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**Product-Service Systems in the Construction Industry: An
Exploratory Case Study in the Portuguese Context**

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Master Thesis

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To my Family and Friends

Abstract

Considering the Portuguese construction industry, which is the area with less computerized documentation, the challenge is to introduce an innovative Product-Service System (PSS). This PSS depends on smartphones and computers so it is a twofold challenge: In one hand, there is the relation cost benefit considering assets management and increased control on employees and so hard to be accepted by the workforce, on the other hand is the service implementation considering technological devices on the jobsites.

The understanding of a PSS process internally is essential in order to successfully implement these systems on these kinds of companies. Therefore, this study will focus on two research objectives. First, finding out who are the potential customers and secondly keep developing the internal On!Track (OT) process.

Several approaches were used to obtain information. A qualitative one embraced participatory observations, primary source study and its qualitative data analysis.

Regarding the internal OT process, the approaches were used to design stakeholders' maps of the company and the PSS under study, and Mind-Maps were used to brainstorming, helping to identify Customers' Profiles, therefore improving the internal OT process.

These methodologies allowed to idealize a table about the main characteristics of a potential customer for the PSS OT and a graphic with the main needs and problems, costs and potential savings for customers, who already had onsite analysis. Additionally, it was possible to achieve one idea of the involved tasks, responsibilities and lead time of the internal process considering As-Is and what could be the To-Be process.

In this study, it is possible to see the creation of a Customer Profile, what are the characteristics of a company which can become a On!Track user and some relevant information about the company's internal process. Moreover, another analysis was made to identify some problems of On!Track processes and improve it. Finally, some findings are presented that reveal the strong characteristics of this industry.

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List of abbreviations

PSS – Product Service System

SD – Service Design

FM – Fleet Management

OT – On!Track

B2B – Business to business

RFID – Radio Frequency Identification

RP – Report Study

1 Contextual Frame of the Construction Industry

Construction Industry is one of the biggest sectors in Portugal, which leads us to be one of the most competitive activities. Within this complex environment, it is necessary to use innovative and productive strategies. Considering a few indicators from previous studies, it is challenging to study innovative solutions in order to help construction managers improve their performance (Horta, Camanho, & Da Costa, 2012). Nowadays, the Construction Industry in Portugal is growing and, after 11 years without a good registration about the growing of the industry, the tendency is beginning to increase even more through rehabilitation according to Instituto Nacional de Estatística.

This part of the sector is carrying all the industry and the main cities where this phenomenon emerge is in Porto and Lisbon, refers a recent research made by Prime Yield Portugal Consulting. Due to entrepreneurs, it will continue to increase. These positive results in the industry are supported by the growth of tourism in Portugal and foreign investments mainly prevenient from Frenchs, Brazilians and Chinese. To do this kind of constructions, rehabilitation, it is necessary a specific know-how which leads to the new appearance of companies only for rehabilitation says Igor Oliveira, Hilti Manager, in an interview made in April 2017 (Silva, 2017).

With more job sites and new companies, it is demanding to have better manage tools. Due to reduced profit margins, the best way to have more profitability is to be more efficient and productive in the internal management processes. This industry is less informatic than others and there are several references to this problem. The industry is aware of the importance of the mega trend towards digitization. The problem lies rather with implementation. This is the finding of an exclusive Roland Berger management survey, above all among construction firms and their suppliers in Germany, Austria and Switzerland (Hoff, 2016).

The study aims to improve company management, reducing unexpected expenses, redundant purchases and trying to keep fixed costs under control. Sometimes, some unforeseen events may occur and all the profit margin can disappear. If the company has some warehouses or multiple job sites, it is very easy to lose track of the equipment, which can lead to loss of money. Due to the low profit margins, the companies cannot make mistakes in adjacent activities to support the core ones. Therefore, there is a need to have a good global view of the company in order to have the assets, documentation and human resources under control. There are some solutions to help the managers achieve a better performance and, consequently, more profit.

The research objective is to identify and understand, through observation, document analysis and field work, the needs of customers from the construction industry. With this knowledge, it might be possible to make a comparison with the software features in order to improve the productivity in several tasks, such as equipment inventory and give its responsibilities to employees. Currently, several tasks are easy to do because of the technological development. To achieve this goal and to improve the implementation of the service at the customer's companies in Portugal, it is necessary to identify the necessities and the requirements of the principal stakeholders. With this information, after a careful analysis, it is possible to contribute to one better and more effective approach of the service in study, from the

company provider to final user. Thus, this topic was very challenging and interesting because of the resistance to technology that the industry has and using this innovative service, the customers would have a good general view of the company, reduce waste and, the last but not the least, help them to make better strategic management decisions.

As consequence of the characteristics previously mentioned, to understand the global process of the service, it should be achieved through field work and document analysis.

1.1 Problem Description

We are assisting to a huge technology development and construction industry which is one of the less computerized, so there is a need to improve it in this industry. Regarding the technology development, it becomes expected the introduction of better systems to manage the construction companies as well as jobsites.

This sector has a lot of characteristics. One of the main characteristics of this industry is the outsourced resources to the job. Normally, the offer includes teams to do specific jobs and these teams must support their work with tools and, consequently, other services. When a team is subcontracted to do a job, if the work is well done, the probability to make other job to the same person increases and, perhaps, a partnership is created.

From here, the concept of Product-Service System (PSS) emerges. Briefly, to start with a PSS is a system where the product and the service have the same weight in the value proposition of the offer. As you may understand, the construction industry is traditionally an industry based in PSSs, even though it is not often referenced as such.

1.2 Research Goals and Challenges

Initially, the dissertation is directed to discover the customers profile and the main needs and problems of them in company management looking for improve internal processes. In other words, first we tried to understand what are the main characteristics of a potential customer profile. Then, after analysing official documents, we tried to organize the information and make an overview to reach what could have more interest to impact in customer's company management. These intentions lead to this research question:

- How could a PSS influence the behaviour of people in the construction industry? What characteristics should have a technology-based PSS considering construction market and its customers? What can be improved?

Furthermore, this study will focus the assets management processes, in order to reduce the lead time and make the process cleaner, from this intention born the following research question:

- How can the global process of assets management be improved? What are the bottlenecks of this service?

1.3 Study and Project Development at Company Hilti Portugal

This dissertation was made in a business environment and to make this possible, a contract was established between FEUP, the student, dissertation author, and Hilti Portugal Produtos e Serviços Lda. Hilti is pioneer (Osterwalder; & Pigneur., 2010) of innovative theoretical concepts and methodologies and because of that; the company is frequently mentioned in articles and case studies. Furthermore, there are news and awards mentioning the company. This research supports the launch of a new service called On!Track (OT).

