). The use of IoT in the construction industry has many benefits as tools, materials, workers, and any other physical object on construction site can now generate data. This

allows construction companies to monitor its assets as well as workers, thanks to the newly generated data, that has not been available before.

Figure 4: Five trends that will shape the construction industry (Sridhar, Agarwal, & Chandrasekaran, 2016)

2.2.2 Applications of IoT in construction

The data that is generated by the physical objects can be used for different purposes. One common use case is equipping tools with sensors to monitor the usage of the tools. The usage data provides the information needed for repairs and preventive maintenance. Based on the number of hours a particular tool has been used, it can inform the system that it has to be serviced. Apart from the tool information, location data of equipment can indicate its current position, which enables the tracking of different types of equipment. This way, the large number of assets such as tools, machines and materials on a construction site can be tracked, enabling digital inventory of the assets. Thus, digital inventory also enables automated replenishment of consumables. Other applications of IoT on construction site can increase energy efficiency, for example, by monitoring fuel consumptions of large machines or increase the quality of a building by embedding vibration sensors into its structures. It gives insights into the imperfections of the building. However, there are not only advantages of equipping tools and material with sensors and electronics, that increase the productivity on site, the Internet of Things also brings safety benefits for the workers. Wearables such as smart helmets or bracelets can sense the environment on construction site and alert a worker about dangers on jobsite such as unnoticed approaching vehicles or hazardous zones due to leaking gas, for example (Sridhar, Agarwal, & Chandrasekaran, 2016).

2.2.3 Opportunities and risks of IoT in construction

Despite the various applications of IoT in the construction industry, there are many more expected to emerge in the coming years. They will continuously increase the job site productivity and enable a fully connected digital construction site. However, the main enabler for all these IoT applications is the availability of data. The data that is generated by the physical objects through sensors and processed to provide a service for the customer will play a key role. This brings many opportunities for companies providing products and services for the construction industry as they can improve their products and services thanks to the newly available data. Moreover, with the data, they can get more detailed insights into their customer's behaviour and thus, provide new services that solve their needs.

However, this does not only open opportunities for long-established E&C firms but also for technology companies and fast-moving start-ups that focus on the topic of big data and IoT. The tempting business opportunities in the digital playground should, therefore, be treated with caution as they can pose a risk for traditional E&C companies. The big engineering firms that provide the equipment for the construction sector might have the know-how about their customers. However, they lack the knowledge and experience to drive the digital transformation. Thus, if they do not embrace the digital change, they might run the risk of getting disrupted and left behind (Ribeirinho, Mullin, Blanco, Pandya, & Parsons, 2018).

2.3 Conclusion

The context analysis looked into two main topics, namely the Internet of Things and the digitalization of the construction industry with a focus of the application of IoT in the construction industry. The research shed light on the technology followed by the opportunities and challenges that come with IoT, especially looking at the changes in value creation and business models of IoT solutions that differ from traditional ones. The research further looked at how these changes lead to new challenges and how they can be tackled by introducing iterative innovation processes.

The second part shows that the construction industry is a very laggard industry when it comes to adopting new technologies; however, it is now undergoing digitalization. Main trends and technologies are explained that will shape the future of construction, followed by various applications

of IoT that are currently being used on the job site. The great opportunities of digitalization for the many E&C companies are depicted, pointing out the danger of technology firms that might be a step ahead due to their leading technological edge.

IoT combines the physical with the digital world by embedding sensors, electronics and connectivity into physical objects and connecting them to the internet. Data analysis enables new digital services that create new value for the customer. It can be concluded that the Internet of Things, creating networks of things that are able to communicate with each other, is a technology that brings the immense potential for new business opportunities that are yet to be explored. The development of IoT solutions involves high levels of complexity and uncertainty created by a large number of changing variables and ecosystems of stakeholders. This makes it difficult for companies to implement this technology and exploit its potential for their business. It is not only the technical challenges that come with the development of IoT solutions but more the new ways of value creation. Other than implementing other technologies, IoT requires rethinking on various levels as the created value does not come from one product or service but an ecosystem of many products and services involving many different stakeholders. It was suggested that these challenges should be tackled by introducing iterative innovation processes as they provide the flexibility to react to instant changes and deal with high complexity and uncertainty. Companies that manage to successfully master the challenges of making the change to becoming a more digital business by changing their business models and switching from linear product development processes to more agile and iterative innovation processes will be the ones winning the race in the connected world.

When it comes to IoT in the construction, as E&C companies are known to be on the rear end of the spectrum of innovativeness, they will struggle to implement IoT. Even though the construction industry is a laggard when it comes to new technologies, digitalization is happening in all industries, and the construction site of the future will eventually be fully connected – it is just a matter of time. Due to the slow development of the E&C sector, the urgency of making the change towards becoming a digital business might not be perceived by many companies. Thus, the enterprises that will embrace the challenge and invest in the digitalization of their business are expected to be the leaders in the construction industry of the future. The ones that ignore the shift to a digital future will get left behind.

3 Internal research

The context analysis gives insights into the world of IoT, the current situation of the construction industry and the opportunities and challenges that engineering and construction firms face that come with digitalization. After a broad look at the industry, this chapter focuses on the company and how the observed trends are affecting Hilti.

An internal research was carried out to get an understanding of the company. The primary source of information came from company internal documents and meetings with employees. Two interviews were conducted, one with a Global Process Manager and one with a Global Innovation Manager to gain deeper insights into the current processes and the meaning of innovation at Hilti.

Firstly, the research aimed at getting an overview of the organizational structure and the current processes that are used at Hilti. It was crucial to understanding this information in order to design an innovation process that fits in the existing organizational structure and complements the current processes. Further, the topic of IoT at Hilti and the current IoT portfolio was looked into, to get an overview of what Hilti is already doing in this field. These insights were needed to understand how knowledgeable the company was regarding the Internet of Things.

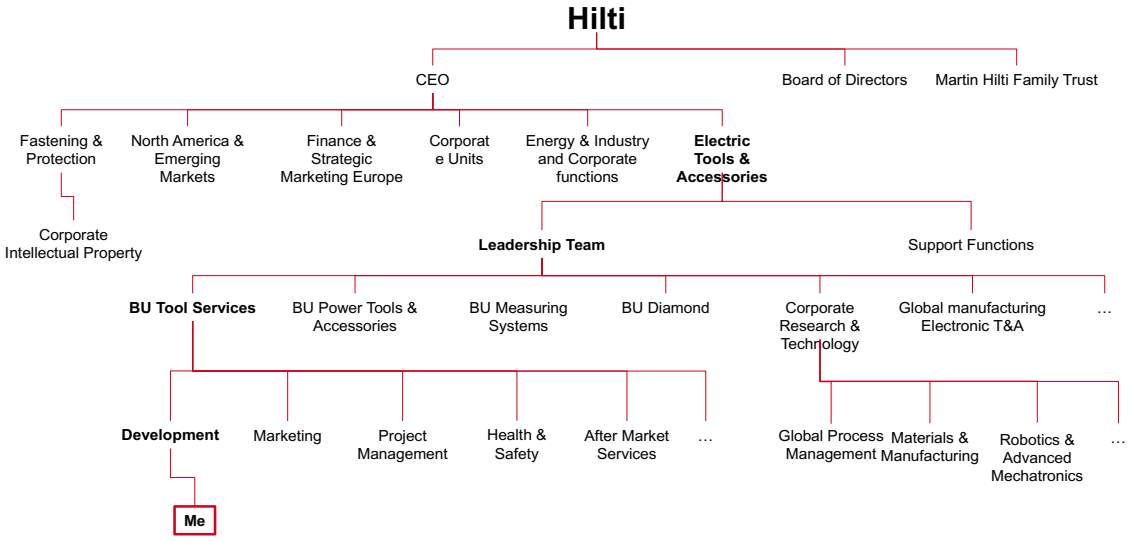

Figure 5: The organization is structured into several corporate functions and different business units

3.1 Organizational structure

Hilti follows a divisional structure and consists of several corporate functions and different business units, as shown in
. The research department at Hilti is a corporate function, called corporate research and technology (CR&T) with the primary goal to research new technologies to assess their relevance for Hilti and to further develop new technologies to prepare them for the product development process. Each business unit has its marketing and development department and acts as an independent organization within Hilti. The product development happens within the individual business units, which are responsible for the success of their designated products.

The structure of an organization into many business units with a very different focus creates on the one hand independence, which enables them to act independently to achieve their business goals. However, such a separation also creates a silo-mentality. Silo-mentality or silo-thinking is a common challenge that such large, decentralized structured organizations face. The silo-mentality describes the restraint of knowledge sharing with employees of other business units within an organization. At Hilti, this phenomenon could also be observed, as several employees repeatedly mentioned that they have no clear knowledge of the field of activity of their colleagues in other business units. When explicitly addressed in an interview, it became clear that the silo-mentality is not a secret at Hilti but rather a well-known fact and almost part of the culture. "***Nobody knows what others are doing, that is the Hilti style! Everybody is doing something.”*** (P01). Instead of fighting against it, people seem to have accepted the silo-mentality as part of the company and find their one way to selected people through direct contact.

However, as IoT solutions include holistic thinking due to the inclusion of hardware, software and services, the business unit tool services is, therefore, is forced to collaborate with other BUs closely. Accordingly, the BU TS can be understood as a horizontal BU that connects the other BUs. In this situation, the observed silo-mentality can become a real obstacle for innovation. The lack of cross BU collaboration might hinder the innovation process and slow down the development and implementation of new IoT solutions.

3.2 Innovation at Hilti

3.2.1 Processes

At Hilti, there several globally defined processes to manage Hilti’s product, software and service portfolio (Figure 6) and are used by all business units. Within the product portfolio management, the processes are structured into four main phases: search, development, product maintenance, and phase out. The most important processes for the scope of this project are the Definition Project, Research, Technology, Time-to-Money (TTM) and patent process.

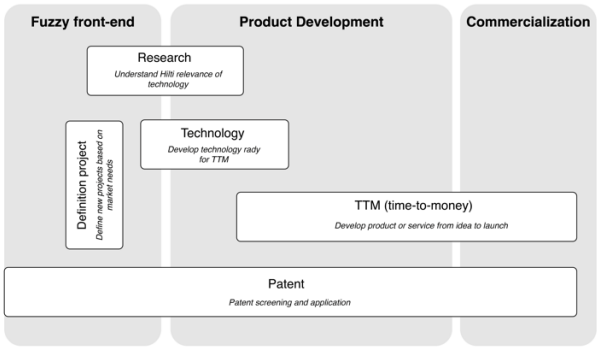

Figure 6: The Hilti Process Landscape

Definition Project
A definition project (DP) is a process used for Hilti's portfolio management and portfolio extension and can be seen as an intermediate step between an identified business opportunity, the roadmap of a business unit and a specific technology or TTM project. The two main drivers for a DP are usually either marketing or development.

Definition sprint
At the BU TS, Definition Sprints are used to before the start of a project, similar to a Definition Project. In three-days workshops sessions, all necessary requirements for the start of new projects are defined.

Research Project
The main goal of the research process is to understand the Hilti relevance of a particular technology. The task of the research process is to identify and develop the necessary technologies for driving product innovations.

Technology Project
The technology process follows and partly overlaps with the research process and is there to develop the technology further to get it ready for the TTM project. It is about the development and integration of a technology for a specific product or product platform.

TTM (Time-to-Money)
The TTM, short for Time-to-Money or Time-to-Market process is the traditional product development process. The process includes every step from the idea, the development until the market launch of a product. Within the TTM process, there are three different types, which are specific TTM processes for hardware, software, services.

Patent Process
The Patent process is used to protect valuable intellectual property (IP) throughout the various development mentioned above process. At any point in time, a new invention might arise in the process that needs to be protected. The two main targets are exclusivity, to have Hilti's exclusive rights and "Freedom-to-operate" with third party rights.

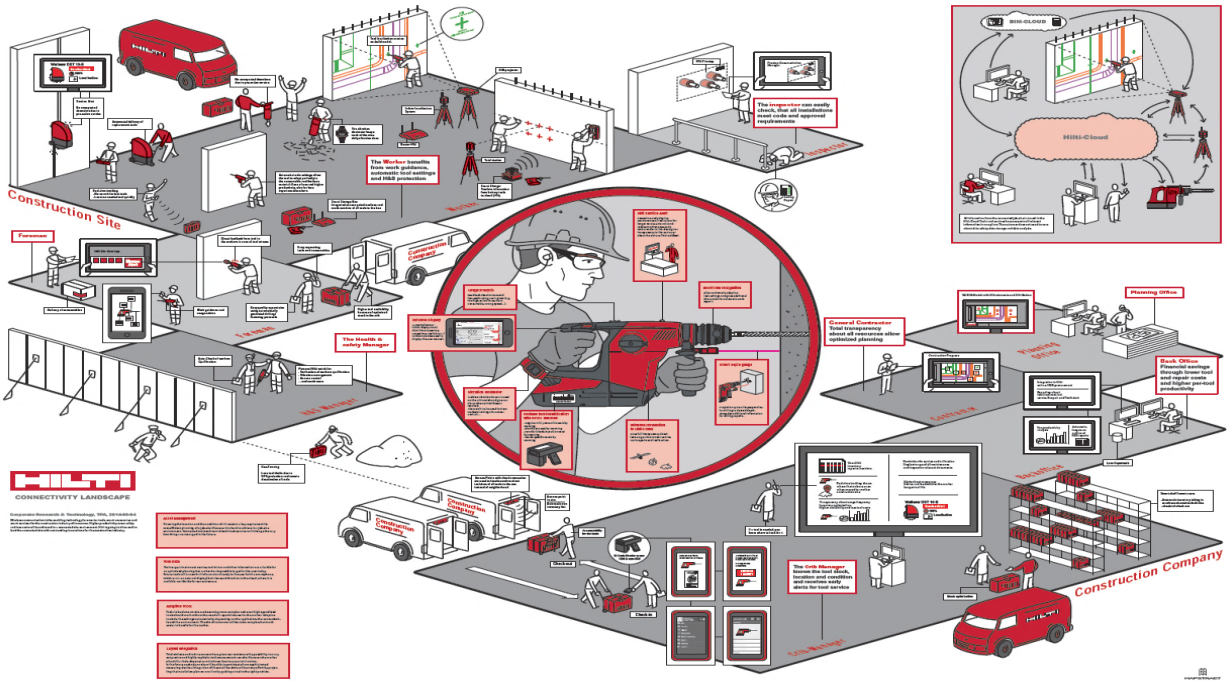

Figure 7: Vision of a connected job site in the future

All of the processes follow a stage-gate approach (Cooper, 1943). Even though there are clearly defined processes with gates and requirements at each gate, it also became clear that theory and practice differ from each other. The processes are adapted and used differently depending on the business unit or the team (P01). This again shows that the business units at Hilti act as independent organizations within the company.

Additionally, it became apparent that there is no process defined that manages the Fuzzy Front End of innovation. All of the processes start with a clear goal in mind and precisely defined steps to follow throughout the process to achieve this goal. There is no global process that is less structured and focuses more on exploration rather than execution. The most explorative was found to be the Definition Sprint, which focuses on directed ideation and brainstorming to discuss hypotheses and define project requirements. Nevertheless, at this point, the business opportunity is already identified.

3.2.2 Innovation initiatives

Although there are no globally defined processes to capture new ideas and manage the Fuzzy Front End, the need for this is there. Within the different BUs there are several initiatives, and that try to capture ideas, and which possibly spot new business opportunities. Depending on the business unit, the initiatives usually consist of weekly or monthly voluntary meetings in a rather informal setting, which gives employees the chance to communicate, discuss and demonstrate ideas and prototypes that they have developed. Not all of the initiatives show the same effect, as some are more structured than others.

The most elaborated is the Hungry Lion initiative, which is part of the manufacturing department and aims at capturing and developing ideas for solutions that come from the employees working in the plants. Ideas are captured with an idea card, which is a one-pager with a short description of the idea and is then discussed in weekly meetings to assess their potential. The process follows the following steps: ideation, focusing, prototyping and implementing and has shown significant success as 2000 people in the plants have contributed a total of 216 ideas last year of which 91 prototypes were created, and 70 of those were implemented. The implementation rate of roughly 30% of ideas is remarkable. However, the innovations are mostly small incremental changes of existing products or manufacturing methods and not breakthrough innovations (P12).

3.2.3 Open Innovation

Hilti is primarily focusing on the development, production and distribution of high-quality products and services in order to provide the best possible experience for their customers. Hilti itself is not a technology company, though, IoT requires many of the latest technologies on the market. In 2017 the firm created an open innovation branch, with a team of four people looking for new technologies and scouting start-ups in the innovation hotspots Tel Aviv and Silicon Valley. The main focus of open innovation at Hilti is to fulfil to the needs and requests of the business units and find a matching start-up that provides a technology that solves their need. This allows Hilti to bring innovation from the outside into the company.

3.3 IoT at Hilti

With the understanding of the context from chapter 2 , this section looks at the current situation inside the company to understand how digitalization is happening at Hilti and what role the Internet of Things plays for the company.

At Hilti, there is currently no clear vision of IoT that is shared across Hilti. Although, within the business unit tool services, a future vision of the connected job site has been developed with the construction worker in the centre (Figure 7). This communicates that worker himself should be able to do his job the way he is used to, however, with a whole system of connected devices in the background that facilitates his work.

	Thing	Gateway	IoT cloud	Business application	Customer interface
What is it?	Cyber-physical systems – devices that are equipped with sensors, actors and electronics to store and share information	Physical devices that serve as a connection point between Things and IoT cloud (gateways can be things, too)	Server-side stack offering connectivity, data processing and storage	Applications that monitor and process collected data to trigger internal workflows or provide information to customer interface applications	Communication channels for customers
Who is responsible?	Tool TTM project - Tool BU - JD	BU Tool Services	Product IT - IoT & Asset Management Solutions	BU Tool Services Product IT - Software IT Services	BU Tool Services Product IT - Software IT Services

Figure 8: Generic IoT architecture at Hilti

Further, there has been a generic IoT architecture defined including a physical thing, gateway, IoT cloud, business application and a customer interface which can be seen in Figure 8. This is used to explain and communicate what the different elements of IoT are in the context of Hilti and who responsible is for each of those.

Within the BU TS a distinction is made between the different types of data that is required to enable a specific solution. The data can be distinguished into static, dynamic or smart (Figure 9).

Accordingly, the use cases are clustered into identifying, sense and control based on the available data from the tool. Further, they can either provide a local service for the customer or automated service that happens in the background (Figure 10).

3.4 IoT portfolio

Currently, Hilti has with Hilti Fleet Management, ON!Track and Hilti Connect three solutions in the market that are part of the BU TS. Hilti Fleet Management is the flagship service of the company demonstrating the business potential for services by offering more holistic solutions to the customer.

Hilti Fleet Management

In 2001, Hilti managed a breakthrough by reinventing its business model from selling products towards selling solutions through the introduction of Hilti Fleet Management. Instead of selling the power tools and accessories to the customer, Hilti Fleet Management offers a care-free service that includes repair, maintenance and replacement for a monthly fee. It has been a great success

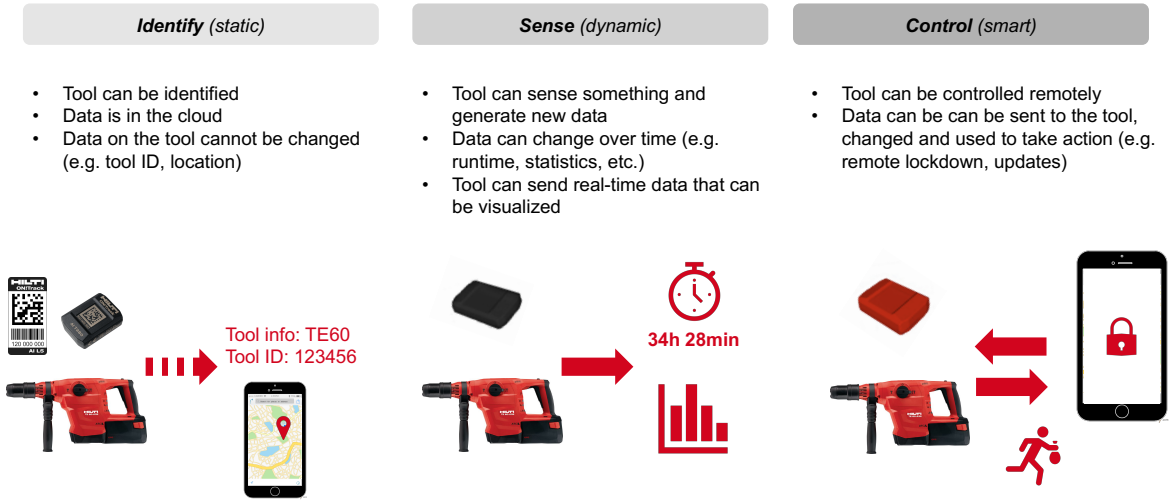

Figure 9: Identify, sense and control require different types of data

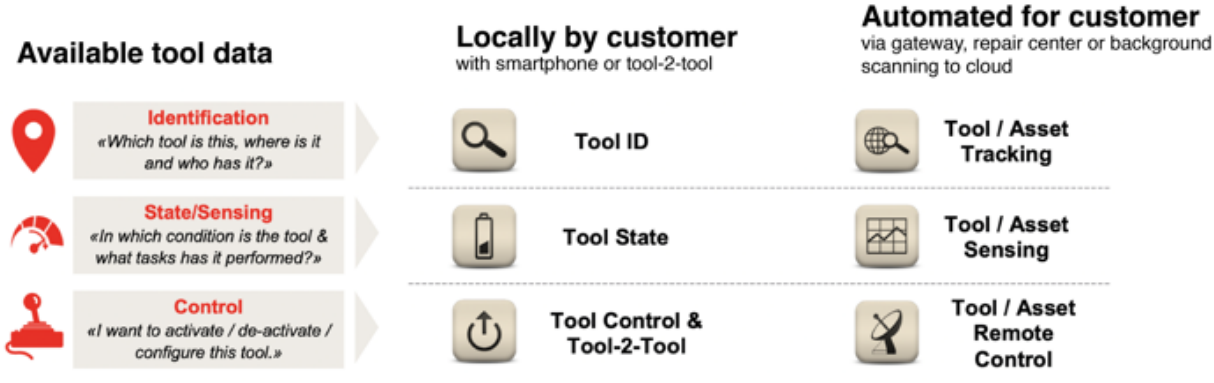

Figure 10: The six types of use cases enabled by different tool data

for Hilti, as there are currently over 100,000 customers using the service worldwide.

This shows a successful first step towards becoming a service-oriented business focusing on selling solutions to a customer and addressing their needs holistically instead of individual products and services.

ON!Track
ON!Track is an asset management solution that enables the job site and warehouse managers to track their tools, manage their assets on various job sites and do digital inventory (*Figure 11*). Data Matrix Codes (DMC), which are similar to a QR code tags are stuck onto the tools and can be scanned with a smartphone. The data is then sent to the cloud. The interface is either the ON!Track mobile app or a desktop application which lets the user access the information.

The newer generation of ON!Track uses active tracking where the tags are equipped with Bluetooth connectivity. The data from the tools is sent via a gateway or smartphone to the cloud. This way, the tools do not have to be scanned individually as they actively sent out the data from the tool. The tags can not only be glued onto Hilti tools but also material and equipment from other manufacturers.

Figure 11: Tags are applied to the tools to identify and track the assets

Hilti Connect
The newest generation of Hilti tools is equipped with NFC chips, which enables to read out tool data such as tool ID, information about certifications or repair and maintenance history. In case of a defect of a tool, the worker can connect to the tool and immediately request a pick-up date for maintenance (Figure 12). There are currently three tools from direct fastening that have a built-in Bluetooth module that does not only read out static data such as tool information but dynamic data that changes over time. For example, when connected to the tool, it can be seen in the app how many fastenings the tool has made. With the availability of such information, use cases in predictive and preventive maintenance will be possible.

Figure 12: The tool communicates via Bluetooth with a smartphone

Apart from the three solutions that are currently in the market, Hilti is developing many new connected solutions. However, there is no internal IoT portfolio at Hilti which makes it difficult for employees from the different business units to know where the company stands regarding this new technology and which connected products and services are currently being developed. Ambitions are coming from Global Process Management, Corporate Legal and from the BU TS to create a standardized IoT portfolio and there have been attempts to collect all IoT related projects and initiatives to document them in a central place.

3.5 Conclusion

The internal research looked into the several aspects of Hilti analysing the organizational structure and processes as well as the maturity of the company regarding IoT. The divisional structure of the company creates a silo-mentality, which has both pro's and con's, the pro is that the focus areas of the BUs can be very different. However, as IoT solutions involve not only the products from different business units but also multiple stakeholders with essential knowledge and experience in different areas, the silo-thinking of employees hinders effective collaboration between them and complicates a holistic approach. Consequently, a lack of communication and transparency can be seen as people from different departments are unaware of each other's activities.

This leads to a lack of holistic thinking, and it seems that it is not yet clear for the company at what layer of the IoT application the value creation happens. This can be seen with the example of Hilti Connect. The three tools that

have built-in Bluetooth modules enable new use cases such as fastenings to count that the tool has made, which gives the customer recommendations when the tool needs maintenance. This might seem like an added value for the customer; however, the user experience is questionable as the worker receives maintenance alerts for one tool but not for another one. Moreover, it might confuse as three specific tools can be connected with Bluetooth while a large amount of other equipment misses this functionality. The BU TS sees its role as a connecting link between different business units to support the IoT use cases which go beyond the borders of a specific product area.

Further, Hilti has clearly defined processes throughout the main phases of the innovation process with a strong focus on fast execution of projects and less on exploration and identification of new business opportunities. A general negative tendency from employees towards processes could be found, partly because processes come from top-down. A certain independence from employees could be seen in several occasions such as the adaption of globally defined process to their individual needs or the start of several initiatives coming from the employees to have a space to share their ideas. This bottom-up approach seems to be much more welcomed than a clearly defined process, with strict rules and requirements. Although, there is room for improvement to foster innovation coming from within the company, turning employees' ideas into reality, the outside-in approach has already been established in the shape of an open innovation department.

Hilti is actively investing in digitalization and developing new IoT solutions. The current offering of connected solutions with Hilti fleet management service has shown itself to be a big success, while the more recent services like asset management and Hilti connect have yet to mature. In general, the grade of innovation of the IoT solutions that Hilti offers is still rather low, and the innovations are not of very radical nature. This might be because, on the one hand, the customers in the construction sector are not ready yet to adopt very disruptive solutions that change their workflows and on the other hand, because Hilti has not acquired enough experience in developing IoT solutions yet.

Within the BU TS, a common understanding is being developed regarding IoT, its architecture, responsibilities, and categorization of use cases based on required data. Although clear norms, guidelines and processes are absent, standards are gradually being introduced to create structure within the domain of IoT. This shows that the ambitions are there to create the necessary conditions to innovate in the area of IoT. However, Hilti seems to struggle with the complexity that comes with IoT, which was discussed in the context analysis (Chapter 2). The overall impression of the BU TS and the topic of IoT at Hilti is "under construction". Apart from the need for an innovation process to identify new business opportunities in the area of IoT, there is a need for an IoT portfolio, a community to align the relevant internal stakeholders, a shared vision as well as a platform to interact with each other and exchange knowledge and best practices.

4 User research

The internal research provided a first grasp of the company Hilti on a broad perspective, uncovering several needs. Now, this chapter goes into more detail and looks at the current situation inside the business unit tool services, focusing on the Fuzzy Front End of the current innovation process at the BU Tool Services. The research will look into the current process that an idea goes through from its origin until the start of a project.

The chapter is divided into an introductory part and two main parts. In the introductory part, the research questions and the approach are explained. The first central part focuses on the user research setup, giving detailed insights into the method that was used to conduct the research. In the second part, the analysis, the results are presented and analysed. The analysis first looks at the situation inside the BU TS and then compares the findings with the situation in other business units. The chapter ends with a conclusion summarizing the insights from the analysis and depicting identified pain points in the current process.

4.1 Research goal & questions

The goal of the research was to get insights into the process, to understand the current sequences of events from an idea that becomes a reality, who the different stakeholders are in the process, what they want to achieve and how they currently achieve it. Further, in order to successfully design a process that addresses the pain points, two main elements were needed: understanding the process and understanding the additional factors that prevent innovation from happening.

For this, four main research questions and several sub-questions were defined. The main research questions aim to get an overall understanding of the status quo and the sub-questions, namely, the process steps, tangible information and intangible information aim to gather more accurate insights.

4.1.1 Main research questions

- *What is the current situation of the Fuzzy Front End inside the business unit tool services?*
- *What is the actual problem that the innovation process should solve?*
- *What are the success criteria of an idea?*
- *What are the barriers to innovation to happen?*

4.1.2 Concrete topics

Process steps
The process steps are the consecutive steps that happen in the innovation process, starting with an idea from its origin until the start of a project.

- *Where does the idea come from and where does it end?*
- *What are the steps in the Fuzzy Front End of the current innovation process?*

Tangible information
The second type, which can be described as concrete or tangible information, comprises stakeholders, tools and methods, and documentation, which are involved at the different stages in the process.

- *Who are the people, department, business units involved?*
- *What tools and methods are used to generate, develop or refine the idea?*
- *What, how and where are ideas documented?*

Intangible information
The third type of information that was intended to unveil with this research was more abstract or intangible information. This contains elements such as goals, challenges, desired situation and improvements.

- *What is the goal people try to achieve?*
- *What is currently not working well in the process?*
- *What could be better in the future process?*

4.2 Approach

4.2.1 Qualitative research

Due to the complex nature of the problem space of this project, a qualitative research approach was chosen to find the answers to the questions. The reason for this was the involvement of several stakeholders with very diverse backgrounds. Further, one goal of the research was to understand the different perspectives from the employees, how they perceive the current situation. Also, to elicit the underlying needs of the different stakeholders and the hidden factors that currently hinder innovation form happening, a qualitative approach was considered most appropriate as it emphasizes the qualitative data leading to more individual in-depth insights.

As a starting point, qualitative interviews were carried out with stakeholders inside and outside the BU TS. The goal was to get an understanding of how this unstructured process works at the moment inside the BU TS as well as to find out how other BUs are handling this process. As the BU TS only exists for one year, it was expected to be very likely that in other business units this process was already put in place. In order not to reinvent the wheel, it was also looked at other business units to learn how they manage the Fuzzy Front-End of innovation. Further, the interviews with the participants from other business units worked as a reference to collate the findings from the BU internal interviews. This enabled the careful evaluation if certain pain points were BU specific or rather exist globally at Hilti.

Semi-structured interviews were conducted as they provide a certain basis for eliciting important information; however, also leave room to uncover unexpected insights.

4.2.2 Customer Journey Mapping

In qualitative research, there are different ways of eliciting information from participants. Customer journey mapping is a method that can be used during qualitative interviews to understand and improve the customer experience. By going through every step that the customer goes through, a customer journey map offers an effective way to get holistic yet detailed insights about the experience of the customer.

In the context of understanding the Fuzzy Front-End of the innovation process at the BU TS, the focus is not put on the customer. However, it similarly involves a journey. The journey that an idea goes through also contains a start and an end, different steps and different topics to focus on. Due to the similar nature of the situation, it was decided to use customer journey mapping as a method to understand the current situation. A tool was created which follows the principles of a customer journey map, however, adapted to the context of the journey of an idea instead of the customer.

4.2.3 Design research tool: Idea Journey Map

The content of the tool was based on the previously defined research questions, putting the focus on the idea. Thus, the tool was called Idea Journey Map, which is shown in Figure 13.

A journey map consists of several parts, which can differ depending on the specific situation that is being researched. In this case, it consisted of the scope, persona, steps and lanes. Following are the four elements described.

Scope
The scope of the journey map was decided to reach from the surfacing of an until the start of a project (TP or TTM). The beginning of the journey can vary significantly based on the moment where an idea emerges. However, innovation always starts with an idea. The end of the journey was defined as the start of a project because that is the moment when the Fuzzy Front-End ends and an idea is believed to have enough value to initiate a technology or product development process. For those, Hilti has global processes in place and are therefore not the focus area of this project. Nevertheless, it was taken into consideration that an idea can also emerge during a TP or TTM.

Persona
As the centre of attention was not a customer and the journey that the customer goes through, but the idea and the journey the idea goes through, the persona should be understood as the idea. The idea can be different and is expected to be either a product, service, software, technology or use case.

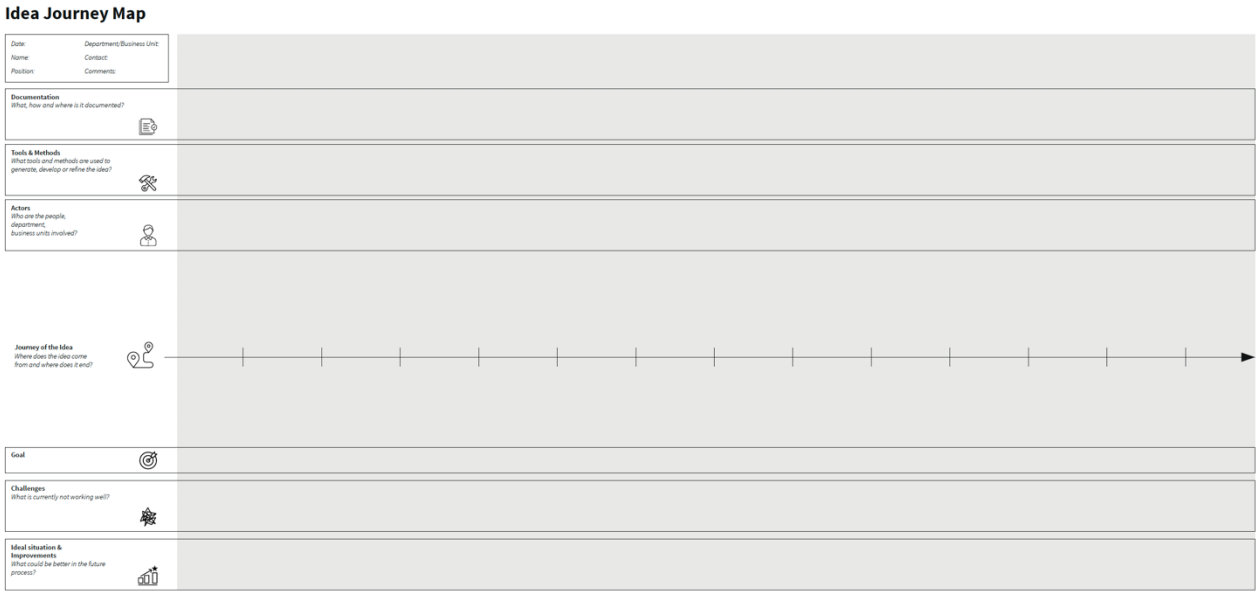

Figure 13: The final version of the Idea Journey Map with the timeline and the different lanes for tangible and intangible information.

Steps
One of the research questions was to understand the process and its different phases. Therefore, as there was not sufficient knowledge, it was decided to not preliminary define the steps based on assumptions. During the interviews, the participants were asked to describe the steps in the process and explain them from their own experience.

Lanes
In the different lanes, the sub-questions mentioned above were placed. The journey map tool was visually divided into three areas, based on the different types of information. In the middle, there is a timeline to map the process steps. Above the timeline, there are three lanes for the tangible information: documentation, tools & methods, and actors. Below the timeline, the three lanes goal, challenges, and ideal situation & improvements were placed to capture the intangible information.

The elements in the lanes of the idea journey map as well as the overall layout were changed and adapted based on feedback from co-workers and a pilot interview with the segment manager from the BU TS. In several iterations, the map was discussed and adjusted to support the elicitation of the relevant information. The different versions can be found in appendix B (11.2).

4.3 Research setup

This section explains the research setup starting with the detailed research questions, followed by an explanation of the research tool that was developed and used for during the interviews, and ending with the description of the interviews including participants, procedure, and interview guideline. The section ends with a conclusion reflecting on the method and execution of the research.

4.3.1 Participants

The participants that were selected were divided into two groups, the ones from the BU TS and the one form other BUs, which can be found in *Table 1*. For the participants working inside the BU TS, it was paid attention to create a representative sample of the people who work with the current fuzzy front-end process. The BU internal participants were recommended by the Connectivity IP Specialist, who was the responsible contact person for this project.

For the second group, the participants were the top inventors at Hilti. It was important to interview people who have several years of experience in the company and that have experience with developing new ideas and turning them into inventions. At Hilti, there is a ranking with the top inventors of the company, which are defined by the number of patents that they have applied. Therefore, they seemed to be the appropriate people to be part of this research, as they have the first-hand experience of turning an idea into an invention.

4.3.2 Interview procedure

Preparation
Before the interviews were carried out, a pilot interview was conducted to test the usability of the research tool. The Idea Journey Map was adapted based on the results and feedback from the pilot interview. In several iterations, small changes were made, mainly rearranging the visual elements of the map to support the interview.

Mapping a customer's journey can be done either in individual one-on-one interviews or in small groups of 3-5 participants. One advantage of doing the session in a group is to receive information from different people at the same time, which leads to a complete journey map, as some participants have knowledge and experience that others don't. This allows receiving much information in a short time. Another advantage is to get insights from different perspectives, such as marketing, development, and project management.

However, there also disadvantages to conducting qualitative interviews with more than one person at the time. The groupthink phenomenon, for example, describes how people in a group tend to agree with a shared opinion, rather than defending their own. Further, individual interviews allow to create a more personal atmosphere and thus, elicit more in-depth information form the participant.

BU Tool Services (TS)	**Inventors from other BUs**
Project Manager HW TTM	Development Engineer, BU Direct Fastening
Product Manager HW TTM	Head of Quality Management, BU Direct Fastening
Product Manager SW TTM	R&D Expert, Robotics & Visual Computing
Program Manager Connected Tools	Development Engineer, BU Measuring
Head of Quality BU TS	
Head of Project Management	
Segment Manager BU TS (Pilot interview)	

Table 1: List of participants from the BU TS and inventors from other BUs

The desired outcome of the project, an innovation process, includes many stakeholders, that have different interests and expectations from it. In order to successfully address their wants and needs, it was important not only to map the process steps but to understand the different perspectives of the participants. Therefore, it was decided to conduct one-on-one interviews and create an individual map for each participant in order not to have biased results, that would be influenced by the perception of the process from other participants. This allowed to both, understand the unstructured journey an idea goes through and more importantly, find the pain points throughout that journey.

The selected participants (*Table 1*) were contacted by email, an appointment was scheduled, and a meeting room was booked. Before the interview, the participants received a brief description of the project. However, they were not sensitized with any additional sensitizing material as this step was not needed for the required information.

Execution

1. *Welcome (5')*
   Informal welcome and small talk.

2. *Introduction (10')*
   The first ten minutes were spent on getting to know each other in an informal conversation to create a relaxed atmosphere. If the participants feel comfortable, they are more likely to share information that can be of high importance for the project. The introduction aimed to familiarize the participants with the topic of the project and to get to know their role in the company, to find out how what information they can provide.

   a. *Introduction interviewer & explanation of the project*
      The conversation started with the personal introduction of the interviewer, followed by the explanation of the project and the goal of the interview. The participant was asked for their consent to be audio recorded during the interview.

   b. *Introduction participant*
      Afterwards, the participant was asked to introduce him-/herself, explaining their role in the company and the projects they currently work on.

3. *Interview (20-30')*
   The main interview was structured into two parts. The first part aimed at mapping out the process steps that an idea goes through, followed by the second part, which focused on eliciting the tangible and intangible information. However, throughout the interview, the conversation went back and forth, filling in more details in the different lanes and adapting the process steps.

   a. *The Idea Journey Map tool*
      The interview started with the opening question asking the participant to explain the steps that an idea goes through. At this point, the Idea Journey Map tool was explained to the interviewee.

   b. *Part 1: Process steps*
      To break the ice, a first sticky note with the word 'Idea' was placed in the middle of the map to visually support their thinking about what happens before and after the idea. In order to get precise results, the participants were asked to think of a concrete example of an idea they had, rather than generally speaking. Each step was named, written on a sticky note and placed in chronological order on the map. This allowed rearranging the individual sticky notes when the interviewee mentioned an additional step in between the ones before.

   c. *Part 2: Tangible and intangible information*
      Once the process steps were mapped out, questions were asked about the tangible and intangible information to fill in the lanes.

4. *Wrapping up (5')*
   This time was used to thank the interviewee for their participation, to answer possible questions from their side and to provide further information about the project if the participant was interested.

4.3.3 Conclusion / Reflection / Limitations of the method

The goal of this chapter was the user research setup used to obtain valuable data for subsequent analysis. Research goal, questions, approach, method and tools were defined to address the design goal of the project.

The focus of the user research was put on understanding the current situation of the fuzzy front-end of the innovation process inside the business unit tool services, as well as in other business units. The information obtained consisted of three types, namely, the process steps, tangible information and intangible information, which built the basis for the analysis described in chapter 4.4.

For the interviews, a research tool was created based on the principles of customer journey mapping. While the tool was handy during the interviews, it also showed some limitations. The tool was positively perceived by the participants, which was explicitly mentioned in feedback after the interview. Especially during the interview, the physical map visually supported the conversation, as both the participants and the interviewer were able to interact with the map and point at specific moments in the process and explain what was done at each stage.

However, the research tool and the interview procedure also included some difficulties extracting the three different types of information. Firstly, as the process happens in an unstructured way, its nature was understood differently, and therefore, the information regarding the process steps was not always comparable. However, this again depicts that the early stages of the innovation process happen unstructured and that the understanding and capturing of an idea can vary greatly. For this, it might have been useful to interview a small group, to stimulate a discussion between the participants and let them come to a common understanding of what the process looks like.

Further, starting an interview with an empty map for each participant has the advantage of giving them the freedom to explain their perception of reality. When trying to paint a picture of the current situation of the process within the business unit, beginning from zero at the start of every interview costed valuable time. In several interviews, information about the process steps was repeated. Conducting the interviews in small groups or using the same journey map for every participant would have allowed to build on previous information and focus more on details.

On the other hand, as expected, individual interviews instead of group interviews allowed deep insights into the participants' thoughts and feelings. Especially personal opinions about other departments and employees would have remained most likely untold if the concerning people had been present in the same room.

Based on these experiences, it can be concluded that most effective way to elicit the information would be first to conduct an initial group session with several people to commonly define the process steps and elicit the tangible information. Consecutively, one-on-one interviews would follow to dig deeper into the intangible information of the individual participants.

4.4 Analysis

This section provides insights into the analysis of the information obtained in the user research. The research analysis starts with an explanation of the method that was used to analyse the interviews, followed by the presentation and analysis of the results. The chapter first looks at the current situation inside the BU TS and afterwards comparing the results with the interviews from the inventors outside the BU TS.

4.4.1 Method

The first step in the analysis of the qualitative data was to transform the data into a format, that can be used to analyse it as qualitative data can come in very different forms, such as text, images, audio, or video files (Sanders & Stappers, 2013). The output of the interviews was twofold: on the one hand, there were the Idea Journey Maps as visual artefacts of the interviews, and on the other hand, there were audio recordings that captured the conversations with the participants.

After each interview, the IDJMs were photographed and digitalised. In a second step, they were compared and checked for similarities and complemented with the

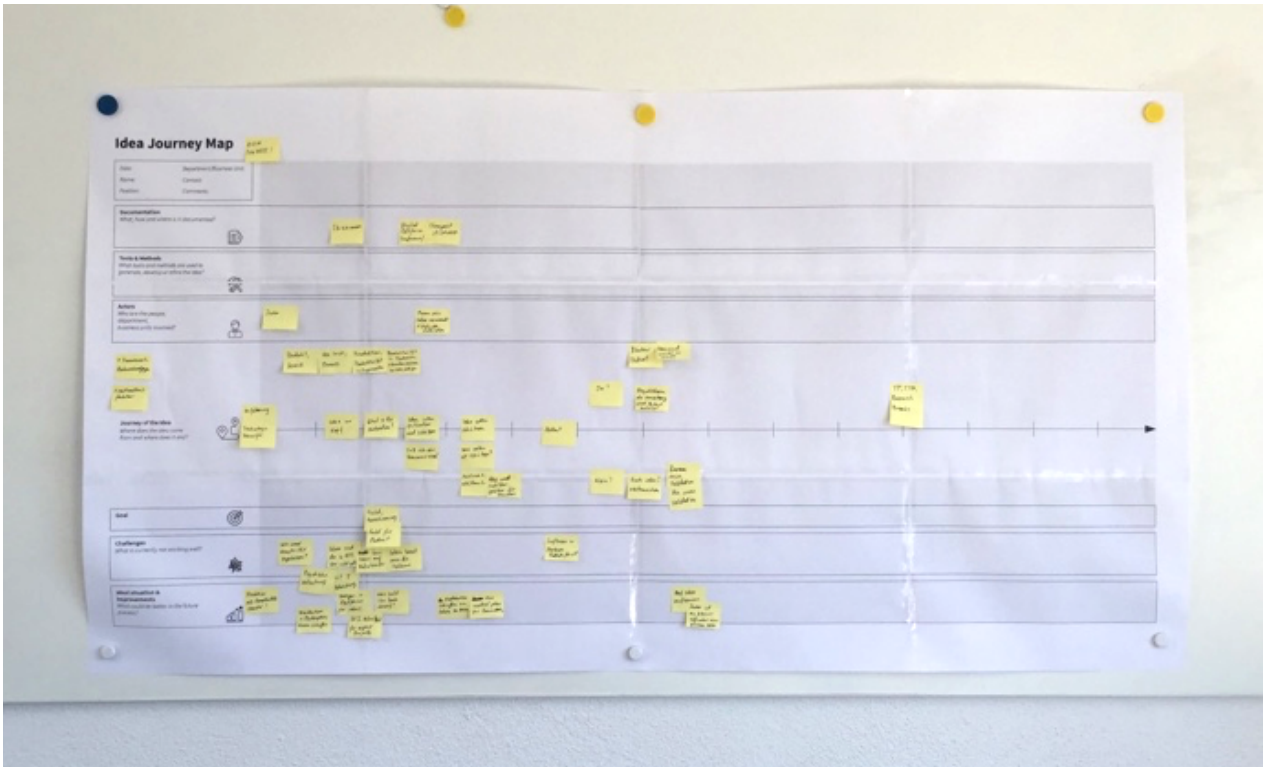

Figure 14: Raw data in the form of an Idea Journey Map

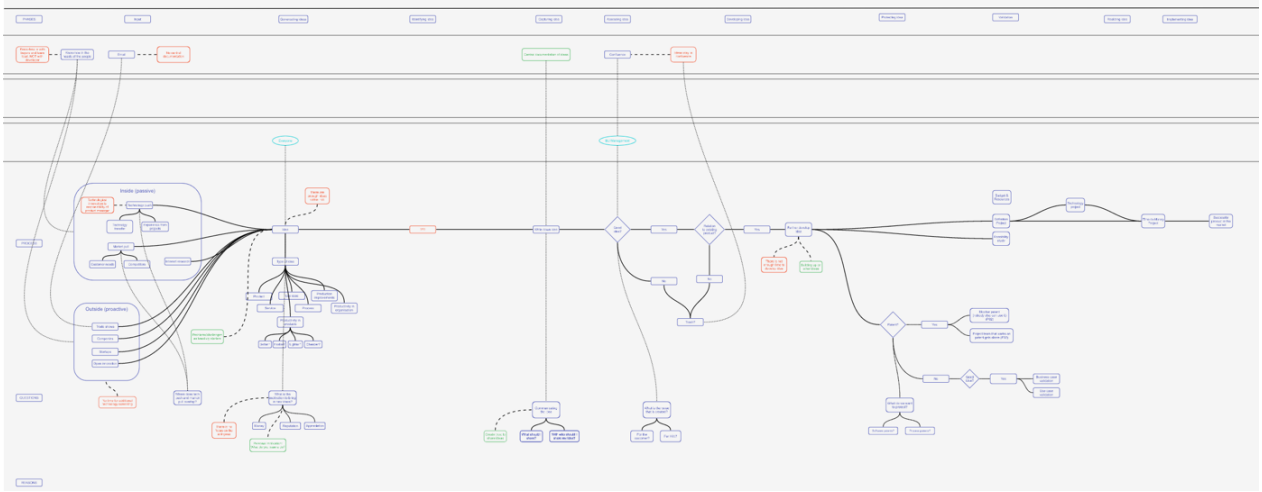

Figure 15: An attempt to summarize the individual journey maps in one master journey map

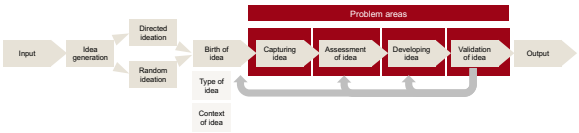

Figure 16: Simplified visualisation of the current process at the BU TS.

additional information. Then, they were summarised in one master journey map that combined all the individual journey maps. Once the preparation of the data was done, the process was analysed.