In Portugal, OT has a small representation comparing to the universe of other services offered by Hilti. In other countries such as France and Spain, where this solution was launched simultaneously, the implementation happened smoothly.

1.4 Dissertation Structure

The dissertation is divided into six chapters to better explain the research made.

Second chapter – is presented the literature review about theoretical concepts, Product-Service System (PSS), Service Design (SD) and Servitization/Deservitization (S/D).

Third chapter – this chapter, the PSS in study is described, all the characteristics and features as well as the process inherent to OT from the customer point of view. It is possible to have a picture of the global process.

Fourth chapter – is about Methodologies used, also have the methods of collecting information; how the data was collect during the project. Then, some outputs are presented provided from that data collection.

Fifth chapter – concerning PSS Design this chapter has described practical approaches, begins with the identification of all stakeholders of the company and, posteriorly, focus to the stakeholders of OT. Another part is about the internal activities using mind maps (brainstorm) as tool to improve parts of the OT process.

Sixth chapter – the last chapter talks about the conclusions of the study and some indications to future research. Some findings and curiosities of the industry are presented such as well as some typical behaviour of the workers. This type of information is only discovered by the field experience and contact with some stakeholders.

2 Conceptual Background

To address the theme of the PSSs, it seemed important to collect definitions and different points of view on this and other concepts. Considering the case study, the PSS theme was a good starting point: we had a product (platform) and a service (process of support and management), in a system (civil construction ecosystem). Hilti is already a pioneer of Servitization and therefore this idea was fundamental to contextualize. In the case of the implementation of a new service, it is also intended, in this state of the art, to identify specific methodologies to Service Design.

In this chapter, it will be talked about important concepts for this research, Product Service-Systems (PSS), Service Design (SD) and Servitization/Deservitization (S/D).

2.1 Product Service-System

To define Product Service-System (PSS) we can begin to clarify the main elements of a PSS. A Product is a tangible object, manufactured to be sold to fulfil the customer's needs. A Service is an activity done for others with an economic value and often done on a commercial basis and are economic activities offered by one party to another. The System is the environment that enables services and products to interrelate (Baines et al., 2007).

There are some other definitions for this same concept, which also go in the same direction. For Brandstotter, Haberl, Knoth, Kopacek, and Kopacek (2003) *“A PSS consists of tangible products and intangible services, designed and combined so that they are jointly capable of fulfilling specific customer needs. Additionally, PSS tries to reach the goals of sustainable development”*.

For Wong (2004) *“Product Service-Systems (PSS) may be defined as a solution offered for sale that involves both a product and a service element, to deliver the required functionality”*.

In summary, a PSS is a system where a product and a service can integrate a bundle of solutions that delivers value in use.

Nicola Morelli (2003) considers the “servitization” concept an evolution or an add-on to the product already existent that then makes the service and the product inseparable one from each other. At the same time, “productization” is the materialization of services to include a product as a new component of the service provided. When these two concepts meet, it is considered an exclusive offering of a product and service - PSS. This idea finds Wong (2004) who puts the pure products in one extreme and the pure services at other.

And some more important findings from Baines et al. (2007) are:

“A PSS is a special case in servitization, which values asset performance or utilization rather than ownership, and achieves differentiation through the integration of product and services that provide value in use to the customer.”

“There are a wide range of benefits of a PSS; to the producer it means an offering of higher value that is more easily differentiated, to the customer it is a release from the responsibilities of asset ownership, and to society at large a more sustainable approach to business.”

“The principal barriers to the adoption of PSS are positioned at both sides of the dyad: consumers may not be enthusiastic about ownerless consumption, and the manufacturers may be concerned with pricing, absorbing risks and shifts in the organization, which requires time and money to facilitate.”

PSS is a concept with significant potential value to manufacturers because it allows the companies to move up in the value chain and exploit activities with higher business value.

A lot of PSSs oriented to user or their outcomes (e.g. leasing, pay per service unit) (Costa, Patrício, & Morelli, 2015) are focused on “sale of use” rather than “sale of product” and the product provider keeps the ownership of the product. Users pay to have the product available and the manufacturer can have the chance to analyse the performance, efficiency and availability of product in order to be improved in use-phase (Baines et al., 2007).

The companies that try to incorporate the services in value proposition face new challenges, and are common to see manufacturers to “give way” service opportunities to focus and increase the product sales. For now, the services are considered as add-ons (e.g. maintenance and repair) and are attached to the product to maximize sales (Costa et al., 2015). It is a clear that we must create a new path for the services when it is verified that manufacturers need to adapt to face the increased competition and saturation of the markets and face the different needs and behaviours of the new markets emerged (Nicola Morelli, 2006).

In a general view, management literature is almost unanimous in suggesting to product manufacturers to integrate services into their core product offerings.

In general services have higher profit margins than products because of special characteristics like perishability and intangibility, and provide a more stable revenue because they are more resistant to the economic cycles that affects products (Oliva & Kallenberg, 2003). Hence, services are more profitable and avoid investments and equipment purchases. Another positive point, services are much more difficult to imitate and that makes the services a sustainable source of competitive advantage (Oliva & Kallenberg, 2003).

Currently the company is facing some of these PSS specific issues: The company is a good manufacturer, and to improve the quality and range of options they are developing the services provided around the products/platforms. Considering Nicola Morelli (2006) words, it means a convergence of products and services. The best and more clear example that comes from Hilti’s context is the Fleet Management (FM) - this service consists in a fixed monthly fee for using tools and equipment, (Hilti, 2017a), and the main issue is about ownership from the customer side and from the company side, is absorbing risks. It is the unique provider of this system in Portuguese market. This PSS adoption has the main advantage that the

customers are demanding more services. You can see in figure below, (**Figure 1**), the diagram of PSS in FM case demonstrates what the company inputs versus the consumer and it is possible to see the customer paying only a monthly fee and the consumables to make the machine work.

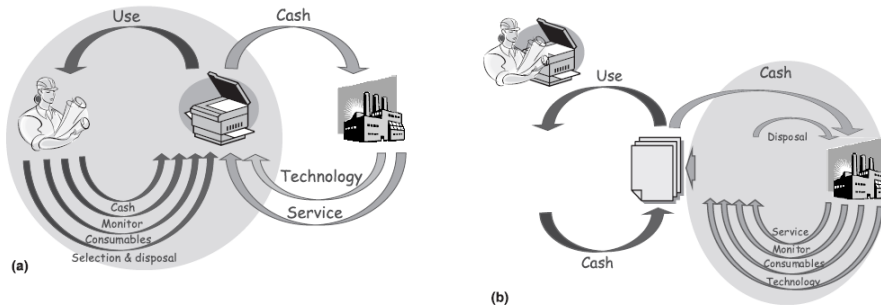


Figure 1 - PSS Diagram according to Baines (2007)

There are several beneficiaries from using a PSS at different levels, according to some researchers: consumer, supplier, environment and society. And according to Beuren, Gomes Ferreira, and Cauchick Miguel (2013), the benefits for the Consumer are the continuous satisfaction, the quality and customization of products and services. For suppliers, the challenges are to improve the loyalty, innovation potential from the consumer feedback and reduction of costs and resources because the product can be used to be recycled to create a new one. Another two beneficiaries are not directly involved in the business; they are the Environment and Society. Regarding the Environment, the benefit is from provider responsible for the products and services, through takeback and recycling in order to reduce the waste. The benefits from Society are the satisfaction, which comes from the importance with environment and with the increase of services demand, consequently the creation of more jobs. Finally, it is important to notice, that PSS create a Circular Economy which help companies to develop products and services in order to evolve the business models with this cycle (Reigado, da Costa Fernandes, Saavedra, Ometto, & da Costa, 2017).

2.2 Servitization

Servitization is the increase of the value proposition of the products, in bundles, offering combination of consumables, services, self-service and support that could provide value to the customer (Reigado et al., 2017).

Servitization definition:

“The transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic.”

Deservitization definition:

“The transformational process whereby a company shifts from a service-centric to a product-centric business model and logic.”

(Kowalkowski, Gebauer, Kamp, & Parry, 2017)

Service systems are configurations of people, technology and other resources that interact with other systems to co-create value (Maglio, Vargo, Caswell, & Spohrer, 2009).

A Service has some special characteristics known as the Five I's of Services.

Intangible - cannot be touched, handled, seen, smelled and tasted;

Inventory (perishability) - Services have a few or none tangible components and therefore cannot be stored for a future use. They are produced and consumed during the same period.

Inseparability - The service provider is indispensable for service delivery as they must promptly generate and render the service to the requesting service consumer. In many cases, the service delivery is executed automatically but the service provider must prepare to assign resources and systems and actively keep up appropriate service delivery readiness and capabilities.

Inconsistency (variability) - Each service is unique. It is one-time generated, rendered and consumed and can never be exactly repeated as the point in time, location, circumstances, conditions, current configurations and/or assigned resources are different for the next delivery, even if the same service consumer requests the same service.

Involvement - One of the most important characteristics of services is the participation of the customer in the service delivery process. A customer could get the services modified according to specific requirement.

The addition of service offerings to the portfolio of traditionally product-oriented companies is of growing importance and this special issue makes to publish works which addresses this observed industry phenomenon, dubbed “Servitization” (Vendrell-Herrero, Parry, Bustinza, & O'Regan, 2014). Servitization is formally described as the process of seeking additional value through taking service propositions to market, and is an academic theme of increasing interest and relevance. This special issue seeks to advance our understanding of the transition undertaken by many firms, not just manufacturers, toward more innovation-based and difficult-to-imitate business models offering bundles of products and services (Vendrell-Herrero et al., 2014).

The general assumption is that companies move in either an evolutionary or a discontinuous manner from basic, product-oriented services toward offerings that include more advanced process-oriented services and product-service systems, leading ultimately to the provision of solutions. Servitization is defined as the transformational process of shifting from a product-centric business model and logic to a service-centric approach. To varying degrees, servitization involves a redeployment and reconfiguration of a company's resource base and organizational capabilities and structures (Kowalkowski et al., 2017).

Service Design

According to (Lovelok & Wriht, 2001) , service is:

“An economic activity offered by a party to another, that would employ time-based performances to bring about desired results in assets for which purchasers would have responsibility. In exchange for their money, time and effort, service customers would expect to obtain value from the access to goods, labour, professional skills, facilities, networks, and systems; but usually, they wouldn’t take ownership of any of the physical elements involved.”

A service is consumed at the same time as it is provided, and this makes the service more difficult to replicate, so it is unique. To have the better experience it is need a co-created value between the customers and organizations and this is an outcome of a SD process. Nowadays, designing services is different than it was a few years ago, before there were fewer touchpoints. Now, designing modern service offerings the companies have an interface combination, technologies to support the customer in the front-stage interactions and more complex backstage processes. Furthermore, the technology helps the companies to have necessary clues to improve the customer experience (Sarmiento, 2013).

The combination of technology and services has created many opportunities to generate and develop new services with better value propositions. However, to take full advantage of this fusion, the technology and customer perspective must be very well coordinated with service design and management. Because of this, SD became the best methodology to architecting intangible experiences in many touch points to achieve the better customer experience (Sarmiento, 2013). Therefore, SD is the bridge to connect digital technologies to the design of the customer experience. Hence, this is a human-centric approach and it is needed to understand the customers, all the stakeholders and their contexts. After this knowledge, it is necessary to organize the information in order to create the better customer experience with the different needs (Sarmiento, 2013). These experiences are co-created and this allows to the company and the consumer to create new opportunities for both, also help the companies to establish better relations with all the stakeholders.

Due to the uniqueness of each service and each customer, the value of services is delivered co-created with the consumer and it depends on several factors, such as person’s moods and other elements that are not controlled by the companies. This means that the customer experiences cannot be predicted by the organization, but services can be thought to satisfy the customer experiences (Verma et al., 2012).

3 Description of the PSS On!Track released in the Portuguese context

3.1 OT Features

On!Track is a recent and innovative PSS, the first major release was in August 2016, this study will be focused on it and it is a solution that combine three dimensions, Software, Product and Services. This is a B2B solution to control and manage with reliable information about the customers' plant, materials, tools and equipment, especially if they operate in several locations (Hilti, 2017c). It is an innovative service, which allows users to register, avoid theft and save all kind of information, such as calibrations and repairs. Besides that, it works in any construction company or any organization, which have, for example, several jobsites and tools exchange. Data can be accessed everywhere at any time because the service it's cloud-based – on computer or smartphone. It is an online platform accessible from a website (**Figure 2**), which does not require any kind of application installation, or a mobile application (**Figure 4**) for Android or iOS.