Further, the audio recordings of the interviews were transcribed. In several iterations, the interviews were analysed and clustered based on different topics to elicit pain points.

4.4.2 Results

The qualitative interviews provided three types of information about the process, which were the process steps, tangible information and intangible information. The first part of this section aims at understanding the process steps that an idea goes through within the BU TS. In the second part, the interviews were analysed with a focus on tangible and intangible information. The information obtained was clustered into different themes.

4.4.2.1 Current situation

In this section, the data from the interviews is analysed with the focus on the process steps, which are individually described and discussed. At some steps, parts of the tangible information are explained, when it is related to the according stage of the process. The section ends with a conclusion of the process steps.

The process steps

A process that does not follow a linear path naturally brought along some difficulties in the analysis. The journey maps visually supported the information from the participants and helped to recreate the actual journey that an idea goes through. However, the journey maps only consisted of keywords written on sticky notes and therefore, lacked detailed explanations and relations in between them (Figure 14). Therefore, the journey maps by themselves did not provide enough information and clarity to understand the current process fully. Thus, the information from the interviews was needed to complete the gaps in the journey maps.

In the first step, all interviews were transcribed (Appendix B). Now, with the interview transcripts combined with the pictures of the idea journey maps, there was enough raw data to start the analysis. In order to get a first understanding of the process and current problems at each stage, the individual journey maps from the interviews were summarised in one master journey map (Figure 15).

The summarised journey map allowed to get an overview of the current situation as it combined the individual perceptions of the process from the different participants. The different perceptions of the process posed one of the main challenges when summarising the journey maps. While some of the process steps were described similarly by different interviewees, other explanations of sequences of events diverged amongst the participants, this showed that depending on the roles and the focus of the participants' professional expertise the understanding of the process differs. An idea for a new software feature might be much faster implemented than a feature for a hardware product. Consequently, it became clear that there is no ‘one way' that an idea goes through, revealing that there are many factors that influence the length of the path, the speed that an idea goes through that path and ultimately, the success of an idea.

First processing of the raw data, the summarised journey maps, allowed to get an overall picture of the status quo. However, even though the accumulation of the information provided some clarity into the process, it also raised new questions. A large amount of data had to be reduced in order to extract the essence of it, as the summarised journey map was too detailed to share it with stakeholders and receive feedback. For this, the pain points, suggestions for improvements and additional information were ignored, only to distil the process steps. The simplified presentation of the process consisted of eight steps that reached from input to output (Figure 16). The individual steps might not be all of the same importance, but they were all perceived as crucial elements in the process. In the following section, the different process steps are addressed; each step is described and discussed.

The eight identified process steps in chronological order were input, idea generation consisting of directed ideation and random ideation, the birth of the idea, capture of the idea, assessment of idea, development of the idea, validation of idea and output. At this point, it is to mention that the ideation phase counts as one step, which is divided into two ways; either directed or random. Further, with the birth of an idea, there were some attributes identified that are associated with it. An idea can be categorised into different types and contexts.

It must be said, as this visualisation tries to describe parts of the Fuzzy Front-End of the innovation process, that does not quite follow a linear path, the visual representation of it must be read with caution, as it represents a simplified approach to reality. The ideas do not follow this exact order of the steps in every case. They might skip a step or go back in the process or pass through a step more than one time.

Input
An input usually triggers an idea. Input can come from different directions from inside or outside the company. Common ways for input that is generated inside the company is a technology push or a market pull. Input from the technology side translates to experience from past and ongoing projects or a technology transfer using existing technology in a new context. Input from the market happens either through competitor analysis or customer needs. Another source of input for new ideas that was mentioned was internet search about new trends and technologies.

In contrast to the inside-out perspective for input for new ideas, numerous outside-in sources were identified. Tradeshow visits, both, either with focus on construction or technology. Further, there is Hilti's open technology innovation branch, where technology screening is done by looking at companies and start-ups, which supports the triggering of new ideas.

In addition to the two main streams that generate input for new ideas, which seem to cover a wide variety of possible information inflows to stimulate innovation, many participants mentioned situations, that cannot be categorised in either of them. Ideas can come up at any point in time; during projects, at lunch, in coffee breaks, waiting for the bus, while sitting on the ski lift, or in the morning under the shower. This shows that many different situations, actions or people can act as an input for a new idea.

Idea generation: Directed ideation & random ideation
After the first phase, which describes the different way of input that can trigger an idea, the idea generation phase follows. The creation of a new idea was identified to happen in two different ways. Directed ideation refers to a controlled ideation process, usually with a clear goal in mind regarding the desired outcome. In other words, creative sessions such as brainstorming, that are carried out within a predefined timeframe, a selected group of people, and begin a question or hypothesis to find solutions to a specific challenge. At the BU TS there are clear processes in place for this, so-called definition sprints (Chapter 3.2.1).

The second possible path for idea generation happens at random. This refers to the previously mentioned fact, that ideas can emerge at any point in time. Unlike in directed ideation, the ideas are not thought of in a controlled setting with a selected group of people, but they come up at a random moment by anyone. For this, there are currently no structured processes at the BU TS to capture them and make use of these ideas.

Birth of an idea
While the idea generation describes the process of how an idea emerges, the birth of the idea refers to the moment that the idea is born. With the birth of an idea, two characteristics that come with an idea were identified; the type and the context of an idea. The type of an idea, especially the ones coming from the random ideation, can vary greatly. An idea can be for new technology, a product, a feature, a service, software or a use case. This shows that ideas are by nature very abstract concepts of thoughts, which makes it complicated to identify, capture and categorise them in a standardised way. In addition to the form that an idea can have, an idea always has a context. The context was found to be of high importance as it includes the product or service related to the idea, the situation of use and its end-user. Thus, the description of the context makes an idea more natural to understand as it depicts the value it creates in a specific scenario. The type and context of an idea will be discussed in more detail in chapter 4.4.

Capture of idea
The process steps until now depict the ways ideas are generated at the BU TS. However, one of the crucial steps in the journey of an idea is the capture of the idea, where one's imagination is brought onto paper. Currently there is no standardised way and place to document ideas; some people at the BU TS collect their ideas in their notes, others share them in an email with the people they think are the ones most likely to listen to, some ideas for features end up in a product backlog and might get implemented in the next release of a product. Capturing an idea means documentation, which could be found to be done in various ways reaching from very fast and simple pen-on-paper notes to more elaborate and detailed digital documents.

Assessment of idea
Once an idea is captured and documented, its quality has to be assessed in order to evaluate if there is an actual value in the idea. Ideas can be very different depending on their type and context and naturally, not every idea is a good idea. The assessment could be found to happen in various ways, mostly through discussions in project meetings, where the project team evaluates if an idea makes sense in the context of the project. Further, several tools and templates that are used to assess ideas such as the value proposition canvas, fingerprints, project order or a business brief.

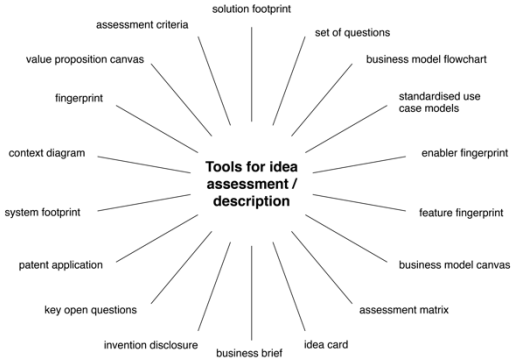

Figure 18: Tools for idea description and assessment

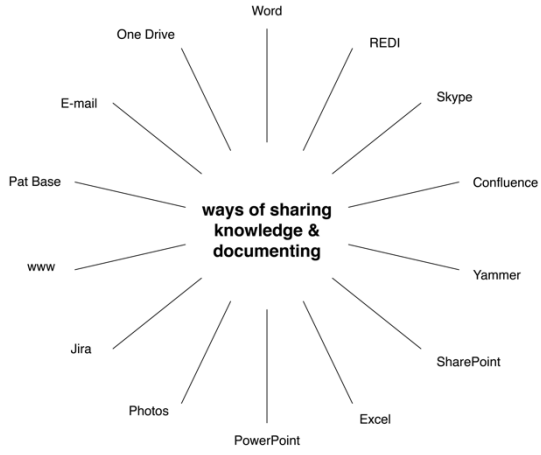

Figure 17: Ways of for knowledge sharing and documentation

However, most of the times, the assessment is done verbally by the inventor of the idea and the person who has the required experience. At the moment, there is no standardised way for this assessment, which means when someone has an idea, the person usually approaches the expert who can evaluate if there is any value in it. For ideas about a product or service, someone from marketing is the right person to talk to, as it includes the customer. Input for new technologies goes to development or sourcing.

Development of idea
After a preliminary assessment of an idea on paper, an idea is further developed. In the directed ideation, in a definition sprint, an interdisciplinary team of roughly five people is put together in a room for three consecutive days, where the ideas are discussed and developed. However, the ideas that come up at a random point in time are more difficult to be further developed. In some cases, if the BU management approves the idea, a small team consisting of around three people is put together, and for four weeks, they work on the idea. Afterwards, the outcome is evaluated, and a decision is made if the idea has enough potential to be implemented or not. Although there is no time assigned for such, some employees with a strong desire to pursue their ideas, sacrifice their free time to develop an idea and prototype a possible solution.

Validation of idea
Again, there is no defined way to validate ideas. Once an idea is developed into a prototype, the validation process depends on the person who is approached. Ideally, the features of the prototype are tested and validated in a real-life scenario, which is not always the case (P07). Mostly, ideas tend to be validated later on during the TTM process.

Output
Due to the very different nature of ideas, the output can vary greatly. The output of the "unstructured innovation process" the way it currently exists can consist of features, use cases, technologies or ideas for new products or services. The ideas that are decided to be implemented are communicated to the concerning project team. One of the outputs are patents that emerge from the ideas. Nevertheless, many products and services do not have a patent behind them. Like the ideas, the outputs are not documented in a standard format or a central place.

Trying to summarise activities and separate sequences of events to fit an unstructured process into a structure with clearly defined steps is rather an approach to the truth than a complete representation of reality. Besides, it has to be emphasised, that the process steps in the Fuzzy Front-End do not follow a clear path, but an idea can skip one or several of the mentioned steps or go through some of them several times. It could be seen, that the way an idea goes through the different steps depends on various factors such as the type of idea, the complexity of the idea, its quality and relevance for the business, and the people involved. Many of these influences, however, play an essential role throughout the whole process and cannot be assigned to a particular step. In the next subchapter, clusters and themes, these influences are explained.

4.4.2.2 Findings

Throughout the analysis of the interview transcripts, participants mentioned different aspects and concerns that they have during the process. Some of them can be associated with a particular process step, while others are more general findings, that happen throughout the whole process. In the following section, this information is

grouped into clusters and themes, which are then explained and discussed. Unlike the process steps, which were only looked at inside the BU TS, the clusters were made from the interviews of all participants. The findings were not separated because they are more generic and are not BU specific.

Further, as the BU TS existed for less than a year at the moment when the research was carried out, the business unit comprises people predominantly from other areas at Hilti. In the last part, the findings are contrasted with factors that influence innovation found in the literature. The subchapter ends with a conclusion, based on the discussion of the clusters.

After a first round of clustering, the information from the interviews was divided into thirteen different clusters, which are illustrated in Figure *19*.However, there were not always clear separations found between the clusters as they sometimes included similar topics or overlapped. From the numerous clusters, four main themes have been identified that cover similar topics the touch on different levels of the current situation. The previous distinction between tangible and intangible information was therefore not considered as such anymore. The first theme covers aspects the concern the organisation on a higher level that is more general and not necessarily directly related to the innovation process. The second theme focuses on topics related to the process itself. The fourth topic is about the content of the innovation process, namely the idea. The third topic can be understood as actions that happen throughout the process but directly relate to the content.

1. Organisation

There is the intrinsic motivation of the employees at Hilti to bring in new ideas and work on innovations (bottom-up). However, from top-down, there is no environment provided that allows this innovation to happen. This environment includes resources such as time, budget, physical space and people.

Motivation through appreciation

There is intrinsic motivation with the people to innovate make great products. The motivation and drive are there to bring in new ideas, develop them and see them becoming a reality through the implementation of products and services. "***I did not get extra time to work on the patent. I did it because I wanted the idea to be heard.***" (P06). This innovative attitude is with the people, and if the urge is big enough, it shows its effects. At Hilti several initiatives were started within different business units, to have a room (not necessarily physical) to share and develop ideas. Most of them were bottom-up approaches, coming from a desire from the employees to drive innovation. This can be understood as the consequence of no defined processes for the early stages of innovation and the fact that the individual business units act like independent organisations, (Chapter 3) which gives them the freedom to start such initiatives. Nevertheless, this again underpinned Hilti's silo-mentality as the different initiatives did not know about each other's existence, although they tackled the same problem.

Further, it could be seen that despite the willingness to share their ideas, people feel strong ownership of them. Thus, there is an intense desire for appreciation as a reward and not necessarily monetary remuneration. It seems like

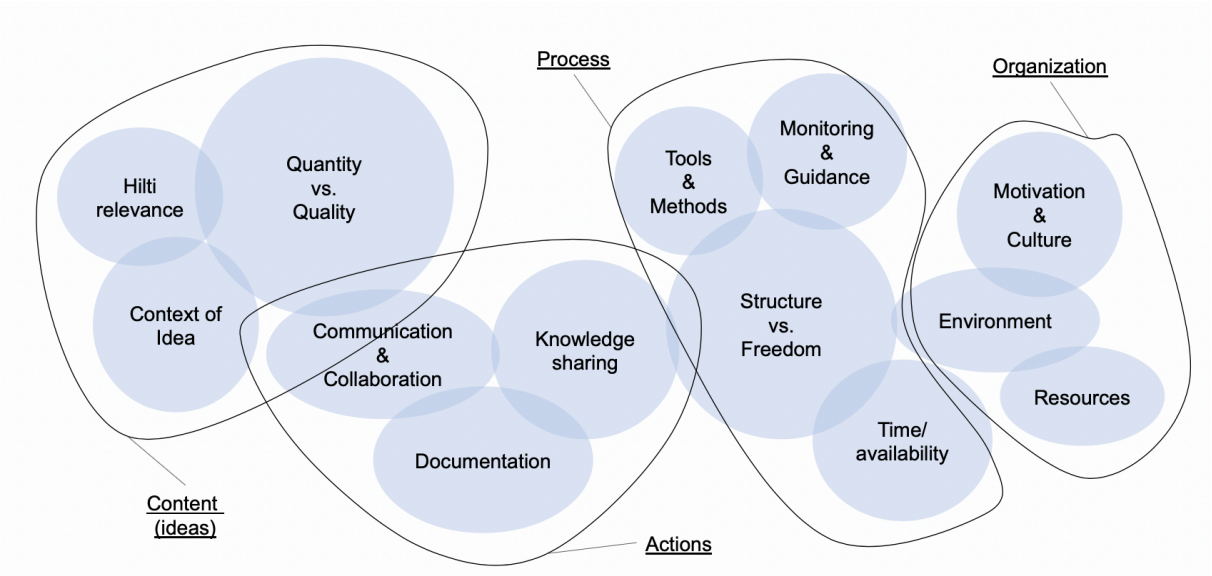

Figure 19: Identified clusters grouped into four themes

there is a pronounced emotional attachment of the inventors to their ideas, which can lead to frustration if the idea is either neglected or the inventor is not correctly recognised. ***"I don't want to share my idea, and later someone else is going to implement it without mentioning me."*** (P02).

Allowing environment
Generally speaking, an open-minded mentality exists at Hilti, though, innovation can only happen if it is allowed. Currently, such allowing environment is not provided at the BU TS. Nonetheless, it could be seen that other business units successfully enabled such environment and made positive experiences. An allowing environment can be understood as the necessary conditions to make innovation possible. This implies low bureaucracy, few regulations, and no precise expectations of the outcome. A "safe zone" to share ideas, to experiment and fail. ***"The success factor was to allow it and not to insist on the focus."*** (P10).

Resources
This allowing environment or the ideal conditions to enable innovation to consist of several elements. On the one hand, the time has to be assigned to exchange knowledge with colleagues and further develop the idea. On the other hand, the budget has to be allocated to create a first mock-up or prototype of the idea. Further, different people need to be involved at a very early stage to create a multidisciplinary team. At the moment, there is no time or money assigned for this at the BU TS and bringing the right people together seems like a challenge. "***Even for a small idea, you have to fight for the resources.***" (P05).

2. Process

At Hilti, processes are generally perceived as slightly negative as they come from top-down. There is a discrepancy between structure for a process to work and freedom to operate within. Further, clear roles and responsibilities are required to ensure such a process to work.

Structure vs. freedom
When it comes to the nature of the process, there seems to be a discrepancy between structure and freedom. A process inevitably entails some structure. On the other hand, a certain degree of freedom is required in order to create an environment that allows innovation. As already mentioned in the internal research, processes are in general, negatively perceived and adapted to individual needs. ***"We do it our own way."*** (P03). Moreover, there even is resistance against standardisation at Hilti, which leads to the failure of standards. Especially in the early stages of innovation, processes do not seem to be welcomed by employees and a high level of flexibility is desired.

As there is currently no process implemented for the very front end of innovation at the BU TS, there is no clear structure. There is no standardised way to communicate, document or share ideas. Thus, the absence of structure implies the presence of complete freedom. This is true in the sense that there is no "right or wrong way" to pursue an idea. Without the necessary resources, the freedom cannot be seized, and the motivation of the people to innovate is not leveraged. Only very determined innovators with the confidence and eager to push forward an idea are the ones whose ideas are heard and recognised. It could be seen that most individual employees or small teams that purposefully pursued their idea were able to secure the required resources to realise their innovation. This means that the success of an idea depends a lot on the determination of its inventor and not necessarily on the actual quality of the idea.

On the other hand, too much freedom does also not guarantee the desired outcome. Even with the given freedom and allocated resources innovation does not just happen, as it is the case in the Inventors Club, one of the initiatives to collect ideas. ***"I wish to have more methods and structure to progress faster."*** (P11). This quote shows that the time and freedom alone to share ideas and further develop them does not support the process enough to progress with innovation to make it more concrete.

One success story of introducing a structured approach in the early stages of the innovation processes shows definition sprints. In definition sprints, a predetermined hypothesis provides a clear starting point and thus, limits the possibilities for solutions.

This shows that there is a need for support when it comes to innovation. Again, the right balance seems to be the challenge between a structured process that provides guidance throughout the progression of innovation, and the freedom to contribute without expectations. Thus, the innovation process should maybe rather be seen as a framework than a process.

Guidance / process management / responsibility
However, not only structure to have clear guidelines to follow, but someone who is responsible for leading the process is found to be crucial for a process to work and innovation to happen. "***If no one is responsible for the process, it will not work.***" (P11). Currently, there is no one responsible for the management of innovation at Hilti. If there is nobody responsible for steering the process, the chances are high that it will not work. Out of five initiatives that aimed at collecting ideas, three initiatives survived, while two disappeared from the surface. The success factor of the ones that are still existing could be identified as the commitment of a dedicated person that is responsible for managing the process. The most successful initiative, the

Hungry Lion, has a clear structure and responsibilities. One innovation manager is responsible for leading the process. However, one major challenge is the frequent change in positions and business areas of employees at Hilti, which leads to the initiatives to become dormant.

Innovation vs. daily business (time & workload)
The main reason for people not to pursue an idea are the daily tasks, as they have higher priority than the development of new ideas. "***I don't share my ideas because I do not want to create additional work for myself.***" (P05). Currently, there is no time assigned for collecting, documenting, developing, or sharing ideas, which is why the ideas stay in the heads of the people. Even though the desire and motivation to innovate is there, innovation is rather seen as a burden or something optional. Innovation is seen as something that gets in the way of the ongoing project work. If someone wants to pursue their idea, they sacrifice their spare time to do so. ***"Everyone is stressed. You have an idea, but it doesn't end up in a tangible document that you can later on assess."*** (P05).

3. Actions

At Hilti, the success of an idea relies a lot on personal contacts, such as the people that the inventor involves in the process. This direct personal contact is also the most effective way to break silo thinking and thus, enable holistic problem-solving. Documentation can happen in many different ways and places, which complicates knowledge sharing.

The burden of documentation
There is no 'one way' for documentation at Hilti. Information is spread across different platforms and formats, such as PowerPoint, SharePoint, Confluence, Jira, REDi, Yammer, and many more. The different platforms are for distinct purposes. However, there are overlaps in the functionalities of the platforms, which enables different options to document something. Also, not everyone can access everything. The many possibilities of documenting create a lack of transparency, confusion, and frustration. Thus, documentation is seen as a burden. There is no clarity and common understanding, where and how a new idea should be documented or who should be approached. In the early stages, ideas are often discussed amongst people. However, they do not necessarily end up in a tangible document. This leads to the loss of potentially valuable ideas because ideas are not documented. ***"Maybe we already lost the top 5 ideas."*** (P09).

Further, another identified struggle after the documentation is the actionability of the information. Interestingly, in almost every case, both, after directed ideation, such as brainstorming sessions, as well as a random collection of ideas in one of the initiatives, the output of ideas was documented. However, the ideas end up in a backlog where they are stored and left behind. Thus, there is a lack of urgency attached to the ideas in order to further develop them from their abstract nature into concrete innovations that create an added value. ***"The information gets caught in an email folder. Most likely nobody will ever remember it."*** (P03)

Communication & collaboration
In general, people at Hilti are open for communication and collaboration. The internal communication at Hilti relies a lot on direct personal contact. For a specific problem, solution or an idea, people directly approach the people they know inside a BU or across other BUs. Thus, the success of a project or an idea depends to a large extent on the personal network of the people. You need to know the right people to make it happen. Similar to the topic of innovation, the motivation is there, but it is not properly executed. ***"If you know the right people within the company, you can assess the business value of an idea very quickly."*** (P08)

As IoT solutions include hardware, software and services, close collaboration with other business units is therefore crucial. The difficulty is to bring the relevant people in the same room, as they are spread across different business units. Though, multidisciplinary project teams are found to be essential and highly competent to assess ideas.

Nevertheless, the urge to collaborate and the silo-mentality both exist at Hilti which create a discrepancy that needs to be addressed.

Knowledge is power
Another critical factor for innovation is knowledge sharing, as additional knowledge can increase the quality of an idea. Knowledge sharing mostly comes down to a combination of documentation and communication, as knowledge can be documented and communicated to others. On the one hand, knowledge about the customer is needed in order to provide a solution that solves a real problem. On the other hand, an understanding of technology has to be there to know what is technically feasible. At the moment, there is a lack of understanding of both marketing and development. Developers do not know what customers want; marketing does not know what is technically feasible.

Especially in the area of IoT, there is a lack of understanding about the technology, as well as the use cases that the BU TS is focusing on. This makes it difficult for stakeholders from other business units to create valuable ideas for IoT solutions. One reason for this is the fact that there is no visible IoT portfolio for people to learn about ongoing IoT projects at Hilti. As IoT at Hilti is a rather new topic, and the company is still learning about the opportunities of the technology, it is crucial to learn from each other's experiences. Currently, there is an

attempt of an IoT knowledge base in its very initial phase to accumulate and share knowledge accessibly for everyone at Hilti.

This leads to another challenge that was identified, which is the accessibility of information. There, the problem lies in the filtering of relevant information. Information should be accessible for the right people; however, not for everyone. Too much information could raise questions about a specific topic or cause an information overflow. ***"I only want to see what is relevant for me."*** (P04).

Another reason, which was previously mentioned is the silo-mentality that keeps business units from closely collaborating and sharing their knowledge.

It seems like the three topics of documentation, communication and collaboration, and knowledge sharing in the context of IoT all lead to the overall goal to move from "silo-thinking" to "holistic problem-solving". To achieve this, a change in mindset is needed, and associated actions are required to enable that.

4. Content (idea)

There is no lack of quantity of ideas but a lack of quality of the ideas. There are different types of ideas, which can be either for a use case or a technology. The more knowledge there is about the customer need and the technology, the better the quality of the idea. Therefore, the context of an idea plays an important role as a good idea truly understands the persona and the situation of use. A third factor for the success of an idea is the business fit, as an idea has to be relevant for Hilti to create value.

Quantity vs. quality of the idea

At Hilti there is not a lack of quantity of ideas. This seems to be a plausible consequence of the innovative mindset and the motivation to bring in new ideas from the employees. However, there is a lack of quality of the ideas. This can be due to misalignment of marketing and development, lack of understanding of technical feasibility, lack of end-to-end thinking, lack of context, customer and end-user understanding, or missing of an added value.

At Hilti, the understanding of a good idea is characterised by an overlap of what should be done and what can be done. In other words, the match of customer need and technical feasibility, which translates to a use case and a technology. The assessment of ideas happens differently in different BUs. In some BUs there are criteria to assess and idea. However, most of the times it is based on discussions, experience and gut feeling. This also relates to the fact that ideas can be very different and thus hard to compare or assess.

At the moment, it is not clear for people, especially from outside the BU TS, how ideas are assessed, and what makes a good idea. This is also realised inside the BU TS. ***"I want people to be able to self-assess their ideas."*** (P04)

Context of the idea

A good idea should keep in mind the persona as well as the situation of use. An idea always has a context. If the idea has a context that fits Hilti, there is a much higher chance of success for the idea. The context can be an existing product, service or use case. If this context fit does not exist, there is a very low chance for the success of the idea. An idea needs to have a use case.

What is the problem?	**Why is it a problem?**
Lack of knowledge sharing	Lack of quality of the ideas
The motivation of people is not leveraged	Unused potential
Ideas are not documented in a central place	Ideas are lost
The necessary conditions are not provided to allow innovation to happen. There is no allowing environment to share and develop ideas.	Ideas are lost
No resources are allocated for innovation (time, budget)	Ideas are lost, Ideas do not progress
There is no structure to follow	Ideas do not progress
No one responsible for innovation management	Ideas do not progress
People do not share ideas because of their daily tasks	Ideas are lost
There is no standardised way to assess an idea	It requires effort to assess an idea, The idea does not progress
Different tools and platforms are used to document ideas	Lack of overview and accessibility of information
There is a lack of understanding of marketing and development	Lack of quality of ideas
There is a lack of understanding of the technology	Lack of quality of ideas
There is a lack of understanding of the customer needs and use cases	Lack of quality of ideas

Table 2: Identified pain points and their consequences

Business fit (Hilti relevance)
You have to show the value in the portfolio. If an idea does not fit with the current strategy of Hilti, or more specifically with the strategy of the BU TS, there is a very low chance of success. This again requires that the BU TS communicates its IoT strategy to the outside. Currently, there is no commonly shared vision of Hilti's future with IoT.

4.4.3 Pain points

The insights from the interviews revealed several problem areas that hinder innovation from happening to lead to several identified pain points, which were all somehow interconnected. The pain points were analysed by evaluating what the problem was and more importantly, why it posed a problem (Table 2). Interestingly, the analysis of the consequences of each pain point showed many similarities leading to two main pain points: the loss of ideas and the lack of quality of ideas (Figure 20). There were a minority of paint points that were found not to be directly linked to one of the two, but instead describe more general issues such as the lack of resources allocated for innovation or the employee's motivation, which is not leveraged.

4.4.4 Comparison with literature

The user research looked into the current situation of the business unit tool services presenting findings concerning innovation and the Fuzzy Front End. Several pain points and challenges in that domain were identified and discussed. In order to understand if they spotted problems areas are common difficulties within the topic of innovation or if they are due to the nature of the company, the findings were contrasted with literature.

The literature describes a division of the innovation process into three main phases, which are the Fuzzy Front End, the product development, and the commercialisation (Figure 21). Looking at the main phases of an innovation process, it shows that Hilti has its strength in the latter two. The analysis of the processes in the internal analysis shed light on the precise definition of global processes in the product development and commercialisation phase, with the TTM process being the most dominant one. (Chapter 3.2.1)

Further, the internal analysis also indicated that there are local initiatives within the business units that aim at managing the FFE. However, the opportunity identification, idea management and concept development are not addressed globally. However, Hilti is not the only company that is not actively managing the early stages of innovation. Literature shows that this is a common problem amongst corporates, that there is a lack of awareness of the FFE or that companies struggle to successfully address it (Jongbae & Wilemon, 2002).

People at Hilti are used to Stage-Gate processes, which leads to a similar structure when it comes to the way the early stages of innovation are managed. The Stage-Gate model by Cooper is a business process used for product and innovation management from idea to launch with a strict division between stages and gates. At each gate, a decision

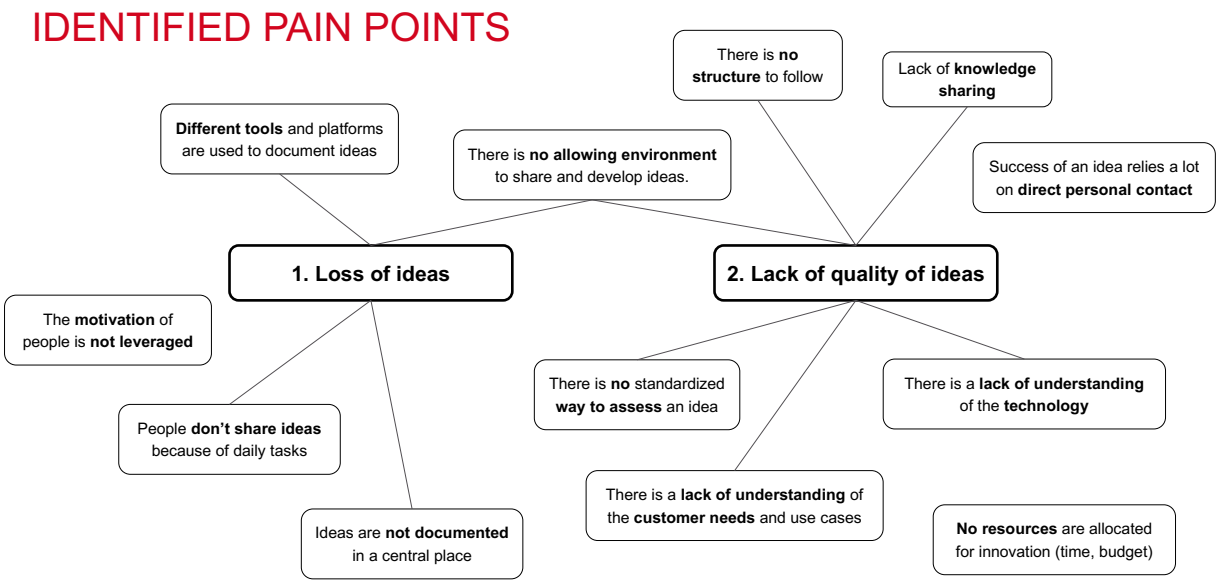

Figure 20: The identified pain points lead to the loss of ideas and the lack of quality of ideas

is taken based on predefined criteria and deliverables to pass the gate and move to the next stage (Cooper, 1943).

The innovativeness of an idea mainly relies on the imagination and experience of the inventor, who came up with the idea. Throughout the interviews, when talking about ideas, participants mostly mentioned innovations of incremental nature such as improvements to existing tools or introduction of new features. It was rarely the case that participants mentioned radical innovations that emerged from their ideas.

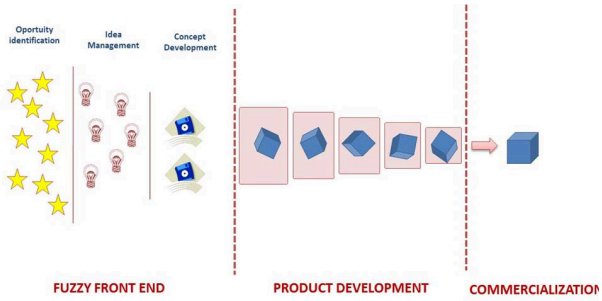

Figure 21: The innovation process inside companies. Source: Adapted from Chesbrough (2006) in (Dornberger & Suvelza G., 2012).

Further, IoT involves high complexity and uncertainty, which require flexibility to adapt to everchanging variables. Due to the fixed stages and gates, such a linear approach does not provide the required flexibility to explore opportunities in such complex and uncertain problem space. Therefore, learning-based processes that follow an iterative structure are better suited for such challenges (Du Preez & Louw, 2008).

Besides, literature depicts, that one danger of a sequential approach is that the gates might be too strict, killing a possible valuable idea too early in the process (Du Preez & Louw, 2008). This might be true when a transparent stage-gate process is actually introduced. However, as in the current situation, there is the absence of any type of structure in the very early stages, this was found not to be the case. The lack of structure theoretically implies that there is complete freedom for employees to bring new innovation, which again is not happening because of the lack of allocated resources such as time and money. This makes evident that there is an imbalance of structure and freedom. Consistent with these findings from the user research, the literature suggests that the presence of both structure and flexibility are key elements for an innovation framework to succeed (Du Preez & Louw, 2008).

4.4.5 Conclusion

The user research focused on understanding the current situation of the innovation process inside the BU TS and how other business units are managing the Fuzzy Front End of innovation. Ten qualitative interviews were conducted with stakeholders inside and outside the BU TS to find out the process steps and to understand the influencing factors that keep innovation from happening. A research tool was developed, which was used during the interviews to facilitate the explanation of the current situation and to support the elicitation of the needs. Four main problem areas and a number of pain points have been identified. The main three challenges that were identified are, on a higher level the right balance between structure and freedom of the process, and on a deeper level the loss of ideas and the quality of the ideas.

The analysis of the results showed that there are eight steps in the process that an idea goes through until it becomes a reality. However, the comparison of the interviews also showed discrepancies amongst participant in the perception of the innovation process. There is currently no standardised way to proceed with a new idea. This might be due to the recent creation of the BU TS, as other business units have more or less traditional ways to collect ideas and manage the Fuzzy Front End of the innovation process (Hungry Lion initiative).

Further, the analysis of the interviews revealed several obstacles that hinder the innovation process. The barriers found concern four different levels starting with a rather global topic of the organisation, then zooming in on aspects of the process, actions that happen within the process, and lastly findings of the content itself. It became apparent that the lack of structure and responsibilities is one of the main hurdles that prevent innovation from happening within the BU TS. It seems that there is not enough importance given to innovation, which is reflected in the missing resources such as time and budget. This eventually leads to the loss of ideas and potential valuable business opportunities, as participants repeatedly mentioned that there is no time for the development of ideas.

After the analysis of the results, it can be concluded that the desired outcome, to create a structured approach to identify and protect business-relevant ideas in the area of IoT, only solves part of the problem. The many identified pain points are not directly related to the process itself, but touch on more global issues such as organisational changes, allocation of resources, or a change in the mindset of the employees. The single introduction of the innovation process will, therefore not be enough to tackle the problem.

The comparison with literature showed that the current innovation process follows, although unstructured, the traditional steps of an innovation process. It also showed that the successful management of the Fuzzy Front End of the innovation process is often not well addressed in companies. Further, Hilti's existing linear approaches for product development are not appropriate for innovation in the IoT. Moreover, the literature showed that the presence of both structure and flexibility are crucial for a successful innovation process.

5 Finding the right problem

The research up to this point, focused on finding the right problem and gave insights into the context of this project, the topic of IoT, the company Hilti and revealed insights from the current situation of the innovation process within the business unit tool services.

This chapter will look at the initially defined problem statement and re-evaluate it based on the insights from the conducted research. The desired outcome is redefined based on the new problem statement.

The second part of this chapter narrows down the desired outcome and defines the focus of the solution. Design requirements are specified, and the solution is outlined.

5.1 Redefining the desired outcome

The desired outcome of this project was to create an innovation process to have a structured approach to identify and protect business-relevant ideas in the area of IoT. The goal of this innovation process was to bring structure into the early stages of innovation at the business unit tool services in order to successfully spot new business opportunities in the area of IoT and protect their intellectual property ensuring long-term differentiation.

The formulation of the problem entails several elements, namely, a structured approach, identification of ideas, business relevance of ideas, protection of ideas and the area of IoT. This section examines the individual elements and reflects on them in order to fully understand the actual problem. First, a closer look at literature gave clarity in the terminology of ideas, inventions and innovations to get a thorough understanding of the domain. In a second step, the desired outcome was redefined, which built the basis for the development of the solution.

5.1.1 Understanding the domain: Idea, invention, innovation

Innovation can be described as "the process of introducing new ideas to the firm, which result in increased firm performance". According to Rogers, such changes can include new products, services, process, the creation of intellectual property, or investments in new machines, technologies, or trainings (Rogers, 1998). This definition implies three remarkable elements. Firstly, it refers to innovation as a process. Secondly, it includes the aspect of creating something new, and thirdly, it mentions the increased performance of the firm as a result. Other definitions solely include the novelty part and see the result of innovation as the product or service that embodies the application of a new idea, which doesn't imply the creation of an added value (Rogers, 1998). Then again, when defining innovation, other literature focuses on the added value, that can either be directly for the enterprise or indirectly for the customer. (Rogers, 1998).

One main difference can be seen in the definition of innovations, which is the understanding of innovation either as the process of creating something new (Dornberger & Suvelza G., 2012), (Rogers, 1998) or as the result of an innovation process. While the viewpoints differ regarding innovation being either the process or the result of such, there is a shared understanding that innovation is new, and that creates an added value. Something that is only novel but does not add value cannot be considered an innovation, but an invention.

Inventions, therefore, contain the aspect of novelty, however, without necessarily creating an added value. This value is only created when an idea or an invention is productively incorporated into an organisation's activities (Rogers, 1998). Roberts concisely describes innovation as "a market-oriented economic use of an invention" (Dornberger & Suvelza G., 2012). It becomes clear that both invention and innovation contain the aspect of something new, however, only through the exploitation of an invention, the added value is created, and innovation is born.

innovation = invention + exploitation
(Roberts, 1987).

With the goal of innovations, Roberts' equation suggests that the two required ingredients are an invention and the exploitation of such. This leads to the invention as a starting point for the process, in order to afterwards exploit it.

Working the way backwards and zooming in on the invention, it becomes apparent that every successful innovation or invention eventually starts with an idea. An idea is a formulated thought, intangible and abstract, that solves a problem and only exists in one's head.

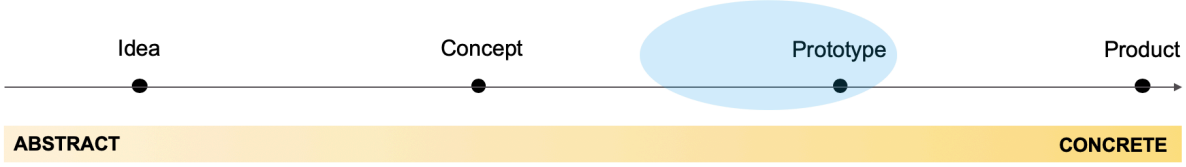

Figure 22: Abstract ideas are developed to become concrete innovations.

An invention, on the other hand, is something real. “Something that has never been made before, or the process of creating something that has never been made before” (Cambridge Dictionary, 2019). For this to happen, an idea needs to be proved either with a solution or a prototype to become an invention. Hence, an invention is an idea that is developed further (Kirk, 2017). Following the explanation of the situation through an equation essentially leads to an invention being the combination of an idea and its development.

invention = idea + development
(Own elaboration)

Apart from the more concrete nature of an invention compared to an idea, the main difference between the two is the ability to protect an invention to prevent others from copying it. There are different ways to protect intellectual property such as copyrights, patents, trademarks, industrial designs or geographical indications (World Intellectual Property Organization, 2019).

In Figure 22, the blue area indicates the level of concreteness for an idea to be able to be protected with a patent. The protection of inventions with patents can be used systematically to follow a strategy with a long-term perspective. Without patents, an organisation is forced to shorten their cycles of which they introduce new products to the market, as competitors can copy unprotected solutions.

5.1.2 Breaking down the problem

Going back to the problem statement, the problem is divided into several parts, reflecting if it concerns an idea, invention or an innovation.

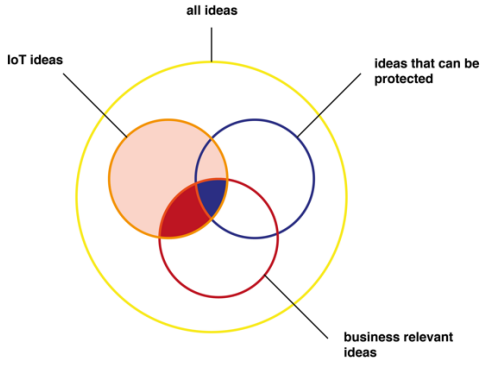

Figure 23: The focus of the innovation process: The identification of business-relevant IoT ideas that can be protected with intellectual property rights

The internal research revealed that there are several initiatives at Hilti that aimed at identifying new business opportunities by capturing ideas from employees, locally within the business units as there are no global processes defined for management of the Fuzzy Front End. Thus, the absence of such process seemed to be a companywide issue and not just a challenge for the BU TS. Although it was found to be of interests to have a global approach to identify and protect business-relevant ideas, not only in the area of IoT, as the BU TS commissioned the project, the scope was to spot opportunities relevant for the business unit – related with the Internet of Things. Out of all the ideas, the scope is narrowed down the IoT related ideas (Figure 23). In the context of Hilti, "IoT related" is understood as an idea that involves the connectivity of physical things to the internet.

Further, out of all the IoT related ideas, only the business-relevant are of interest for Hilti, which is illustrated by the overlap of the orange and red circle in Figure 23. At this point, the questions arise how business relevance is defined. The user research showed that the understanding of "business-relevant" for Hilti is characterised to be by creating value and to be aligned with the strategy. In the context of Hilti, an idea that creates value and shows a strategic fit is defined by the overlap of technology and use case (Figure 24).

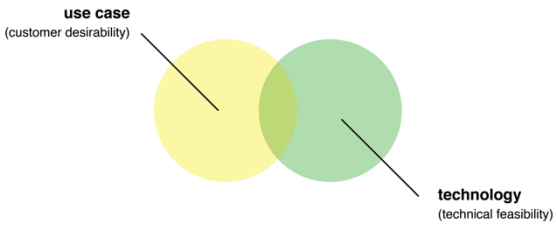

Figure 24: New ideas should fulfil the desired overlap of use case and technology in order to create value

From an innovation perspective, the overlap of technology and use case only addresses the desirability and feasibility and leaves out the aspect of viability. Though, undoubtedly, the consideration of viability is essential in order to create successful innovations (Brown, 2019). However, as the goal of the innovation process was not on the exploitation of ideas but their protection to ensure differentiation, the viability played a secondary role at this point.

From an intellectual property perspective, the technology as well as the use case play the central role in order to protect an invention. Especially in the area of

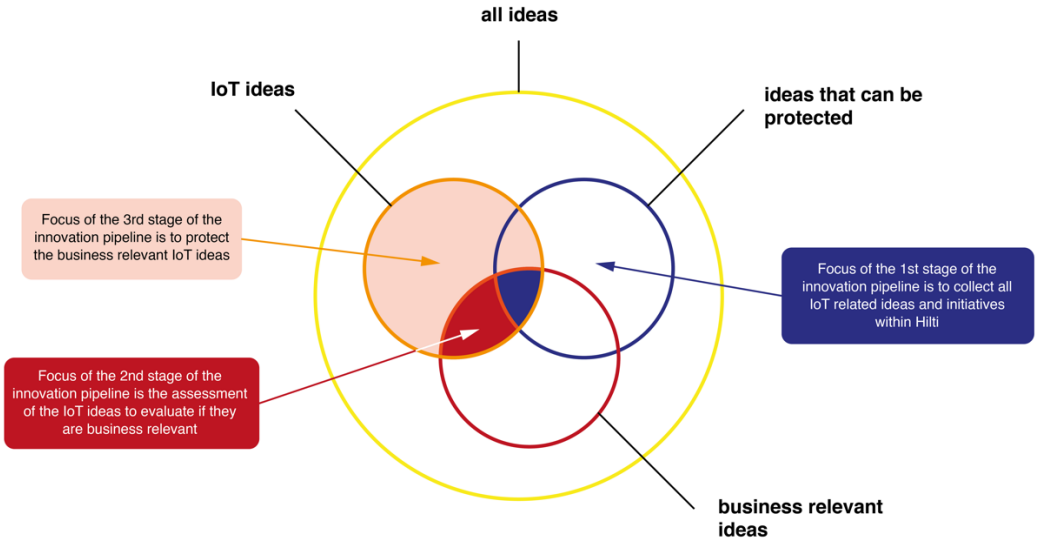

Figure 25: The different elements of the problem are addressed in three phases of the process

IoT, the combination of technology or technologies in a specific context makes an invention protectable.