The value proposition of OT PSS is very extensive. It is directed to professionals of construction industry and can be applied to all construction assets. The objective is to help administrators and managers to have a good view of their company and make consistent decisions. Looking to the main features of OT, we can expect:

- Fast and reliable identification of assets;
- Transparency on costs, condition, status, location and history of all assets;
- Clear accountability for all assets;
- Transparency on services and inspections;
- Compliance with health and safety regulation;
- Flexible reporting for improved decision making;
- Reduction of paper-based processes in the warehouse and in the field;
- No local software installation or maintenance;
- Access to professional support and advice by Hilti specialists.

OT Web Application (**Figure 2**) works in any computer connected to internet provided with an internet browser. It is more complex than the mobile version, because it is more operational, and allows having a better global view. Some features are:

- Dashboard with key information at a glance;
- Ability to add/edit assets, to view and search for assets, to transfer assets between locations and employees, and to manage services and inspections;
- Ability to manage locations, employees and user roles/permissions;

- Ability to generate reports.

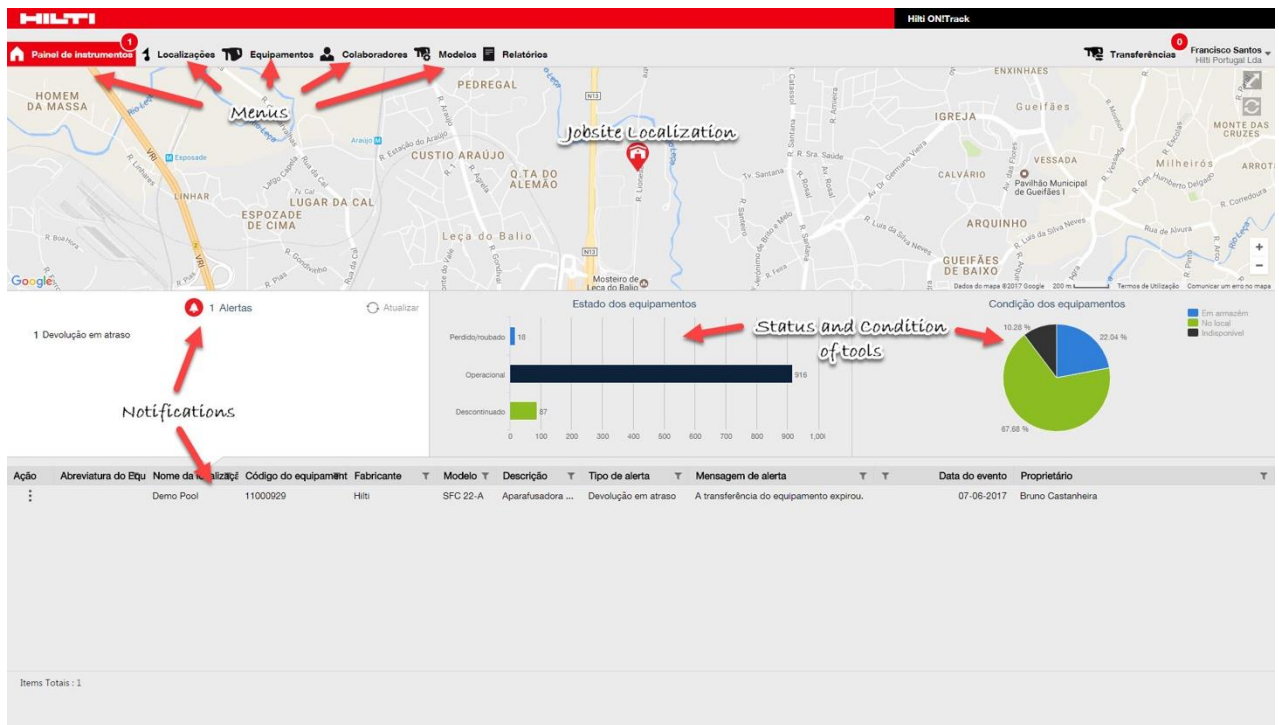


Figure 2 - On!Track Website Application

About the Scanner and Smartphone, they have similar characteristics. The Scanner is equipped to detect RFID (**Figure 3**) and Barcode through the OT Mobile Application and can connect to the Internet via Wi-Fi or Mobile Network. On the other hand, the Smartphone has the OT Mobile Application (**Figure 4**) is available to download in Online Stores. The camera allows the user to read just the Barcode. Mobile Applications offer some targeted functionalities for users in the field:

- Ability to add assets;
- Ability to transfer and confirm delivery assets;
- Ability to identify and view assets;
- Check inventory;
- Both of versions, Scanner and Smartphone can operate in online and offline mode, when online; the information synchronizes with Web Application.



Figure 3 - Scanner

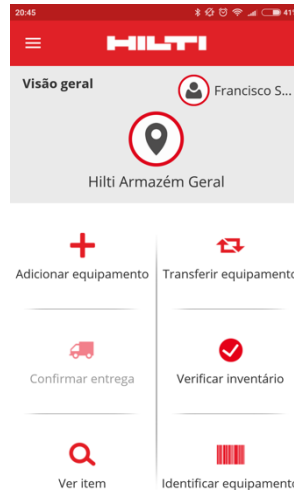


Figure 4 - On!Track Mobile Application

Also, is complemented with RFID tags and Services. Through RFID, it is possible to see all the information about the equipment previously edited in the software. To read the tag it can be used a scanner to read the RFID passive signal or digitalize with a smartphone the bar code at any time. This tags have different sizes and are adapted to each type of tool, for example, there are hard tags with high resistance to mechanical impacts and abrasion that can be read up to four meters' distance and must be fixed with screws (Hilti, 2017c).

The tags (**Figure 5**) are responsible for saving the information referent to each tool and should be attached to it. Additionally, as mentioned before, they are equipped with RFID signal, bar code and number to be read through different ways:

- Each Tag comes with a globally unique number, called a “Scan Code”;
- In each Tag, the Scan Code is represented by 1) RFID, 2) Barcode, and 3) a Visual Number printed on the Tag;
- The Tag can be read with Scanner and Smartphone;
- There are different types of Tags, which are optimized for different types of assets and environments.



Figure 5 - Tags

To achieve the maximum value, delivered from the PSS OT solution, there are a few support services. The services are:

- Onsite Analyses;
- Tagging Services;
- Implementation Services;
- Training Services;
- Support Services.