5.1.3 Solution focus

Going back to the user research, it revealed two main pain points, which are the loss of ideas and the lack of quality of ideas. Consistency was found between the identified pain points and the initial problem statement. In order to collect the IoT related ideas that exist within Hilti, the issue of losing ideas needed to be addressed. Further, the lack of quality of ideas relates to the business relevance, that was mentioned in the initial problem definition. The initial problem definition was, therefore, not changed. The different challenges were addressed in three phases, which build the basic structure of the process (Figure 25).

The three different phases together have the goal to develop the ideas from their abstract nature to concrete inventions that can be protected (Figure 26). The sole collection of ideas does not guarantee successful innovations (Morris, 2011). Thus, the main focus was put on the second phase as the development of the idea was seen to be the most crucial part.

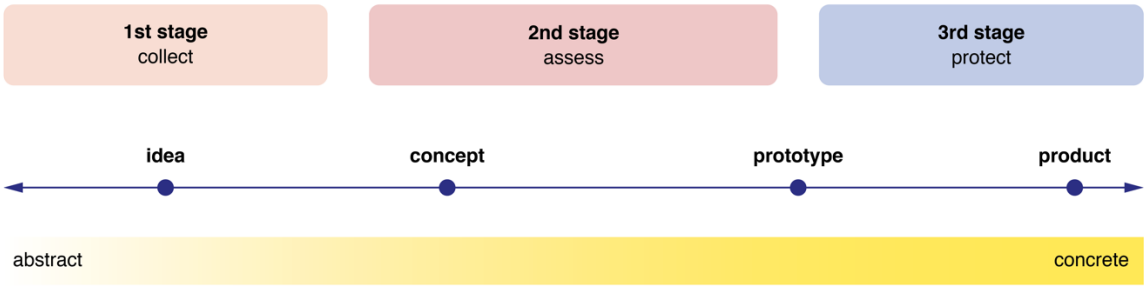

Figure 26: The three phases of the process help to develop an idea from abstract to concrete

5.1.4 Conclusion

This chapter aimed at finding the right problem to solve. First, the domain of the problem was explored, then the initial problem statement was analysed and synthesised with the identified pain points from the user research. The last part focuses on how the problem statement translates to the solution.

The findings from the user research were consistent with the initially defined problem. The different elements of the problems statement were translated into different phases forming the overall process structure.

6 Solution development

Once the problem and the desired outcome were defined, this chapter gives insights into the development of the solutions, the innovation process. The chapter consists of three parts, first introducing the approach that was used, followed by a detailed explanation of the development of the solution and ending with the presentation of the outcome.

The process was designed in several iterations. Throughout the process, different activities were done, that either helped for inspiration and ideation or for testing and validation of the process.

The final solution consisted of several parts: the blueprint of the process, which gives a holistic explanation of the process, the Idea Canvas, which is an artefact that is used as a tool and acts as the primary touchpoint throughout the process and a digital platform to submit and keep track of the ideas. Finally, several suggestions for further research are presented.

6.1 Approach

6.1.1 Iterative approach

For thesolution development, an iterative process was used, similar to the Lean Start-up method by Eric Ries (Ries, 2011). Rather quickly, an MVP of the innovation process was designed in order to test it with real employees to receive feedback from them and adapt it to their needs.

Figure 27: The overall process structure with the three main phases: collect, assess, protect

There were several reasons for this approach. Due to the complex nature of the context, at this point in the project, there was not enough knowledge about all the relevant stakeholders of each business units, the ongoing IoT projects, initiatives, tools and processes used in each business unit to come up with a solution for an innovation process that would work for all, or at least most of them. However, due to the time constraints of this project, it was decided to initiate the solution development instead of continuing with more in-depth research to fill the current knowledge gaps. Moreover, an iterative process allows us to quickly adapt to user feedback and new knowledge acquired throughout the process.

Another reason for an iterative approach was to increase the likelihood of acceptance of the process by the employees. With short iterations that react to the users' feedback, the chance is higher than employees will accept the process and use it. Such a bottom-up approach creates ownership for the people involved in the process as they can see their feedback being put into practice. Based on the findings from the internal research, such a bottom-up approach through continuous involvement of employees was found to be appropriate in the context of Hilti.

6.1.2 Service blueprinting

For the design of the overall process, the service blueprinting method was used. This method was chosen as it allows to visually explain and communicate the process with all its layers regarding the user and the organisation. It describes the process in a holistic way, including different levels of visibility and interactions between the customer (or employees in the case of this project) and the organisation (Stickdorn, 2018).

6.2 Development process

The development process first explains the overall process structure, which was designed based on the findings from the research conducted. Then, solutions were designed for the different phases and tested through experiments in order to validate them.

6.2.1 Overall process structure

The overall structure of the process is divided into three phases consisting of collection, assessment and protection of ideas, which is illustrated in Figure 27. This structure was proposed based on the findings from the research.

Stage 1: Collect
As the goal of the process was to capture new ideas to spot possible business opportunities in the area of IoT. The first stage of the innovation process addresses the first pain point, focusing on collecting the ideas related to IoT that emerge amongst employees during their daily work. Thus, the goal of this stage was to bring the ideas out of the heads of the people and document them in a standard format and store them in a central place.

Stage 2: Assess
Once captured, stage 2 aims at assessing the idea to evaluate its business relevance for Hilti. The goal was to solve the second pain point: the lack of quality of ideas. For this part of the process, an iterative approach has been proposed in order to develop an initial idea further and increase its quality. The previous chapter showed that the development and continuous assessment of ideas are essential in order to move them from an abstract thought towards a concrete innovation, where value can be derived from. After this phase, a proposed idea has to be explicit enough, providing enough information to file an invention disclosure.

Stage 3: Protect
The last stage of the process focuses on protecting the idea in order to ensure long-term differentiation.

6.2.2 Stakeholders

As the process involves several different stakeholders who have different wants and needs, the expectations of the innovation process varied greatly. It was a challenge to define requirements to make everyone happy. For the process, the stakeholders could be divided into two clear groups. The ones who contribute ideas to the process, which are the inventors coming from all different business units at Hilti. On the other end are the ones who receive the output, which is the patent department, the other

business units, and the BU TS who acts as a middleman between two. With the different expectations from the stakeholders, also discrepancies between employees from different positions and levels of the company hierarchy could be sensed.

6.2.3 Creating the solution

Throughout the project, several activities were done in order to arrive at the solution. This section gives insights into the procedure following the chronological order of events. Each subsection explains the challenge that was faced, how it was addressed, what was learned from it, and how it influenced the further development of the solution.

6.2.3.1 First steps to collect ideas: Confluence database

One of the requirements given for this project was to have an overview of IoT related ideas and inventions made accessible in a digital tool.

Question
What digital tool is most appropriate to collect and manage ideas and inventions?

Method
Comparison of different tools and platforms that are used within Hilti (Confluence, SharePoint, Jira) and from external providers (Brightidea) regarding functionalities, user interface and implementation. Several similar ideation management platforms have been considered of which Brightidea was looked into more in detail.

Results

- Confluence, SharePoint and Brightidea have a database character, Jira is for project management
- Functionalities: Brightidea better than the other tools, specially made for idea collection and management
- User interface: Brightidea visually more attractive and more intuitive
- Implementation: Brightidea comes at a price, Confluence, SharePoint and Jira are currently used within Hilti

Conclusion
Although the clear advantages of Brightidea and other idea management tools due to their better functionalities and more appealing user interface, it was decided to use Confluence as the platform to build the idea database. The main reason for this was due to the smooth implementation as Confluence is already a commonly used tool within Hilti. The introduction of a new tool requires approval from management and IT, which would take several months. In order to set up the database and test it with real users, the immediate implementation was essential, and the introduction of a new tool was out of scope. Further, based on insights from the user research, the general preference of Confluence over SharePoint was identified. This was important to increase the likelihood that employees use the tool and submit their ideas.

6.2.3.2 Making a thought explicit: Assessment criteria

The second element of the solution focused on the introduction of assessment criteria. During the collection of existing ideas and inventions in the database, one major challenge posed the different nature of ideas and different forms of documentation. The introduction of assessment criteria aims at solving two challenges: firstly, a standardised way for documentation, which makes ideas completer and more comparable, and secondly, the quality of ideas was expected to increase due to the consideration of different elements defined by the criteria.

Question
How useful are predefined assessment criteria to increase the quality of ideas?

Method
A 4h workshop was organised to validate the proposed assessment criteria with interns from different departments at Hilti. Twenty-nine participants with little prior knowledge about the topic of IoT took part in the workshop. The topic of the workshop was to generate new ideas for applications of IoT to increase health and safety on the construction site. The workshop structure started with general information about IoT, followed by brainstorming, idea development, and presentation of their outcome (Figure 29). The assessment criteria were introduced during the idea development phase.

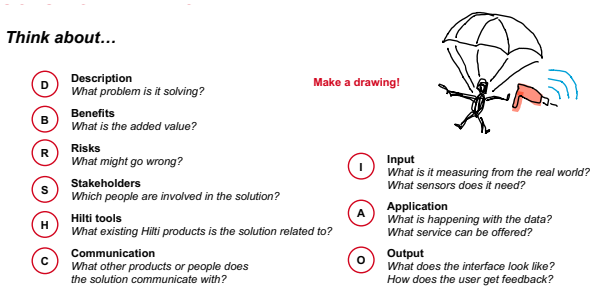

Figure 28: The proposed assessment criteria

The criteria given to the participants (Figure 28) involved general characteristics about an idea such as description, benefits and risk as well as more company-specific criteria such as stakeholders and Hilti tools. Further, criteria concerning IoT were included, such as communication, input, application and output. The latter were expected to

increase the completeness regarding end-to-end thinking of IoT solutions. Before the workshop, the criteria were discussed with a project manager regarding appropriateness.

After the workshop, a feedback survey was sent to the participants to gain more insights into the perception of the usefulness of the assessment criteria from their perspective, see appendix D (0).

Results
In five groups, the participants ideated several ideas and further developed one of them (Appendix E).

- Every group answered all the questions
- Every group sketched the idea
- All the groups were able to explain their idea to their peers clearly
- Participants mentioned assessment criteria helped to formulate the idea
- Some criteria were too similar (description, benefits, application)
- Some criteria were difficult to fulfil: stakeholders, communication
- Not enough time to answer all questions

Conclusion
The use of predefined assessment criteria seemed to work well in a workshop setting. It showed a positive effect on the completeness of the ideas as participants achieved to answer all the questions provided. It was especially apparent that without much prior knowledge about IoT, the majority of ideas were of good quality. This showed that triggering questions help to improve an idea as they encourage to think of the different elements of the solution.

Figure 29: Introduction of the workshop

Nevertheless, the ideas were rather superficial and not entirely thought through due to the time constraints of the workshop and the participants' lack of professional background knowledge in the topic of IoT. This posed the question: Would additional criteria further increase the quality of ideas by asking more detailed questions?

Further, as expected, the standardised documentation format made the ideas easily understandable and more comparable. Although this worked in a workshop scenario with active participation and group work, the second questions arose: Would the standardised documentation of ideas also work in an online environment, where participants document their ideas individually?

The third interesting observation was that during presentations of the idea to others, participants explained their idea following the order of the criteria, which facilitated the different participants to understand the outcomes of the other teams.

Lastly, sketching the idea has shown very positive results. It was remarkable that during the presentations, the ideas were mainly explained by pointing at the different elements in the visualisation.

6.2.3.3 Reality check 1: Testing with inventors

The goal of the innovation process was to enable employees at Hilti to submit their ideas individually to the platform. The questions that emerged from the workshop in 6.2.3.2 was addressed, and the positive results from the use of assessment criteria were regarded and implemented in the digital tool (*Figure 30*).

Question
- Would additional criteria further increase the quality of ideas by asking more detailed questions?
- Would the standardised documentation of ideas also work in an online environment, where participants document their ideas individually?

Method
In several iterations, a template was created with a set of more detailed questions, which was integrated into the digital tool. Two participants were chosen, who had an idea related to IoT. The participants were given a 15 min verbal introduction of the procedure to fill in and submit the idea. The participants were then asked to individually enter their idea in the template by answering the questions.

Figure 30: Assessment criteria integrated in the digital tool

Results

- In both cases, the template was not filled in completely
- Some of the questions were understood differently
- Both participants were able to submit their ideas on the platform individually

Conclusion

The reality check with the two inventors showed that the use of predefined criteria also works in a digital environment. It provides an easy way to document and idea, which makes it understandable for other stakeholders that are not familiar with the content.

However, with sole instructions and no guidance throughout the process, people tended to leave specific questions unanswered. Feedback interviews revealed that a large number of questions was perceived negatively as it required much work to answer them. It was also perceived as discouraging that when participants did not know the answers to specific questions.

The quality of the ideas could not be found to be increased as certain sections of the template remained empty. Nevertheless, this showed that the quality could potentially be increased if the template was filled in completely. There the next question emerges: How can employees be encouraged to fill in the whole template and answer all the questions?

6.2.3.4 Reality check 2: More testing with inventors

The next phase aimed at further developing the assessment criteria. The main goal was to find a way to get people to use the template. After some ideation, the template was designed in a more visual way with the goal to increase the acceptance of users (Figure 31). A more visual representation and division of the content into different areas was expected to increase clarity by providing a better overview, and thus, the user won't be confronted with such a large amount of plain questions.

Further, the medium of the template was changed to a PowerPoint document for several reasons. Firstly, it allows more flexibility in terms of designing the template visually as the design options in Confluence are limited. Secondly, the usage of the template was expected to increase as PowerPoint is a widely adopted tool within Hilti that is used for documentation. Thirdly, the PowerPoint document was designed interactively, consisting of an overview of the content and a separate page with a set of questions for each topic. This was expected to increase the likelihood that people will complete the template, as it allows a more playful and interactive way to describe the idea and not just answering a questionnaire.

Question

How can employees be encouraged to fill in the whole template and answer all the questions?

Method

Different versions of the tool were prototyped (Appendix G), continuously validated and adapted through 30 min – 1h feedback interviews, meetings, participants filling in the template, and observing people use the tool. Participants from different departments and roles were involved, such as inventors, product managers, program managers, developers, sourcing, open innovation manager, researcher.

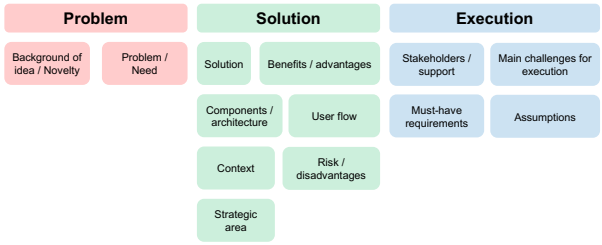

Figure 31: First version of the IoT Idea Canvas

Results

- Assessment criteria and template useful to document an idea
- Keywords/tags are useful
- Strategic areas are useful
- Visual design better perceived than pure text
- Too many questions prevent people from filling it in
- The personal connection of inventor and idea is important
- Make it actionable
- The template is useful to compare solutions
- Right way to introduce someone to a new project
- It should be clear that the canvas and booklet are not meant to be filled in all at once, but rather in iterations

Conclusion

The more visually appealing design resonated positively amongst participants. Especially the division into the different sections problem, solution, context and execution increased clarity and overview of the content of the tool.

Although all participants were familiar with the use of PowerPoint, the expected increased engagement of users through the interactive PowerPoint did not show any positive results. Participants usually started at the beginning and went through slide by slide. On the other hand, PowerPoint enabled the multi-usability of the document as it provides an excellent way to communicate an idea to others or share it via email.

One major downside that was mentioned was the number of questions. Many participants responded that there are still too many questions for the first description of an idea. Based on this feedback, it was decided to divide the assessment criteria into two steps. First, three questions regarding the main overall sections are asked and second, the template with all the detailed questions. A short description of the problem and the solution were found to be the most important aspects to communicate an idea (Figure 32).

Besides, the execution part enables the idea to become actionable. The actionability of the idea seemed to be a crucial element. In the user research, several participants from other business units mentioned that although they manage to collect ideas and store them in a database, they lack an actionable output and struggle to develop the ideas further. For this, the key challenges are defined, which can be actively addressed and thus, the development of the idea begins.

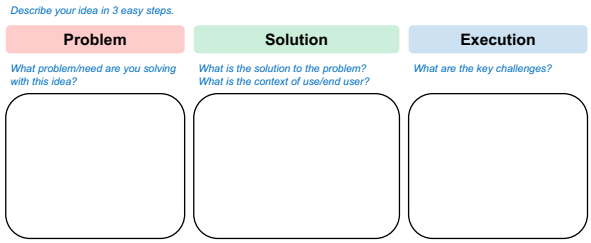

Figure 32: 3 questions to lower the threshold to submit an idea

6.2.3.5 Putting ideas into words: Experience exchange with BMW

Hilti is not the first company to address the issue of managing ideas coming from employees. In order to find more inspiration for the idea-collection, it was looked at other companies to gain insights into how they deal with the same challenge.

Question

How to get the ideas out of the heads of the people and document them in the database?

Method

An experience exchange was organized with the Innovation Management at BMW in the form of a 1h Skype conversation with the Innovation Manager from BMW and an IoT IPR Specialist, Global Process Manager and Product Manager from Hilti.

Results

BMW established an innovation system consisting of 12 ghost-writers (students) who write down invention disclosure together with the inventor. For this, a digital tool was developed to store the ideas and connect the inventors with the ghost-writers.

- 1h meetings: Inventors do not want to write invention disclosure themselves
- Networking is vital: People learn from each other through conversations

- Keywords are useful: finding similar projects and people
- One-pager: Summary of information form a research
- The template helps to capture the idea: an easy way to document an idea including a quick sketch
- Patent sight: Website that gives weekly newsletter of patents, filtered based on topics and interests
- Digital tools to submit an idea: One-click button to send the idea to a ghost-writer or patent attorney
- Important: Clear definition of the functionalities of the tool

Conclusion
One main takeaway was the proven success of an established innovation system consisting of a digital tool, a template and designated people (ghost-writers) that support the process. This addresses several pain points found in the user research, such as the importance of a responsible person actively involved in the process and to have a central place to document ideas.

One exciting element of BMW's innovation system was the template consisting of predefined questions that facilitate the description of an idea for the employee, which later on builds the basis to write an invention disclosure. The experience exchange showed several similarities, such as the use of a template to have a standardized format for documentation and a digital tool to document them in a central place. However, the innovation system from BMW focused only on the collection of ideas and protecting their intellectual property. The aim of their process was not to further develop an idea and increase its quality.

Especially interesting was the use of ghost-writers, that help inventors put their ideas into words. Although, the innovation system at BMW was a project of a bigger scope, the aspect of a selected person that meets with the inventors and helps them formulate their idea could be feasible in the context of Hilti. This would take away part of the effort of employees that comes with documentation of an idea and thus, lower the threshold to communicate them. During the last pilot tests (6.2.3.4), one major challenge was that people did not complete the template and left certain areas out. With the guidance of a designated person, this problem could be solved. The creation of a whole innovation system was out of scope as this project only focused on the BU tool services and thus, not enough resources were available. However, this could be an interesting thought for further research to address this topic on a company level

6.2.3.6 How to design for the IoT?: Expert interview IoT Design Kit

The insights from BMW's innovation system revealed some interesting elements, though, one of the focus of this innovation process was to increase the quality of ideas through development, which was not addressed in the BMW's approach. For this, it was further looked into the improvement of the template as this was the main tool to be used throughout the process. In order to understand different approaches to design solutions for the Internet of Things, an expert interview with a design strategist and a design researcher was organized, who developed a tool to design IoT solutions (Figure 33).

Question
How can a tool help to increase the quality of an idea?

Method
1h Skype interview with a Design Strategist and Design Researcher/PhD candidate from the design consultancy StudioDott, who developed a tool to design solutions for the Internet of Things.

Results
- Tool kit for early-stage companies and SMEs
- It is important to have a shared context
- The main goal is to make things tangible and explicit
- The modular approach of the tool, different ways to use it proved to be successful
- Four different starting points: product, technology, idea or problem
- Aspects of desirability, viability and feasibility are addressed throughout the whole tool
- No strict step-by-step process but rather a partial completion of the content, idea develops over time
- Multipurpose of the tool: individually, in teams, guided in workshops between 1h - full day
- Modularity allows playful exploration of the domain IoT, enhances learning and understanding of the technology
- Combination and integration with other tools like Business Model Canvas, Value Proposition Canvas, etc. possible and suggested

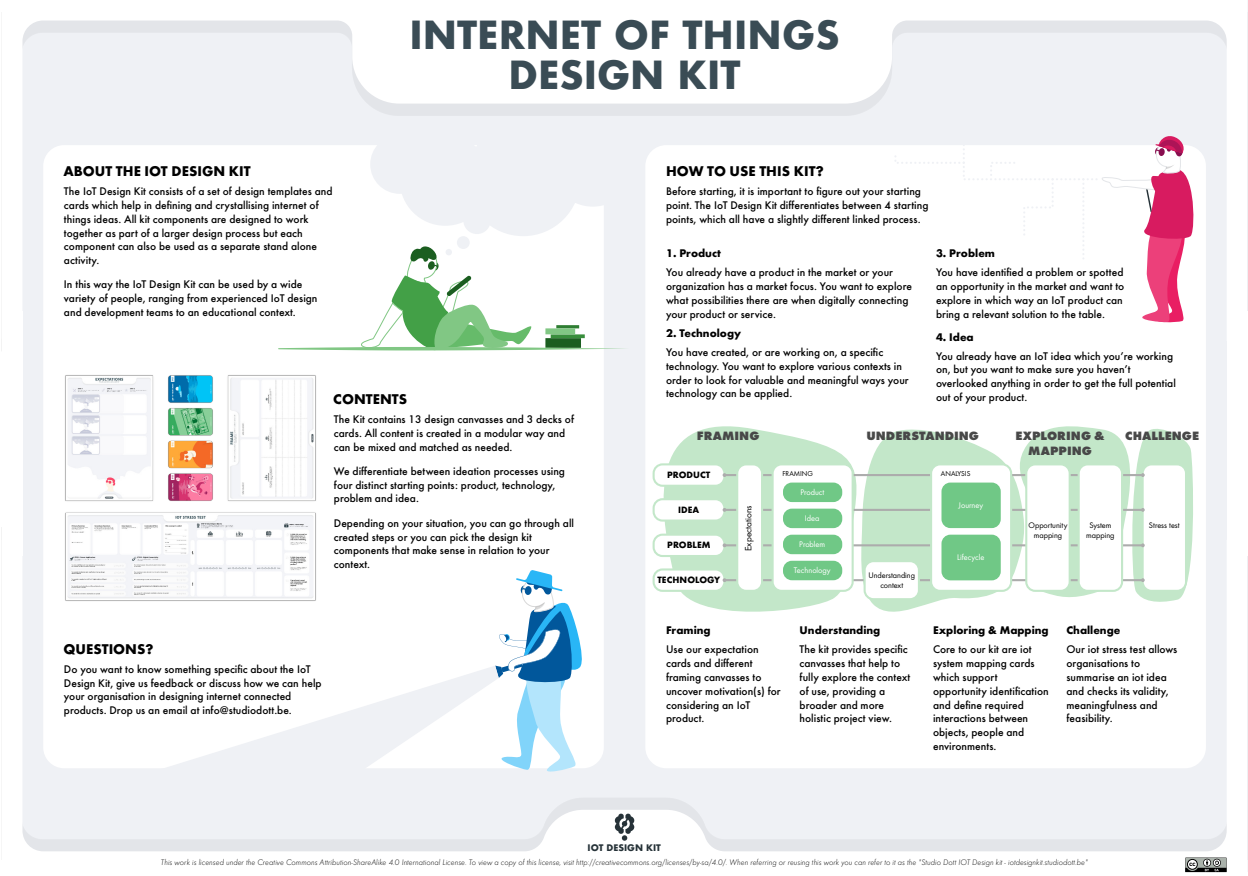

Figure 33: IoT Design Kit by StudioDott

Conclusion

The IoT Design Kit was not meant to be understood as a tool that provides the absolute golden egg questions that ensure the success of IoT solutions when answered correctly. It is instead a set of triggering questions that stimulate the user to consider the many variables and stakeholders that are involved in IoT solutions. Thus, the tool kit is not meant to be a standalone design tool, but rather a framework that can be combined with other tools such as the business model canvas or the value proposition canvas.

Besides, the approach used in the design kit implements the findings from the context research, which suggest a more flexible and learning-based approach for IoT applications to deal with its complexity and uncertainty by developing the solution in several iterations. One important aspect that was depicted in the interview was the necessity to make the content tangible and explicit. This shows parallels to the findings from research that describe the essential development of an idea to become more concrete.

Further, the design kit presented a multipurpose and modular tool with four different possible starting points. Thus, the tool can be used differently based on the different needs of the user. In the context of Hilti, this is relevant as a similar situation exists: Ideas can be both, use cases or a technology, which was shown in the user research.

Although the tool can be used individually, it also becomes clear that the most significant success comes when used in a guided workshop. This again shows the importance of a responsible person who gives directions throughout the process.

6.3 Conclusion

This chapter gave insights into the development of the solution. The starting point of the development was the overall process structure with the three phases collect, assess and protect. An iterative approach was used to ideate, prototype and test different elements of the process. The main focus was on the development of a tool to develop ideas. The final outcome is presented in the next chapter.

7 Final outcome

The final outcome of the solution development is a process blueprint, which provides a detailed description of the proposed innovation process, including any activities and stakeholders involved. Further, two touchpoints that are used in the process were designed: a tool was developed, which is a tangible artefact and a digital platform that supports the process.

7.1 Process blueprint

The process blueprint explains all the different elements of the front-end and back-end of the process and how they are related to each other. These include employee actions, touchpoints like tools and platforms, events, back-end systems, stakeholders, and backstage actions (Figure 34). The full sized blueprint can be found in the appendix I (Chapter 11.9).

7.1.1 Phases

The overall sequential structure of the process with three proposed phases collect, assess and protect (Chapter 6.2.1) were proved to build a useful basis for the innovation process.

Stage 1: Collect
As the user research pointed out, the lack of time is one major reason for employees not to share their ideas, the thus goal of stage 1 was to keep the threshold low to submit an idea. The collection phase is therefore meant to be made as easy as possible for the inventor to communicate an idea yet providing enough information for other people within the company to understand it.
→ *Deliverable to move to next stage: Filled in IoT Canvas and list with assumptions.*

Stage 2: Assess
Further, the main focus is on the continuous assessment of the idea in stage 2, which is made possible through the integration of an iterative phase within the linear process. The user research showed that both, the understanding of the technical aspects regarding IoT as well as the understanding of customer needs showed room for improvement. The iterative process provides a learning-based approach, which allows people to explore and understand the context of IoT better through the refinement of an idea during the iterations. The primary purpose of the iterative nature of the assessment phase is the continuous validation of assumptions, that come with the high complexity and uncertainty involved with the development of IoT solutions. Thus, the primary purpose of the process is to increase certainty and gain clarity in the complexity of ideas for IoT solutions.
→ *Deliverable to move to the next stage: Filled in IoT Canvas with validated information.*

Stage 3: Protect
For the third stage, the goal was not to create a parallel process but to ensure the seamless integration of stage 2 into the existing patent process that aims at protecting intellectual property.

Stage 0: Ideate
Besides, before the collection phase, stage 0 was added, which describes the individual ideation of anyone working

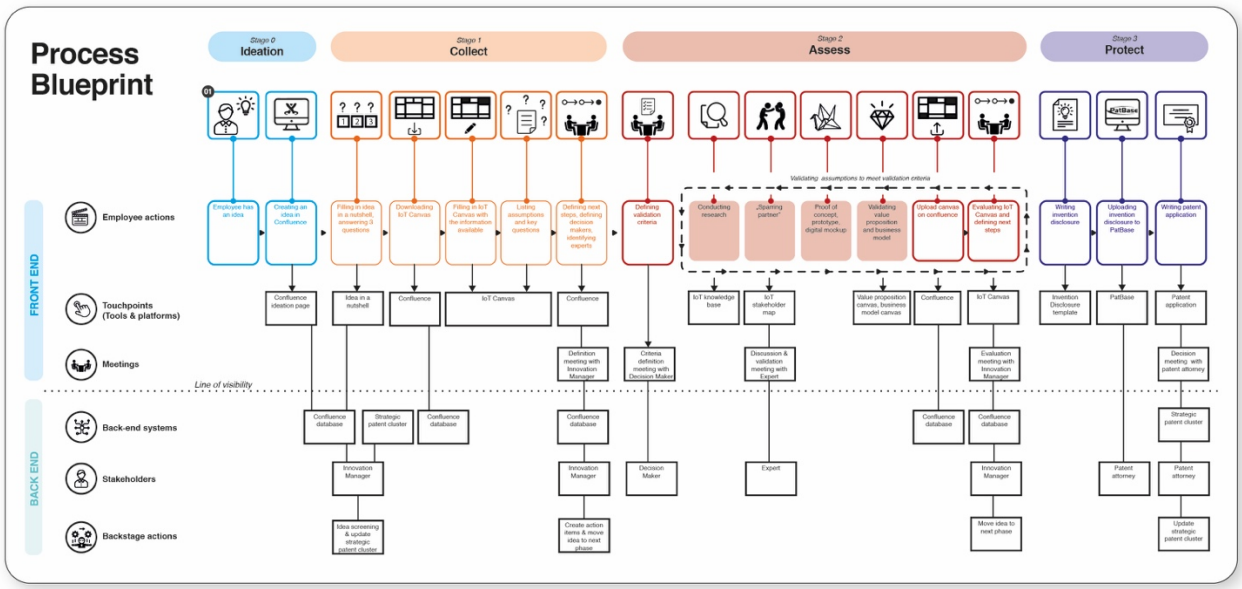

Figure 34: Process blueprint with its front end, back end, and the three phases of the process

at Hilti. This ideation happens in an unstructured way, referring to the ideas that can emerge at any point in time. The user research showed that there is not a lack of ideas, meaning that there is no need to generate new ideas. Although this stage was not primarily considered during the development process of the solution, as the ideation can be understood as the starting point of any innovation process, it is visually represented in the process structure as stage 0.
→ *Deliverable to move to the next stage: Idea created in Confluence and filled in Idea in a Nutshell.*

Input
The input of the process are ideas that are related to the Internet of Things, coming from any employee within Hilti. The ideas can be for small improvements such as smart features for specific products, as well as big visionary concepts of more radical nature that might require large investments.

Output
The main output of the innovation process is intellectual property, such as invention disclosures. This output goes to the patent department. Further, the innovation process provides validated ideas that are the starting point for a new project. This information goes to specific project teams.

7.1.2 Rows

Horizontally, the process is structured in six rows that contain elements throughout all four stages of the process. The three rows in the front end; employee actions, touchpoints and meetings, describe the elements visible to the user, while the back end concerns the aspects that are not directly related to the user, such as back-end systems, stakeholders and backstage actions.

7.1.3 Employee actions

The employee actions explain the steps that are taken throughout the process by the user, which can be any employee at Hilti. The process steps, or employee actions, are explained using an example to illustrate how the user, Tom in the example, will experience the process.

1. The process starts at stage 0: Tom had an interesting conversation at lunch with a colleague about connected tools. He has an idea of how sensors could be integrated into the construction worker's helmet and provide data about the location of a worker. He believes that this idea is new and that it could be a big success for Hilti.
2. After lunch, Tom has some spare minutes before he has to go back to work. He opens Confluence and goes on the IoT ideation page. There he reads the instructions on the page, creates a new idea, gives it a title: “Location Helmet” and adds the key words “helmet”, “smart-helmet”, “GPS” and “location”.
3. Once the idea is created, there he finds a template, called "Idea in a Nutshell" with three questions about the problem, the solution and the execution of the idea. He answers the questions and saves it, which does not take him more than 10 minutes. Now, Tom can see his idea amongst all the other ideas in the database. His lunch break is over, and he has to go back to work.
4. The idea kept him busy in the back of his head, and a couple of days later, he has some time in the afternoon to continue working on it. Tom goes on Confluence and opens his idea. He follows the instructions on the page and downloads a PowerPoint template called "IoT Canvas".
5. He looks through the Canvas and answers all the questions that he can. Some of the questions he cannot answer, such as the specific components that are needed actually to make it.
6. Then he lists assumptions about his idea. One of them is that the helmet needs a GPS sensor to locate the worker. Tom also lists some questions such as: Is Hilti already looking into the topic of smart helmets? Do customers want to have a smart helmet? How much does a GPS sensor cost? He follows the instructions on Confluence and uploads the Canvas on his idea page.
7. After a couple of days, he gets an invitation for a 1h meeting from John, who is the innovation manager. The John and Tom meet and discuss the IoT Canvas. Together, they discuss the questions and assumptions that Tom listed in the Canvas and define the next steps. Now, it is time to validate the assumptions and find answers to the questions. For this, the innovation manager defines decision-makers, which decide when a particular assumption is validated. The innovation manager also connects Tom with the right people, so called experts, who help him answer his questions and validate his assumptions. One of the experts is Peter, who works in sourcing and has information about the prices of GPS sensors.
8. Now, Tom knows what he needs to do to get his idea off the ground. He schedules the meeting with the first decision-maker, Martina, a segment manager from the business unit tool services. In a 1h meeting, Tom explains his idea and states his assumptions about the customer to Martina. He uses the IoT Canvas to communicate his idea, which makes it easy for her to understand what he is talking about. Martina has much experience and knows what customers want. She tells Tom to get out in the market and contact sales

representatives. If he can prove that 10 out of 15 salespeople want a smart helmet to sell to their customers, the assumptions regarding customer desirability are validated for her, and she will put his idea in her product backlog.

9. Once the criteria are set in stone, the validation process can begin. In order to validate his assumptions, he has several options. Tom can find information on the internal IoT knowledge base, where information about sensors, connectivity, standards, data formats, etc. are stored. Another option is to go on the IoT stakeholder map to find a "sparring partner", who has experience in a similar topic, such as a smart helmet. With his sparring partner, he can discuss his idea back and forth and ask the critical questions. At some point, he will have to make a proof of concept, to make sure his idea works from a technical perspective. Alternatively, he creates an MVP of the app, to show to customers and validate the customer desirability. Additional tools such as the business model canvas can be used to gain clarity about how the business model for his smart helmet will look like.
10. After a couple of months, Tom managed to create an MVP and get a "yes" from 12 out of 15 sales representatives that customers would buy the product. This means that the validation criteria for his assumptions have been met. He fills in the Canvas and uploads it on Confluence.
11. Now Tom meets with the innovation manager again to evaluate the Canvas. Together they define the new decision-makers and the next steps, which means going back to step 8. to validate the remaining assumptions. This cycle can repeat several times until all the assumptions related to the idea are validated. Once this is achieved, Tom's idea moves on to the next phase.
12. John, the innovation manager, explains Tom how to write the invention disclosure (ID) in order to protect his idea. With the IoT Canvas, all the necessary information is provided to write the ID easily.
13. Then the ID is uploaded to the internal database PatBase.
14. This is where the existing patent process starts. A meeting with the patent department is scheduled, and a decision is taken by the patent attorney if the invention is worth protecting.
15. If decided to protect the idea, Tom writes the patent together with the patent attorney.

7.1.4 Touchpoints

7.1.4.1 Digital platform: Confluence database

The online database allows acts as the main touchpoint throughout the whole process and has several functions. For the employees, it allows having a place to communicate and store an idea. For the business unit tool services, it provides an overview of the current ideas and inventions

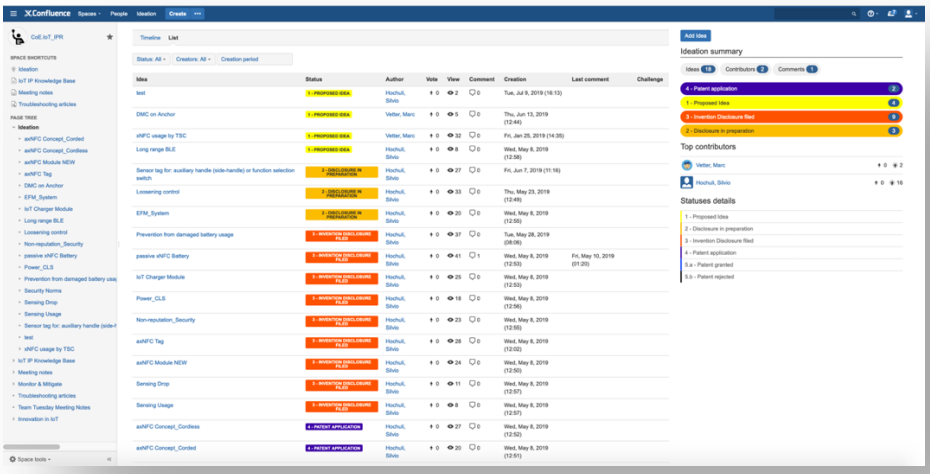

Figure 35: The dashboard of the digital platform to track ideas and inventions

related to IoT that exist within Hilti and allows for tracking their status regarding their maturity. (Figure 35) The maturity of an idea regards the status of the intellectual property and is indicated with different colours, giving the user clear information at what stage a specific idea is. The stages are proposed idea, invention disclosure in preparation, invention disclosure filed, patent application, a patent granted, and patent rejected.

The platform is accessible to anyone within Hilti, which allows users to interact, comment on ideas and share their knowledge and experiences. Keywords facilitate to search, and filter ideas based on specific topics. The platform includes instructions which guide the user through the process.

7.1.4.2 Idea in a Nutshell

The three questions that are asked regarding the problem, the solution and the execution, once a new idea is created. They are easy to answer and keep the threshold low for users to submit an idea. It provides a standardized way to document ideas. With few words, the essence of an idea is captured (Figure 36).

7.1.4.3 IoT Canvas

The IoT Canvas is a tool that is used throughout the innovation process and acts as the main touchpoint (Figure 37). The purpose of the tool is to provide a tangible document that is used during the continuous assessment process of the idea. The IoT Canvas should be seen as a working document that gives insights into the current status of the validation process of the assumptions related to the idea. The tool is divided into different sections that follow the main areas problem, solution and execution. The use of a tool was found to be a useful and appropriate solution for the context and the company of this project as it addresses several pain points that were found during the research phase.

Documentation, communication & collaboration

First of all, a canvas facilitates the description of an idea as it consists of a standardized format. It provides a clear structure to describe ideas for IoT and thus, makes them easily comparable. The PowerPoint document can easily be stored on the digital platform. As the tool is intended to be used as a working document throughout the development of an idea, it enables collaboration and communication of ideas and brings everyone on the same page. It provides a commonly understood way to talk about an IoT idea. The tool aims at creating a shared understanding of marketing

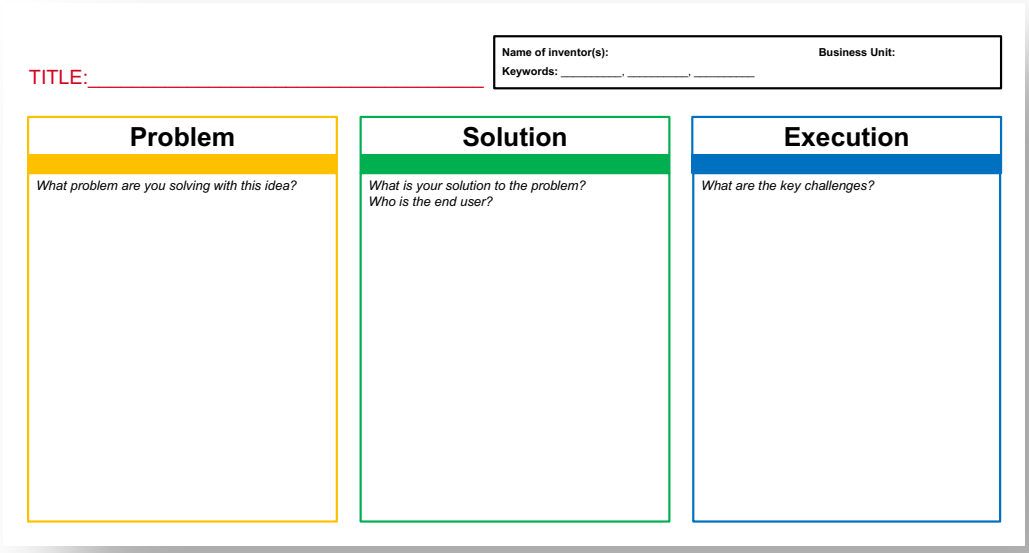

Figure 36: Idea in a nutshell: 3 questions about the problem, solution and execution

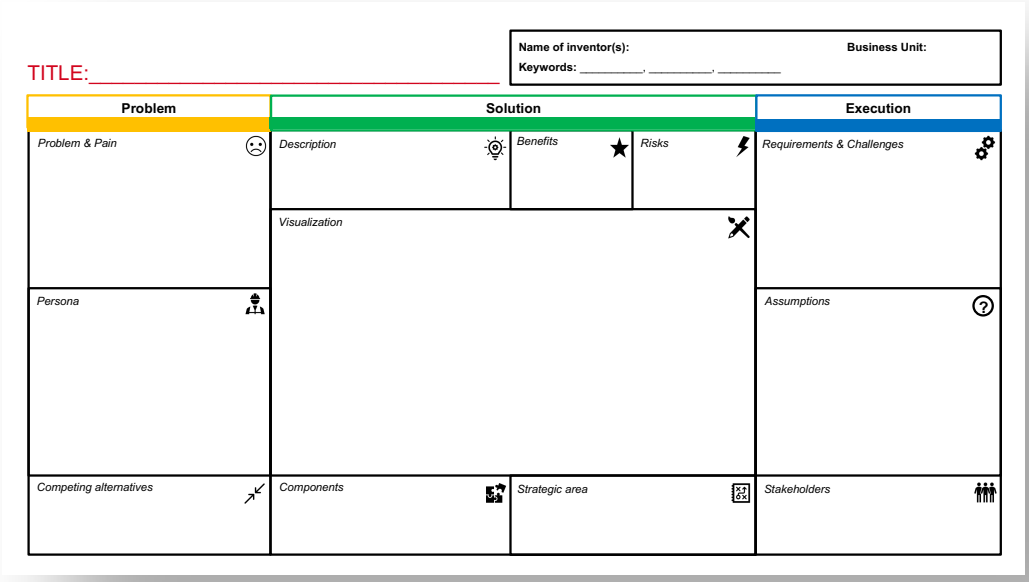

Figure 37: Idea Canvas containing all important information regarding the problem, solution, and execution of an idea

and development, as the canvas includes both customer need and technology aspects.

Structure vs. flexibility
The process provides some guidelines to frame the idea and support the inventor to think the idea end-to-end. Nevertheless, the tool does not define a clear starting point, which gives the user the freedom to initiate the validation process of his idea with the information available at that moment. The freedom to explore was found to be an essential aspect of the early stages of the innovation process. At the same time, the questions provide enough structure for the user to progress with the idea. Canvases such as business model canvas, value proposition canvas and similar tools showed to have high acceptance and positive effect within Hilti.

Multipurpose of tool
Depending on the level of knowledge and the intended purpose, the canvas can be used either digitally or physically. Digitally, interactive PowerPoint can be easily edited, shared across different platforms and presented to other stakeholders. Physically, the canvas and booklet can be printed out and used in a workshop.

Quality of the idea
As ideas come from employees, which might not have much prior knowledge about IoT, the canvas allows stakeholders from different backgrounds and business units to work with it. Clear assessment criteria facilitate the development of the solution as they provide a starting point or checklist to complete an idea. At the same time, it provides enough information to preliminary assess it. The filled-in canvas with validated assumptions provides enough information to file an invention disclosure, or it can be used as a starting point for a new project. The Canvas should not be seen as an ultimate solution for the problem but more as an approach to reduce complexity in the topic of IoT.

The questions throughout the booklet aim at validating assumptions regarding customer desirability and technical feasibility. For the systematic identification of new business opportunities, the BU TS uses a strategic patent cluster, which categorizes ideas and inventions based on use case (desirability) and technology (feasibility). Thus, the tool aims at finding ideas that create a match between use case and technology. Although the validation of assumptions regarding viability is inevitable to enable successful innovations, it was not considered in the canvas. For further validation of viability of an idea, the canvas is

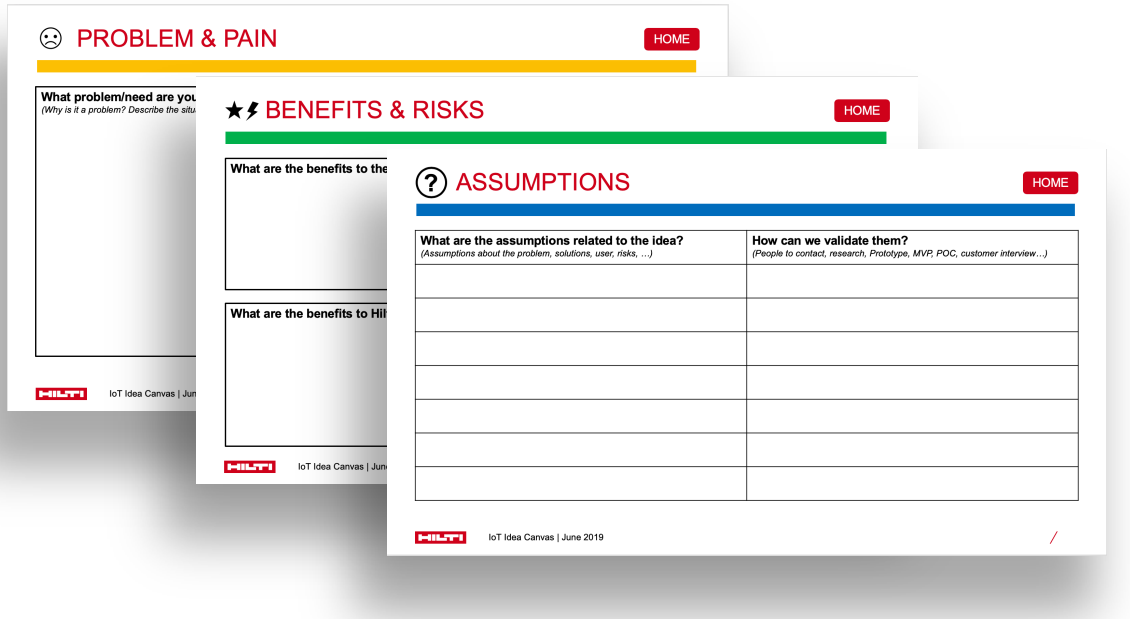

Figure 38: Individual pages in the booklet

meant to be complemented with additional tools such as the business model canvas, value proposition canvas, or an in the definition of a business case description.
The canvas comes with a booklet, which consists of 15 pages, dedicated to the individual sections of the canvas (Figure 38). The complete booklet can be found in Appendix H.