Onsite analysis is a consultancy session in the client environment, where the OT specialists look for information about the business for one day. After collecting data about some core processes and activities, OT specialists design a possible solution. The solution aligns OT features with business activities and must be validated by the customers. However, it could not be accepted and so can happen two options, or redesign the potential solution or the service is declined. Nevertheless, the results of the analysis are presented in a report, normally in the end of the day, and the objective is to verify the costs and estimate a potential saving.

In the positive scenario, the next step is the tagging day. Tagging is the process of going to a jobsite or warehouse of the customer and put tags in every tool. Then, implementation is to insert all the information, such as serial number and their brands in the software (**Figure 6**). This information can be uploaded to OT software very quickly through an excel worksheet. As soon as the tags are attached to the tools, an excel sheeey is being done. Normally, to do this type of work, some human resources are punctually contracted by outsource.

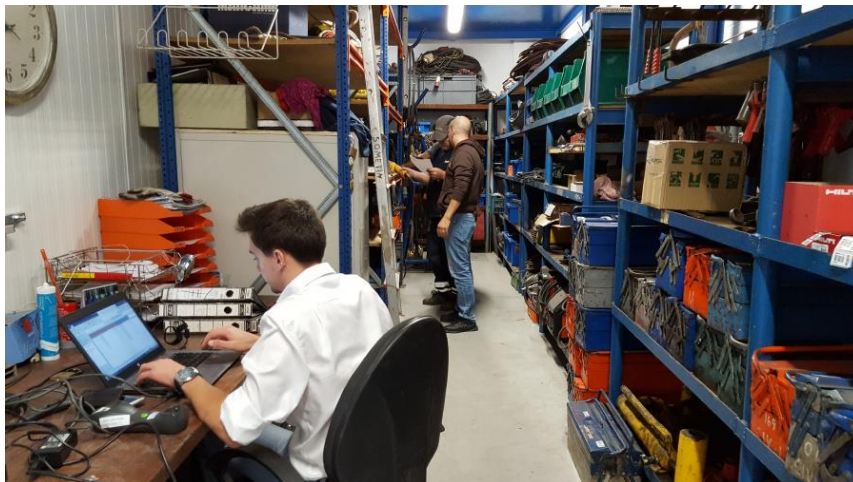


Figure 6 – Tagging and Implementation Services with outsource HR

After deliver, the software ready to use, with all information about the tools, as previously explained it is possible to have a good general view of the assets of the company. Furthermore, it is possible to assign responsibilities, locations, car fleet and employees management. Therefore, there is an internal optimization of the processes per each customized solution suggested.

Then, it is necessary to teach the final users through training days. To better train them, real examples are used and in the end of the day, a survey is done to collect feedback about the good and not so good points or opportunities to be improved about all the OT process.

The final step is the first year of the partnership through OT. Here the customer uses the software with customize solution and work together with the PSS supplier. The contact is constant about updates as well as doubts, which will be always intrinsic to the PSS. The communication could be made through customer service or the OT back office. This support service is called Care Program.

Briefly, as you can see in the image below (**Figure 7**), OT global process begins with a meeting with the board of the customer previously selected. If accepted, make an onsite analysis, as explained before, with demonstration and proposed solution, leaving the decision of accept or not to the directors/managers of the company analysed. Then, in positive decision, it can advance to implementation and training. Lastly, the customers have support through customer service or OT back office.

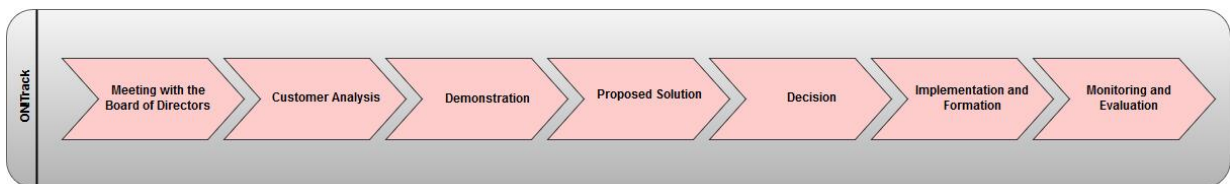


Figure 7 - On!Track Process

Consequently, OT is considered a PSS because of the equilibrium between the services and the products. The products are the tags and software, which the customer pays for (pay per tags and subscription fee for cloud based). Moreover, for service is considered all the activities to deliver the software with all information and all the support given in post-sale. This combination of product, software and services makes evident that OT is a PSS. For being a PSS, it is possible to draw the following diagram (**Figure 8**).

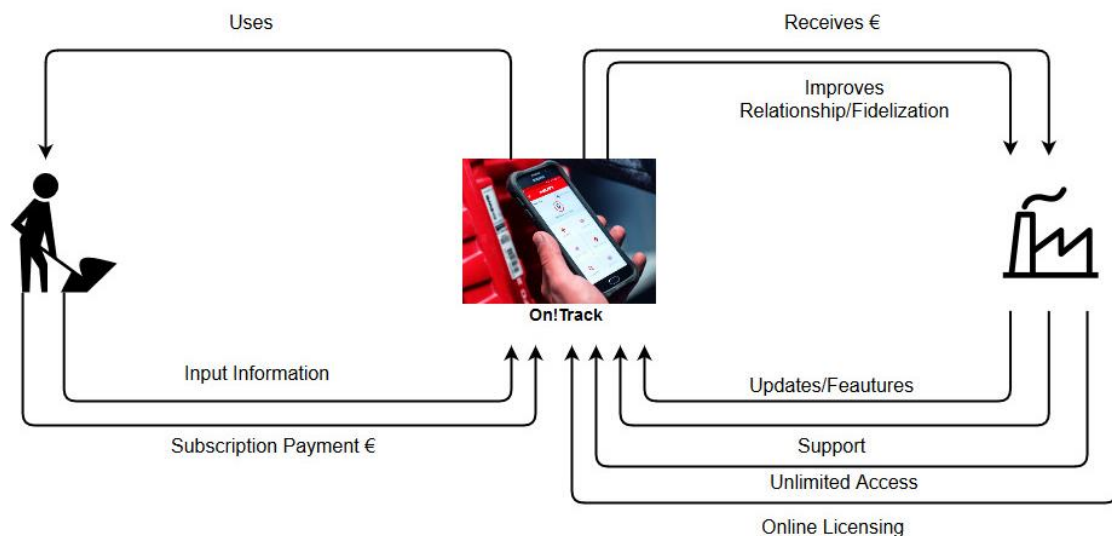


Figure 8 - On!Track PSS Diagram

This diagram represents the responsibilities of the user and the costs and actions, which the company provider supports. Here, the company provider gives support; pays the online license while improve the relationship in exchange of subscription payment.