Problem & pain
An idea that adds value has to solve a problem. When explaining an idea, people tend to talk about the solution and forget about the problem. Therefore, a clear explanation of the problem that is solved is needed.

Persona
The careful consideration of the persona was found to be essential as there was a lack of end-to-end thinking and end-user understanding shown in the user research.

Competing alternatives
The research and formulation of competing for alternatives together with the explanation of the novelty aspect was necessary to write an invention disclosure later on.

Description
This section describes the solution to the idea.

Components
This section describes all hardware components, such as affected Hilti products, sensors, gateways, or smartphones that are needed to enable the solution. In other words, these are all the things that exist in the physical world of the IoT layers.

Data
The description of that data focuses on the IoT layers in the digital world. The page is divided into two parts, the generation and the data visualization. Data processing, which happens in between the two, was decided not to include in the canvas as the data processing doesn't change in a way the affects the idea at this stage. Further, the data generation the specification is made between identity, sense and control, which are the standard ways to different data types at Hilti. Based on this information, the use cases can be categorized.

Visualization
Visualization is a powerful way to communicate an idea, which was shown to be very successful at different moments throughout the solutions development process. Further, IoT solutions include a variety of physical objects and stakeholders that are connected. An illustration of the content facilitates the visual communication and explanation of the idea, oftentimes more comprehensible than in words.

Benefits & Risks
As the value creation can happen at different layers of the IoT application, some solutions might not bring a direct benefit for the customer. The availability of data might improve backend processes at Hilti and thus, create a benefit for the Hilti, but nor for the customer. Further, with the large number of variables that IoT solutions entail

comes high uncertainty and therefore risks in different areas.

Strategic area
Within the business unit tool services, there are currently 14 major use cases defined that are enabled by IoT. The strategic fit of ideas was found to be a crucial factor of success. If an idea supports one of the listed use cases, the chance of implementation is much higher.

Requirements & challenges
This section describes the must-haves for the solution to succeed and what stands in their way.

Assumptions
This section is the most important part. This is where the most critical assumptions regarding the content are listed, followed by the explanation of how they can be validated.

Stakeholders
The clear definition of stakeholders creates clarity and transparency of who is or should be involved in the project.

Next steps
This is where the idea turns from a documented thought into an actionable output. The definition of next steps can vary greatly, based on the assumptions that need to be validated. However, in any case, it creates urgency as a task can be defined with a deadline that has to be met. The desired outcome can be agreed on, and it makes progress measurable.

7.1.4.4 IoT knowledge base

A knowledge base in the form of an internal encyclopaedia on Confluence with information about IoT. The goal of the knowledge base is to collect, document and build on the knowledge and best practices that arise from projects. The accessibility of information allows stakeholders to learn about the domain. Throughout the solution development participants repeatedly expressed their lack of knowledge in the field and their desire to improve their understanding of IoT.

The IoT knowledge base was not further developed due to the scope of this project. It is recommended to consider the development of an IoT knowledge base in the future.

7.1.4.5 IoT stakeholder map

The stakeholder map provides an overview of the different people involved in IoT projects such as key persons or experts. Due to the many stakeholders that are spread across business units, it is a challenge for employees to approach the right person regarding a specific topic.

The IoT stakeholder map was not further developed due to the scope of this project. It is recommended to consider the development of an IoT stakeholder map in the future.

7.1.5 Meetings

At several points in the process, mandatory meetings are set for alignment, information exchange, and decision making. This was found to be the most effective way as people at Hilti rely a lot on direct personal contact.

Meeting with innovation manager
Evaluation of the IoT Canvas to define next steps, define decision-makers and connect to experts. The innovation manager has a supportive function and takes decisions regarding the next steps in the process.

Meeting with the decision-maker
Decision-maker defines the validation criteria that need to be met in order to call an assumption validated. The decision-maker defines their commitment met (time, money, resources) if the criteria are met.

Meeting with expert
The expert provides the inventor with information regarding his questions and assumptions.

Meeting with a patent attorney
Discussion of the invention disclosure. The patent attorney decides if the invention is worth protecting. Defines the next steps for the inventor to write the patent.

7.1.6 Back-end systems

Back-end systems support the user interactions that happen in the front end.

Confluence database
Whenever the user creates, changes or deletes an idea, or when the innovation manager moves an idea from one phase to the next, this changes the data in the Confluence database.

Strategic patent cluster
A strategic patent cluster is a tool used by the innovation manager to cluster and organize ideas based on use cases and technology.

7.1.7 Stakeholders

To ensure a seamless operation of the process, several roles and their responsibilities were defined, which are crucial for the successful execution of the process (Figure 39).

Employee, inventor
The main actor of the innovation process is the inventor, which can be any employee at Hilti. The success of his idea is in his responsibility. His job is the description of the idea, registration of idea in Confluence, definition of assumptions, documentation of validation criteria, validation of assumptions, writing the invention disclosure and eventually writing the patent.

Innovation Manager (IM)
The innovation manager is the key link and main point of contact throughout the whole process. The main job of the innovation manager is the coordination and supervision of the process, including front-stage and back-stage interactions. The IM's responsibility is the successful management of the process, ensuring a continuous flow of IoT innovations such as filed invention disclosures, patents and initiated projects (TTM, TP). In the research and the solution development, the importance of a dedicated person that provides structure and guidance throughout the process was shown to be essential for the process to work.

In the front stage, he has a support function for the inventor, such as setting up meetings to evaluate the IoT Canvas and define next steps, connecting the inventor to the right stakeholders and provide the inventor with relevant information about IoT topics. Further, the IM is responsible for the successful management of the different stakeholders involved throughout the process including key people within the business units, decision-makers, experts (marketing and development), BU management and patent department.

In the backend, the IM is responsible for keeping the overview and tracking the status of the ideas in the ideation database in Confluence, the maintenance and update of the IoT knowledge base and IoT stakeholder map, screening ideas, moving the ideas from one phase to the next, grouping similar ideas, sorting out old ideas and updating the patent cluster to spot new opportunities.

Additional tasks of the innovation manager include the fostering of a community of relevant internal IoT stakeholders to strengthen the network of skilled experts and build up know-how in the area of IoT. For this, the IM organizes (half-) yearly events and empower employees to engage with the IoT community actively and contribute ideas to the process.

Further, the IM's job is to do training around the process in order for people to correctly understand the steps that need to be taken to progress with their idea. The trainings aim at educating the key people, which will then pass on the knowledge within the individual business units. Thus, the

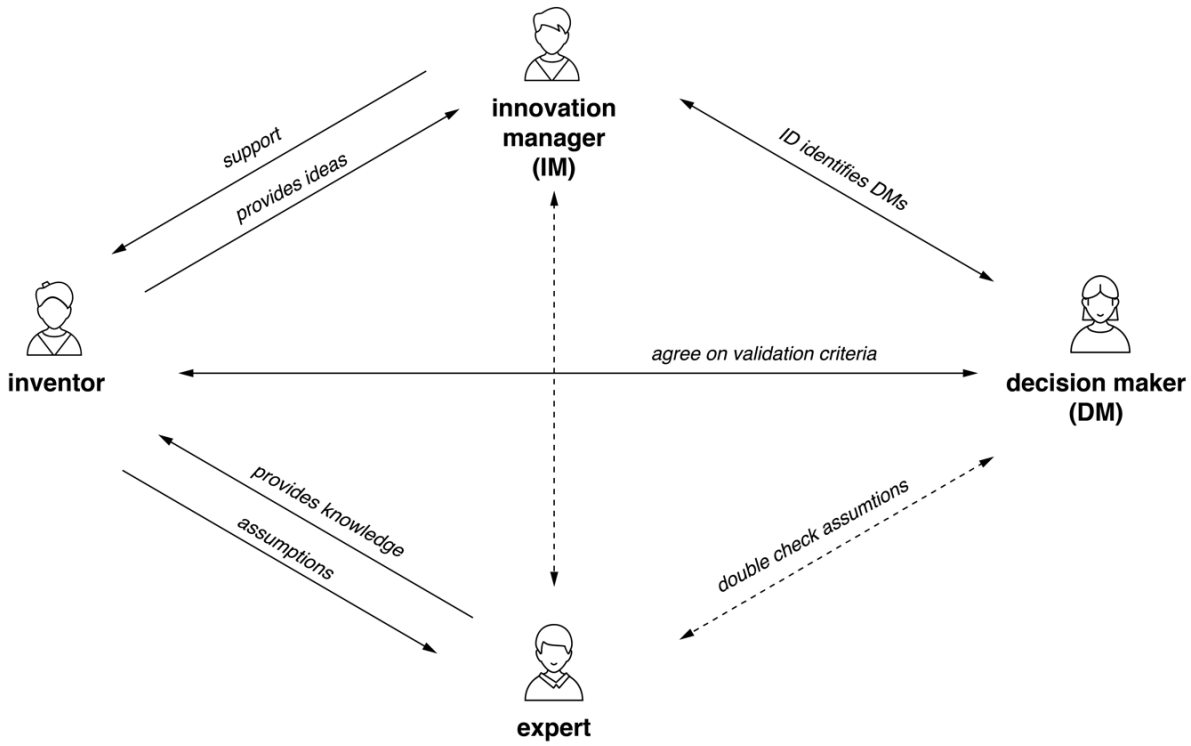

Figure 39: The ecosystem of stakeholders, their roles, responsibilities, and relations with each other

profile of the IM is someone who fully understands the process in detail.

In the future, the role of the innovation manager can grow to a small team of several people.

The decision-maker (DM)
The decision-maker has the role in defining the criteria by which a particular assumption is considered to be validated. He has the position of a segment manager, for example, and is the power of taking decisions and providing resources such as time, money or people. The responsibility of the DM is to commit the inventor by agreeing on a certain action from his side if the validation criteria are met. This could be that an idea for a feature if validated, will be put on the DM's product backlog. This commitment creates importance for the inventor to pursue his idea and acts as an incentive to validate the assumptions.

Expert
The expert is a specialist that brings know-how in a specific topic, which can either be in marketing (sales representative), development (development engineer) or any other business area. The expert plays a supportive role, providing the inventor with information regarding a specific topic with the goal for the inventor to validate his assumptions and find answers to his questions. The expert is not in power to make any decisions.

Patent attorney
The job of the patent attorney is to inform the inventor about the decision taken to protect his invention or not. Further, the patent attorney supports the inventor in the formulation of the patent.

7.1.8 Backstage actions

The backstage actions are the actions taken by the innovation manager that are not directly related to the inventor.

Idea screening
Screening of the ideas that are submitted to Confluence regularly to check for similarities and previously validated ideas.

Update strategic patent cluster
Collate the newly submitted ideas with the existing ones and categorizing them by use case and technology.

Create action items in Confluence
Documentation of the defined next steps in Confluence as action items, which are assigned to a specific person and have a due date. This creates urgency to validate the assumptions and keeps the idea of progressing.

Move idea to next phase
After the idea screening and evaluation meetings with the inventor, the IM changes the status of the idea in the Confluence database.

7.1.9 IoT Community

Complementary to the process, which describes the set of actions that need to be taken to collect ideas and turn them into innovations, the community builds a central part of the solution. The IoT community consists of an ecosystem of stakeholders from different business units and corporate functions that are relevant in the development of IoT solutions (Figure 40). This community is crucial to connect the people across the company, break the silos and thus, enable a holistic approach to master the topic of IoT collaboratively.

The main purpose of the community is to share knowledge and best practices in the different areas of IoT and provide information about security standards and data formats, for example. The high level of complexity that comes with the Internet of Things can be reduced with collective thinking and available knowledge from peers.

Further, as the community grows, more employees will become knowledgeable in the domain of IoT. The increased engagement with the topic is expected to motivate people to become active, which leads to more ideas that will go through the process and uncover new business opportunities. The community can, therefore, be understood as the fuel that nurtures the innovation process and a key to enable a continuous flow of innovations.

The community is organized into two levels. The first level consists of the innovation manager and a network of key persons that each represent a business unit. Together, they discuss important topics regarding IoT, such as the definition of standards for connectivity on job sites. The key persons support the innovation manager as they act as the link between their business unit and the IM. They can inform employees on IoT related topics and guide them through the innovation process. A key-person fully understands the process makes sure it works within the individual business unit.

The second level involves any member that is actively involved and contributes either knowledge or ideas to the community.

The innovation manager organizes events for the community regularly (2-4 times a year) to inform the members about latest innovations, the progress of new ideas and to discuss the needs of the different stakeholders.

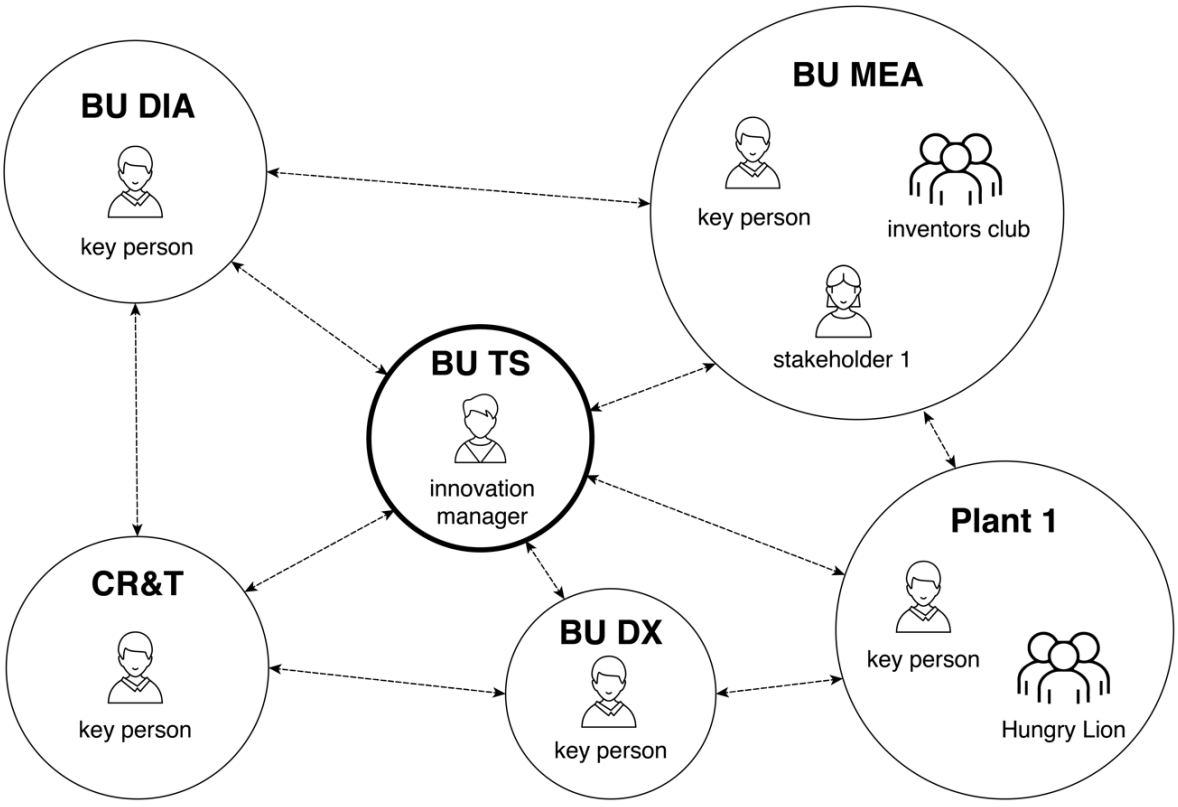

Figure 40: Structure of the IoT community with the key people inside the individual business units

7.2 Validation of the final outcome

A process is a set of actions that happen over a certain period, which inherently impedes the validation of such. In order to validate the proposed solution for an innovation process, one of the main touchpoints and tangible outcomes, the IoT Canvas, was tested. This validation aimed to understand how people interact with the tool and to observe if it was used as it was intentionally designed.

Question

- How do people use the developed tool in real life?
- Does the use of the IoT Canvas increase the quality of the idea?

Method

As part of a full-day event a 1.5h workshop was organized to define use cases, find solutions to IoT related problems in ongoing projects or formulate new ideas related with IoT. Fourteen participants from marketing and development who are currently working on projects with IoT related topics took part. By choice, the participant worked either individually or in small groups of up to four people, based on similar topics/interests (Figure 42). Prior to the workshop, the proposed innovation process together with the IoT Canvas and the booklet were explained to the participants.

Results

The participants formed six groups with the following numbers of participants: 1, 1, 2, 3, 3, 4. The results were five new ideas and one documentation of an existing invention. The complete outcomes of the workshop can be found in the confidential appendix J (Chapter 11.10).

- Not enough time: full day or multiple day workshops more appropriate
- Questions were understood differently, more guidance needed
- Sometimes sections were mixed, or information repeated (problem, solution, benefits)
- The part of the execution was mostly left out, either not perceived as relevant or due to lack of time
- Feedback: Problem section in the canvas should be bigger
- The majority of the groups actively used the booklet
- Feedback: Booklet helped to think of different elements of an idea
- Booklet helped to describe the idea and stimulate their own thinking: Individual participants filled in booklet more completely that groups
- Questions in the canvas triggered discussions: Groups focused more on discussions, they did not go into detail of the booklet
- Participants either filled in booklet or canvas, not both, repetition of information seemed to be a barrier to fill it in again
- Sketches helped to communicate and present idea visually (*Figure 41*)
- Sketches without explanation can be impossible to understand
- Handwriting can be difficult/impossible to read

Conclusion

One remarkable observation was the active participation of the attendees and the use of either the booklet or the canvas during the workshop. This shows proof that the tool is designed in a way that is easily understood by the user. Although some questions were understood differently by certain participants, the overall structure of the tool was clear. However, none of the groups answered the questions regarding the execution. It is unclear if the execution part was left empty because of lack of time or because it was unclear how to answer the questions. Nevertheless, more

Figure 41: One participant presenting his idea with the IoT Canvas

Figure 42: Participants working with the IoT Canvas

attention should be given to the execution part of the canvas in order to make the outcome actionable.

Further, regarding the design of the tool, feedback from participants pointed out that the problem section should be bigger. More feedback like this is expected to arise after some more people use it. The design of the tool should be adapted in some more iterations based on the amount of content written in the individual sections. Even though most participants did not fill in the whole booklet, it was apparent that every group sketched their solution. The visualization seemed to be a good way to express a thought.

One major downside when using the tool in a workshop was the physical booklet, which had to be digitalized afterwards. The handwriting of some participants was hard to read, which made it very time consuming to translate them in a digital format. This shows a likely barrier that might keep people from documenting their ideas. However, when used in a digital format, this is not the case.

The tool showed a positive effect to document and describe the idea. However, the validation of assumptions in order to progress with the idea, which is the central element of the process could not be tested in the workshop. Thus, no conclusion can be drawn regarding the quality of an idea.

7.3 Conclusion & discussion

This chapter presented the final outcome of the project. An innovation process was designed, which focuses on the collection, assessment and protection of ideas. The output of the process is validated ideas that can be either turned into an invention disclosure or act as a starting point for new projects. The process follows a sequential structure with the integration of an iterative phase, that focuses on the continuous validation of assumptions. The process is explained and visualized in a process blueprint consisting of all the relevant information of the process.
Further, a tool was developed, which is used throughout the process and facilitates documentation, description, communication and development of the idea. Besides, a digital tool acts as the main touchpoint between the user and the process. Apart from the process, a community was introduced that consists of IoT stakeholders from different business units. One part of the outcome, the tool, was tested in a workshop to validate its usefulness.

One danger that exists is that people see the IoT Canvas as the main artefact and do not understand the importance of the validation process. The validation of assumptions is the crucial element in the process and should be the centre of attention. The final validation of the tool also showed that participant did not fill in the part of the execution, which entailed the formulation of assumptions. Retrospectively, the assumptions could have been given more importance to with a different design of the canvas. However, even with a different design of the tool, people will most likely still not understand the importance of validating assumptions. This has to do with the abstract nature of assumptions, which implies the uncertainty about something that is believed to be true. Validating assumptions means facing reality, which often comes with discarding an idea. This poses a problem as people oftentimes have an emotional attachment to their ideas, which could be seen throughout the whole project. People struggle to "kill their darlings" and accept that their idea might not be of value.

In order to bridge this knowledge gap and avoid misunderstandings in the execution of the process, it is suggested that more importance is given to the supervising role of the innovation manager. The innovation manager should be actively involved in the process to provide the necessary guidance for the employees and to ensure that assumptions are correctly validated.

Further, touching on the first pain point "the loss of ideas", the tool was proved to be very useful for the description of an idea and has therefore fulfilled its purpose for capture and documentation. The simplification of the full canvas down to three questions showed general acceptance amongst employees. Keeping the effort low to share an idea could indeed be found to the solution to the challenge. This again raises the question if there are even better ways that would work for Hilti instead of using Confluence, which is a multipurpose tool and not specifically made for idea management.

8 Implementation

This chapter explains how the proposed innovation process should be implemented. It describes the requirements to operationalize the process successfully. Further, it explains the next steps that need to be taken to start the roll-out of the process.

8.1 Implementation plan

8.1.1 Allocation of resources

First of all, resources need to be allocated for the innovation process to work. Regardless of the ease of use of the process, without time assigned for idea development, people will continue to follow their daily routines, keep their ideas to themselves. The user research depicted that employees have no time to work on individual projects if there is no time dedicated to this.

The suggestion is that any employee is provided with 10% of their working time to work on their ideas. The requirement is that the employee has submitted an idea and finds himself in stage 2 of the innovation process. Regularly the progress of the idea is evaluated. Further, the budget should be made available to enable for prototyping, material, organization of events and workshops.

8.1.2 Definition of roles and responsibilities

In the final outcome, several roles and their responsibilities have been defined such as the innovation manager, decision-makers and the key people that are the main point of contact within their business unit regarding IoT topics. For the successful operation of the process, people need to be identified that take over these roles and provide the necessary guidance throughout the process. They are also crucial in the fostering of the community.

The suggestion for implementation is first to define the person who takes the role of the innovation manager, who is someone from the business unit tool services. In a second step, an IoT committee should be initiated consisting of the key people. The decision-makers should be defined by the innovation manager.

8.1.3 Trainings

The conclusion of the final outcome showed that there is a lack of understanding of the importance of the validation of assumptions, which are the essential part of the process. Thus, additional training and explanation of the proper use of the process is needed.

For this, trainings in the active or passive form are suggested. Effective training can be understood as regular hands-on workshops and masterclasses on the innovation process, explaining the concept of validating assumptions and the right use of the Canvas. Passive trainings refer to videos or interactive online learning tools that help the user understand and use the process independently.

8.1.4 Community & events

As daily business seemed to get in the way of innovation, events are needed to inform and share experiences with stakeholders regularly and foster the community. The maintenance of the community is essential to create movement, that leads to new ideas that end up in the innovation process.

The suggestion is to organize bi-monthly alignment meetings for the 1st level of the IoT community, the IoT committee, which is initiated by the innovation manager. The purpose is to inform, discuss and decide on current IoT topics and projects.

Further, it is recommended to organize an IoT innovation day 1-2 times per year, which has the purpose of updating the 2nd level of the community regarding recent topics and the showcase latest innovations in the area of IoT.

8.1.5 Integration in existing processes

As the innovation process focuses on the capture of ideas coming from employees, it is not a mandatory process that people are forced to use such as the TTM process for example. This poses the challenge to engage employees with the process. Apart from increasing awareness through the community, the process should be integrated into the existing Hilti processes.

The suggestion for implementation is to integrate the process in the global process management system. This would increase the global awareness of the process across Hilti and thus, increase acceptance and engagement.

8.2 First steps in the implementation

Implementation means action. The importance of actionable outputs was shown throughout the project, both in the hands-on approach of the solution development as well as during the user research. Thus, the first steps to operationalize have been taken. The goal was to introduce the IoT community, raise awareness of the topic, align stakeholders and introduce the innovation process.

In a joint effort with the team, a full-day event was organized with over 40 participants (Figure 43). The participants were stakeholders from different business units and functions, who are currently working on projects with IoT. Keynote presentations, demonstrations of innovations regarding IoT, discussions around the topic and topic-oriented workshops were organized.

Main takeaways

- Lots of positive feedback
- Clarity and transparency on roles and responsibilities, whom to approach regarding specific topics
- Breaking the silos
- Topics of common interests were identified and discussed
- Major problem areas lead to topics for future events
- Too many steps to sign in to Confluence page to submit an idea
- Demand from more people to attend the event
- Networking: Relevant stakeholders were able to connect and exchange experiences
- A feeling of a community and togetherness was created

Conclusion

The introduction of the IoT community through this event was the first moment where all relevant IoT stakeholders came together in one room. In general, the interest was high, which was shown in the participants' active engagement. Lively discussion and networking were signs for a successful kick-off of the IoT community. Further, several people were interested in becoming more involved in the community, which could be possible candidates to take the role of a critical person.

The feedback from the audience, however, pointed out the importance of allocation of resources, especially time, as well the necessity of proper guidance. Similar processes that have been used in the past struggled with the same challenges.

Figure 43: The IoT IPR Specialist introducing the IoT community

A full-day event proved to be an effective way to inform and align stakeholders from different business areas. Further, the discussion amongst participants revealed significant areas of interests and questions, which built the basis for topics to discuss in future events. Last but not least, the innovation day showed to be a great way to break the silos, embrace the Internet of Things holistically and take the first step into the digital future of Hilti.

8.3 Next steps

This section describes the immediate next steps that need to be taken to start the operationalization of the process.

8.3.1 Allocation of resources

The project will be pitched to BU Management in a Project Review Meeting in September 2019, where the suggested request for resources will be presented.

8.3.2 Roles and responsibilities

The role of the innovation manager has been defined to be the IoT IPR Specialist from the business unit tool services. Further, two decision-makers have been defined from the business unit tool services, one from marketing and one for topics regarding development. The next step will be to set up a meeting with selected stakeholders to define the roles of the key people.

8.3.3 Trainings

This topic needs some further research. The next steps are to formulate a project description for an internship or a master thesis to find out the most appropriate way to inform and engage people with the process. The project involves research in operationalizing processes and the design of either digital trainings or a workshop.

8.3.4 Community & events

A survey has been sent out after the innovation day to receive feedback from participants. The next steps will be to evaluate the survey results, sent out a follow-up email to the participants with the summaries from the innovation day, define the topic and agenda for the next event and initiate the planning for the next innovation day.

8.3.5 Integration in existing processes

Schedule a meeting with the global process management to discuss how the process can be integrated in the global process management system.

8.4 Conclusion

The chapter provides an implementation plan, including suggestions for activities that need to be taken for the successful operation of the process. The activities include the allocation of resources, definition of roles and responsibilities, training, community & events, and the integration into existing processes. Further, the chapter describes the first steps that have been taken in the implementation. The chapter ends with actionable next steps regarding the suggested activities.

The first steps of implementation showed the positive effect of a community in various ways. The interaction of different stakeholders is key in order to grow as a community and push the topic of IoT within the company. A growing community also creates attention and importance, which is likely to facilitate the allocation of resources for the process and the integration within existing processes, as a bigger need is more worth solving.

Although the community is an important part that complements the process, most attention should be given to the development of trainings in combination with guidance from the innovation manager. Change often comes with resistance, which makes it extremely difficult to engage people with a new process. Especially since employees at Hilti are generally not very enthusiastic about processes and people tend to follow their habits, trainings will help to overcome these barriers.

9 Evaluation

This chapter provides a final evaluation of the project, including a reflection of the solution, the process and the personal ambitions of this master thesis project.

9.1 Solution evaluation

The aim of this project was to look at the current situation of Hilti and propose a solution for them to innovate on the Internet of Things. Desired was an innovation process to identify new business opportunities and protect them with intellectual property rights to enable long-term differentiation. The Internet of Things is becoming an essential topic within Hilti, which points out the relevance for this project.

The designed solution solves the problem as it provides structure in a previously unstructured environment. The proposed process is very user-centred and defines a start and end with clear steps in between. The solution takes into consideration the needs of the different stakeholders as well as the context of the project. With the IoT Canvas, a tool was created that addressed several of the identified pain points while fitting in the context of Hilti. The solution is thought through, and the implementation plan defines the requirements and actions to operationalize the process.

On the other hand, much focus was given on the design and development of the IoT Canvas, which put the innovation process in the background. The importance of assumption validation is not addressed enough.

Further, the solution is designed explicitly for Hilti and has a strong focus on feasibility and implementation. Thus, the final outcome lacks a bit of creativity and out-of-the-box thinking. The overall process is more focusing on the idea management and not so much on the actual development of IoT solutions. This was partly due to the closeness to the company and their clear expectations, to have an operationalized and implemented process by the end of the project. As the project was very focused on solving the problem of the company and less on filling a gap in the literature, the outcome does not add much new knowledge to the academic world.

Looking back, the designed process does not differ much from traditional innovation processes. Although it fits the company, a more disruptive solution could have been proposed. Especially because IoT enables a whole new way of value creation. Thanks to its complex nature of physical products and digital services, the innovation for such should be disruptive as well. The proposed process would not differ much for the development of non-IoT product or services. The project brief and the expectations of the company could have been challenged more and defending my role as a designer more clearly.

Nevertheless, thanks to the close development together with employees, the process can be expected to be implemented with the proposed steps.

9.2 Process evaluation

The process of the whole project followed a traditional design process starting with research in context, company and the user, identifying problems, defining a problem to focus on, developing a solution and thinking ahead giving suggestions for implementation. I was able to show my abilities as a strategic designer to use design thinking to solve complex challenges in a business context. The approach was adequate, and I chose different methods appropriately to solve parts of the project.

Throughout the project, I tried to be as close to reality as possible to understand the actual problem and design a solution that works. This had the result that I sometimes got caught up in details of the solution development and forgot about the big picture, to take a step back and reflect. This also leads to the fact that then decisions were at times a bit rushed and made based on gut feeling instead of reflected information. Although I had a clear process structure and detailed planning, I struggled to stick to it and follow the defined phases. This lead to a lack of clarity and certainty throughout the project; thus, I sometimes didn't take the time needed to deal with a specific problem properly.

Further, I spent much time on user research. Even though it revealed interesting and useful insights, I spent a large amount of time on the transcription and analysis of the interviews. Looking back, it would have been useful to first treat it as an initial round of information giving rather superficial insights. It would have been helpful to conduct then the second round of more in-depth interviews looking deeper into specific topics. The findings from the user research were therefore not so ground-breaking insightful.

Further, the topic of the thesis, the design of a process, was challenging as a process is something rather abstract, and it involves the dimension of time. As the approach to solving the problem was focused a lot on real-life feedback and testing with the user, I was only able to validate parts of the solution. In general, it was difficult to validate a process due to the involvement of time, and I was sometimes overstrained with the situation. Therefore, a bit more thorough research in innovation processes and process design at the beginning of the project could have helped to get a better understanding of how to design a process.

Finding the right balance between a hands-on and academic approach was a challenge throughout the project.

This went hand in hand with managing the discrepancy of expectations from the company, with the main interest in the outcome, and the mentoring team from the university, with interest in the insights and knowledge generated from the project. As I was situated in the headquarters of Hilti, I was very close to the company and tended to focus more on their expectations. Thus, it was sometimes difficult to see the big picture and not focus too much on details. In hindsight, some days physically outside the office would have helped to get some distance and have a more objective view on the situation.

Moreover, I realized that the process of writing by putting experiences and observations in words does not only fulfil the purpose of documentation but for the processing of information. Many times, throughout the project, a particular problem or situation became much clearer after describing it on paper. Although I took notes and documented my process, looking back, I should have taken more time to sit down on a regular basis and process the information through written words. Besides, not only words but images help to process information. Especially as a designer, I should have used my abilities more to visualize content to digest information and communicate it to others.

Nevertheless, I successfully managed to engage with the company, manage stakeholders, organize events and create an outcome that solves a problem. Although there are points to improve, I am satisfied with my process, how I approached and executed the project.

9.3 Personal evaluation

My motivation for this project was the combination of three things. My fascination of the Internet of Things, my part-time work experience as a construction worker for many years, and the ambition to use my creative problem-solving skills in a challenging environment. I wanted to dive into the topic of IoT, explore its potential in the world of construction and become knowledgeable in the topic of innovation.

Throughout the project, I was challenged and grew a lot. First of all, I experienced first-hand what it means to work in a large corporate, which is unaware of design thinking. Coming from nine consecutive semesters of studying design, I was confronted not only with the real-life business world but also with an environment that does not share the creative thinking and problem solving the way I do. At several points in the project, these different mindsets caused friction. In inconsistencies with the company supervisor, it was hard to defend my opinion as I could not determine if I had a lack of work experience, a lack of understanding about the way things are done within Hilti, a lack of knowledge about IoT, if it was because of the personality of the person in front of me or if it was because I simply think differently as a designer.

Though, I learned to speak up, explain my role as a designer and defend my opinion, even if that meant disagreeing with my direct supervisor. I managed to communicate my different way of thinking and to work to non-designers and show the different approaches of problem-solving. I also realized that I do not want to work in an environment where Design Thinking is a foreign word. I do not want to explain and justify my way of thinking, daily, as it cost me much energy to just “get on the same page.”

Further, I realized that I get much inspiration through discussions with other people. Thinking out loud and discussing specific topics helps me understand a situation and find a solution to a problem. Looking back, I can see that I did not discuss my project enough with similar minded people, such as other designers. This was also partly the reason that the outcome was not as “out-of-the-box” as it could have been. Nevertheless, within a short time, I managed to adapt to the company, get involved in daily life and became a part of Hilti.

Although I am very interested in the topic of innovation, I noticed that it did not excite me very much to design a process. My background as a product designer focuses on the end result, a physical product that solves a problem for a customer. This is where my passion lies. In the future, I will, therefore, go back to designing more tangible things such as products and services, and not processes.

Regarding my ambition to dive into the world of the Internet of Things, I have gained deep insights and knowledge in the field of IoT. I continue to be fascinated by the immense potential that this technology offers. I am looking forward to exploring the endless opportunities of IoT further and contribute my part as a designer to a connected future.

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11 Appendix

Appendix A
Project Brief

Appendix B
Idea Journey Map versions

Appendix C
Interview transcripts + Idea Journey Maps

Appendix D
Intern feedback survey results

Appendix E
Intern workshop brainstorm
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Appendix H
IoT Canvas (Final)

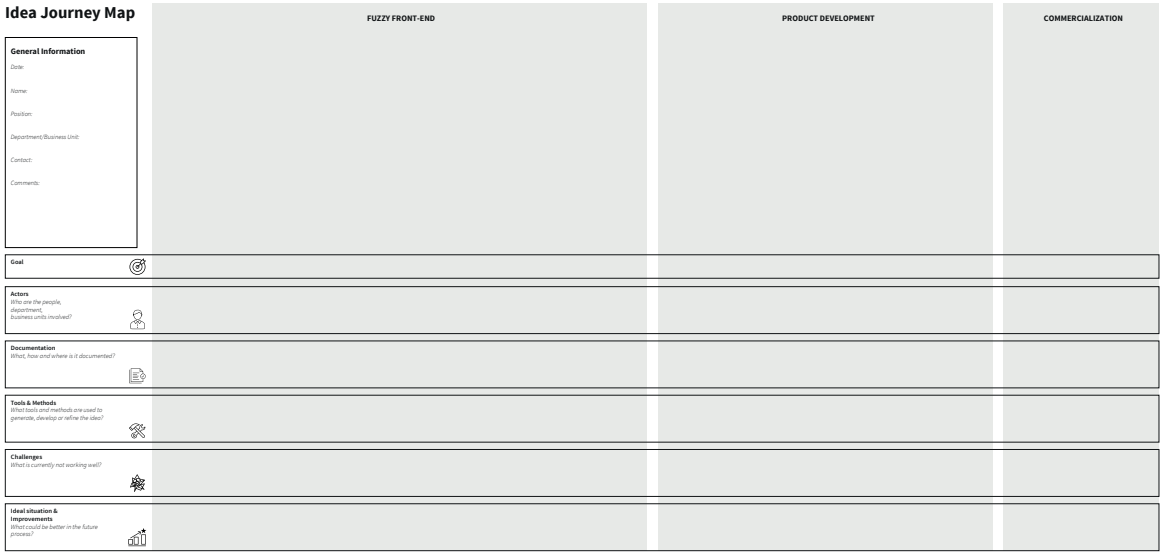
Appendix I
Process blueprint (Final)

Appendix J (Confidential)
Workshop results evaluation of final outcome

11.2 Appendix B – Idea Journey Map versions

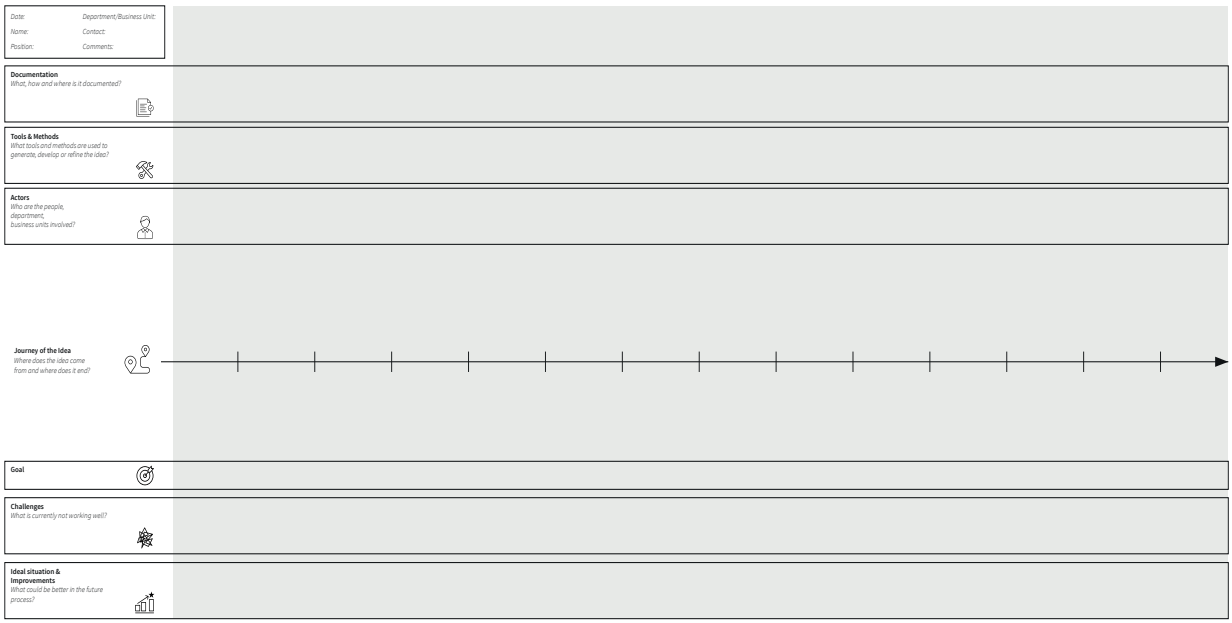
Version 1

Version 2



Version 3

Idea Journey Map



11.3 Appendix C – Interview transcripts & idea journey maps

11.3.1 P01

Main research question:
What are current pain points in the process?

Was assigned for service TTM
There was no common understanding or process for service projects
It was not clear what they had to do at a particular point of the project and what the most important milestones were
The Hardware TTM is not applicable for services, then STTM (service TTM) was created
TTM is very stage gate
STTM is more agile concept and iterative development, lean startup and all that
The process has a loop in the development phase and then it's linear road to the market
Services are becoming really important for Hilti
Construction services
Tool services
Teams and BUs use the process in their own way, they can adapt it, the process is improving all the time
there was a framework, it was not clear what had to be done between the phases, activities
maturity levels for different activities are important
construction services community Check in SharePoint
there are overlaps in processes across Hilti
there are tools and methods within Hilti and people are aware of it but they are not really used
there is no central documentation of the processes
The CCDT is rarely used, it is also better suited for services, rather than products
people don't understand the value of the Design thinking tools and methods, that's why they don't use them
it should be more targeted at the Product Managers because they are the voice of the customers c
There is a tool called Applicaton matrix = customer journey
People are used to have predefined requirements
Get early customer connection with a prototype
Hilti is becoming more dynamic
in the TTM you refine the value proposition until G2 or G3
projects usually come from the market side
trade off between amount of requirements vs. delivering the product
you need to go to the customer at least 4 times in the TTM
you don't go to the customer with the prototype before you patent it
the TTM is very conceptual, processes are applied differently in different projects
Nobody knows what others are doing, that's the Hilti style! Everybody is doing something.
1st version was a framework that already existed by some people working in the service area, 4-5 people
2nd version validated through ½ day workshops with project and product managers, created a framework and explained it to them, joint effort together with them
Validating processes is not easy at Hilti, nobody is asking for another process
Processes come from the top to control the people on the bottom
They take away a bit of freedom
Top down together with management, nobody will use the process
Bottom up approach, super slow, a lot of testing, more realistic, more work
Do reality check, find a couple of key guys, that will work with the process and help you validate it

Questions for myself:
What is useful from previous processes?
What is the state of the art of innovation process in the industry?

Check literature, benchmark, IBM, SAP, what are others doing?
What are Hilti internal processes?, what is going on outside (competitors)?, what are methods and tools for innovation and idea generation?
→ Talk to product managers, project managers, how are they applied in reality

Process
How are things done currently? What process is used? Why?
Where does your process start?
Where do the ideas come from? Where does the project come from?
What happens before?
Where do they end up? What happens afterwards? (ideas graveyard)
How is the process documented? How do you keep an overview?
How is the progress being documented?
What are your experiences with the CCDT? Challenges?
Is the CCDT being adopted and used?
What challenges do you see with a Service TTM?
People
Who is involved in the process? Why?
Who should be involved? (End-user, Customer, Other departments, Third parties/partners,…)
How is collaboration organized? Who approaches who? Why?
Problems
What are current problems in the process? (Ask for concrete examples)
What was the biggest failure that ever happened? Why?
How could it have been prevented?
What is the goal you're aiming for? What is the desired outcome?
Is there a shared vision? (Lean Startup pyramid: Vision (Why?) – Strategy (How?) – Product (What?))

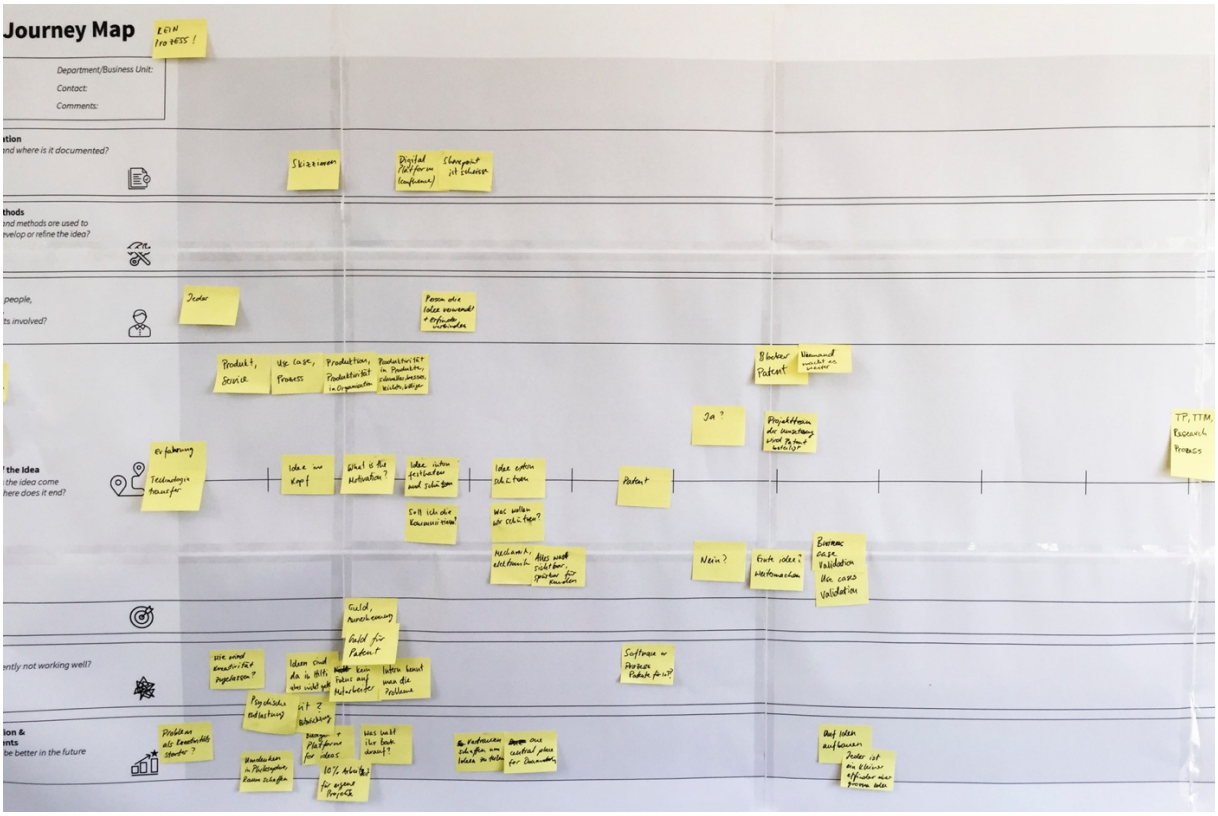
11.3.2 P02

Role: Project Manager TTM, ON!Track
BU: Tool Services
Main Insights:
1. Framework (NOT a process),
2. Motivation. Trust and appreciation have to be provided.

Overall impression
He has 19 years of professional experience at Hilti. He has made several inventions, some of which were patented and implemented. He is happy that he still receives money from some of the inventions he made. However, he somehow seems a bit frustrated that there is not enough reward (time, money, appreciation) for new innovations and thus a lack of motivation.

There are no innovations coming from a process. I shall not design a process, but a framework. He clearly doesn't like processes.
Do I have a safe space to express my ideas? There has to be the right framework or environment for the people to bring in new ideas. There should be time assigned that can be used for developing new ideas.
What is the motivation to bring in new ideas? Money? Appreciation?
Why should I give my idea to Hilti and not go home, write it down, talk to a patent lawyer and sell it to the highest bidder in the market?
Innovation in BU measuring
You can't force to be creative, the ideas pop up at any time. How is creativity allowed? Do people feel safe to bring in ideas? How can we create a safe environment to allow creativity and innovation and to share the ideas with other without getting them stolen?
There is no need to get new ideas from the outside (like open innovation), we should focus on the inside. Hilti is the expert in the field, we know how the construction site works, people at Hilti have enough ideas. We just need to collect them and bring them together.

It is important that the ideas are protected, not only from the outside but also internally. People don't trust each other. I don't want to share my idea with someone and then later someone else is going to implement it without mentioning me. I will only do that once. Then my motivation is gone.
Ideas can pop up at any time in the process (Research, TP, TTM). It doesn't matter if the idea is patented or not, it can still be further developed and implemented. Most of the times the drivers for new ideas are experience and technology transfer. (check literature)
There should be a digital platform (confluence yes, SharePoint is shit) to have an idea database where everyone has access to bring in new ideas. There should be an easy and fast way to protect an idea. (Hungry Lion Idea Card?)
The person who uses the invention in the project and the inventor should come together and exchange their knowledge. For knowledge exchange but also appreciation and inclusion in the project. How can we build up on other ideas?



11.3.3 P03

Job description: Head of Project Management
BU: Tool Services
Main Insights: No standardized process for whole Hilti (don't call it process at all, better Framework, format, platform, …). There are things happening in CR&T, BU Measuring.

Overall impression
He seemed very calm and understanding. He is well aware of the problem and the need for an innovation process. However, nothing should be forced. Everyone should be able to use their own framework, document in their own ways. Otherwise it won't work.

(02:44) In the end you have to fill the technology roadmap in the area of IoT and everything that comes with it.

Proposed solution for innovation process
(06:17) I am not (anymore) in development. I can tell you how it works in CR&T and BU Measuring. In BU Tool Services this hasn't been a topic yet. We have enough to do for the next 4 years. Of course we want to have the latest things but it's a lot of work. We don't have anything established at the moment at Tool Services. Also not for Hilti. Every department does it for themselves, if even. At CR&T we created it with this inside and outside view. The rating system and so on can be individual, that doesn't matter. The documentation and how the ideas are put on the roadmap, for this there was a process created.

(08:12) At the beginning you don't get money, how are you going to get money and resources? How to put a focus? Firstly, you have to give these things a chance. At BU Measuring they have monthly meetings, half a day. Ideas are presented and assessed, you get feedback, we did group workshops with different methods, brainstorming.

Input for new ideas
(09:33) At tool services we are at stage zero. People go out, with certain topics, to trade shows, the feedback is written in an email and is sent to people who are believed are of importance or interest. It is not directed. It is case by case. If I see 3D glasses, I think about these three people, if I see a Bluetooth chip then I think about 4 other people and then I send them the email. And it gets caught in an email folder. And that's it. Nothing happen with it. In the best case someone will remember that there once was something regarding that, but most likely nobody will ever remember that there was something with that.

(10:57) As a second source, we have a lot of requests from companies, that want to present new things. That is always the bigger source for us. Thanks to our strong brand, we have a lot of startups and companies that present us their new roadmaps and products. This is mostly filed on the supply side and not on the innovation side. If you are looking for something new regarding new technologies you should rather go to the buyers than to the developers. If you need know-how about IoT, go to Alfred Lupper, team leader IoT (Kaufering) and to Soenke Becker, buyer. Then you have 80%. Is it centrally documented? NO! Spread out on Inboxes, sharepoints, probably ordered by supplier and not by topic.

(12:59) We have a lot of personal contacts. People know each other from previous projects. From intern to extern. (I know someone who knows someone). And then you also have newsletters. These are the 4 channels. So, on the one hand proactive, we go out to trade shows where we discover things which we were not looking for. But that is also needed, it helps a lot. Or we directly approach a company, when we do a search.

Innovation vs. daily business
(14:40) Where do we do technology screening? Some areas we are passive, in the middle areas we want an update once a year, and in some areas we want to stay tuned. The interesting thing is that we actually don't have time to do so. There is a two-sided sword. Why should we screen now, because when we're going to start a project in that area everything will be outpaced. On the other hand, how can we start a project if we don't know what exists? Chicken-egg situation. People are interested in searching for new technologies, but the time is limited. We don't have separate positions in the business unit that are responsible for technology screening. There is an innovation department at CR&T and there is Open Innovation which is focused on startups screening. But the technological innovations are responsibilities of the business units, which are the developers, which don't have the time. Maybe 5-10% of their time is used to develop new technologies. We rather don't invest too much time now, because until the project is on the roadmap, it's already outdated and we have to start over again. It's going to be early enough.

(17:43) It's not really wrong. We are not required to always be up to date and know what google and apple is doing. We are still in the construction industry. This could also change, but for the moment it's also a cost-benefit question. There is not enough payback. We will deal with it once it becomes important. The gap between technology and the construction site is still big. Technology screening is only done if it is directly needed in the project. There are other more important things, technology is not waiting.

(19:00) Only CR&T is really focusing on that. They have a strategy once a year and a process to look for technology fields where Hilti could invest in the future. Also together with engineering and consulting firms.

(20:15) There are two things. 1. Fundamental research or 2. technology ready (after the trough of disillusionment, "Tal der Tränen"). we never go in with the first hype, only when the technology is mature. we are not the ones who prepare

the market. 21:20 There are several small players in the construction industry that are doing things with new technologies and digitalization, but they are not harvesting yet.

Proposed solution for process
(21:35) At BU measuring they have monthly meetings, idea is captured, documented in confluence, what is the idea, benefits, the business value, how would you continue and how much money do you need to make a prototype. everyone from the BU can see the ideas and assess them. Like social media with Like button. Ranking and award for the best ideas to motivate people to bring in new ideas. The creator of the best ideas present them in 30 min to BU management. Then they might get a budget (10, 20, 30k) and resources for a prototyping/feasibility study/definition project. Then a fingerprint of the idea about technical benefits and in which product that could be used. If that goes well, it goes on the roadmap for a TP in the next year.

Problem with innovative ideas
(24:43) You need to have an idea how to implement it quite early on. What would never work for us is if you just have a cool idea: "idea looks for business case". If there is no link to a product or feature, there is no chance. The best chances you have if you address a specific problem of a product category. Make it cheaper, better, faster. You have to show the value in the portfolio. Then you have good chances that you get money and resources. In the end it's business. We are not a technology company. In the end it's a product.

(26:26) Another way is to pass it on to research, if the technology is not ready yet. We start with development of a technology for a product.

(27:09) [If there is no direct link of an idea to a product] Aahh! That's really difficult. Then it's like an island. It's cool and so is the google glass, but what are we going to do with it in our portfolio?

Idea x application/use case
(27:32) These ideas stay in confluence. The challenge is always "idea looks for application/use case". It's easier to find "application/use case looks for idea". If you can make the link between a technology and an application and show the value, then you are on the right path.

Communication of idea
(29:48) [Are the different types of ideas (technology, product, service, use case) clearly distinguished?] Unconsciously, we distinguish them, but there is no process. When an idea is about a service, they automatically go to the product manager because they are the ones who make the fingerprints. Ideas for new product/services go to marketing, because it includes on the customer. Input for new technologies go to development or sourcing. The challenge is how to bring them together. At the moment, that happens at random. Interestingly, if you have a competitor's product everyone runs to marketing. That comes from the TTM process. Before G2 you need to do competitor analysis and take apart their products. If direct competitors --> marketing, if competitors outside construction industry --> development. With a problem or idea, you go directly to the person that you think will listen to you.

Proposed solution for process
(32:57) We don't have a structured approach like BU measuring. They made it that people bring in their ideas, that they are documented, that they are discussed and assessed.

(35:44) CR&T do it very structured because it's their business goal. They have the biggest motivation to do that.

"We do it our own way."
(38:53) [There are different initiatives for idea collection: Hungry Lion, Inventors club BU measuring, CR&T. Why not for whole Hilit?] There is no urge to standardize this process. It's not a goal. Why should you standardize something if you are going to adapt that standard to your own needs anyways? I think it's more important that these different initiatives know about each other. We (at Hilti) resist against standardization. We fail on standards. There is no need for one innovation process. It's more important that these different ways are allowed. You will always hear: "We do it our own way." And that's okay. Never say the word "process".

Documentation

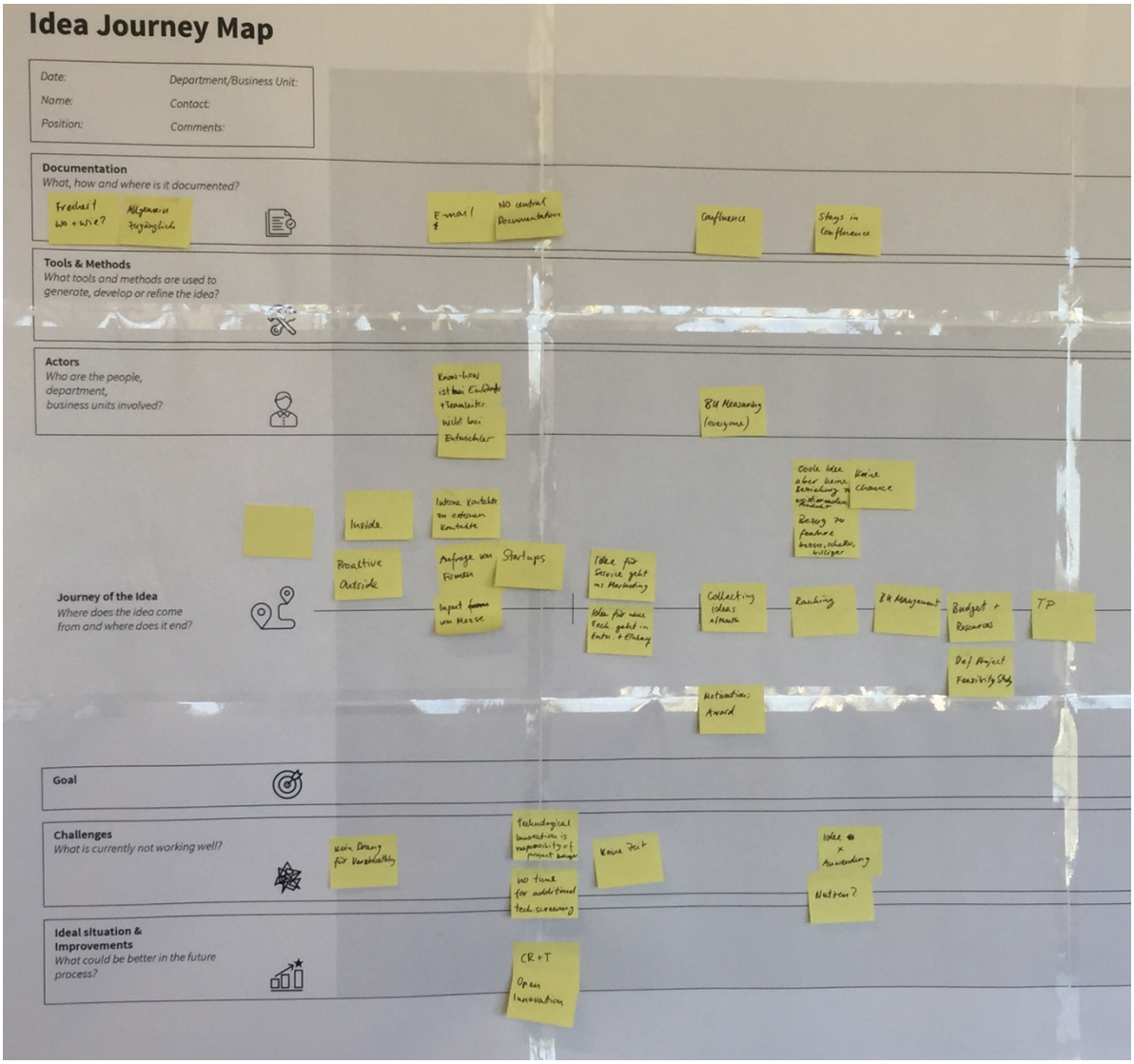
(42:54) It is important that it is documented. You have to give the people the freedom how (SharePoint, Confluence, office notes). It has to be generally accessible and in one place. What are the touchpoints of ideation that are fixed in order to work? The way to get there is up to the people.

Requirements for process

(45:50) First it's about what to do and why to do. Then how. We already struggle with the why. We are too slow and it takes too long when it comes to new technologies in a project. We can still deal with it once it becomes relevant. Once there are requirements for the product, we look into the technology, that is still early enough for us. Until now it worked like that.

Motivation, idea capturing

(47:00) I am convinced we need something like that (ideation process). You won't have a lot of resistance as a third of the people from our BU Tool services come from BU measuring and they are familiar with the inventors club. The question is if that is the right thing for us. The biggest challenge is to get people to document the ideas they have in the shower, while playing cards on Sundays, while waiting for the lift when skiing. If that process is too tedious, "forget about it". That's why at CR&T they still do it on paper. 3 sentences on a paper an pinned onto the wall. This takes 30 seconds, if you do the same in JIRA it takes 10 minutes. Afterwards it should be documented more detailed and digitally.



11.3.4 P04

Participant number: P04
Date: 29.3.2019
Job description: SW TTM ON!Track
BU: Tool Services

Main Insights: **Ideas are documented but there is no overview**. There are different levels where ideas can happen. There are top down ideas and bottom up ideas. Ideas that come from the top are usually for new use cases that will be discussed in definition sprints. This is then broken down into features and enablers, and these further into smaller pieces for development. Ideas that come from the bottom are usually solving the problems at the bottom, bug fixes and small improvements. However, it can happen that there are ideas that come from the bottom that might be that basis for a whole new use case. The question is, what needs to be shared with who? If everyone has access to everything there is an information overload and people don't find what is needed.

Background information
00:59 Background in business informatics. Started in IT at Hilti, since 2 years with ON!Track. Was involved in active tracking.

05:10 Is it actually a problem that we have that we don't apply for patents early enough? Where does this idea come from, to combine the two outputs: products/services and patents?

Idea identification, idea development, idea evaluation
12:34 We had a technical meeting (technical roadmap) where the idea came up to combine the Hilti Connect and ON!Track, so there is only one Hilti App. Some users are interested in one thing and others in other functionalities. It makes sense for both the user and also for the technical architecture of the app that they are both integrated. It started from the technical perspective. Then we got the OK, we needed a team who have a look at it for 4 weeks and then come back with 1 proposal. We made one product out of two existing ones. Important note: ON!Track is a paid product, Hilti Connect is a free app.

14:55 We also had the assumption that it is preferred by the customer to only have 1 app instead of 2. The motivation to combine the two came from the technical side as you don't have to build certain things twice for both apps. Also the idea to generate more data when the apps are integrated. This way, the ON!Track use cases for our customers become stronger. The idea came from the Head of Development.

17:20 Idea came from technical steering meeting, BU tool services intern, every 4-6 weeks, discussing different technical topics/ideas/problems, every time different topics. Decision was taken to sit together 3 people (Product manager (Puneet Raj), architect, product owner) to think about if it makes sense to do this project. They had 4-6 weeks. Documented in meeting minutes: idea and responsible person. Afterwards analysis was documented in PowerPoint, what should be considered when combining the two apps.

Decision making
20:46 Decision was taken that it makes sense to combine the two apps. I don't know in what meeting this decision was taken. Note: she could look it up if needed. Now, we have a new project which is Asset Management 3.0, where we build up everything new. We're going to wait until this is ready then we integrate the two apps. Now it is a TTM project on the roadmap.

Focused ideation, definition sprint
22:48 For every TTM project we start with a Definition Sprint to sit together very early in the process and see what we want to do, what do we offer to the customer, why are we doing this, what are the risks. There are some templates, a blueprint and some questions that need to be answered. Project lead, product manager, architect, BU management. Product manager is responsible for the organization and a hypothesis to start with. He gets input from the roadmap, he works on ideas and brings them to the definition sprint where they are discussed. Documented in PowerPoint, not yet clear where it saved but somewhere central.

26:26 Before the definition sprint, in JIRA there are epics (PowerPoint) for everything that is big enough to make a TTM out of it. After the definition sprint there are features and enablers, the children of epics. This works very well so far (we started 3 weeks ago) because we start right away. We immediately uncover different points of view and misunderstandings. There are always surprises. E.g. a project manager wants something that is technically not possible. There is some structure but the goal is brainstorming and not planning. We need to check what is true, what is not. Challenge is that the project manager brings his own ideas and it's hard to say something against it. The moderator (Head of Project management, Marco Dietz) leads the session and facilitates the decision in the case of disagreements. He doesn't take decisions based on content, he points out pro and con arguments. It is important to have someone that is not into the details but observes and decides in certain situations. Decision is made based on consensus, in some cases only product manager.

Clear topic for ideation, there is not a lack of ideas
34:09 The ideas can be of any type: services, use cases, solutions how to sell something. It was about stationary gateways. The question was how do we offer it, what are the use cases, what services do we need, do we sell it or lease it. You can do anything. We had 1000 ideas but it was good that the product manager already had a hypothesis: we should lease it, that we have services where it will be installed and use case 1, 2 and 3. It was a clear starting point, you go crazy as a group if you have too many possibilities to discuss.

Assessment and prioritizing of ideas
36:03 In a second step we looked at the details and functionalities that need to be developed. We intensively discussed what we need, which things are very difficult (we marked them with a star), which things we are not going to do. If we didn't see a connection between the functionality and the application, we didn't do it.

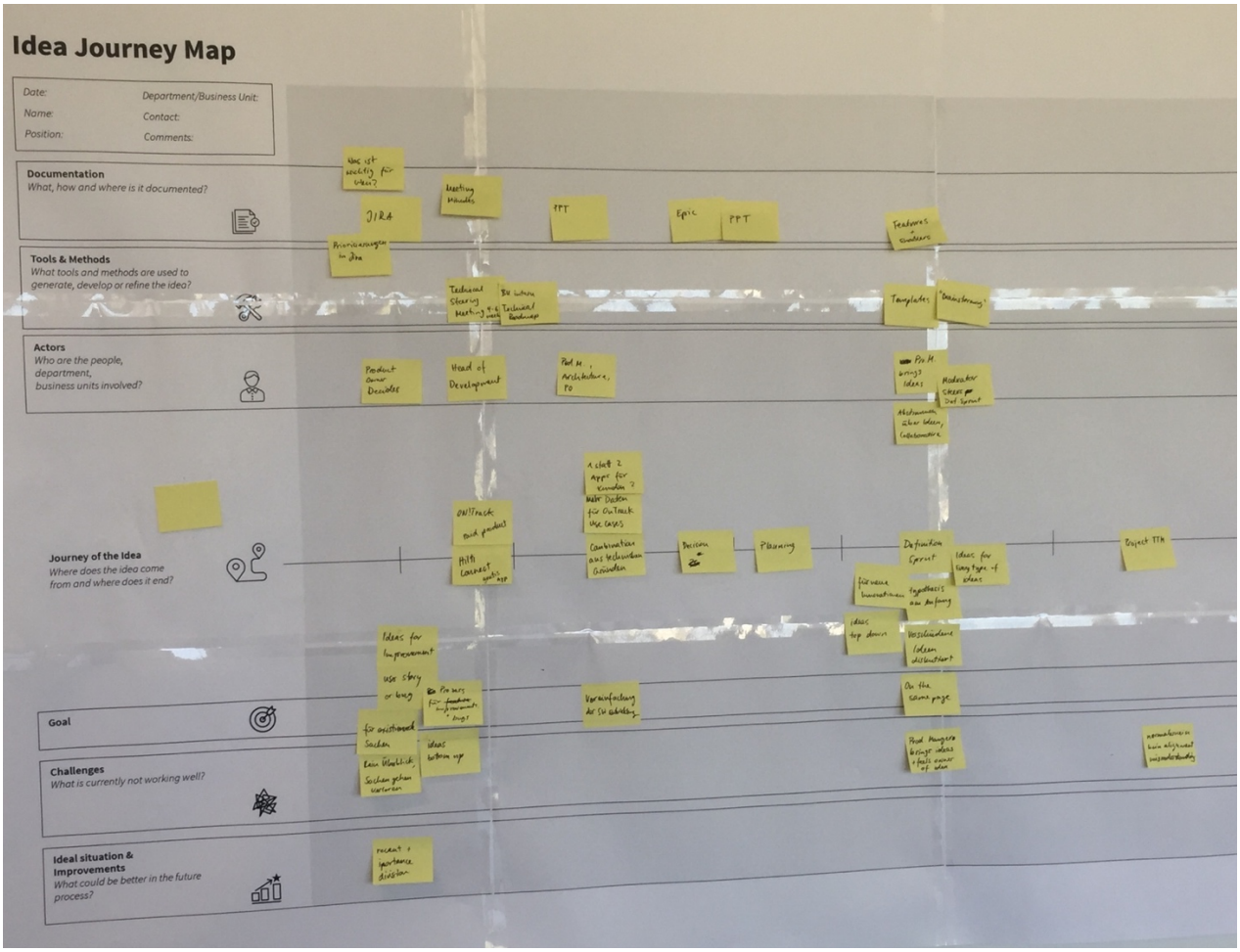
Documentation
37:04 We have a lot of ideas, that we have to say we didn't think about that, but it would be nice if the user could see this and that in the system. Example: the scanning, the user doesn't know if the devices is scanning or not, there is no feedback. We have a lot of ideas for improvements, maybe not use cases. Usually first documented in JIRA as improvement, user story, feature, bug. Product owner evaluates it, must have or nice to have. It also happens that we say that's a good idea, we're going to do it somewhen and then it goes in the backlog. BU and MO's have access to backlog. But I think it's better if only BU has access and MO's get information in another way. It's not good if everyone has access to everything. It might raise a lot of questions which are not important to them. These ideas for bug, improvements, ... usually go into the standard processes. There are a lot of ideas for small improvements. Everything is documented in Jira. We have the problem that we have too many ideas in Jira and we can't do everything. At some point we have to close certain things, but it's much easier to just leave it there in Jira.

Prioritizing
42:50 They are automatically prioritized in Jira. The MO's use a label to have a preview of what is important to them. There are no criteria to prioritize, only for bugs, there you can see how many times people had this problem with this bug.

Documentation
44:32 [How do you keep an overview of the ideas? Do you remember where to find things?] Most of the times these ideas are lost. When you want to find something later on you search in your inbox or directly in Jira.

Idea for improvement
46:19 It would be good to automatically throw out things that were not viewed or updated within the last couple months. You could still find it if you need it but it wouldn't just appear.

Different type of ideas, bottom up or top down
48:07 The small ideas (during projects) are usually about something that already exists and the definition sprint is an initiative for something that does not exist at all (big ideas). There is usually no overlap of these two. For the big ideas it's top down: epic, features, enablers, then user stories and enabler stories. It can also happen bottom up, that from a small improvement there is an idea for a whole new product. E.g. active tracking, we could make a second app that is only for scanning. It didn't happen in the end, but it could.



11.3.5 P05

Participant number: P05
Date: 1.4.2019
IDJM: Yes
Job description: HW TTM Connected Tools
BU: Tool Services
Overall Impression: He has experience in innovation at CR&T and is well aware of the Fuzzy Front-End of innovation. He says there are ideas in his head, but he only communicates them if they are aligned with the strategy. Otherwise he will only create more work for himself. One big challenge is also the silo thinking. There is no central documentation of ideas, there is however like a backlog of ideas. There should be startup environment to develop ideas (time, resources).

Background information
00:44 At Hilti since 2010 (9 years), background in telecommunications engineering and finance management. Was 6 years at CR&T, where they have a sturctured approach for innovation. Now TTM project lead at BU Tool services.

Directed ideation

08:26 We are working from different channels/sources for the innovation pipeline. You can use a Design Thinking approach, for example, we want to connect the tools and we see left and right what possible problems can we solve, if we would have certain data available for the customer so we can solve certain pain points. This we call directed ideation.

Random ideas
09:16 Another direction is during day to day work, when an idea pops up. We could apply something similar (a similar setup) to a completely new area. There is good potential (for an innovation process), because everyone is stressed, and you have the idea, but it doesn't end up in a tangible document that you can later on assess. Also think about market and customer input, that's a big topic.

Input from trends
10:17 You can come from megatrends, such as IoT, you see a business opportunity and you ask yourself: how can we solve this. Or you look at other trends and do problem spotting, such as efficiency in different industries. For example, in production, over ten years there was like an improvement of 50%, thanks to robots, automatization, standardized processes, ... In construction it's pretty much flat, no efficiency. Then you can think about how we can profit; you have a problem and you put ideas around it.

Input from customers
11:46 The other one is the classical customer talks and you listen to their problems. Like a customer says, "I have a mess. I can't manage my assets." Then you can solve that problem. If you give a context it's much more efficient and easier to get ideas.

Proposed solution for process
14:26 (At CR&T) We have key technologies at Hilti, differentiating technologies where we are better than competitors, with these we want to keep ahead. Then we have trends and innovation areas that we define, like smart systems, which create swimlanes form ideas. Bi-weekly we have low burocracy meetings, write down on piece of paper problems, ideas, key challenges, questions to help mature in a 12 weeks kanban approach. In these 12 weeks you have to decide: 1. project pool, you have to prepare a bit the idea, BOD, why should Hilti invest or 2. just do it, we ship it to the business unit, TTM, or 3. idea is nice, but too far in the future, we put it on hold, backlog.

Where ideas come from
16:33 At BU Tool services, there is no standardized process. It's up to the people and their relationships. If somebody has an idea there are two ways: 1. technology review meeting (tech push), I have an idea (based on technology) and I want to get input. There are currently no many examples. Ideas are discussed and feedback from group leader. Decision: A. is it potential new project or B. it can be integrated in existing product, extension. 2. Marketing meeting (market pull), same procedure as above. Decision: A. is it potential new service solution or B. it can be integrated in existing product.

20:02 Work and discussion are not really made visible, like protocol-based meetings. This can also end up in the roadmap. Every year, end of May/June, there is a Business area strategy meeting. 3 months before every BU has to provide their roadmap. For each area, like Fleet or On!Track they have to say, what is the big bang, the big developments. For this you have to prioritize the backlog of ideas with defined criteria, is it implementation feasibility, rescource, ... Then you can build the roadmap.

Documentation
22:07 Currently there is no stadard backlog. Documented in PowerPoints and output of workshops. It's up to the group leader of each area to push it or not. Normally, the ideas is alway linked to the application, it has to have a context. If you have a good idea but Johannes Paefgen (head of development) is not behind and is not pushing in these meetings, nothing will happen. For tech ideas it's Johannes Paefgen, for services it's Martin Inganaes. Then they do the roadmap proposal. This is the master plan, the big swimlane and all around it's not operationalized. There is the 1 year and 3 year roadmap and the then you have the directions which give you the context where you want to focus.

26:14 It's a multidisciplinary assessment of the ideas. Tech guys think it's fun, but there is no business.

Types of ideas
26:58 Two options for ideas: 1. related to exiting product, 2. completely isolated idea. During a project, if an idea is realted to product, I go to the product manager. If enough value, it goes to the first release otherwise it goes into backlog

for future releases. Backlog documented in powerpoint. Two reasons to put it in backlog: 1. availability of needed components (back end), it's not yet there, 2. no resources, this happens a lot because of multitasking.

Motivation, lost ideas
30:22 I have a lot of ideas that are not realted to the product. They stay in my head. They are in different contexts and in business areas to play. I don't share my ideas because the likelyhood that they turn into a product project is limited because of the focus areas at Hilti. If they are aligned with the strategy I share them. I don't want to create additional workload if they are not fitting with our strategy. If I would have time assigned for this, that would make sense. Currently there is no time assigned for this. I would like to have like half a day per week to work on this.

32:26 At CR&T they have 10% for that. It's difficult to put this inpractice. I have 60% in one project, 30% in another and 10% for this. Not every week is the same and not every stage of the project needs the same amount of time. Normally there is no much time reserved for unplanned problems.

Proposed solution for process
34:17 Ideally it would be more like a startup setup. You run a proof of concept, where you have all the resources needed for the idea assigned, for the project, a very short period of time, so you can validate the idea. Challenge: Know-how is spread across the business unit, it's hard to get one multifunctional team assigned. Even for a small idea you have to fight for the resources.

Knowledge sharing
36:18 Knowledge sharing is about mindset. Silo thinking (I'm a hardware guy, i don't care about software) vs. problem solving (how can I make this work). You have to know what you are searching for. Challenege: a lot of people don't know what they are looking for. There needs to be a more holisitc understanding and not just specialists.

Communication
39:42 Unrelated ideas, also interesting for other BUs are communicated via email to product manager. This input from other areas to me does not happen as much as I would like. I know a bit what other BUs are doint with IoT, but not in detail. When you talk to people you realize what they are doing.

Assessment of idea
42:06 Idea assessment: 1. What is the value for the customer? What is the problem? Is the solution solving the problem? 2. How feasible is it to make it happen? 3. Do we have the resources? No predefinded questions, only discussion. Product mananger needs a certain business knowledge. If it's nice to have but no market pull, you just leave it there. you have to have a real use case.

47:22 Does an idea have a platform potential? Then you have a multiplier of the value.

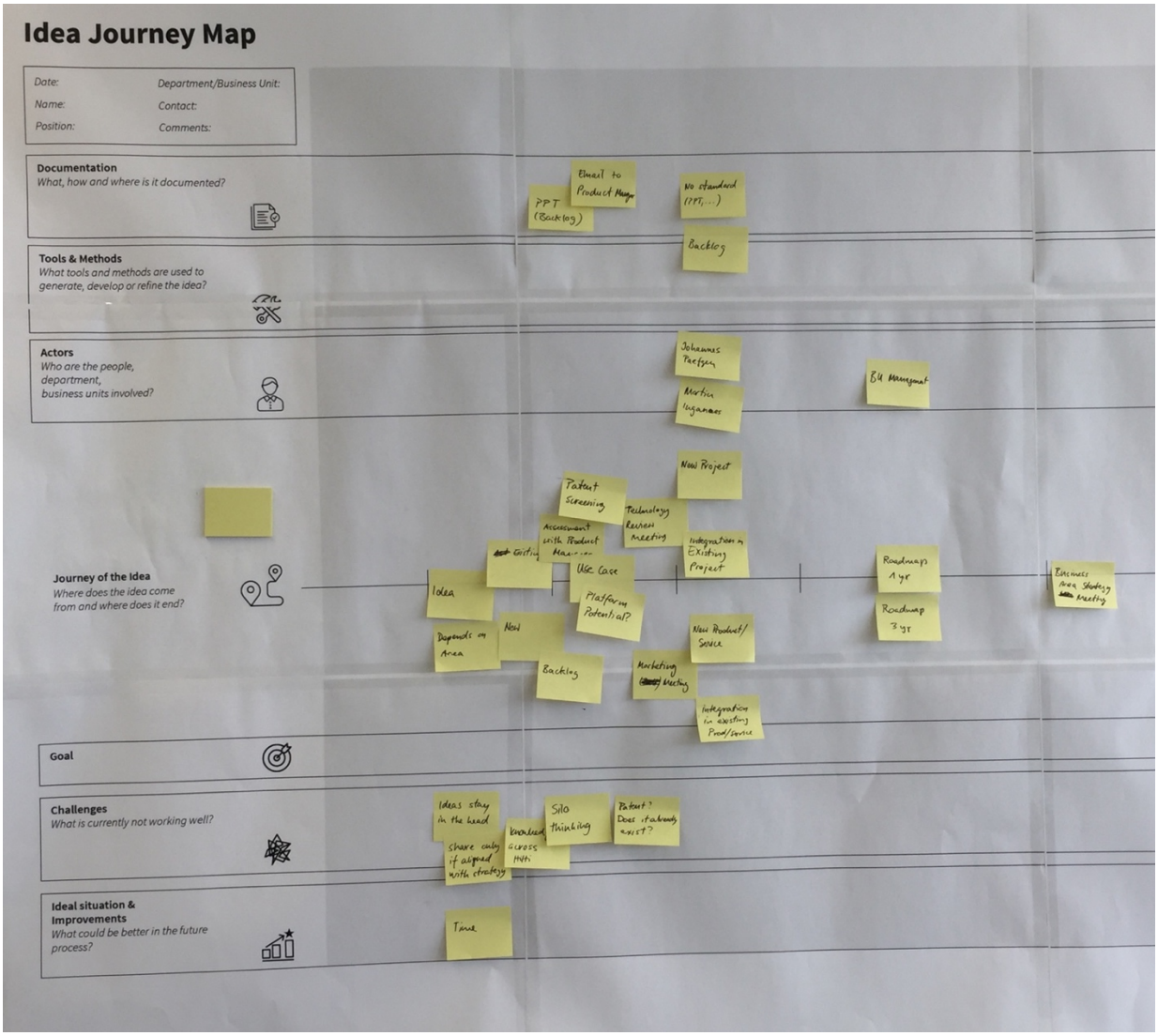
Patent
48:08 Challenge: Not everything is patentable. Patent screening takes time. It's rarely the case that you have a blue ocean.

49:53 Patent screening: when the concept is fixed, you have the use case, the technical solutions, you know the system, the data flow, power supply, communication, etc.

50:53 Not all products have a patent behind it. If that would be the case, many products wouldn't have come to market.

51:21 IoT is complex and we're not competent in that area. We are newbies. We have to gather the knowledge from all the projects and Marc Vetter checks for the patents.

53:10 The technology is there, it's just applications and the context of the use case that are patentable.



11.3.6 P06

Participant number: P06
Date: 2.4.2019
IDJM: Yes
Job description: (Inventor)
BU:
Main Insights: He believes that IoT will reshape the whole organization as it will affect all BUs.

Background information
03:20 over 30 years at Hilti, background in electronics, now in development, we started with IoT 13 years ago. We wanted to collect market data. We wanted to know what the user does with the tool. There like 30 different equipment for a DX460 for different applications. A lot of customers don't know what they could actually do with the tools. The customer should know what he can do with the tools and he should do it the right way. If he does something wrong, he can break the tool. The customer doesn't know that he's doing it wrong. With IoT you can give the user a feedback that he's doing it wrong. 1. It's about gathering data, 2. it's about giving feedback.

06:26 When positioning a nail, the tool can give you instructions and feedback if the nail is placed in the right position. You don't have to measure it manually (with a stupid gage that are difficult to use on construction site) but it should be integrated in the tools. There are the hidden IoT applications.

07:47 In the future it will be like this, if a worker does something on site, it will immediately be aggregated in our database how much percent he does in a certain market segment. There will be no more writing on paper and copying several times. Everyone can take the information he needs from the database.

10:05 This tool (GX, electronic) can detect 65 error messages and does a diagnose itself on the tool. It knows when a part of the tool is not inserted properly. In CR&T they are working on a project with AI to detect new errors. For us at research, it is important to get information early on. Not all information but the right information. We have now a case where there was a small mistake in the production, which caused the tool to be able to activate itself, which could have consequences regarding safety. This error we want to know immediately, before the tools get delivered all over the world.

Documentation
12:18 We not only want to gather data from the field, but also internally, when we test the tools at Hilti. We want all this data to be stored in the database.

Tools/Method
13:34 From time to time we do brainstorming which is then left somewhere in a drawer.

Ideas come from project
14:32 We have a tool with a mechanical part in the front that detects if the nails are in the right position. In our area, we still work with a lot of mechanical solutions. I had the idea to put in sensors. Most of the ideas come from problems, during a TTM for example.

Writing a patent is work
16:06 Writing a patent creates a lot of work, you're going to be busy for a year with it. I have written about 30 patents. Usually you are with both hands in you daily work, then you need a team, rewrite it, check with the patent lawyer. It's hard to bring proof, the patent lawyer always says, that already exists. What is special about it?

17:20 In this case, we did brainstorm, what could we do, how could we solve the problem? We saw that all the mechanical solutions were not satisfactory as they were using too much space. So, the options were inductive and capacitive. Capacitive got rejected by research department.

18:14 We created a service where we collect data from the market (13 years ago). We put in electronics to monitor the amount of fixings that were made. We built a modem and a database, and this data was transmitted daily.

19:31 In a group we did the brainstorming, we had a lot of ideas and then quickly assessed them and decided which solution to continue with. We are all experienced developers. I don't know if anyone documented all the ideas.

Death of ideas
19:57 When you are in the TTM process, such ideas almost never have a chance (to put in a sensor) as it is a completely different solution. Unless someone has the motivation, takes initiative and writes a patent, these ideas usually silt up and get forgotten. You always go for the low-hanging fruit. Whatever is feasible within the given time. That's why some things never get implemented.

21:11 This young guy sat together with the research team and built in the sensor, but only to show proof that it could be possible. But the project was discontinued because there were no resources. During a TTM process everyone is under time pressure, that's why it's called Time-to-Money. It's not like in research where they have the time to experiment.

Documentation
22:15 There is no standardized process to document ideas. The goal of the brainstorming is to provide new ideas for the designer of the solution. His goal is not to document ideas but to have a solution. (Note: focused ideation)

Intrinsic motivation
23:55 This guy did it out of his own initiative. He was able to show proof that it could work. Now he wrote the patent. But that's normally not the case.

25:00 We would have a lot of topics, like in measuring, where IoT is crucial. Simple things such as connecting a measuring device with a database. I know they are working on it but I don't know how far they are. To have one interface where the different measuring devices can access that database.

27:10 We don't patent everything. There are masses of ideas. The whole world is creating ideas.

28:16 Another thing that they are working on in CR&T is predictive maintenance. That the tool communicates that it needs repair, before to worker knows that it breaks down. But I don't know how far they are.

Direct personal contact
28:47 If you have a problem during a project, usually you approach the people you know that they have experience in certain things. Then we invite them for idea generation.

Idea generation
29:25 This idea generation always happens differently. We tried tons of different methods, like house of quality, 3-4 ways of brainstorming. What worked really well was writing down an idea on a piece of paper, pass it to the next person, then that person continues with that idea. That was really interesting, because new ideas were generated, and it was efficient. It's also important that there is not too much writing and reading. This was really creative, and you could see how people built up on each other's idea (Note: everyone is a small owner of each idea).

31:09 In the last couple of years a lot has changed regarding bringing new ideas. Before you were talking against a wall. Now it's much better, that ideas are collected.

32:14 Ideas that don't fit in the concept are killed quite quickly. The goal is always to develop a product as fast as possible. A project leader doesn't really have an interest in innovative ideas. That's not his goal. Innovative ideas are in the interest of CR&T. They only cost unnecessary effort for a project. The project leader is busy with project related work.

Documentation, database
33:51 We solve the same problems over and over again. We have a database (in SharePoint) where we document ideas and at the start of a new project, we are obliged to research what has been done in the past. But we don't really do it for the brainstorming. Only selected users have access. In there is a gigantic amount of know how.

37:30 But IoT will affect all areas. It will change the whole company structure.

41:55 [What was your motivation to write patents?] When you see all the possibilities that you would have. And there was a small amount of money you get, like 300€.

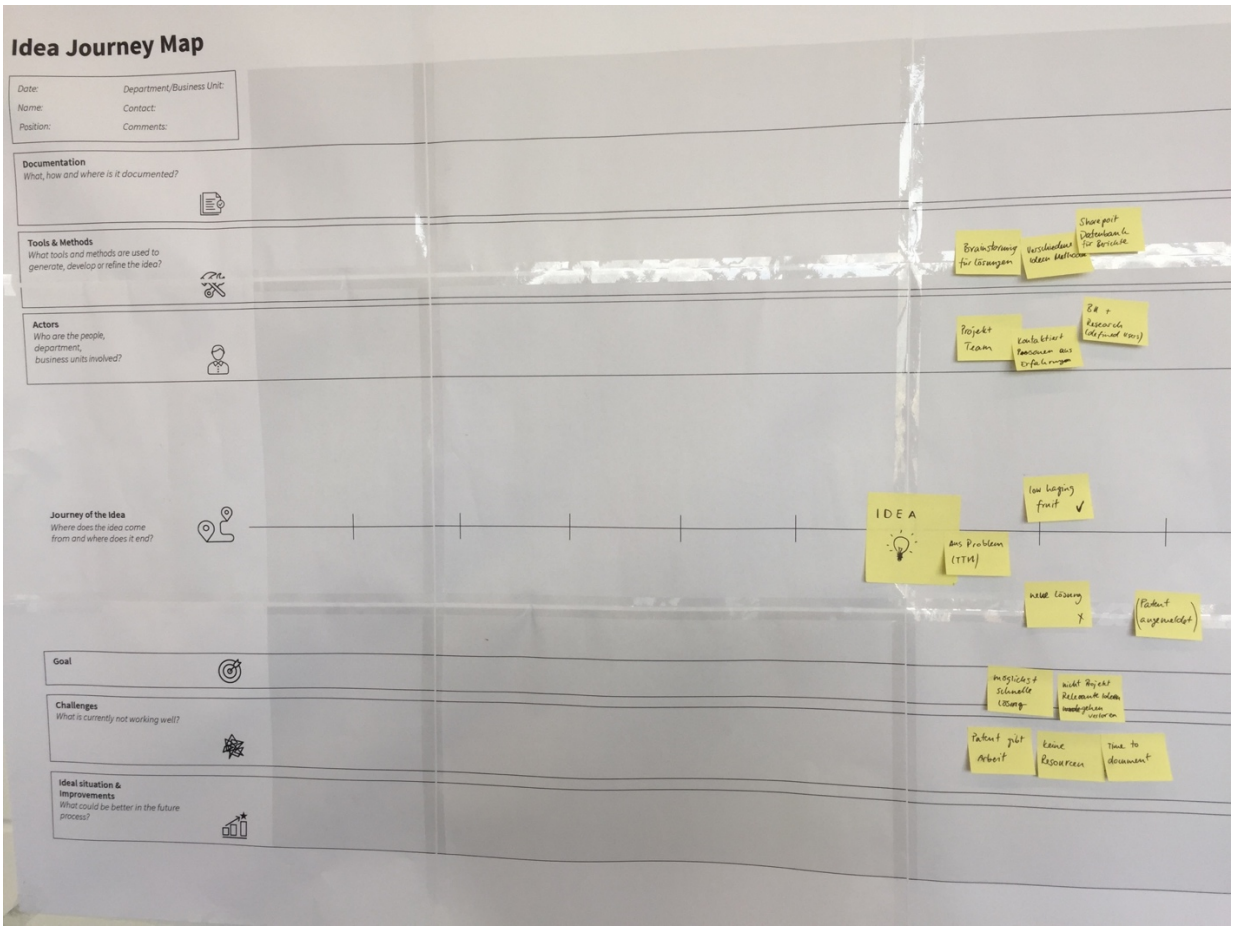
Writing patent takes time
43:01 It took about 1.5 to 2 weeks of work all together to write a patent. I didn't get extra time to work on the patent, it was besides the running projects. First of all I did it because I wanted the idea to be heard. And later when you get something for it, you're happy too. But that is not the focus in the beginning.

45:40 I'm convinced that a lot in the company will change due to IoT.

47:51 I imagine that in the future on construction site everything will always flow. The right things will be at the right place. That's just something you have to implement.

Customer centricity
53:19 What I also find important are our customers. They have a lot of ideas for a lot of new applications. They should also have the option to communicate this, so that this comes all the way through to us. We always say that we (Hilti) are so close to our customers, but it's important that we really use that close relationship.

55:16 There are different inputs: market, technology, external companies, ... Maybe there should be something like artificial intelligence that looks into all that different inputs and sees how all this can be connected.



11.3.7 P07

Participant number: P07
Date: 2.4.2019
Job description: Program Manager Connected Tools Solutions
BU: Tool Services
IDJM: Yes
Overall impression: Very analytical person, knows where the ideas come from (Different Bus) and has a good understanding of the customer. He knows how to assess the potential of an idea (decision matrix). He would like to have more quality than quantity of ideas. There are enough ideas at Hilti, but not all make sense or actually deliver value to the customer. He would like to have a framework for validating ideas, so the people with the idea could validate it themselves and not come to him with stupid ideas. His motto: the KISS principle. “Keep it simple, stupid“.

Background information
02:06 At Hilti since 3.5 years, runs Connected tools program. We create and deliver IoT solutions which are oriented around a single tool (individual tool level). ON!Track creates solutions around an entire asset park (enterprise level). How can we make a tool that makes the life easier for this worker, by adding smartness to it. That's the scope. For ON!Track it's more about how can we improve things on the whole construction site. ON!Track and connected tools will merge into one soon.

Idea generation
03:55 How do we come up with use cases, features, etc. 1. technology centered approach, 2. customer centered approach. A good company combines both. You need technology outlook, enough technology projects in the pipeline, to see what can be done. And customer pain-point centered approach to see what should be done. There is an overlap and you do the overlap. That's essentially a good funnel process.

Knowledge, know-how
04:46 What we don't have today is a lot of technology fronted-ness as we don't really run tech projects in the field of IoT yet. In the customer pain-points fronted approach we have a fairly decent understanding at an enterprise level. Unfortunately, the understanding is only with a few people. It's not spread far.

Lack of customer understanding, feature ≠ value
05:45 We have 5 tool business units and each of these BUs have their own development setups. And all these bright developers think about what new cool features could I do. Not everyone has the same understanding of the customer pain-points. So, you have a lot of cases where people say I want to do something because it looks very cool. But they might not put the customer hat on and think of the customer pain-point and realize that it might not be of any value. The challenge that we face is: we have a lot of people with ideas about features and they do not have the understanding that a feature is not equal to value.

Example
06:40 Example: tool with a light. Due to cost reduction the light switch was replaced with an IoT base solution, an mobile phone app. ... Cool feature, zero value. In fact, negative value.

Proposed solution for innovation process
09:08 If we can create a mechanism by which people who come up with features can very rapidly test value without spending a lot of time and money. That would be a great outcome. Because you should never tell engineers not to think of ideas, they should, that's their job. They're the ones who come up with incredible ideas, but out of every 100 ideas 3 or 4 will be really valuable. The rest are so-so. So, we need a mechanism by which individual development engineers in the company, who will always be within different business units, can quickly test the value of their features. And then they can kill these features before they waste other people's time.

Quantity ≠ quality of ideas
10:20 There is no dirt (lack?) of ideas. IoT is a landscape where everybody's grandma has an idea. Ideas are very simple to make. If I call a workshop tomorrow with 10 development engineers I come up with 100 ideas. I am not looking for ideas. We have too many of them. I am looking for people to be given a framework, where they can self test those ideas and check if they have value. And then come to me with the funnel of value-adding features. I don't want them come to me with a feature idea and I have to kill it in 10 minutes.

Example
11:16 Example: Rotating laser, base, tripod. Every time laser does calibration check, laser does auto log. With the smart phone app, you can read out the data and check when the laser was calibrated. Fantastic use case. However, storage of the log is on the remote and not on the laser. It is not initiative.

Lack of end-user understanding
15:33 They didn't think through the actual end usage. They thought through the usage in the digital world but not in the physical world. Naturally you would go to the tool and not to the receiver.

Requirements for innovation process
16:22 What I then want is: How is that feature used end-to-end, not just in the digital world. I really want people to think end-to-end, in the instance of use. On the jobsite, in the warehouse, in the truck. I want people to go and spend time there to figure that out. Otherwise we always end up with things like this. And that's a disaster.

Knowledge and experience sharing
17:02 The next issue: When it comes to thinking of IoT features, we have a lot of development engineers who are super enthusiastic. It's really cool stuff to do for them. But if you take a look at Hilti's marketing people, we have a range. 1.