4 Methodology

As previously said, the objective of this research is to identify improvement points in the contact with customers and to improve the OT internal process. However, this industry is very resistant to exchange and to new behaviours. From the description of OT PSS - this is an innovative solution to improve old internal processes and management of other companies in a slow market. The implementation of this solution should challenge the inertia of this industry slight digitalized but with this system, it will increase the turnover and commercial power of the PSS provider. Regarding the OT internal process other methodologies, such as mind-maps, were used to be able to identify the problems and improvement points.

As previously mentioned in this dissertation the study was done at Hilti - a multinational company that provides PSSs to other companies in the construction industry in Portugal. A case-study design is an approach considered appropriated with the complexity and particular nature of a case in question (Bryman, 2012). This B2B case-study supplies approximately six typologies of services, being some of them technology-based. Departing the recently implemented OT service and the research goals, a qualitative approach was used. Considering the subjective nature of customer behaviour towards the concept of a PSS, it is expected that the Portuguese case study might have specific aspects, although with a small population to be under study. This research will consider the needs and problems of the companies, information gathered through primary source reports and semi-structured observation. Then, followed by a Design stage of mapping and improving the PSS processes.

These methodologies were found convenient to identify the customer and service provider needs and this way to improve the SD. In addition, for still being a new service and have few clients, qualitative approach is preferred.

4.1 Participatory Observation

The participatory observation (Laurel, 2003) allows to the researcher to immerse in a group and context for a certain period. This integration is good to observe behaviours, listening to what is said, and ask questions because it is possible to live the experience and there are small interactions and types of communication that only can be interpreted with physical presence. Additionally, researchers will look in documents to gather more information.

Moreover, this method revealed to be a good way in order to the researcher understand the business environment considering participates in core activities but not as a full member, it allows to find some internal problematics and bottlenecks. Outside the building, the researcher is involved fully in the core activities (Bryman, 2012).

To understand the business internally, regular visits were made to the different departments in order to have a general picture of the company structure. The departments visited and persons accompanied were: The Credit and Collection; Customer Service; Marketing; Logistics, Store and Sales (Account Managers). The department where the researcher was integrated was the Services Department.

The connection between the customer and the company is made by the salesman and it was important to go on the jobsites to fully understand the service approach. To document the visits a report (**Appendix A: Observation Template**) was developed to register some important comments. The main objective was to understand how the company works, also

live the experience like an employee when integrated in the service team and it allows retaining some important facts. With this participatory observation, it was possible go through the process and feel flaws or positive steps. Therefore, a board was made about all OT process As-Is due to the contribution from observation.

4.2 Primary Source Study

Companies and organization in general produce many documents; some are in the public domain, such as annual reports and advertisements. On the other hand, another's documents are confidential such as, minutes of meetings and organizational charts. Due to the difficulty of achieve this kind of information by the researchers, this means that in many times, they must rely on public documents. Thus, when researchers in company's private documents, they might have an idea of what goes in that organization. Normally, this documents are windows onto social and organizational realities (Bryman, 2012).

To do a more in-depth study, it was given access to an archive with reports about analysis made to the companies where the service was required. OT specialist, who spent a day analysing the internal processes of the customer's companies, produced the documents. For that reason, the production of these documents is genuine. The sample is composed by thirty-nine companies, which were analysed with intention of using OT service.

The report from now on (Report Study - RP) analysed is an outcome from the service provided, which is a customer analysis. The document reports the company's current reality in five pillars and they are transparency and responsibility, stock optimization, certifications and security verifications, reports and control and speed up the registration process. In each pillar, it is possible to see the potential monetary and time savings due to technologic advance provided by OT. This OT instrument cannot be presented in this dissertation because of confidential issues. After analysing these data, it was possible to identify some common needs in all cases. These points were counted and compared with features present in the service to meet the customer's needs, as can be seen in the table below.

4.2.1 Qualitative Data Analysis

It was made a content analysis because it is a very transparent and flexible research method considering RP and Observation data gathered. Additionally, it is a good method to apply to a wide variety of different kinds of unstructured information (Bryman, 2012).

After gather, all the information provided in RP, as above explained, the researcher looks for similar expressions. Through this approach, it could be identified core needs of potential OT customers considering the analyses done by the company, previously.

From observations data, we could see how difficult is to interact with customers because they have their own desires and motivations. Here it is possible to enumerate a few discovers during the experience such as the feeling of power, own the tools and resistance to change. So, to pass the message about PSSs is not easy because it is an innovative concept and it is based on paying a fee for use.

Regarding the data bases in the RP, the research can access to study the customers who required an analysis for OT. Therefore, it is possible to have a picture of the current situation on the used internal processes. Moreover, the RP also allows the study of current costs as well as the dimension of each customer (number of vehicles, tools, employees, etc). The Appendix

C: Part of Sampling resumes and allows a comfortable look to the data beyond pointing out to the problems in the current situation.

4.3 Qualitative Data Results

Framing the content analysis results, a coding procedure was initially based formed by (a) size of the customers, (b) principal problems, (c) self-assessment, (d) current costs and (e) potential savings.

(a) *size of the customers*

The OT customers are professionals of construction industry and in this universe of services provided, they are a small percentage. Looking to a PSS like OT, it will connect a service of assets management and a bundle of goods (mainly tools). The size of the customers depends of the number of employees and assets. In average, the customers have a lot of tools to manage, approximately $\frac{3}{4}$ of all the factors that they should manage. About of $\frac{1}{6}$ is related to the number of employees (potential final users of the system). These employees can be organized by teams, this affects in terms of assets management. Then, the rest of elements are managed by OT are teams, jobsites and warehouses (**Figure 9**).