Young and enthusiastic, 2. Old and experienced, know construction industry very well, not very digitally enthusiastic. We need to create the same level of awareness in the marketing community. The marketing people within the different BUs need to support the development colleagues, because they are coming up with ideas. If the development guys come up with a new idea, marketing usually says: "Do it!", because they are getting something new.

Misalignment marketing / development
18:01 What I want the marketing colleagues to know, it's not just do it. How to implement such a use case is equally important. And that "how" is only going to come from the marketing guys, because they are closer to the customer. That process needs to be put in place. That for me is the innovation pipeline. We have ideas coming from the customers, we have ideas coming from development. Ideas we have no problems. We can generate a list of 200 ideas tomorrow morning. What I want is a good framework for people to self evaluated whether their idea has value and then to evaluate the best way to bring this idea to life. Keeping in mind the persona as well as the situation in which this feature is going to be used.

Who is the end customer? Who is the value created for?
19:48 Example: At direct fastening, they have very good developer guys who want to bring IoT use cases to life. They have one use case where they track the usage of the tool. The question is: To whom is this use case useful? Our customer is very different. CEO (doesn't care about usage, only about costs), purchasing manager (cares about renewals), warehouse manager (cares about location of the tool), foreman (which worker to give the tool), worker. For purchasing manager is probably most useful. IoT can enable, it cannot make the process. In a use case like this, there is a lack of end-to-end thinking. Who is actually benefitting? Does this use case as a stand alone use case make sense? Actually it doesn't. It makes sense when your sales guy can use this use case to set up a reordering process with the purchasing manager. This use case should be accompanied with a lot of training to the sales force. How to take this cool use case and deliver real value with non-digital stuff is the piece that we currently miss. It's real life interaction enabled by digital data. The magic will happen through a mix of everything.

Propose solution for innovation process
24:04 It's also a learning curve for us. Within one year, since the beginning of the connected tools program last year, we are learning a lot from these implementations. What can actually help is putting down 2 or 3 good processes. Not for idea generation. Idea generation is not the problem. It's more about killing ideas. I really would love if somebody would actually come to me and say: "We had 10 ideas for this tool and we killed 9 of them." That would be really valuable.

Assessment criteria for ideas
26:24 [IDJM] In connected tools, there is a tool TTM. One day, someone hears that another company announced smart tools and then they come running: "we need smart features." We need help, what can we do? They come with a list of ideas of smart features or self-generated ideas. Then 'we' (Puneet) usually do a consulting process with the particular business unit which takes about 1-2 months, to evaluate the business landscape. Basically, I ask them questions. Who is the customer? Who is the person using the tool? How are they buying it? How is buying it? Why is it being used? What are the problems? I send them some surveys usually. They come back with the problems and some use cases that might be useful. Then I send them to finances. I also have a list of standardized use case modules, that are applicable to any tools. I try to guide them towards those modules rather than let them come up with their own ideas (like switch removal).

Business brief
28:56 Then we have to agree upon certain use cases and features. Once we agree on those, I ask them to prepare a project order or a business brief. For the business briefs I have a format. Usually it takes a couple of rounds for them to write it well, including all business logic. Then we define the final business brief, which is documented in confluence. Then comes kickoff meeting, where I call the tool business unit and all it's major actors: tool marketing guys, tool development guys, everyone in the stack such as someone who works on connectivity, SDKs, edge connectivity, cloud, mobile app, etc. I bring everyone in the same room, where I connect the right people and we see how to proceed.

33:13 Already in the business brief we see if this is a super massive effort or massive effort. One step that I missed: Once they have the business brief, I take this business brief through my BU management, because I need this project financed and put on the roadmap. Management decides if it goes on the roadmap.

User understanding

34:37 When someone comes up with an idea for a feature, I take them downstairs to the trade hall, where we have a jobsite setting and to test the feature, I let them use the tool as they were the worker. Typically then they understand. The best thing is to show them and preferably next time they will go and test it in the trade hall first. There are around 200 development guys and 50 product managers, I can't afford 250 people coming to me with ideas. I need to create competence that they themselves can kill ideas.

Loss of ideas
36:21 New ideas are typically never picked up during the TTM. In the TTM process after G2 the specs are already locked. Depending on the agility of the lifecycle of a tool, you can or cannot put things in the TTM. Example: TE3000 for 2023 specs are already locked. If you want to influence the next generation TE3000, it's for 2029. Once we finalize the business brief, we're shooting.

38:38 The challenge during the consultation phase with the BU is to ensure that we pull out all the use cases of real value and through out all the ones without value.

Platforms and modules
39:12 Another challenge is to create similar use cases for different tools. You can't have 3 different tools with completely different use cases. In the end the sales guy is the funnel and he won't remember the different use cases for all the different tools. If he doesn't remember the use case, he won't tell the customer and your feature and use case dies there – even if you build the best feature in the world. That's why I lead them towards common use case modules. All the smart tools have the same features – that would be the ideal world. Like this you can create platforms. I want to create modules and platforms, not tool specific use cases.

Type of idea
41:06 What happens with an idea depends on which layer of the IoT stack the feature impacts. If it doesn't touch hardware and only uses data that is already there, it goes into the backlog as an improvement idea. Documented in connect improvement ideas Jira board. A lot of times we release a feature, customers use it and come up with an improved idea, which is then documented in this Jira board.

Documentation
43:27 Soon we will have a common Jira board with ON!Track as they will merge.

44:23 Bad ideas are hopefully gone for ever and not documented anywhere. Or maybe we created a Jira board of shitty ideas.

44:57 Example: BX3, has a find me feature, which is only used as a prank.

Misalignment marketing / development
46:59 The main challenge is that development guys are very in tune with IoT, but not every marketing guy is. Marketing guys like new features, but they don't put the customers hat on.

48:49 KISS: Keep it simple, stupid.

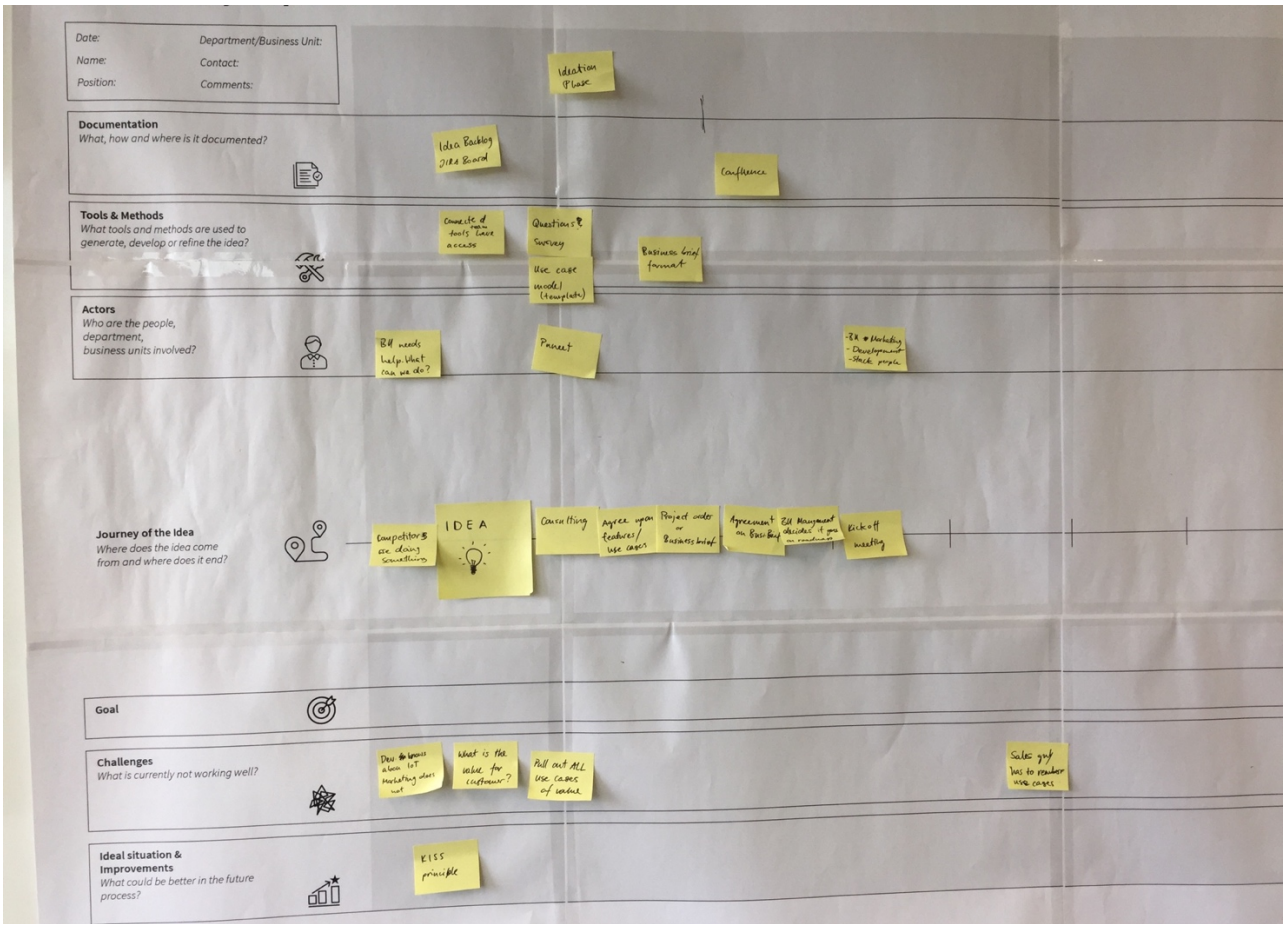
Assessment of ideas
49:14 I am very okay NOT doing a fantastic feature, which adds a lot of value but only for one tool. I would rather do a okay feature, which adds medium value, but goes to every single Hilti tool.

50:07 I have a matrix to assess ideas.

51:26 Sometimes there are multiple features competing for the same time, then you negotiate with the tool BUs, if not possible you go for the one that adds more value. Usually, we find a way. Hilti is very collaborative. With objectively evaluating which feature has more value we have no problem.

Next steps

54:03 Go out and meet the tool business unit guys. They are the ones who come up with these ideas. Marc Schäfer (BU Diamond), Bert Klaus (Direct Fastening), Marco Barasa (PT&A), Ian Kearney (Measuring). They have tool TTMs, which we are currently working on.



11.3.8 P08

Participant number: P08
Date: 3.4.2019
Job description: R&D Expert
BU: CR&T, TPR Robotics & Visual Computing
Main Insights:

Background information
00:20 15 years at Hilti, CR&T, in the area of visual computing

Business need vs. feasibility
00:55 My task is about finding innovation. The key is the match between business need and feasibility. Business needs from marketing are usually 'wish lists', but they are not doable as listed. What makes sense vs. what is possible. That only works if you bring both sides close together or if you know enough from both sides that you can assess it yourself. As we have a dedicated research department we can look into more long-term topics. 30% of what we do should end up in a product.

Misalignment marketing and development
03:54 There is always the problem that you have people who are very good with technical things but have no idea about marketing. On the other hand, you have people who know what the customers want, but don't know what is actually feasible. There it's important to bring together the right people. In project teams there should always be the both, people who know the needs and others who know what can be done. A lot of times it happened that the outcome of a project was different than the initial project definition. During the project we saw that certain things are not possible and other things were more relevant.
Example
06:23 Example: Anchor fastening tool (power tool and anchors). It is difficult to do projects that include different business units besides your daily business. You have to see what others are doing and how they could be brought together? This freedom is very important, but you only have it, if it is given. If you start with something that is already very strictly defined, it usually doesn't lead to the great innovation.

Freedom vs. combination of needs and technical possibilities
07:40 Freedom vs. combination of needs and technical possibilities. Of course, it would be helpful if there were more structure. It is all based on who you know, who do you have to talk with, where do you get good input? Of course, a product manager always sees it through his lens. It would be nice to have an overarching objective opinion from someone who is above BUs and takes both into consideration, product and marketing.

Requirement for innovation process
09:13 At the moment it is very much based on experience. It is difficult for new employees to place a good idea that has a relevance for our business needs. It took me about 4 years to develop the feeling for what ideas make sense and what doesn't. It would be nice to accelerate this process.

Input
12:24 I think an important part of the innovation process is to understand the market needs, what does the customer want, what are competitors doing, what happens in other industries? To have an overview. However, in the end you have to implement something, and this is mostly technology-driven. We have a lot of new technologies that pop up where we evaluate what it can be used for and how it fits our customer needs.

Relevance vs. feasibility
13:34 If you only look at 'wish lists' from marketing with the most important customer needs and try to implement them without understanding the technological feasibility, it won't work. There has to be a balance between how easy it is to implement with the technology available and how relevant it is for the customer. From technology perspective they should at least have a rough idea how to get to the final outcome.

Assessment criteria
15:01 A good check (at least for myself): If I had € 100.000.- that I could invest in that idea, would I do it or not? If I think I wouldn't do it myself but it's just a Hilti project, then you shouldn't do the project. You should somehow have an idea how it might work. You can still fail at it, but at least it should be possible.

Idea management process at CR&T
17:30 At CR&T there is an idea management process. Every idea should end up in that process (it's not always the case). If you have an idea where you don't know exactly what to do with it and you don't take own initiative to further evaluate it right away, end up in the process. There is a one pager of every idea, which is presented every 2-4 weeks to all the people that are somehow interested in it within CR&T (30-40 people). In that meeting the idea will be discussed, specific questions are asked, idea is sometimes a bit further developed, what are the next steps? Do we do an additional workshop? Communication with marketing? Communication with external partner? In the following meeting the idea is discussed again and after 12 weeks the decision is made: 1. Is it filed somewhere, 2. Project pool, idea is later further developed for research project or feasibility study, 3. sent to a BU. The idea is to always decide together what are the next steps, such as a workshop. If you don't have a detailed solution or don't know the market relevance, you do a workshop.

Knowledge sharing

21:35 The meeting is mostly for ideas that are not related to what you are currently working on. It's also to connect the right people and exchange information. This way people know who is working on what and they can contribute their knowledge to other ideas.

22:54 We used to have regular meetings where we invited people from marketing or development who presented their current projects and problems to get input across BUs. However, these meetings "fell a bit asleep". In theory they exist but the guy who led those meetings left Hilti. It should be reactivated. Malte Seidler, Head of TPA used to be responsible for that.

Input
24:33 Also everyone is encouraged to go in the field with a sales person. To experience the construction site. How are the tools used? Talk to the people. From my experience it's better to do that when you are already in a specific project as you have specific problems. What we also do is to go to the customer with demonstrator to get feedback or to do customer acceptance test. However, usually we don't speak to customers about our ideas as we might not have patents yet.

Documentation
26:26 All the one pagers are documented in confluence, with their status, what happened to them, for what reason they got rejected or ended up in a product. Not everyone has access. The rule is, marketing shouldn't have access to everything as they might promise things to the customers that are not fully developed or don't exist yet.

28:08 A lot of times ideas are not really ideas but rather wishes. "Wouldn't it be nice if we would make..." Like this, the idea has no value. It only has value if there is a certain relevance and a connection to a technology. It can also be that you have a technology but no relevance yet. Then you can ideate about applications.

Where ideas come from
30:54 1. Friday for the future. Workshop, one topic, people from different BUs are invited, ideation about applications for a certain technology, sometimes good, sometimes not. 2. Random ideas. During a project, under the shower, etc. In principal, everyone should have 10-20% time for idea management, such as internet research, tradeshows, etc. to bring new input. Everyone has topics that they should monitor (technology monitoring). This however depends a lot on the person if they do it or not. Some don't do it because of project work they don't have time; others don't feel like doing it. You can't force anyone to do it, but you have the chance to do it. It is also pushed that people do it. You have to reserve time for that because in a project you always have something to do. It has to be pushed from top down.

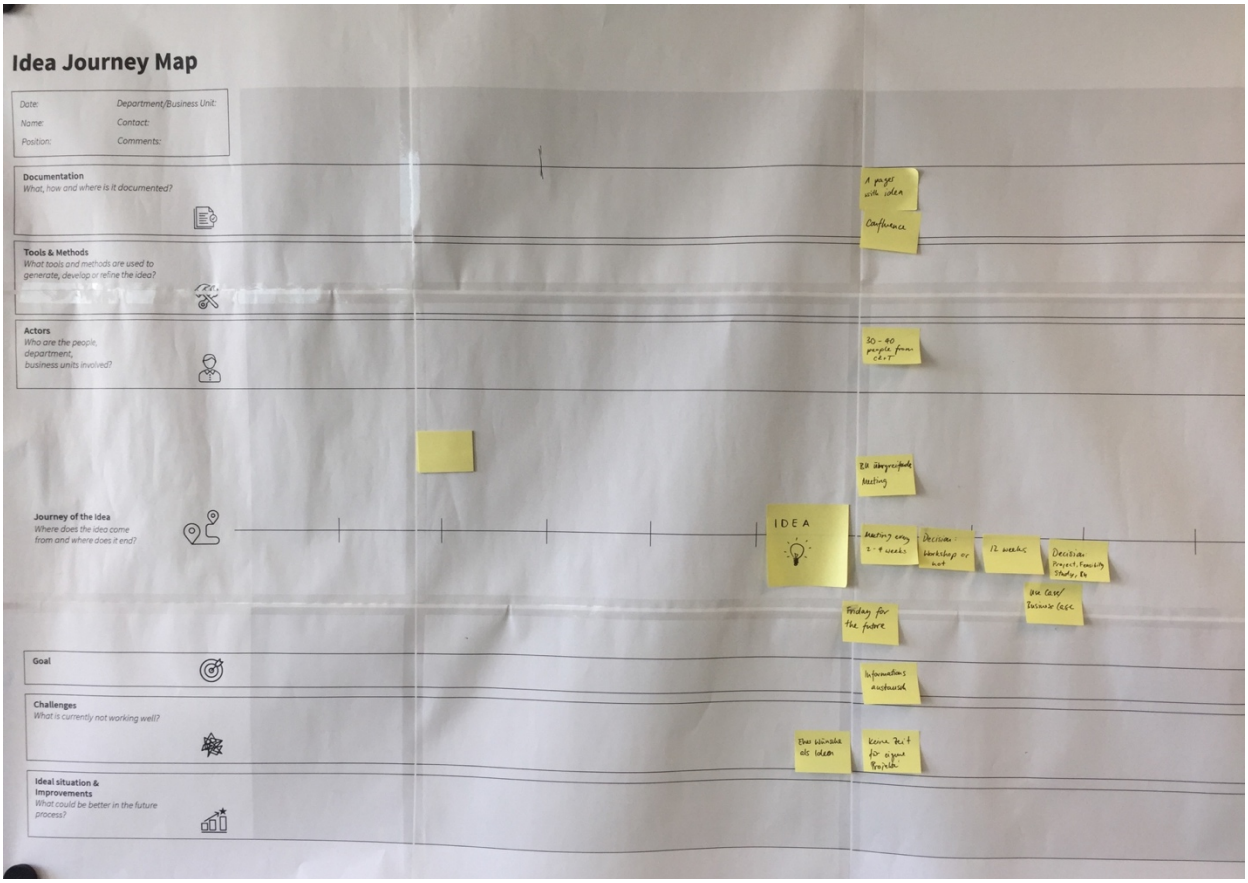
Idea validation, direct personal contact
34:59 The process is nice and all, but you are much more efficient with your idea if you already know in advance which person to talk to. If you know the right people within the company, you can assess the business relevance of an idea very quickly. But you also get opinions and no objective view. In the end it's also gut feeling, how relevant something is. And this can hardly or not at all be standardized.

Lost ideas
37:02 I'm convinced that there are people who have good ideas but never talk with anyone because they're working on their projects and don't feel like sharing their ideas. But you will never get them anyways. Also, not with tinkering process around them. Maybe you get them during coffee break or lunch by just talking to them.

Proposed solution for innovation process
38:41 If someone believes in their idea, they should get the time to further develop them.

39:48 A workshop must not end with a list of sticky notes. That doesn't work. The goal is to have 2-3 ideas that you develop so far that you come to a project definition. If you have it as a project definition you can seriously evaluate if it makes sense or not.

41:31 The creative techniques are relevant that everyone has a basic understanding of them. There is room for improvement to invest more time to understand the basic methods for doing workshops.



11.3.9 P09

Participant number: P09
Date: 3.4.2019
Job description: Controlling
BU: Tool Services
Main Insights: Innovation is like a Business jet. The desire is there, but not the budget.
Overall Impression: He knows very well what the problem is. He has experience in innovation process at Thyssen Krupp. There is not really the need for a holistic Hilti wide innovation process. You have to balance between structure and flexibility.
Morphologic Box for IoT solutions (thing, gateway, connectivity, business value, interface,…) and find out what combinations are possible. Knowledge is power, which is a reason why people might not share their ideas. This is a hurdle in enhancing innovation. When there is a new idea, is it a low hanging fruit? How easy is it to implement it? Is it proven to be working in an other industry/company? How big are the chances of success? How big is the business value? In the end it's all about the money and the risk involved with it.

Background information
01:16 8 years at Hilti, Head of Quality of BU tool services, before in BU measuring, before at Thyssen Krupp, where we also developed such an innovation process.

Motivation

02:07 The crucial aspect of such an innovation process is: How can I get the people to share their ideas? How can I motivate them? I think there are different types of employees that react to different triggers. Some like to write their ideas down for themselves, others prefer to do it in a workshop scenario. (In Measuring they have inventors club)

Motivation, Input
03:21 People can present their ideas in their community. I think that is very important. There are thousands of ideas, but we want the ones that fit our business or that we are able to implement. I think that's one of the main aspects.

03:52 Of course you also want the outside view, but the ideas we have inside the teams are very good.

04:01 In these meetings, the "create, collect and combine" happens on the fly through discussions. The ideas with their different degrees of maturity are documented in confluence. This collect information and sharing knowledge can help to quickly find out the relevant information. Is a solution patented already? Do we have that?

Framework
05:23 It is a situation in which they feel taken seriously and they feel comfortable sharing their ideas. The combine part also happens, because you have the community that knows about the topics, which you can then combine. But this is a very early stage.

Method, morphological box
05:52 Innovation also happens through the simple combination and variation of existing things, such as with a Morphological box. You have your swim lanes and note different parameters.

08:47 Which would be the parameters for an IoT morphological box?

10:16 There was a laptop with an email program, there were mobile phones, there was touch technology and organizers already existed. They were combined and made smaller. Everything was already there, and it was just combined in a smart way. It was an innovation that changed the world. The principals were basically the same.

11:15 I think the basis for a morphological box should be much more rule based. 15 years ago, at Presta we only included certain physical principals that are somehow related to each other. An ontology took the physical principals and searched in our database for technical solutions that corresponded to the physical principals. Only the ones that were close to them were shown, in order to reduce the mass. The problem is the mass.

Hurdle for knowledge sharing
12:12 We created a database for ideas, which however, didn't work. You need to manage the process of disclosing knowledge. For quite some people it is a conflict of surviving to disclose their knowledge, as they see it as the basis of their job/function. "Knowledge is power" also manifests itself in the innovation process. People keep their knowledge to themselves to ensure to keep their job.

13:58 This knowledge sharing only works if the people understand this as part of their culture. If they don't see it as their culture, they won't share anything. The workshop scenario at BU Measuring (inventors club) is a great way to trigger the ones that are on the edge of not sharing their knowledge. You will always have a hard core of people that will never share their knowledge willingly. The questions is if it makes sense to focus on those or rather on the ones that are more willing to share.

Motivation
15:20 [What is the motivation for them to share ideas?] There are different things. It is great when you bring in an idea that ends up in a successful product. 1. It's about recognition and reputation. "Look he did this." What is the remuneration model? Reputation can also mean more power in the future, as they might get a team. 2. Others just want to show, look what I can do. 3. And others you can motivate with money, like a bonus for the best idea. 4. Others just like to have fun and enjoy the common experience in the team to develop something innovative. I wouldn't focus on one but rather try to create a diverse remuneration system to trigger that.

Methods

17:37 There are different ways to stimulate these innovation discussions, such as Walt Disney method, 4-5-6 method. They are a great way to come up with new ideas. The morphological box, on the other hand, is a very structured method, that you should always use as a basis, at least as a basis for documentation. Brainwriting didn't impress me that much.

Framework
20:00 There are different factors. You have to create a pleasant environment, the rooms that you are in, how the infrastructure is being used. This is what can create a creative atmosphere. In the end it probably doesn't really matter which method you use. It is important to structure this process and to have documented results.

Prioritizing ideas
20:56 Then it's about prioritizing the ideas. At BU Measuring they have voting system in confluence. I think it's good, but it might have to be extended in direction business value. There are some great ideas, where a lot of money (€300.000 - 400.000) has to be invested, but you can't really estimate the business value. It's too difficult to predict. For other ideas you have to invest maybe €60.000 and you already have a clear idea what service you can provide with it. That is much easier to estimate and there is more willingness to invest.

Development of idea
22:20 An idea is nice, but quite quickly you have to create a prototype in order to be able to assess it. I have seen a lot of innovation processes and I think this is missing for a lot of them. A lot of times this prioritizing, prototyping, going back and prototyping again is not done very disciplined, because creating a prototype means effort. At some point you have to decide that you will take the time to create a first prototype or draw the idea. For this you need clear rules, because you need budget for such an innovation process.

Motivation, appreciation
23:31 There is nothing worse to have 10 good ideas but no money to even make a prototype for 1 idea. Then the people who had these 10 ideas are demotivated as they shared their ideas with the company and they end up in a drawer, because we don't implement anything. That's the worst that can happen.

Budget, resources
24:06 The solution is budget. The company has to be aware of the fact that starting an innovation process first of all means effort for the team. Regular meetings (monthly) would be great, but that means half a day out of 20 working days, which is 1/40 of the department capacity, that are 6 days a year, which means 3% capacity. Do I want that? To develop such an idea, you also need time and resources, which quickly adds up to 10 days, a team of 2-3 people, that means 30 man-days à 1000 CHF means 30.000 CHF. Additionally, there is money needed for material. If all this money is not there, I shouldn't do it in the first place. And if the money is there only sporadically, I also shouldn't do it. No matter how much budget or capacity I have, the important thing for an innovation process is the continuity, a continuous flow. If you don't have the capacity and the budget, you better not do it at all.

26:18 "Innovation is like a business jet. The desire is there, but not the budget." Innovation should be business driven and not just come from individuals. Innovation should be part of the company and then, there should be money and resources available for that. Then you say 1% or 3% or so of our department budget are available for Innovation. That will work! At BU Measuring they were able to do so with a relatively low input. They came up with 1-2 great ideas, 1 of which is soon in the market. The idea came simply from a use in a different industry, a carry-over. There it was easy to show the business value, because it already existed in another industry. Maybe we should focus on such innovations as they are easier to handle, and we could learn how the innovation process for our business unit works.

Stakeholders
29:41 Another question is who should be involved in the innovation process? Does it make sense to include universities and to be up to date with the latest research? Then again, do I have the budget for that?

Output
31:57 The problem is that you can't guarantee a certain output of the innovation process. It can be that you put in money for two years and nothing comes out. It's like an incubator. First you have to make it run, which requires capacity and budget. But you can't predict when an innovation comes out of this process. You can only provide the best possible framework that this could happen.

Monitoring, motivation
33:48 Example: It didn't work with our database (at Presta). Everyone put in their ideas, but nobody cared about prioritization and nobody thought about the budget. So, the first attempt fell asleep. Only when we had a more structured approach (with the ontology), a budget and some awards and prizes like a team dinner, then it worked.

Motivation
35:36 An idea is not killed, an idea is reasonably documented, filed and categorized for a later use. This is very important. If you kill an idea, you kill the person who had it. It is also important to do this in a group where people feel comfortable and appreciated, otherwise they lose countenance. But this person might be the one who after the 10th time has the great ideas that saves the business. You don't know it.

Input
37:44 In innovation there is the storming phase, where a lot of ideas come up at different points. You should allow the different organizations (BUs) to have their own innovation process, but at some point that should be standardized, if it makes sense. You always have a phase where there is a hard standard and then you allow new innovations based on that standard (diverging-converging-diverging-converging).

Elements of innovation process
38:48 In my opinion, the pain not big enough yet that there is the desire to have a Hilti wide innovation process. Think of, what are the good elements of the current processes (Hungry Lion, Inventor's club, Friday for the future, etc.) and use them for the creation of the innovation process for BU Tool Services.

Lost ideas
40:40 [What happens with an idea today?] I don't know. We don't have an innovation process. Ideas can be lost because they're not documented, they can be rejected by someone. Maybe we have already lost the top 5 ideas. Ideas should be documented in a structured way. You have to create an incentive for the people to document their ideas. BU Measuring uses confluence plugin which is a first step into the right direction. There is no process that exists, that people know, that they like and that is being monitored.

Monitoring
41:52 Monitoring is also important. Results should be presented to the management. 20 workshops, 40 ideas, 3 prototypes that could be implemented. Innovation management should be with the Head of Development, as innovation is product related. Someone who is solely responsible for that role could be of interest, however, most likely no budget. However, I could imagine something like that on Hilti level. I could imagine a small team that does innovation management, coaching and support.

44:27 The question is: How much worth is innovation to the company?

Value, justification of innovation process
46:26 Of course, it can also happen as it did to Nokia, where they missed something in an important moment. In the 90's Nokia used to be the brand. The new generation probably doesn't even know the name anymore. This is how fast it can happen. They missed one innovation, one disruptive technology and they were out.

Input
48:22 I also think there is not one process, but rather different ways where input comes from. More importantly is how do you continue with it. If an idea stays in a database, you don't generate an added value.

11.3.10 P10

Participant number: P10
Date: 4.4.2019
Job description: Head of BU Quality Management
BU: Direct Fastening
IDJM: Yes
Main Insights: Freedom and curiosity.
Overall Impression: Most of the innovations come from the projects. During the project it usually happens that you come up with a new idea. The most important thing is to communicate the added value. A good idea consists of three parts: novelty, customer need and technical feasibility. Customer need can be checked in discussion with the Product Manager or segment manager and technical feasibility can be checked with a senior engineer or development lead. When someone comes up with an idea the first motivation is not to file a patent but rather to make a great product. The patent comes afterwards.

Background information
00:12 28 years at Hilti, always in product development, group leader, team leader, now at BU Direct fastening.

Input
01:06 The number of patents has a limited significance. Most of the patents result during the Technology project, sometimes during TTM.

Freedom and curiosity
02:07 (For this front-end innovation process,) there have been various attempts to capture and structure ideas. There is a contradiction: it is new, it is undefined, it can't just be put into a structure. 1. Freedom is important. You need the freedom to have a closer look at an idea. Sometimes after a while, an idea is not as good anymore as it seemed and sometimes a project starts to take off. 2. Curiosity. It is important to have a culture of curiosity. Curiosity paired with the freedom to pursue this curiosity are the main success factors. (3.) A culture where uncertainty and ideas are perceived as something positive and encouraged.

04:15 Freedom is a difficult topic because you have to follow the project roadmap. That is certainly an area of tension.

Idea development
04:35 In the BU DF we created interesting projects and start innovations with a slim budget. When we had an interesting idea, we tendered it as an internship or master thesis to further look into it, because the developers are busy with their projects. We have more ideas than we can implement. It's always a painful process to decide which projects we are not going to do. When a developer has an idea, he then also supervises the intern who works on the idea. The developers liked to do that, because he could further look into their idea, even though it was extra work. For this, the culture is important. It's mainly about the appreciation of the idea, the freedom that is given with this and the small budget for the internship.

08:27 Example: Double row magazine technology. We always had this idea, then we defined 3 internships to look at it from different perspectives, built hardware with rapid prototyping to excite the people and to show the added value. The combination of an internship and 3D printing for a quick prototype builds the basis to get management attention in order to get the project. Validate the idea in a cheap and fast way and communicate the added value. It's a huge step from a PowerPoint to a tangible prototype.

Patent
12:46 The patents usually emerge after the red area (front-end innovation process), during the projects. You don't have an idea; develop it a bit further and then apply for a patent. The patent application happens later. There are very few patents that arise from that red area.

Idea generation
14:23 For me, ideas happen in a problem-solving phase, when you have an assignment and you look for technical solutions. Then you will also find new technical solutions. This is mostly during a technology project.

15:16 I would separate the formulation of the question about this red area (innovation process) from the patents.

Input
15:37 We have the classic differentiations of a technology push and market pull. You see an application for something, and you want to create a solution for that. Then we create a definition project. After the definition project, ideas are generated. 1. Intuitive: brainstorming, brainwriting, in small groups, workshop. Then you work a bit on the ideas and then a lot of times patents are applied. 2. Systematic: There is a concrete question and you see which active principles can be used or a solution brochure.

Patent
19:33 Another phase where patents can be applied are subsequent. When we had a technology developed, we thought of other ideas about how that could be done in other ways. We formulated ideas and patents to impede the field of innovation for competitors. But that has nothing to do with the red area.

Type of idea
21:12 In a technology project, ideas are usually focused on the specific product (faster, better, cheaper). When it comes to smart features you see ideas that can be used for more than one product and not specific for a certain tool.

Idea capturing
22:10 It's not really defined what happens with these ideas. We tried several times to create an idea pool where we capture them, but we never made it. It always fell asleep as there was nobody really taking care of it. You need someone who maintains and promotes it. But when this person suddenly has no time or changes position the initiative fails. There is a contradiction in this phase as you need freedom and structure.

Motivation
23:47 There have also been some gifts for the best ideas as an appreciation. But after 2 years the initiative kind of stopped again, because no one really took care of it. Only the managing of ideas doesn't get you anywhere. The second part is more important, that you get time to follow up on an idea. The ideas that you really care about, you won't forget. If someone gets pregnant with an idea, he won't forget it. It doesn't have to be on a list, it has to be further developed. It is important that there is open-minded culture where ideas can be communicated and discussed in an informal way. If people say: "We've tried this so 100 times, this won't work, forget about it." it won't work. But this is not the case, I think. For this you should ask the developers.

27:36 My motivation was always to create a good product. I think that is in the gens of a good developer. That's why there is also the motivation to take on extra work and supervise an intern for example. People like to innovate. In general, it's about finding a cool solution, the patent is only to protect it. The motivation is not the patent.

Input
30:35 The battery nailer was triggered through a competitor product. We saw that they had a product in a different area, and we checked if we could do something with it. You have to be open about such things.

Idea assessment
31:45 1. Novelty: A good idea has to solve a problem that hasn't been solved before. 2. Customer value: It has to solve a need for the customer. Knowledge about use cases, understand the end user on construction site. 3. Technical feasibility: It has to be reasonably implementable with technical means. You need competence and experience. Reality check. Desirability + technical feasibility + curiosity/creativity.

34:07 A multidisciplinary team is important.

35:01 We don't have system to measure or quantify this (novelty, feasibility, desirability). Communication and interaction are important. Product manager/segment manager for customer needs, senior engineer/development lead for technical feasibility. Someone who has an idea should approach one of them and discuss the idea with them. Like this, an idea is developed, and a dynamic can arise.

Idea development

36:50 Ideas are like little plants: very sensitive and fragile. It's very easy to kill an idea, also unconsciously. Most important is the team culture and innovation culture, that appreciates ideas and lets the little plants grow. In my opinion, this culture exists here.

38:16 We have several ideas in technology projects and even products that originally were evaluated with interns, which for me is a sign of success.

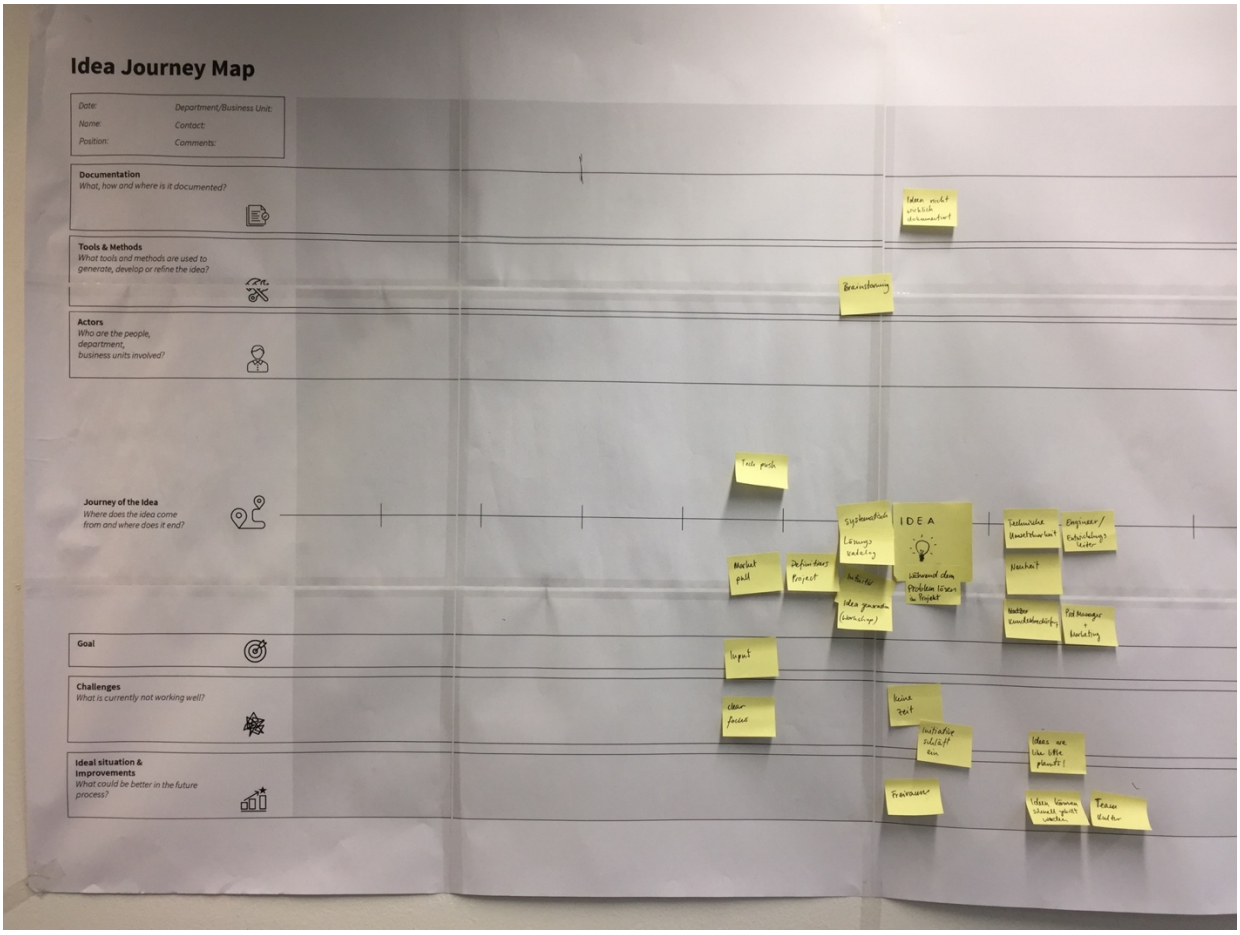
Purpose of innovation process
39:46 [Is there even the need for an innovation process?] I think the desire is there as there have been several attempts, however, it's probably not easy as they all failed. Creating an innovation process is not a success factor. You have to create the framework. Maybe at the narrow end of the innovation funnel processes come into play.

41:44 What are the elements of the framework? Apart from the process, what elements of a team culture are important? How can they be supported? It's a lot about soft factors.

Innovation vs. daily work
42:56 At Hilti we have a strong focus and we work very goal oriented. In a project you are focused, and you go all in. Thus, you run the risk to not seize ideas. "Grind abe und sekkle und du gsesch die schöne blueme am Wegrand nid, wo Inspiration wered." It's about mindset.

Proposed solution for innovation process
44:25 The coolest ideas usually came up when we allowed something. After a brainstorming for a new plunger break, we made a decision about the best ideas. However, one guy further developed his own idea, which was not amongst the chosen ones. His team leader and I discussed it with him during a coffee and decided to let him to it. It ended up in a cool innovation. The success factor was to allow it and not to insist on the focus. The decision was made by gut feeling and the enormous engagement from the guy.

47:50 I wouldn't separate people doing projects and others 'playing around a bit.' Chances are high that the relevant ideas arise where people work closely with the products. Once the idea is there, someone else should work on the idea. I don't think you should create a group that only generates ideas. Bosch does that. They have a group of people who only focus on how to solve problems, on a very abstract level and not related to projects.



11.3.11 P11

Participant number: P11
Date: 4.4.2019
Job description: Development engineer
BU: Measuring
IDJM: Yes
Main Insights:

Background information
00:04 13 years at BU Measuring

00:14 Inventors club, once a month, 14:00-16:00, documented in confluence, one page for every month, process is not really managed. Everyone who has an idea can write his name in the agenda, then 5 min to present idea, afterwards brainstorming, sometimes there is guitar music in the beginning, some snacks.
Documentation
02:23 There is a backlog of existing ideas in confluence. There are assessment criteria for the ideas, such as robustness, visibility, ease of use, new application, improved application, cheaper, level of novelty, development effort, technical risk, etc.

Prioritizing

04:27 New ideas. Everyone (at BU Measuring) can vote for them, add links what could be interesting for others, comment.

Motivation
05:40 There is also a bit of fun. For us it's important that there is a good atmosphere so that creativity can happen. The idea with the most clicks and likes gets a small price as appreciation.

Tracking progress of ideas
06:28 You can track the status of the ideas. If a topic is important enough, it goes to the management meeting, because you need money to proceed with the idea.

Stakeholders
07:46 Marc Vetter used to present quite a lot of ideas, but when the BU Tools Services was split off from Measuring, then this also disappeared. But it would be nice to have him back as a guest. In general, the inventors club is open for everyone.

Creativity vs. structure
08:37 It would be nice if you could present a method for idea generation. With this we always struggle. We usually just do brainstorming. My wish is to bring in a bit more structure. It's a bit contradictory: being creative vs. having structure.

Type of ideas
11:12 There is not a lot innovation coming from software, it's mostly from mechanics and electronics, which is a pity. It is divided into 1. request for solution which concrete challenges and 2. random ideas.

Lack of engagement
11:54 Unfortunately, there is not a lot of interaction on confluence at the moment. People don't have the time, because of ongoing projects. At the beginning it was a bit of a hype, then it came to a standstill. Now we are around 20-30 people (out of 60 at BU Measuring) in the Friday meetings, which is quite good, also because a lot of people do home office on Friday. They still have the possibility to post something, but that usually doesn't happen.

13:05 It's basically a way to document ideas. There is also a section about competitors' information, but there is also not a lot going on.

Monitoring, responsibilities
13:45 Everyone is a bit responsible for it. Till Cramer is development lead and he sometimes go around to ask if people want to present their ideas, because they forget that they could share their ideas. I took over the role of the moderator on Fridays. Ivan Sojic does everything on confluence.

Communication
14:44 It is not really communicated to the outside, people from other BUs only know about through personal contact or through invitation.

Example
17:42 Example: Airbag for total station. Total station costs about €30.000 and an airbag is released in case it falls over. The idea came from the automotive industry. At the beginning there was resistance: it is an expensive device. Is the effort justified?

Patent
19:38 There is nothing like this in the market yet. By now we also applied for a patent.

Idea generation, idea development
20:16 First the idea was discussed in the inventor's club. Then it was discussed in management team with BU Head, where it's discussed if it turns into Technology Project. Then we did simulations and now we have a working prototype. Then it goes into TTM.

Idea generation

23:03 During a technology project, there are also project related ideas for existing products, which flow into the projects. They are usually customer needs (from customer surveys) or technology advancements and are not related with the inventor's club.

Knowledge sharing
25:59 The inventors club is also for knowhow transfer. We see BU internally (we have 5 divisions) how we can use certain solutions in other areas.

Pain point, lack of creativity
26:58 Challenges of inventor's club: Lack of creativity, lack of knowledge/understanding/shyness about methods. We used to do brainstorming without cards where a lot of ideas were lost. You need someone guide the process to keep it moving. In the end I am usually the one documenting the ideas in confluence.

28:46 There is a hard core of about 10 people who always come to the inventor's club. There are top contributors, who always bring ideas and other who only listen. We still lack of actually further developing the ideas.

Method
29:23 We tried the Osborne checklist. TRITZ is also something we've talked about, but we never used it. Nobody really knows how it works and there is nobody who moderates a methodical approach.

Documentation
33:15 I would like that people would photograph and document their ideas themselves. The motivation of the people is not the documentation.

33:45 Usually there is one person continuing with the idea, defining the next steps, maybe create a prototype, rewrite a software.

Motivation
35:03 [What is the motivation for the people?] Just because it's cool to see an idea end up in an actual product. Inventiveness.

35:23 Till Cramer allows 5-10% of time for innovation projects, which is very little. The rest is taken from free time.

36:18 There are people who have over 100 patents. For some people this is recognition for themselves.

Input
38:33 Input can come from trade shows, internet, research, competitors, and most importantly customers.

Documentation, lost ideas
40:22 Ideas that are interesting but not relevant for our BU are archived, but not communicated to other BUs.

Assessment of ideas
41:16 Ideas are assessed by their business relevance. But I don't know exactly how they decide in the management meetings. That would be nice to have more transparency for the inventors to know why one idea is chosen and another one not. Communicating decisions.

Input
42:38 New technologies and materials are also input for new ideas.

Assessment
43:13 There are no assessment clear criteria for ideas. There is only the voting system, which still has room for improvement.

Time
44:22 It would be ideal to have more time.

Idea capturing, Idea development
46:05 It's difficult to formulate an idea. It's easy to implement it and make a prototype. We the rule that you are not allowed to kill an idea, because of negative feedback, which is not always possible. It's difficult to sell your idea and fill it with life, to turn a spark into fire. Realizing the ideas is our daily business, we're good at that.