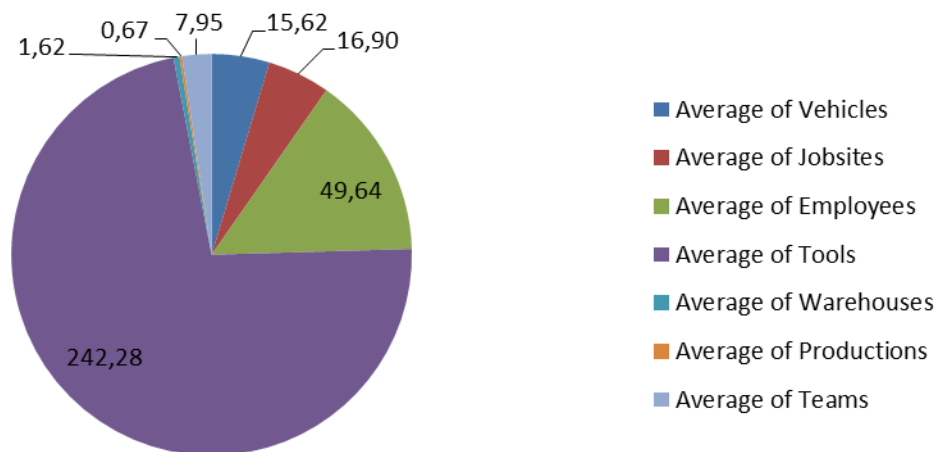


Figure 9 - Average Size of Customers

(b) *principal problems*

The RP permit a deeper analyse of the code “problems”, departing from the dimensions defined in this report. Were they: Transparency and Responsibility, Stock Optimization, Certification and Security Verifications, Reports and Control and Speed up the Registration Process (**Figure 10**). The group of dimensions was made by counting how many companies felt needs and problems about a specific category. Each colour represents one dimension where each category is aggregated (

Table 1). The main problem has to do with Certification and Security Verifications, the customers complain about fleet car management and employee management. The dimension of Transparency and Responsibilities, despite not being the most remarked one, is the dimension where OT has the most important role. This has to do with the fact that the tag system linked with the application will be a tangible indicator of responsibility and transparency of the service. Last but not the least, is the Stock Optimization which with a new service will substantially be benefited.

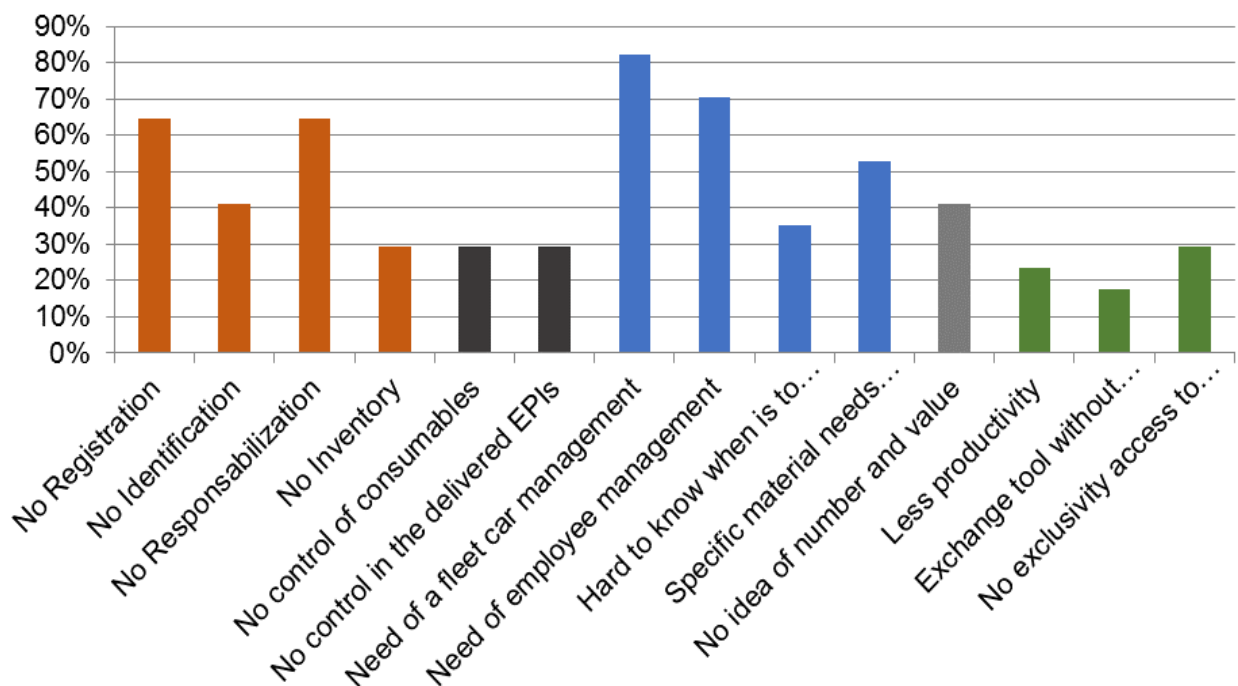


Figure 10- Principal Problems

Table 1 - Meaning of Concepts

Dimension	Categories	Meaning
Transparency and Responsibility	No Registration	There is no Registration about equipment and tools
	No Identification	The tools do not have company Identification
	No Responsibilities	No one has Responsibility in case of loss or theft
	No Inventory	There is no Inventory of tools in warehouse
Stock Optimization	No Control of Consumables	There is no control on Consumables given to employees
	No Control on delivered EPIs	There is no control on EPIs given to employees
Certification and Security Verifications	Need of a Fleet Car Management	Manage Documents and Repairs
	Need of Employee Management	Manage Documents, tools associated, jobsites
	Specific tools need Calibrations	Which tools need Calibrations
	Hard to know when is to Calibrate	When tools need Calibrations
Reports and Control	No idea of number and value spent for each tool	There is no idea about how much was spent in each tool
Speed up the Registration Process	Less Productivity	Look for a tool makes everyone stop decreasing productivity.
	Exchange tools without knowledge	Employees exchange tools between them without warning the Superiors
	No exclusive access to warehouse	The access to the warehouse is not exclusive to some persons

(c) *self-assessment*

Benefiting once again from the provided data in the RP, a careful analysis was made considering the customers self-assessment on things that the OT would help them. Considering their answers to the same five dimensions we can verify in average, what is the evaluation given to each one (maximum value is four) (**Figure 11**). It can be concluded that the first (Transparency and Responsibilities) and third dimension (Certifications and Security Verifications) have more impact and the needs adjacent to these dimensions are the ones with more complains.