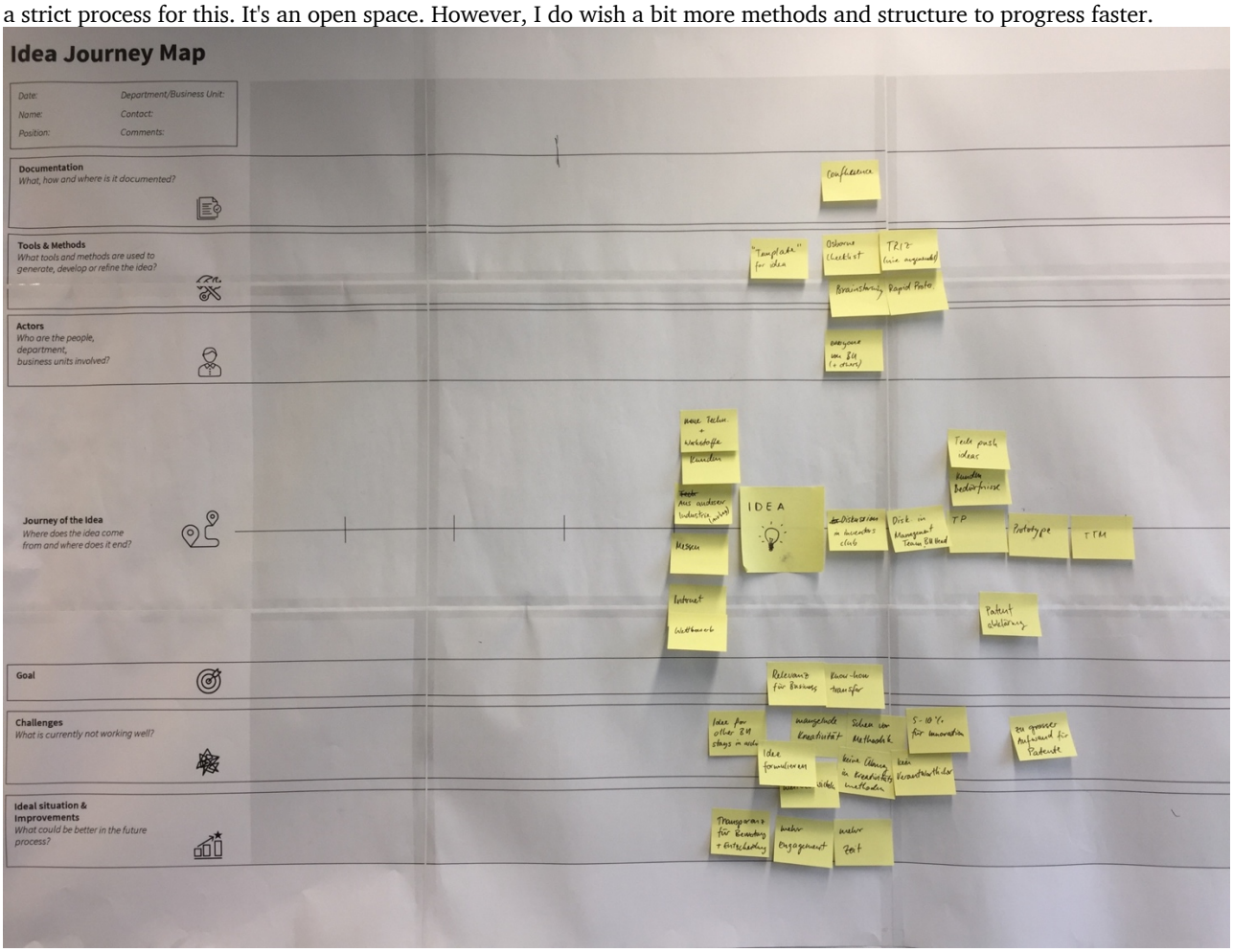
47:49 We have a template to formulate the idea, but there is not much written on it.

Focused ideation
49:05 There are not a lot of request for solutions, where someone poses a concrete challenge. I don't really know why, because a lot of people have challenges that could be more easily solved in a team.

50:13 People rather like to bring in new ideas than to solve a problem.

Time
51:21 Unfortunately, I also don't have more time for the inventor's club.

Motivation
54:29 For the inventor's club it was a bottom-up approach. The drive came from the employees, they had the desire to do more with innovation. We have a lot to do with processes in our daily business, which is why we didn't want to create a strict process for this. It's an open space. However, I do wish a bit more methods and structure to progress faster.



11.3.12 P12

Interview about Hungry Lion

Questions for the innovation pipeline
Interviewee: Tobias Kurz, Global Innovation Manager
Main research question: How can this Hungry Lion be applied to BU Tool Services?
What is the input?
What is the output?
Who is involved?
Who benefits the most from it?
Intro
What was the reason for Hungry Lion?
Who created it?

Notes:
Until now only in manufacturing
5 Team leads at each factory
Hungry Lion consists of 4 Elements
Process
Communities
OLLI: Open Lion Lab for Innovation
Lion Box
Idea generation in 2 parallel processes
Active: workshops for focused problem solving with selected people from different areas. This is more for converging.
Clear desired outcome or problem to solve. Maybe similar to definition sprints?
Passive: colleting ideas → idea card, everyone can submit ideas. This is more for diverging. Finding new ideas
Weekly 1h meetings for idea ranking by Jury
The best ideas are developed further → 12 weeks until prototype, cardboard prototype, proof of concept
Incentive is an award, small prizes, team event for best prototype
Ideas are documented in SharePoint, automated and synchronized idea card with details and a table of all ideas
In the OLLI the ideas are physically tracked, paper on the wall
There are process facilitators that enable these sessions. They come from different areas, engineering, lean management, interns
Once a year there is a Lion Cave where the BU heads are present
Most people are good at finding the right solution, but not the right problem
Finding the right problem: problem should be defined by few people who know about design thinking
Once the problem is defined, the specific challenge can be presented to a selected team who then looks for solutions
In manufacturing they are putting a lot of effort into industry 4.0
Might be interesting for collaboration or knowledge exchange with BU Tool Services
2000 people in the plants, 216 ideas generated last year, 91 prototypes, 70 were implemented → 30% of ideas were implemented
Mainly not breakthrough innovations, but rather small incremental innovations
Some ideas were patented, but normally ideas are not focused on filing new patents

Process
How are things done currently? What process is used? Why?
Where does your process start?
Where do the ideas come from? Where does the project come from?
What happens before?
Where do they end up? What happens afterwards? (ideas graveyard)
How is the process documented? How do you keep an overview?
How is the progress being documented?
What are your experiences with the CCDT? Challenges?

Is the CCDT being adopted and used?
What challenges do you see with a Service TTM?

People
Who is involved in the process? Why?
Who should be involved? (End-user, Customer, Other departments, Third parties/partners,…)
How is collaboration organized? Who approaches who? Why?

Problems
What are current problems in the process? (Ask for concrete examples)
What was the biggest failure that ever happened? Why?
How could it have been prevented?
What is the goal you're aiming for? What is the desired outcome?
Is there a shared vision? (Lean Startup pyramid: Vision (Why?) – Strategy (How?) – Product (What?))

11.4 Appendix D – Intern feedback survey results

How much did you know about IoT before the workshop?
I have never worked with IoT, but I knew how it works (Input, cloud, output)
I have heard about IoT, but I never really understood what it actually is
I have never worked with IoT, but I knew how it works (Input, cloud, output)
I have never worked with IoT, but I knew how it works (Input, cloud, output)
I have already worked on projects with IoT, there was nothing new to me
I have already worked on projects with IoT, there was nothing new to me
I have never worked with IoT, but I knew how it works (Input, cloud, output)
I have already worked on projects with IoT, there was nothing new to me
I have never worked with IoT, but I knew how it works (Input, cloud, output)
I have never worked with IoT, but I knew how it works (Input, cloud, output)
I have heard about IoT, but I never really understood what it actually is

How much do you know about IoT after the workshop?
It's clear to me what IoT is and how it works, I could explain it to someone else
It's clear to me what IoT is and how it works, I could explain it to someone else
It's clear to me what IoT is and how it works, I could explain it to someone else
It's clear to me what IoT is and how it works, I could explain it to someone else
It's clear to me what IoT is and how it works, I could explain it to someone else
It's clear to me what IoT is and how it works, I could explain it to someone else
It's clear to me what IoT is and how it works, I could explain it to someone else
It's clear to me what IoT is and how it works, I could explain it to someone else
It's clear to me what IoT is and how it works, I could explain it to someone else
I understand the basic concept of IoT, but I still don't fully understand it
It's clear to me what IoT is and how it works, I could explain it to someone else

How did you like the case topic "How can we use IoT to prevent accidents on
Yea was nice, I really had the chance to discover a new topic
Amazing, I loved it
So so, but it could have also been something different
Amazing, I loved it
Yea was nice, I really had the chance to discover a new topic
Yea was nice, I really had the chance to discover a new topic
Yea was nice, I really had the chance to discover a new topic
Yea was nice, I really had the chance to discover a new topic
Yea was nice, I really had the chance to discover a new topic
Amazing, I loved it
Yea was nice, I really had the chance to discover a new topic

What did you think about the assessment criteria of the ideas?
They were useful, they somehow helped to improve the idea
They were useful, they somehow helped to improve the idea
Yea it was okay, but the idea didn't change much
Very useful, they really helped to think about the different elements of the idea
Yea it was okay, but the idea didn't change much
They were useful, they somehow helped to improve the idea
They were useful, they somehow helped to improve the idea
They were useful, they somehow helped to improve the idea
They were useful, they somehow helped to improve the idea
They were useful, they somehow helped to improve the idea
Yea it was okay, but the idea didn't change much

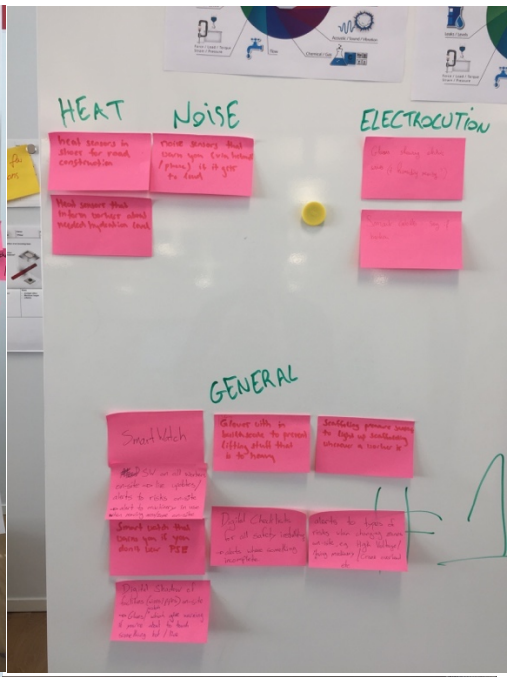
Maybe some of the assessment criteria were a bit hard to answer. If so, which ones? And why?
There were alot of assesment criteria for a very short amount of time
The risks because when we are intern we don't really know the danger of the real work so I don't think that we have put all the risks
I think it's a good framework. I would recommend keeping it for other projects, and might even use it for my own.
The stakeholders and communication criterias still are a vague notion for me.
stakeholders
Stakeholders
Comunication, it was hard to find how the idea comunicate with other products and from the comunnication with people side it looks pretty much as the Stakeholders...
Some of the criteria (descripton, benefits, applications), at least in my undertanding, were very similar, so it was difficult to answer those uniquely.

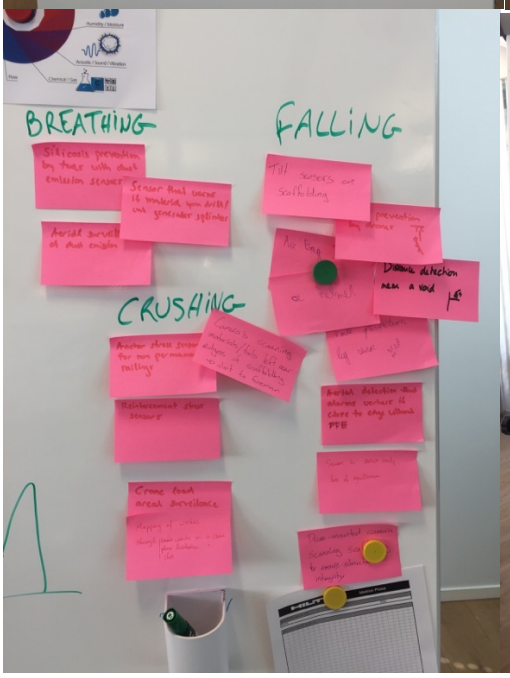
What did you like most about the workshop?
Relaxed atmosphere, good creativity outlet, quick and fun
Give a view of our ideas and the team work
Getting in touch with the other interns. The discussion in the groups.
Very good structure and explanation of the challenge for the participants. Well explained at each activity, and good structure given for our presentation of ideas at the end which helped us to 'fill out', so to speak, our ideas. By this I mean the asessment criteria, outlined below - I will be running the next i3 workshop and will definitely try to do something similar
Working on safety and prevention is actually useful, which is a great think to work on because I have the feeling that an important part of IoT projects are more like cool gadgets that are fun to develop but that people don't necessarily need.
the group productivity
The lunch! Just kidding. I appreciated that we got the chance to developp an idea that far : we could think about the applications and the feasibility (idea ould be implemented with Hilti solutions) of the idea... Could introduction for me to what is a business case and how you build it.
group preparations, brainstorming, share the ideas
creative ideas, clustering in the group and really really cool was the sketch noting
The indepth explaination of the Hilti IoT Tools
I finally figured out what IoT is - I'd been meaning to for a while but had never gotten around to it - and also learned about ON!Track, which was quite interesting. I really appreciated that you explained how it works as of now, but also how you see it developing in the future.

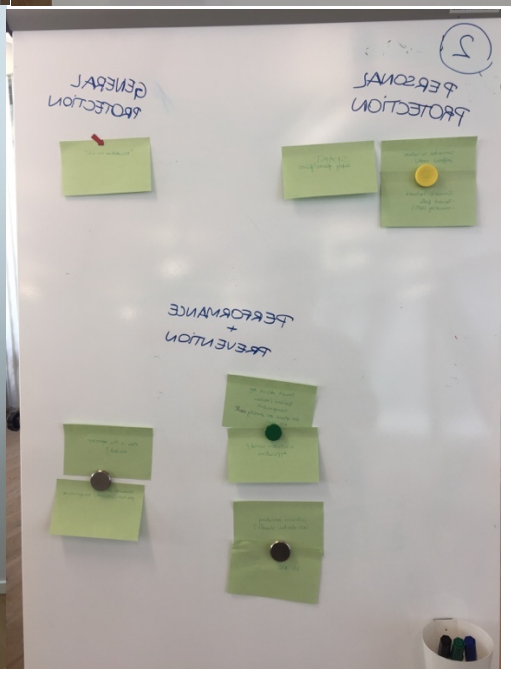
What do you think could be better next time?
Maybe more time for the developing session (the one at the end)
time management
Maybe have a bit more visibility concerning what is already done concerning safety in current jobsites. That actually changes a lot depending on the country and the jobsite, but if we base our reflexion knowing European standards we might put aside some IoT ideas that would be redundant in case something already exists and works fine, and focus on the ones that actually make a difference.
Specification of death reasons. E.g By what get workers hit? Flalling objects was too less information
- Let everyone present (I was in the last group and a fellow member decided to not present our last idea which was to my opinion the most interesting one). - Give more precise directions after the clustering. It would have helped us to decide what idea to developp, because you would have told us what was interesting / would have make sense for your project.
have more time to pitch about the project, and maybe have more time to build powerpoint presentations
include sketch noting more
Even more practical examples
Nothing that I can think of

11.5 Appendix E – Intern workshop results

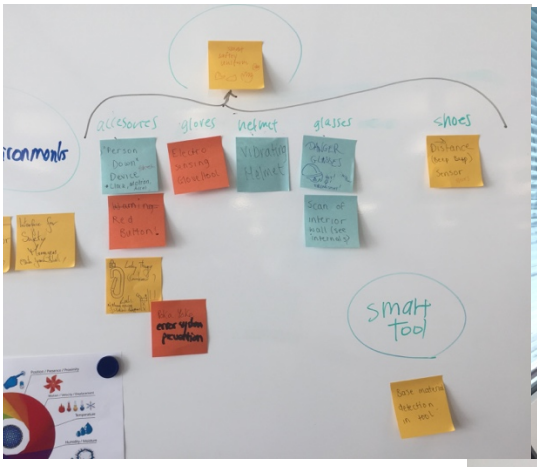
11.5.1 Intern workshop brainstorm



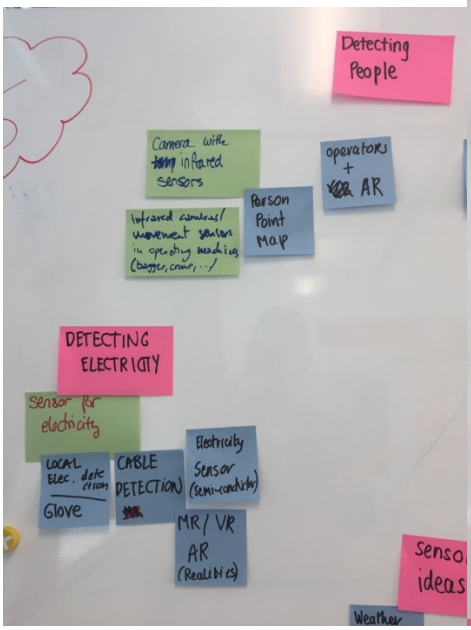


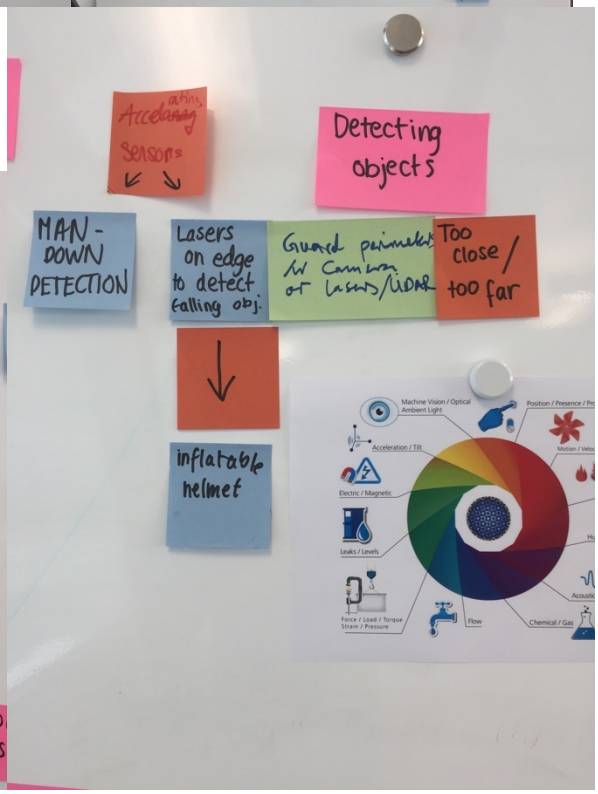


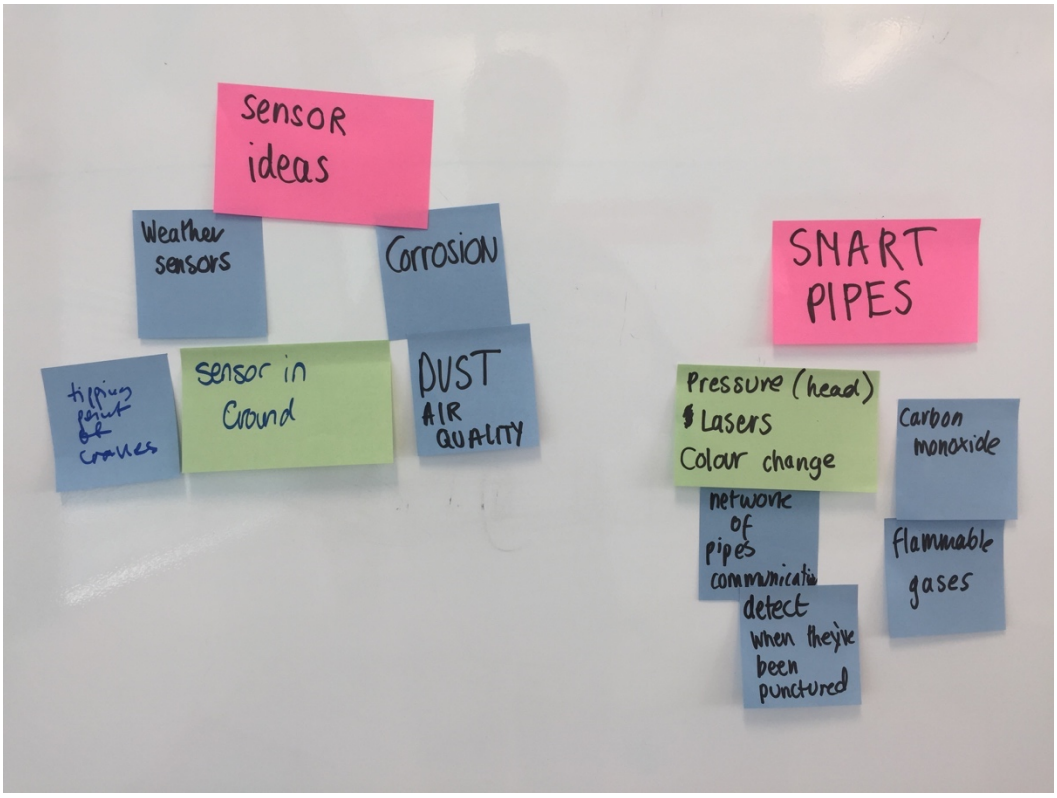

GROUP 2
SITH LORDS
Hardware (Tool/Accessories Equipments)
Software (App+ Data Collected)
Cloud
1. Falls
2. Struck by an object
3. Electrocutions
4. Caught in between
Cameras
e-Bracket (1,
Tool (emergency stop → falls
Helmet (acoustic, camera
→ tools only work with helmet
gloves → E-Fuse → catalog
Wearables
Surveillance
Wearables
VEST / BELT
Gloves
ELECTROCUTIONS
Vest / Belt
schoch vögtli
Fon 0848 724 624
schochvoegtli.ch
FATAL 4
smart work environments
smart tool
Kit


accessories
gloves
helmet
glasses
shoes
smart tool

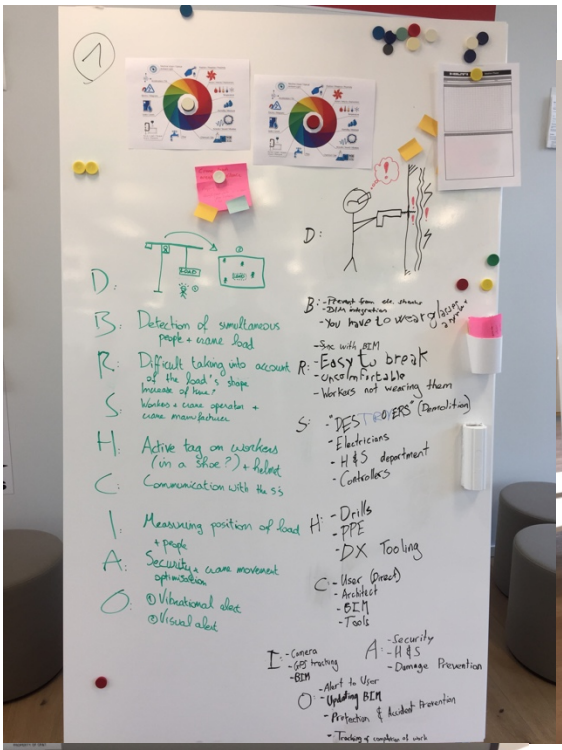

Detecting People
Detecting objects
DETECTING ELECTRICITY
SENSOR ideas
SMART PIPES

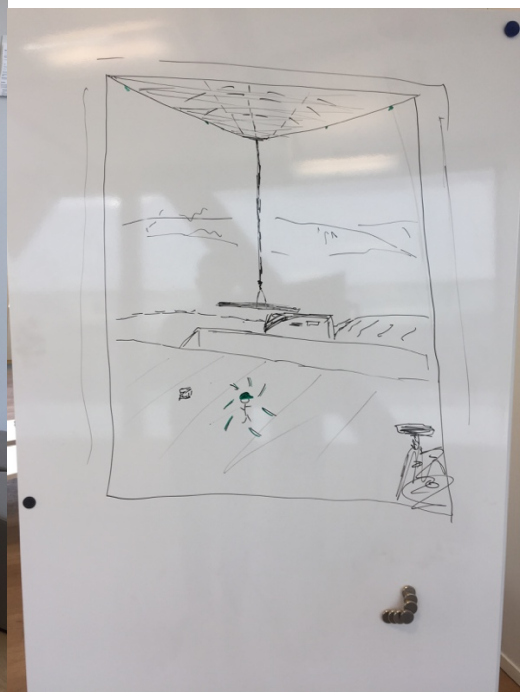

Detecting People
Camera with infrared sensors
operators + AR
Person Point Map
DETECTING ELECTRICITY
Sensor for electricity
LOCAL Elec. data
CABLE DETECTION
Electricity Sensor (semi-conductor)
Glove
MR / VR AR (Realities)

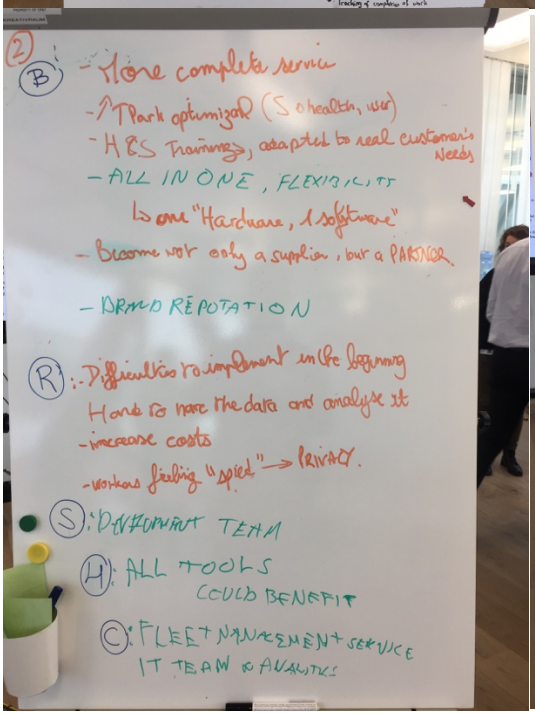

Accelerating Sensors
Detecting objects
MAN-DOWN DETECTION
Lasers on edge to detect falling obj.
Too close / too far
inflatable helmet

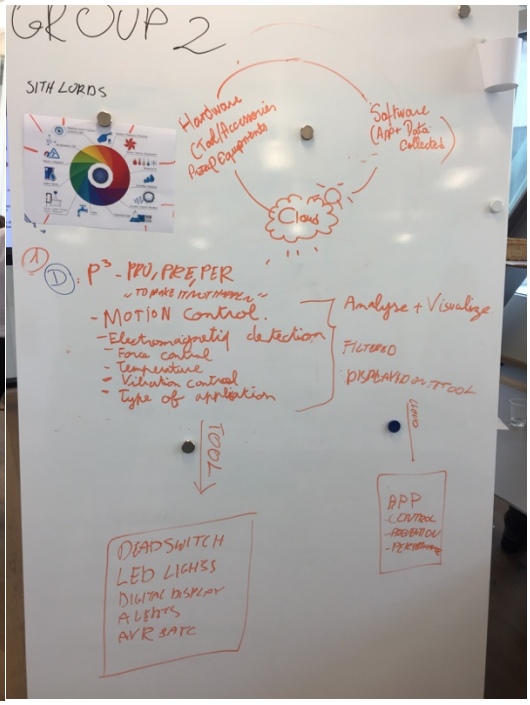

sensor ideas
Weather sensors
Corrosion
tipping point of cranes
sensor in Ground
DUST
AIR QUALITY
SMART PIPES
Pressure (head)
$ Lasers
Colour change
network of pipes
communicati
detect when they've been punctured
carbon monoxide
flammable gases

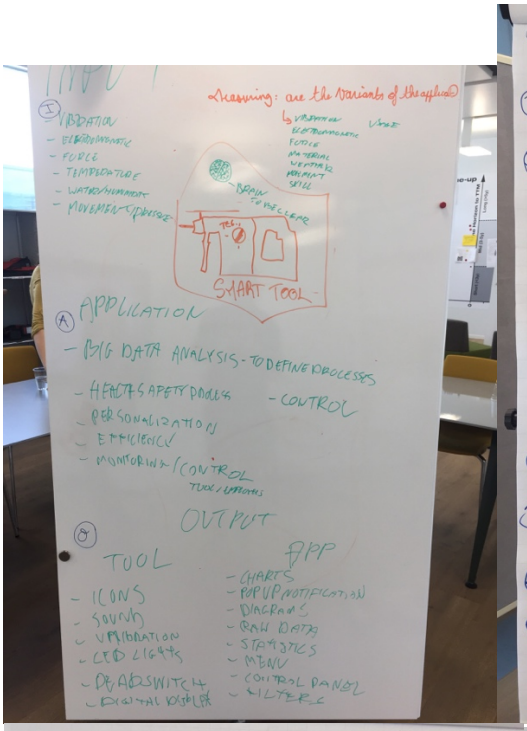
11.5.2 Intern workshop idea development output

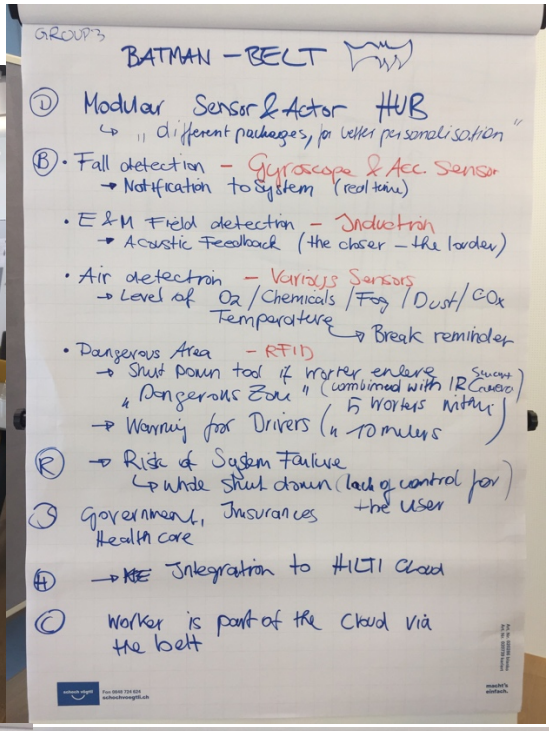


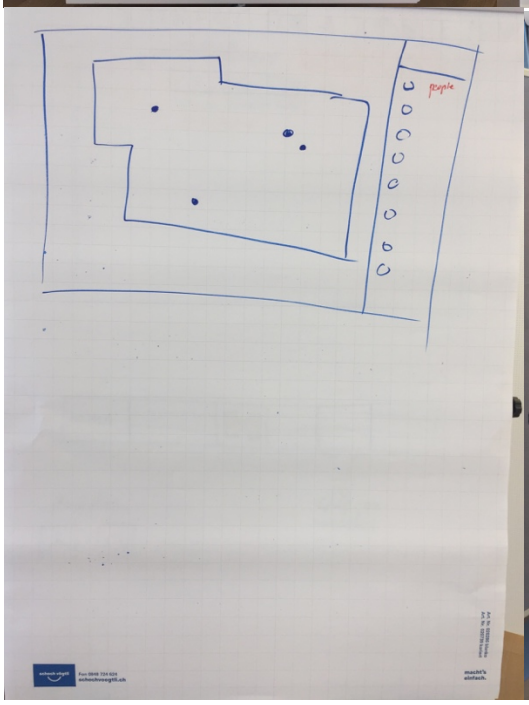


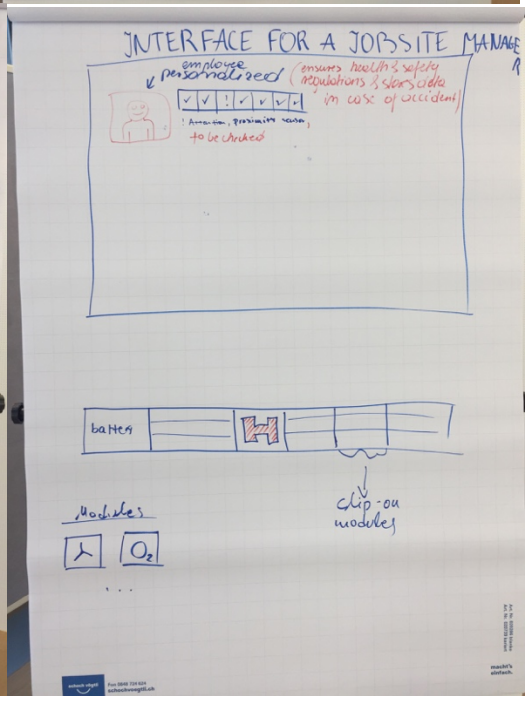




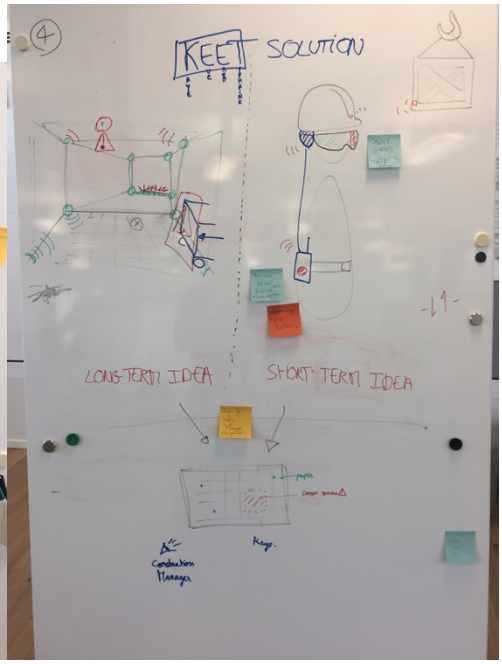

Reasoning: are the Variants of the applied
APPLICATION
BIG DATA ANALYSIS - TO DEFINE PROCESSES
CONTROL
OUTPUT
TOOL
APP
ICONS
SOUND
VIBRATION
LED LIGHTS
CHARTS
POPUP NOTIFICATION
DIAGRAMS
RAW DATA
STATISTICS
MENU
CONTROL PANEL
FILTER
SMART TOOL

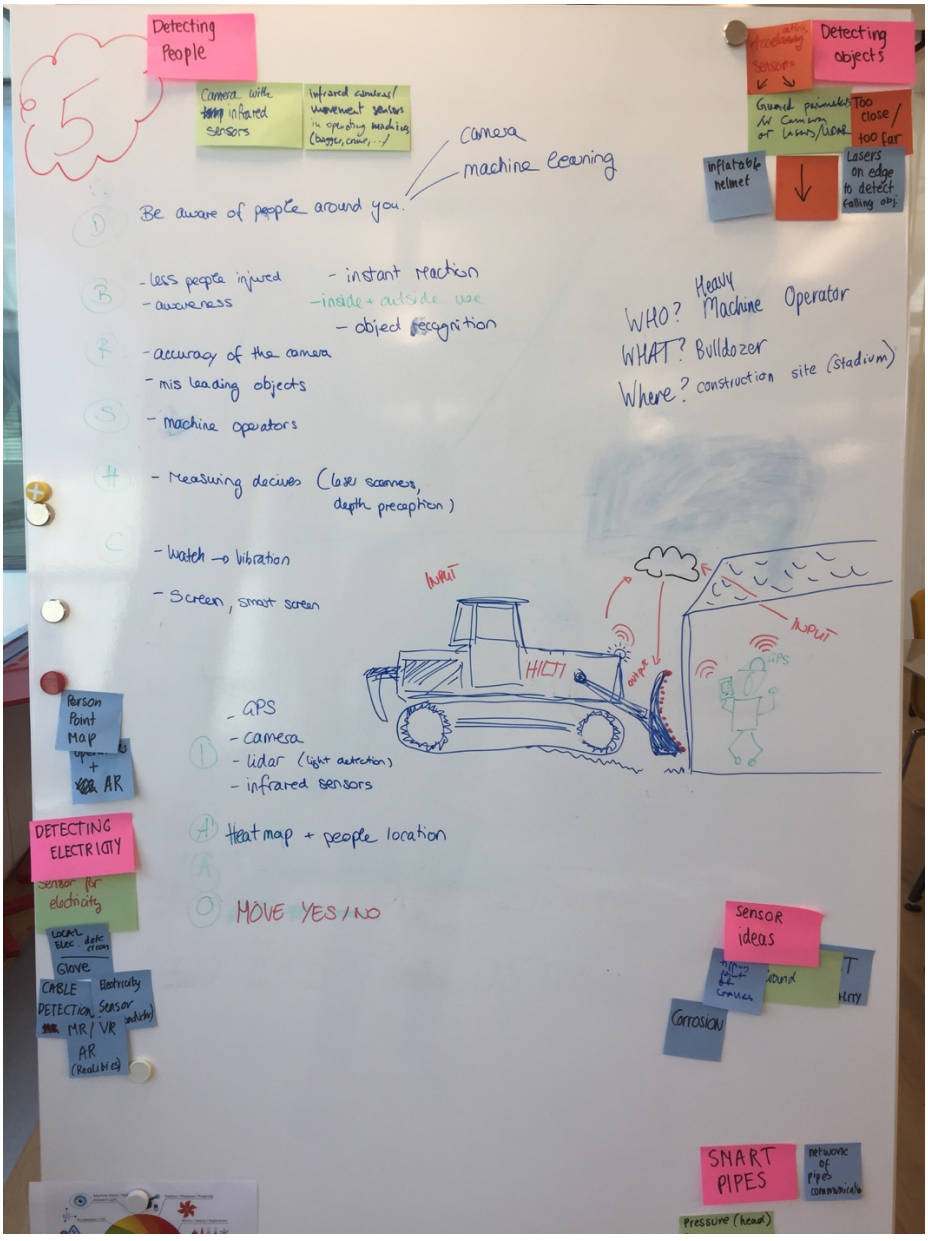

GROUP 3
BATMAN - BELT
Modular Sensor & Actor HUB
" different packages, for better personalisation "
Fall detection - Gyroscope & Acc. Sensor
Notification to System (real time)
E & M Field detection - Induction
Acoustic Feedback (the closer - the louder)
Air detection - Various Sensors
Level of O2 / Chemicals / Fog / Dust / COx
Temperature
Break reminder
Dangerous Area - RFID
Shut down tool if worker enters (combined with IR Camera)
„ Dangerous Zone "
5 workers within
Warning for Drivers (in 10 meters)
Risk of System Failure
while shut down (lack of control for the user)
Government, Insurances, Health care
Integration to HILTI Cloud
Worker is part of the Cloud via the belt


people

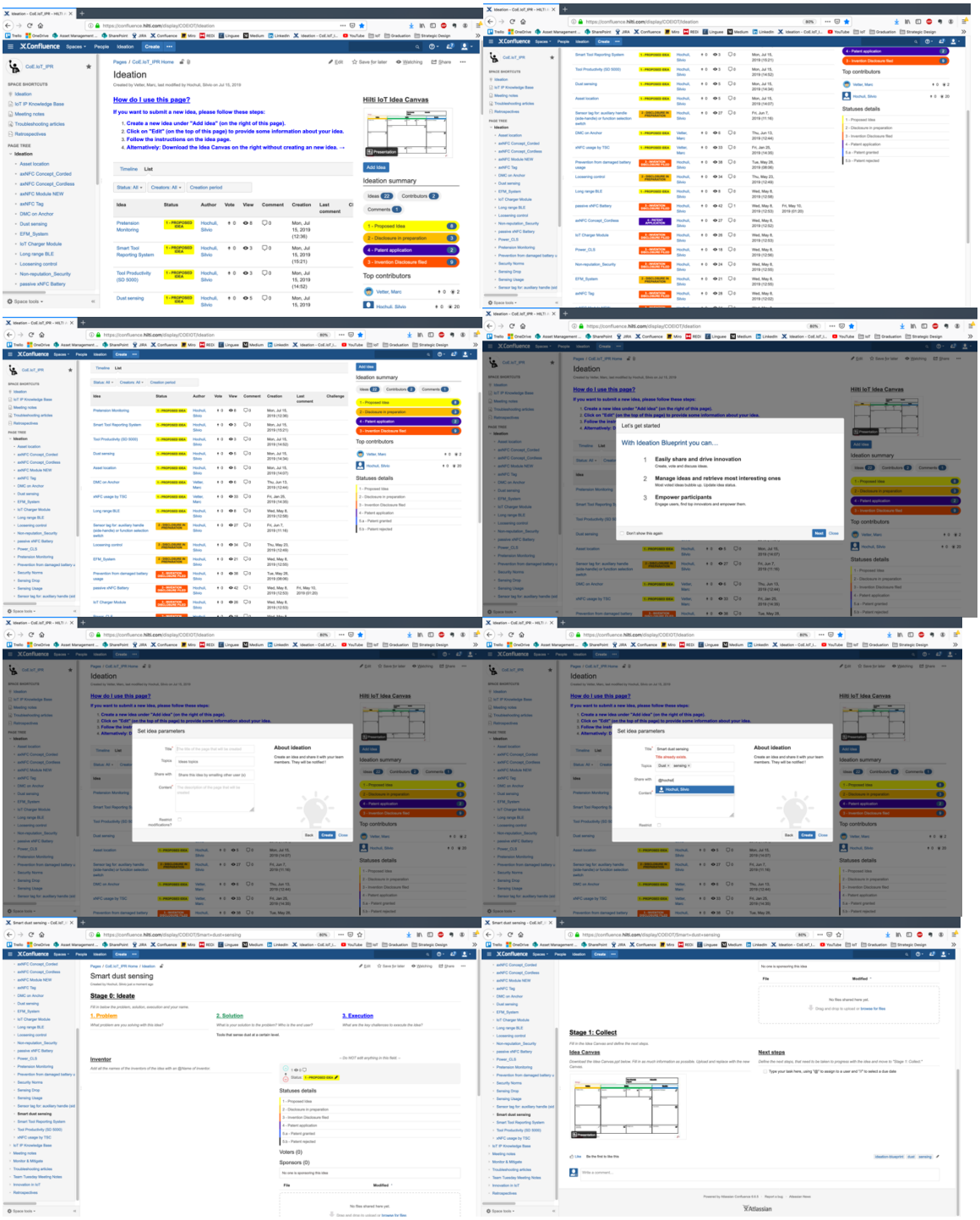

INTERFACE FOR A JOBSITE MANAGER
employee personalized
(ensures health & safety regulations & stores data in case of accident)
to be checked
battery
Modules
clip-on modules

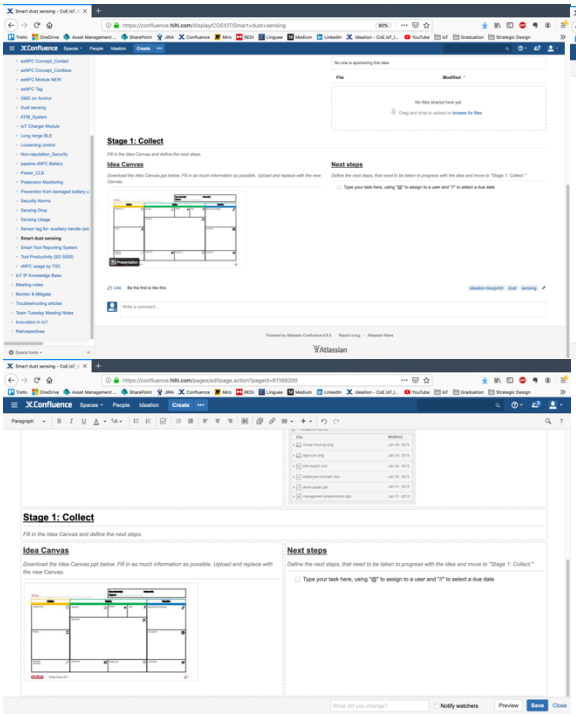

smart
Work environments
smart
Tool
Kit
Keet
PERSONAL
SAFETY
NETWORK

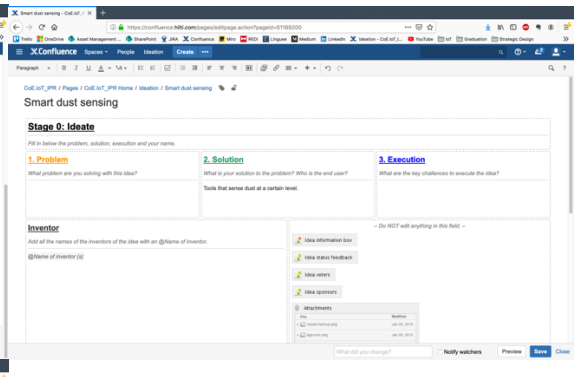

KEET
SOLUTION
LONG TERM IDEA
SHORT TERM IDEA


Detecting People
Camera with infrared sensors
infrared cameras / movement sensors in operating machine (bagger, crane, ...)
Detecting objects
Sensors
Guard perimeter Too close / too far
Lasers on edge to detect falling obj.
inflatable helmet
camera
machine learning
Be aware of people around you.
- less people injured
- awareness
- instant reaction
- inside + outside use
- object recognition
- accuracy of the camera
- mis leading objects
- machine operators
- measuring devices (laser scanners, depth precaption)
- watch → vibration
- screen, smart screen
WHO? Heavy Machine Operator
WHAT? Bulldozer
Where? construction site (stadium)
INPUT
HILTI
output
INPUT
GPS
- camera
- lidar (light detection)
- infrared sensors
Heat map + people location
MOVE YES / NO
Person Point Map
+ AR
DETECTING ELECTRICITY
Sensor for electricity
Glove
CABLE DETECTION
Electricity Sensor
MR / VR
AR (Realities)
sensor ideas
Corrosion
SMART PIPES
network of pipes communicate
Pressure (head)

11.6 Appendix F – Confluence page



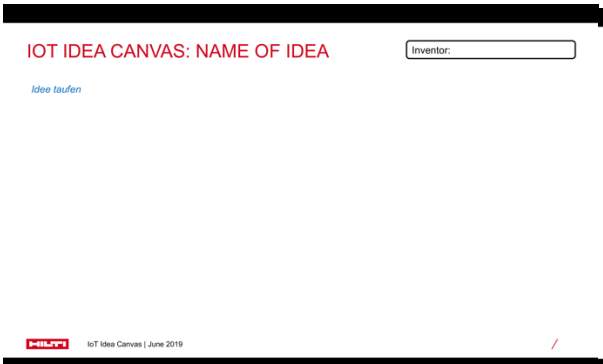

Stage 1: Collect
Idea Canvas
Next steps
Atlassian

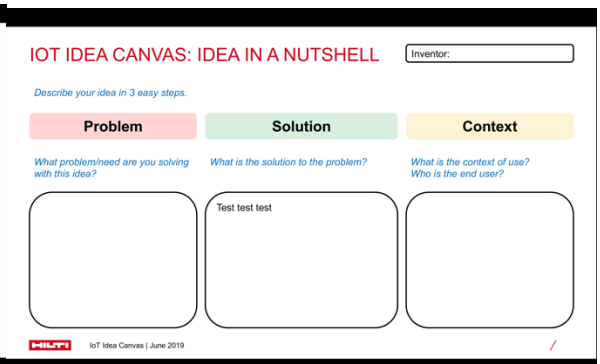

Smart dust sensing
Stage 0: Ideate
1. Problem
2. Solution
3. Execution
Inventor

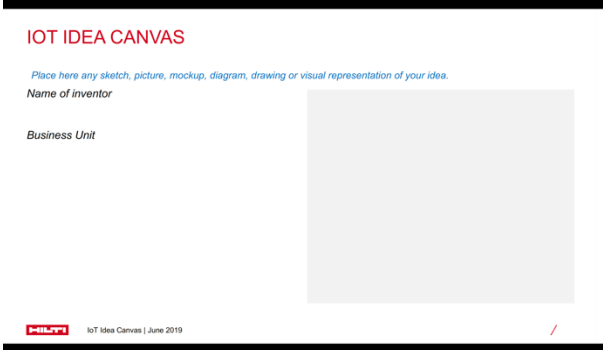
Stage 1: Collect
Idea Canvas
Next steps

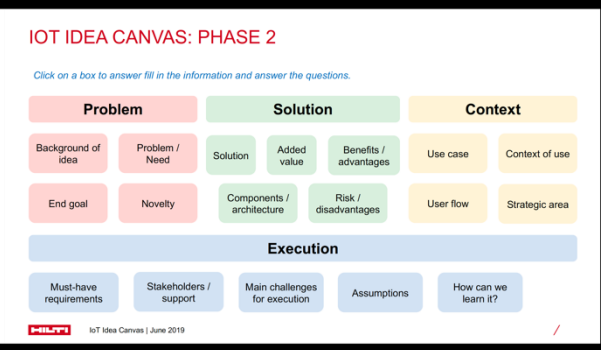
11.7 Appendix G – IoT Canvas versions

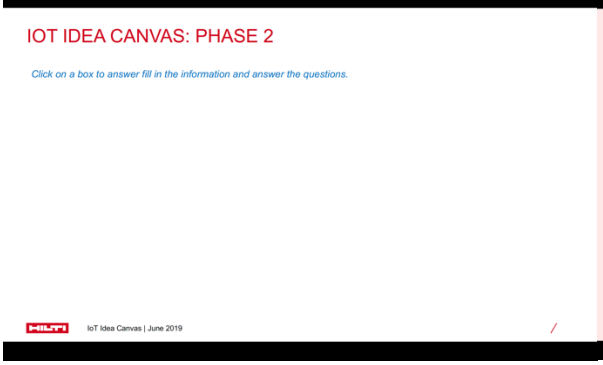
11.7.1 IoT Canvas version 1

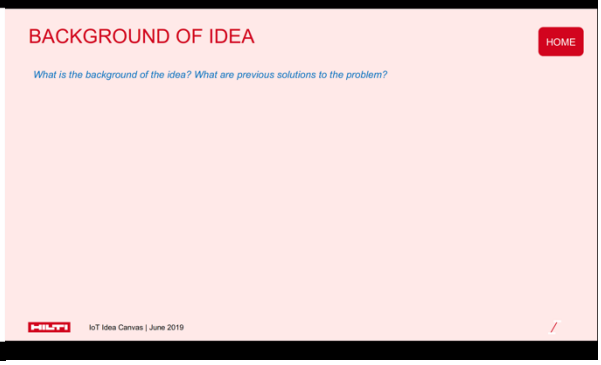


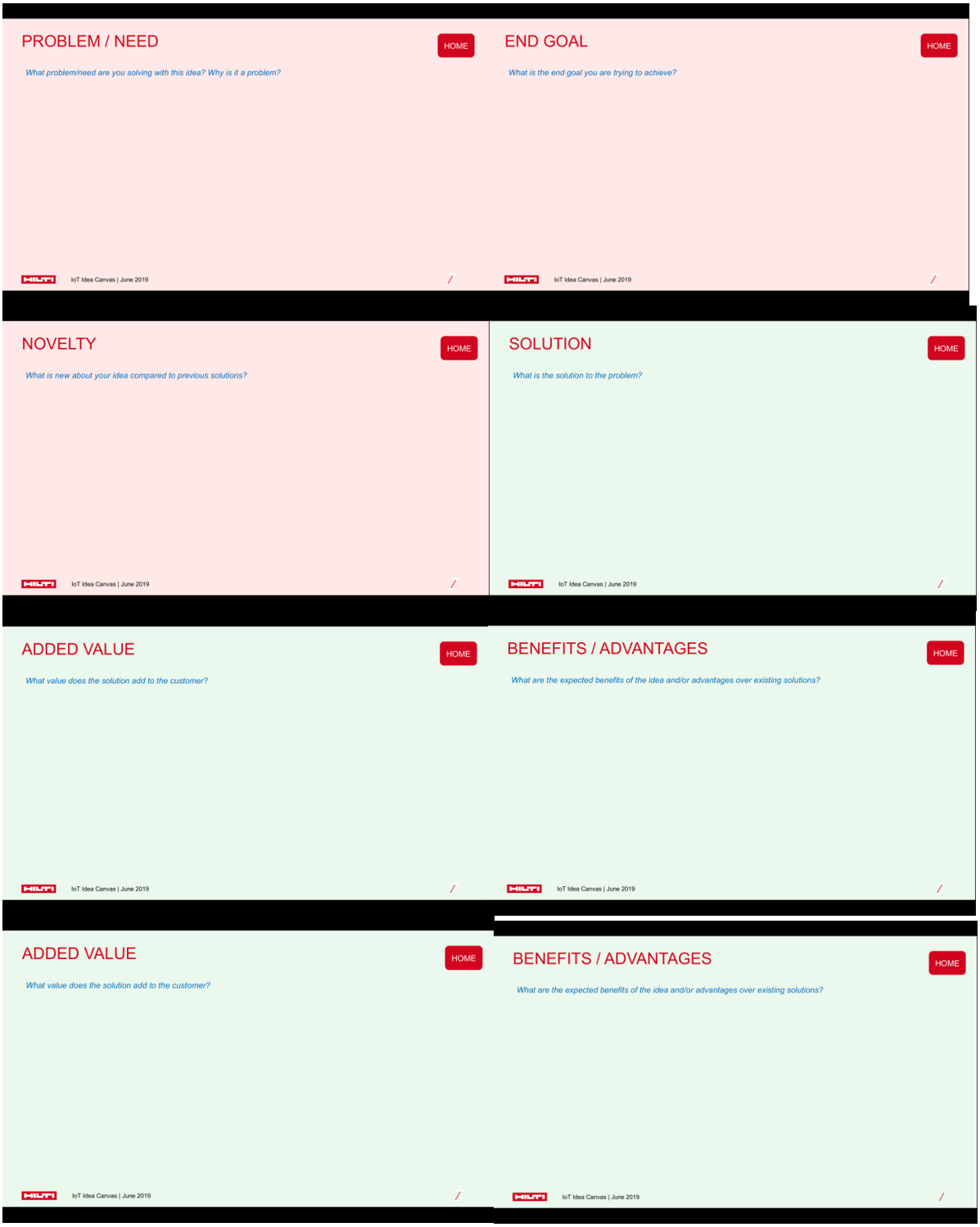











PROBLEM / NEED
HOME
What problem/need are you solving with this idea? Why is it a problem?
IoT Idea Canvas | June 2019
END GOAL
HOME
What is the end goal you are trying to achieve?
IoT Idea Canvas | June 2019
NOVELTY
HOME
What is new about your idea compared to previous solutions?
IoT Idea Canvas | June 2019
SOLUTION
HOME
What is the solution to the problem?
IoT Idea Canvas | June 2019
ADDED VALUE
HOME
What value does the solution add to the customer?
IoT Idea Canvas | June 2019
BENEFITS / ADVANTAGES
HOME
What are the expected benefits of the idea and/or advantages over existing solutions?
IoT Idea Canvas | June 2019
ADDED VALUE
HOME
What value does the solution add to the customer?
IoT Idea Canvas | June 2019
BENEFITS / ADVANTAGES
HOME
What are the expected benefits of the idea and/or advantages over existing solutions?
IoT Idea Canvas | June 2019

RISKS / DISADVANTAGES

HOME

What are possible risks of the idea and/or disadvantages over existing solutions?

IoT Idea Canvas | June 2019

COMPONENTS / ARCHITECTURE

HOME

What are the different components needed for the solution? Fill in the elements of the IoT architecture for the invention.

Thing/ product	Sensor	Gateway	IoT cloud	Business application	Customer interface
Which tools or hardware elements are involved? (e.g. DX5, Sensor Tag, NCP Battery)	*What is beeing measured? What type of sensor is required? (e.g. vibration, accelerometer)*	*Which gateway is needed for the solution to work? (e.g. Hilti Connect App)*	*TBD*	*What is the application that monitors abd processes collected data? (TBD)*	*What is the communication channel for the customer? (e.g. Hilti Connect App)*

IoT Idea Canvas | June 2019

USE CASE

HOME

What are possible applications and use cases for the idea?

IoT Idea Canvas | June 2019

CONTEXT OF USE

HOME

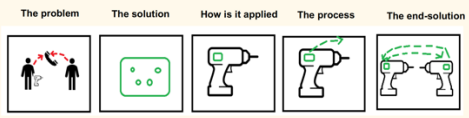
What is the context of use?

IoT Idea Canvas | June 2019

USER FLOW

HOME

How is the product used? Who is the end user? Sketch the problem, the solution, the user's flow.



IoT Idea Canvas | June 2019

STRATEGIC AREA

HOME

To what item of the roadmap/ KPIs/ vision of your team is the solution related to? In what strategic area is the idea?

Asset tracking	Predictive maintenance
Asset theft alert	Remote tool lock-down
Asset dash-board	Integrated replenishment
Asset service alert	Feature unlock / upgrade
Seamless Docu Mgmt.	Tool self-diagnosis & help
Tool as a Service	Applicat. profile selector
Digital fleet label	Digital service request

IoT Idea Canvas | June 2019

MUST-HAVE REQUIREMENTS

HOME

What are the must-have requirements for the solution to succeed?

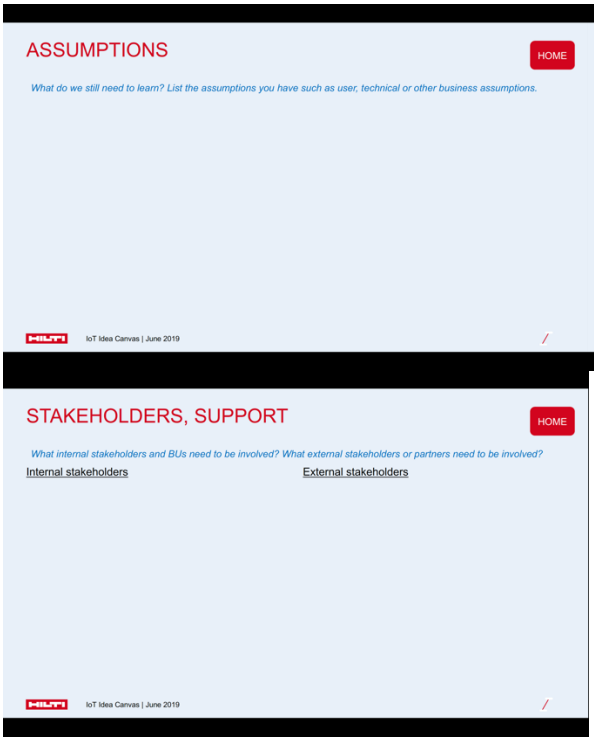
IoT Idea Canvas | June 2019

MAIN CHALLENGES FOR EXECUTION

HOME

What are the main challenges for the execution of the idea (budget/ priorities/ technology/ etc.)?

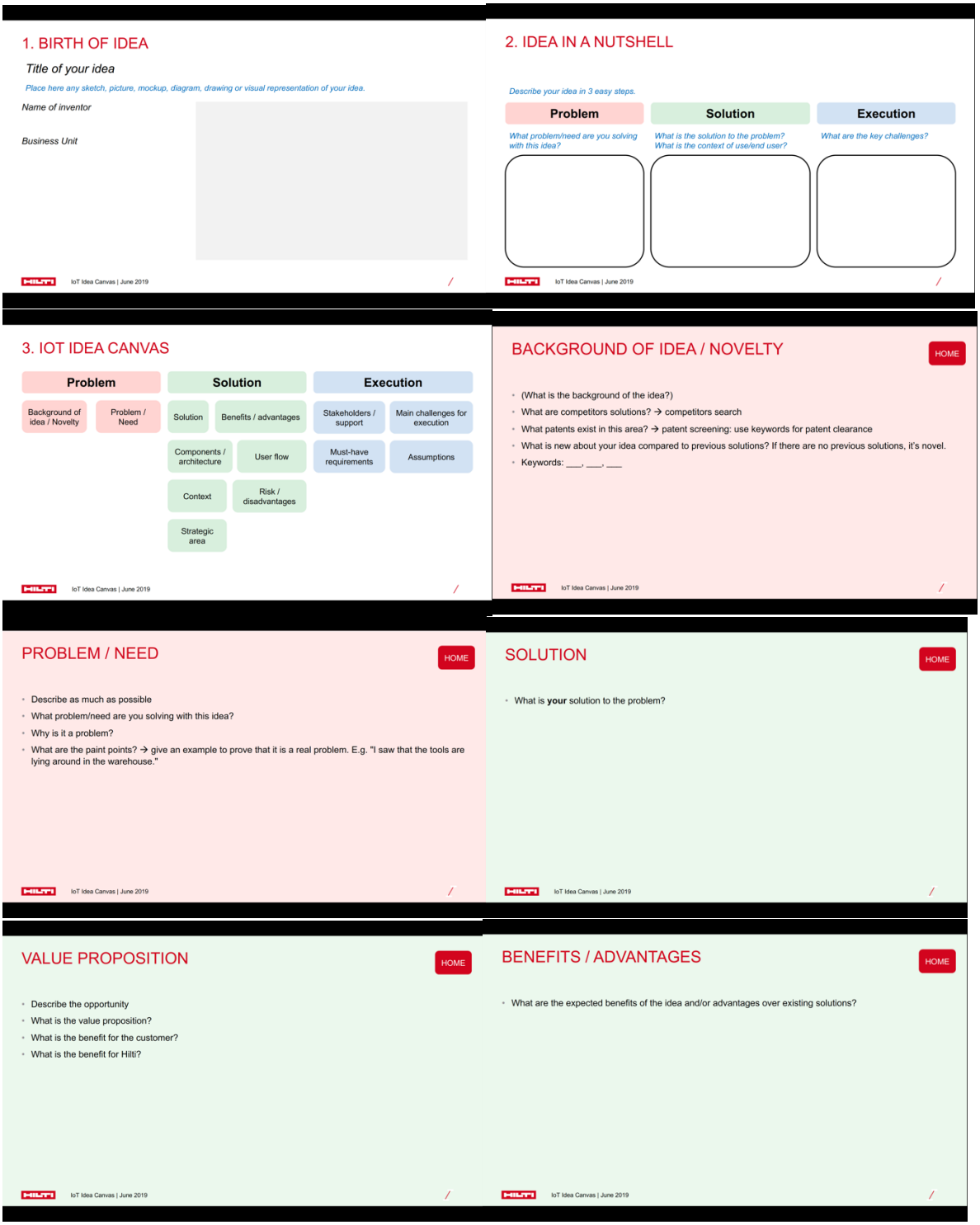
IoT Idea Canvas | June 2019


ASSUMPTIONS
HOME
What do we still need to learn? List the assumptions you have such as user, technical or other business assumptions.
IoT Idea Canvas | June 2019


HOW CAN WE LEARN IT?
HOME
How can we test and validate the assumptions? Describe the test. (Prototype, MVP, POC, customer interview, etc.)
IoT Idea Canvas | June 2019

STAKEHOLDERS, SUPPORT
HOME
What internal stakeholders and BUs need to be involved? What external stakeholders or partners need to be involved?
Internal stakeholders
External stakeholders
IoT Idea Canvas | June 2019

11.7.2 IoT Canvas version 2



1. BIRTH OF IDEA

Title of your idea

Place here any sketch, picture, mockup, diagram, drawing or visual representation of your idea.

Name of inventor

Business Unit

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2. IDEA IN A NUTSHELL

Describe your idea in 3 easy steps.

Problem	Solution	Execution
What problem/need are you solving with this idea?	*What is the solution to the problem? What is the context of use/end user?*	*What are the key challenges?*

IoT Idea Canvas | June 2019

3. IOT IDEA CANVAS

Problem		Solution		Execution	
Background of idea / Novelty	Problem / Need	Solution	Benefits / advantages	Stakeholders / support	Main challenges for execution
		Components / architecture	User flow	Must-have requirements	Assumptions
		Context	Risk / disadvantages		
		Strategic area			

IoT Idea Canvas | June 2019

BACKGROUND OF IDEA / NOVELTY

HOME

- (What is the background of the idea?)
- What are competitors solutions? → competitors search
- What patents exist in this area? → patent screening: use keywords for patent clearance
- What is new about your idea compared to previous solutions? If there are no previous solutions, it's novel.
- Keywords: ___, ___, ___

IoT Idea Canvas | June 2019

PROBLEM / NEED

HOME

- Describe as much as possible
- What problem/need are you solving with this idea?
- Why is it a problem?
- What are the paint points? → give an example to prove that it is a real problem. E.g. "I saw that the tools are lying around in the warehouse."

IoT Idea Canvas | June 2019

SOLUTION

HOME

- What is **your** solution to the problem?

IoT Idea Canvas | June 2019

VALUE PROPOSITION

HOME

- Describe the opportunity
- What is the value proposition?
- What is the benefit for the customer?
- What is the benefit for Hilti?

IoT Idea Canvas | June 2019

BENEFITS / ADVANTAGES

HOME

- What are the expected benefits of the idea and/or advantages over existing solutions?

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RISKS / DISADVANTAGES

HOME

- What are possible risks of the idea and/or disadvantages of the idea?
  - Too expensive?
  - Too complicated to use for the user?
  - Technological risk
  - Market risk
  - Patent infringement
  - Security risk (cyber security)
  - Safety risk (can somebody get injured?)

IoT Idea Canvas | June 2019

SOLUTION SYSTEM FOOTPRINT

HOME

What are the different components needed for the solution? Fill in the elements of the IoT architecture for the invention.

Thing/ product	Sensor	Gateway	IoT cloud	Business application	Customer interface
Which tools or hardware elements are involved? (e.g. DX5, Sensor Tag, NCP Battery)	*What is beeing measured? What type of sensor is required? (e.g. vibration, accelerometer)*	*Which gateway is needed for the solution to work? (e.g. Hilti Connect App)*	*TBD*	*What is the application that monitors abd processes collected data? (TBD)*	*What is the communication channel for the customer? (e.g. Hilti Connect App)*

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CONTEXT

HOME

- What are possible applications and use cases for the idea?
- What is the context of use?
- Who is the user/persona?

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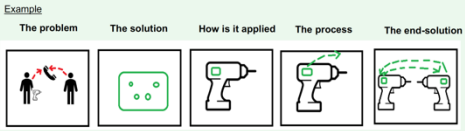
USER FLOW

HOME

How is the product used? Who is the end user? Sketch the problem, the solution, the user's flow.

Example



IoT Idea Canvas | June 2019

STRATEGIC AREA

HOME

To what item of the roadmap/ KPIs/ vision of your team is the solution related to? In what strategic area is the idea?

Asset tracking	Predictive maintenance
Asset theft alert	Remote tool lock-down
Asset dash-board	Integrated replenishment
Asset service alert	Feature unlock / upgrade
Seamless Docu Mgmt.	Tool self-diagnosis & help
Tool as a Service	Applicat. profile selector
Digital fleet label	Digital service request

IoT Idea Canvas | June 2019

MUST-HAVE REQUIREMENTS

HOME

What are the must-have requirements for the solution to succeed?

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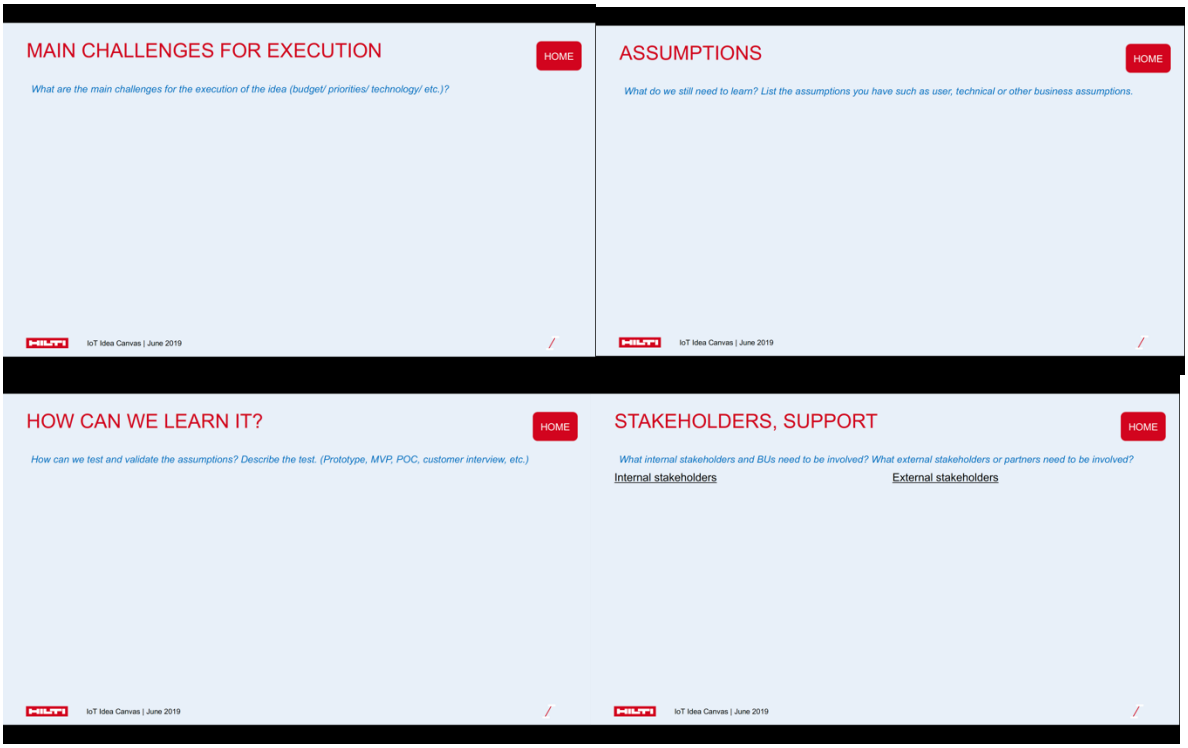
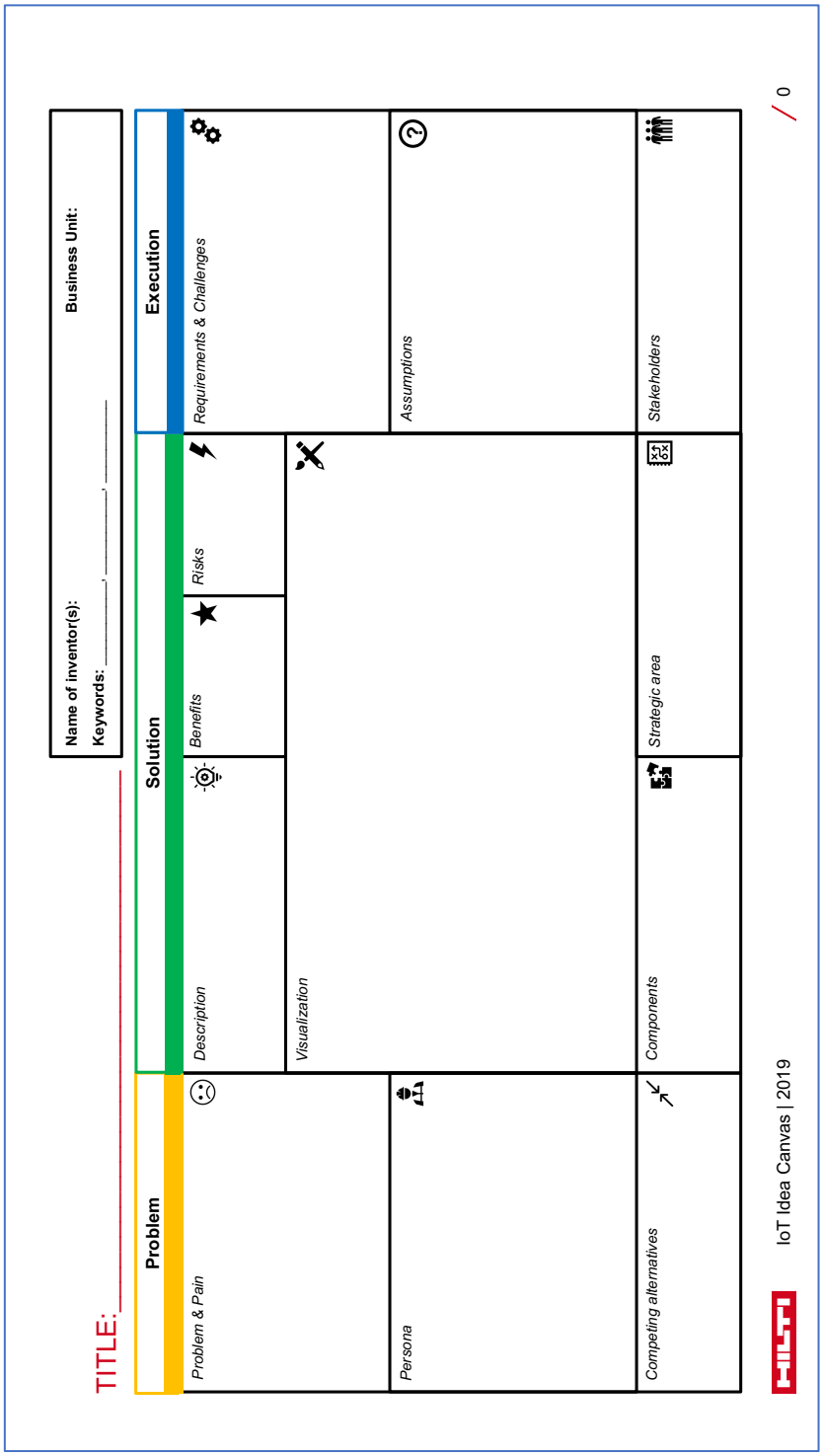
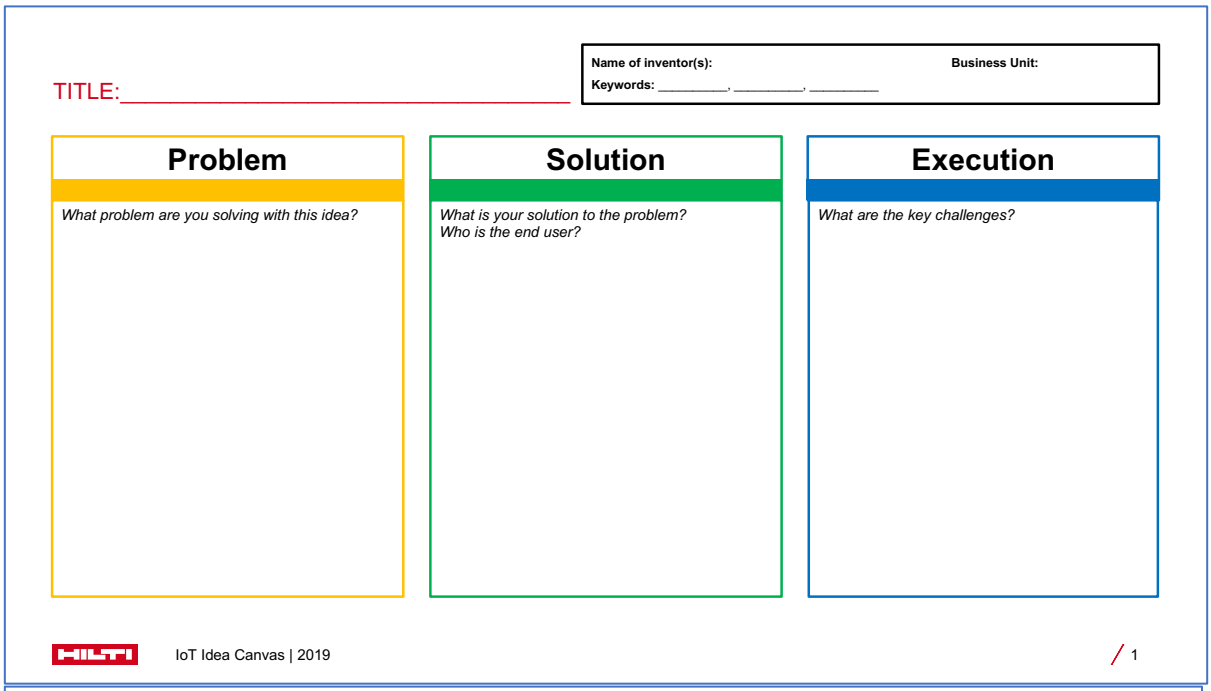

MAIN CHALLENGES FOR EXECUTION
HOME
What are the main challenges for the execution of the idea (budget/ priorities/ technology/ etc.)?
IoT Idea Canvas | June 2019
ASSUMPTIONS
HOME
What do we still need to learn? List the assumptions you have such as user, technical or other business assumptions.
IoT Idea Canvas | June 2019
HOW CAN WE LEARN IT?
HOME
How can we test and validate the assumptions? Describe the test. (Prototype, MVP, POC, customer interview, etc.)
IoT Idea Canvas | June 2019
STAKEHOLDERS, SUPPORT
HOME
What internal stakeholders and BUs need to be involved? What external stakeholders or partners need to be involved?
Internal stakeholders
External stakeholders
IoT Idea Canvas | June 2019

11.8 Appendix H – IoT Canvas (Final)





TITLE:_____

Name of inventor(s): Business Unit:

Keywords: _____, _____, _____

Problem

What problem are you solving with this idea?

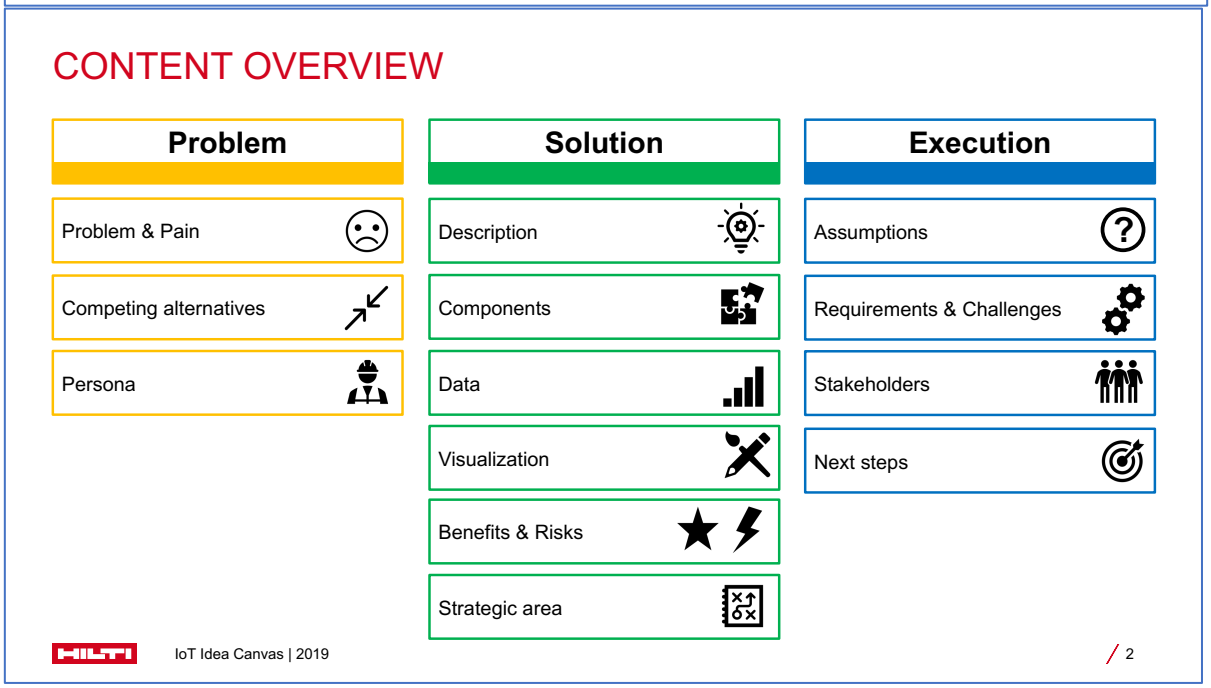
Solution

What is your solution to the problem?
Who is the end user?

Execution

What are the key challenges?

IoT Idea Canvas | 2019 / 1



CONTENT OVERVIEW

Problem

- Problem & Pain
- Competing alternatives
- Persona

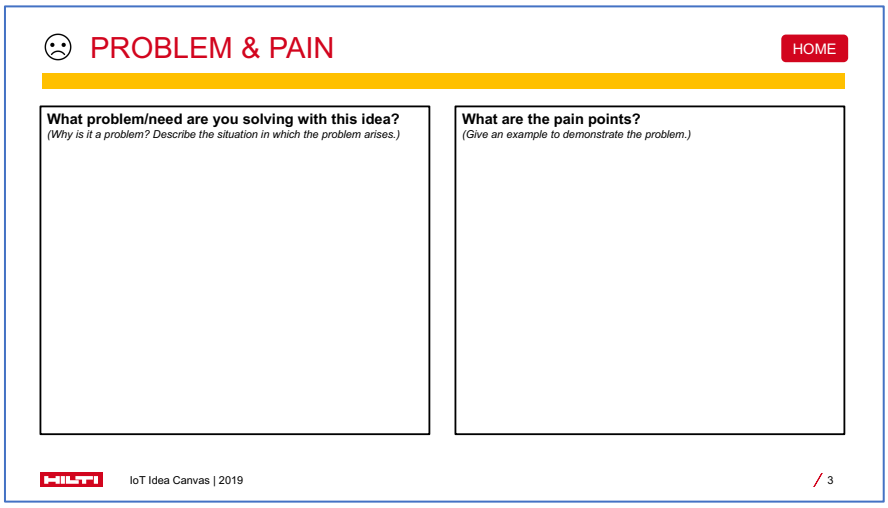
Solution

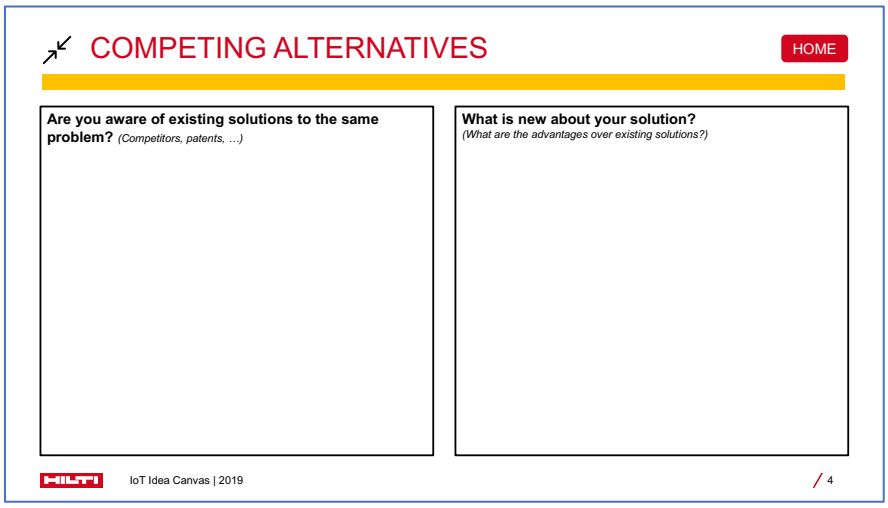
- Description
- Components
- Data
- Visualization
- Benefits & Risks
- Strategic area

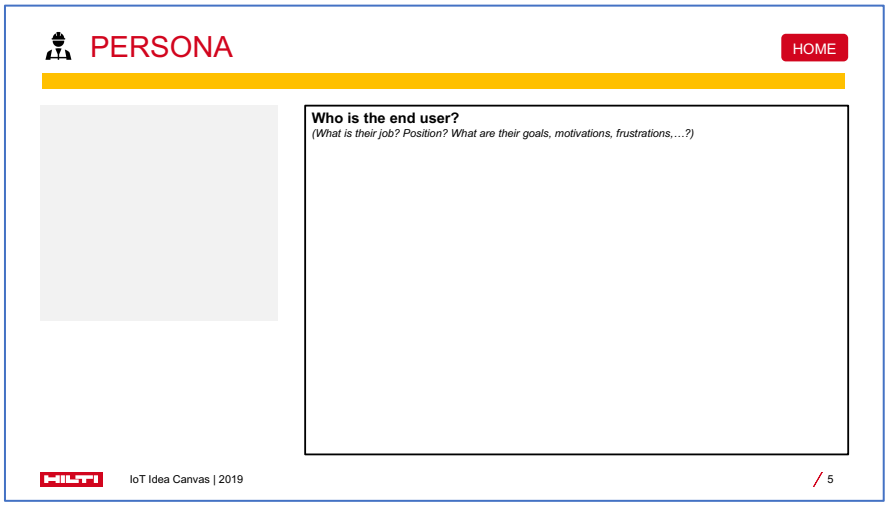
Execution

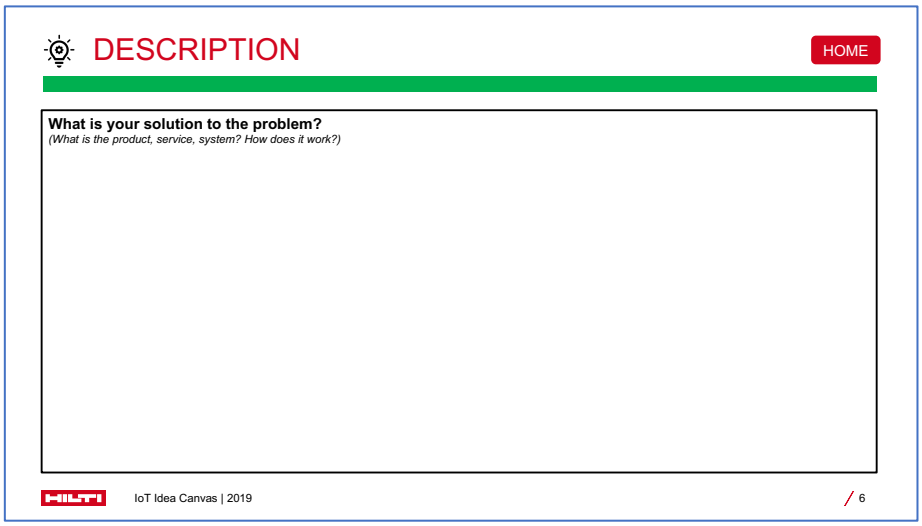
- Assumptions
- Requirements & Challenges
- Stakeholders
- Next steps

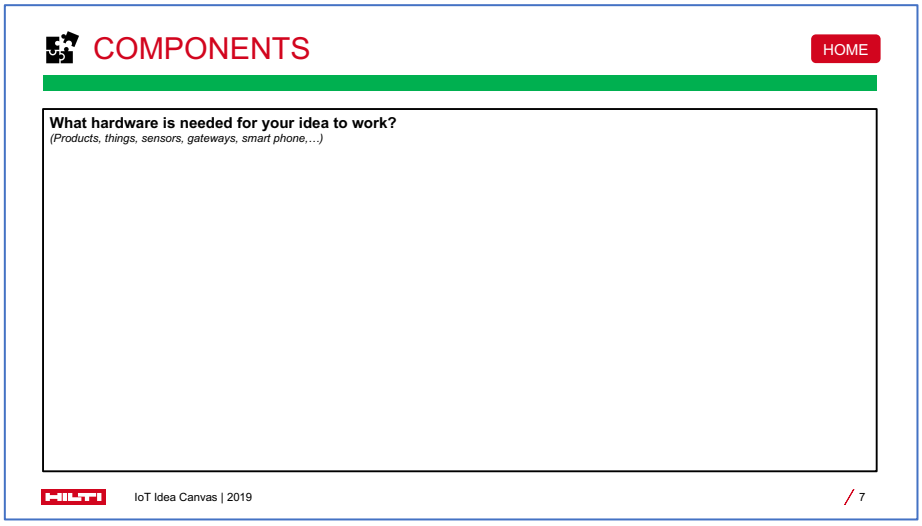
IoT Idea Canvas | 2019 / 2

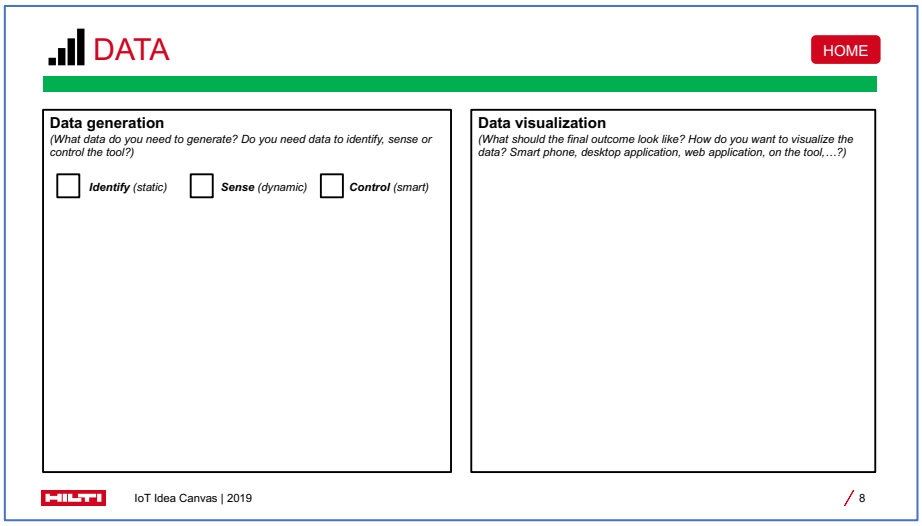

PROBLEM & PAIN
HOME
What problem/need are you solving with this idea?
(Why is it a problem? Describe the situation in which the problem arises.)
What are the pain points?
(Give an example to demonstrate the problem.)
IoT Idea Canvas | 2019
/ 3


COMPETING ALTERNATIVES
HOME
Are you aware of existing solutions to the same problem? (Competitors, patents, ...)
What is new about your solution?
(What are the advantages over existing solutions?)
IoT Idea Canvas | 2019
/ 4


PERSONA
HOME
Who is the end user?
(What is their job? Position? What are their goals, motivations, frustrations,...?)
IoT Idea Canvas | 2019
/ 5


DESCRIPTION
HOME
What is your solution to the problem?
(What is the product, service, system? How does it work?)
IoT Idea Canvas | 2019
/ 6


COMPONENTS
HOME
What hardware is needed for your idea to work?
(Products, things, sensors, gateways, smart phone,…)
IoT Idea Canvas | 2019
/ 7


DATA
HOME
Data generation
(What data do you need to generate? Do you need data to identify, sense or control the tool?)
Identify (static)
Sense (dynamic)
Control (smart)
Data visualization
(What should the final outcome look like? How do you want to visualize the data? Smart phone, desktop application, web application, on the tool,…?)
IoT Idea Canvas | 2019
/ 8

VISUALIZATION

HOME

Sketch your solution!
(What does your idea look like? How does it work? How are the hardware components arranged? How does the data flow between them?)

BENEFITS & RISKS

HOME

What are the benefits to the customer?

What are the benefits to Hilti?

What are possible risks of your idea?
(Price, complexity, security, safety, market, …)

STRATEGIC AREA

HOME

In what strategic area is the idea? Which of the main use cases does the idea fit in?

Main use cases

- □ Asset tracking
- □ Predictive maintenance
- □ Asset theft alert
- □ Remote tool lock-down
- □ Asset dash-board
- □ Integrated replenishment
- □ Asset service alert
- □ Feature unlock / upgrade
- □ Seamless Documentation Mgmt.
- □ Tool self-diagnosis & help
- □ Tool as a Service
- □ Application profile selector
- □ Digital fleet label
- □ Digital service request
- □ Other: _____

To what item of the roadmap/ KPIs/ vision of your team does the solution relate to?

REQUIREMENTS & CHALLENGES

HOME

What are the must-have requirements for the solution to succeed?	**What are the main challenges for the execution of the idea?** *(Budget, priorities, technology, …)*

ASSUMPTIONS

HOME

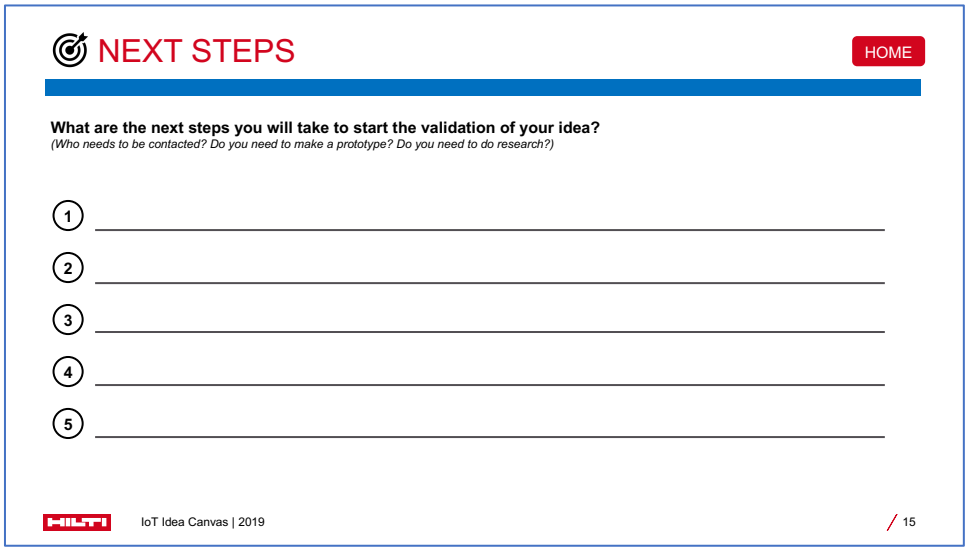
What are the assumptions related to the idea? *(Assumptions about the problem, solutions, user, risks, …)*	**How can you validate them?** *(People to contact, research, Prototype, MVP, POC, customer interview…)*

STAKEHOLDERS

HOME

What internal stakeholders and BUs need to be involved? What external stakeholders or partners need to be involved?

Internal stakeholders	**External stakeholders**


NEXT STEPS
HOME
What are the next steps you will take to start the validation of your idea?
(Who needs to be contacted? Do you need to make a prototype? Do you need to do research?)
1
2
3
4
5
IoT Idea Canvas | 2019
15

11.9 Appendix I – Process blueprint (Final)