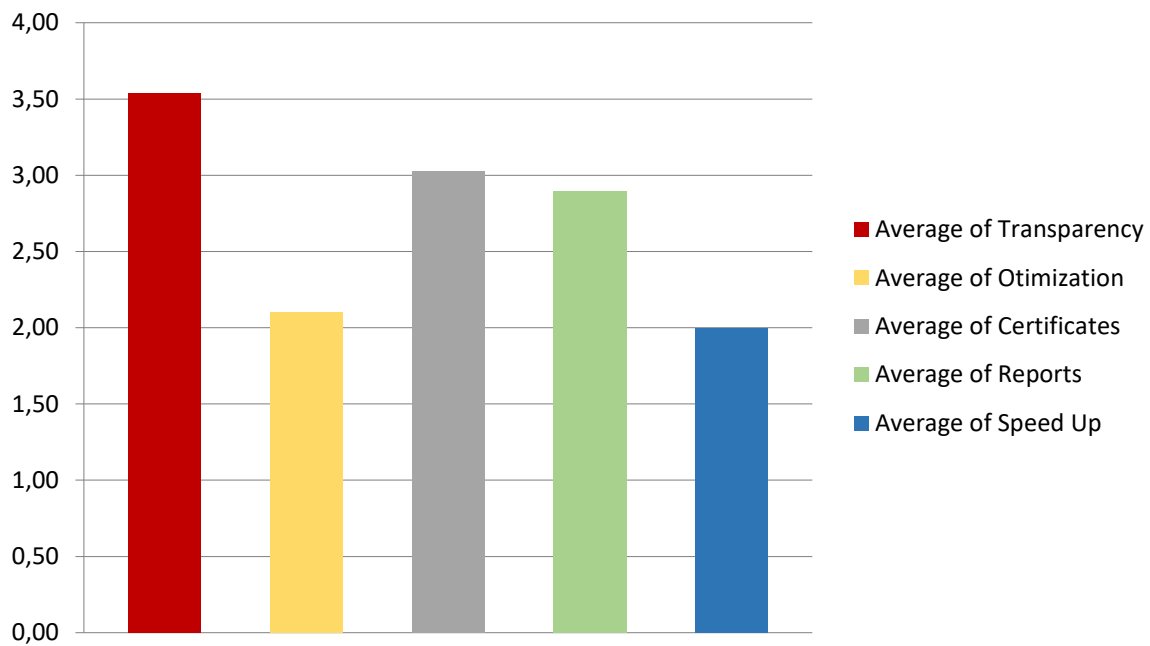


Figure 11 - Average of Each Dimension by Customers Self-Assessment

(d) *current costs*

The RP and customer onsite analyses permitted an actual calculation of costs. These costs concern the dimension of each customer. Regarding this information, it is possible to verify how much each company spends on each dimension/organized by activity. The companies in activity sector of Steel and Metal and Civil Construction have more expenses considering the services that OT provides (**Figure 12**).

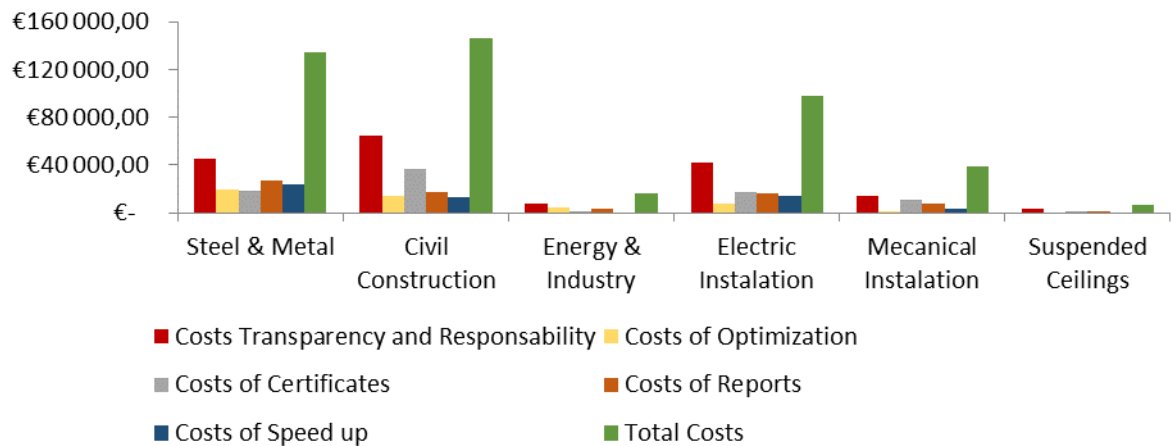


Figure 12 - Current Costs

(e) potential savings

Departing from the cost analysis, one can look at the potential savings in order to improve some tasks while being more productive. The analysis provides a feedback about the potential savings with the OT use, which also can be analysed in the same way. Customers may save mainly in Steel and Metal and Civil Engineering activities. In terms of OT growing strategies, this analysis contributes to define the prior segments to investment.

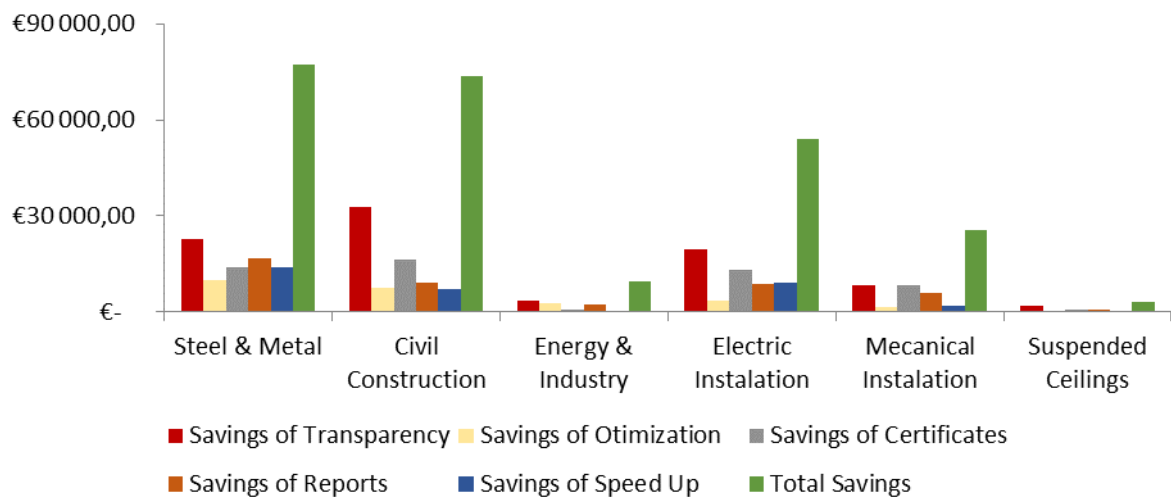


Figure 13 - Potential Savings

Finally, a comparison of the actual costs with the potential savings (**Figure 14**), gives the insight that the average of savings in every dimension is about half of the costs. This is a good indicator that should be address for commercial and marketing purposes as well as in the improvement of the service itself.

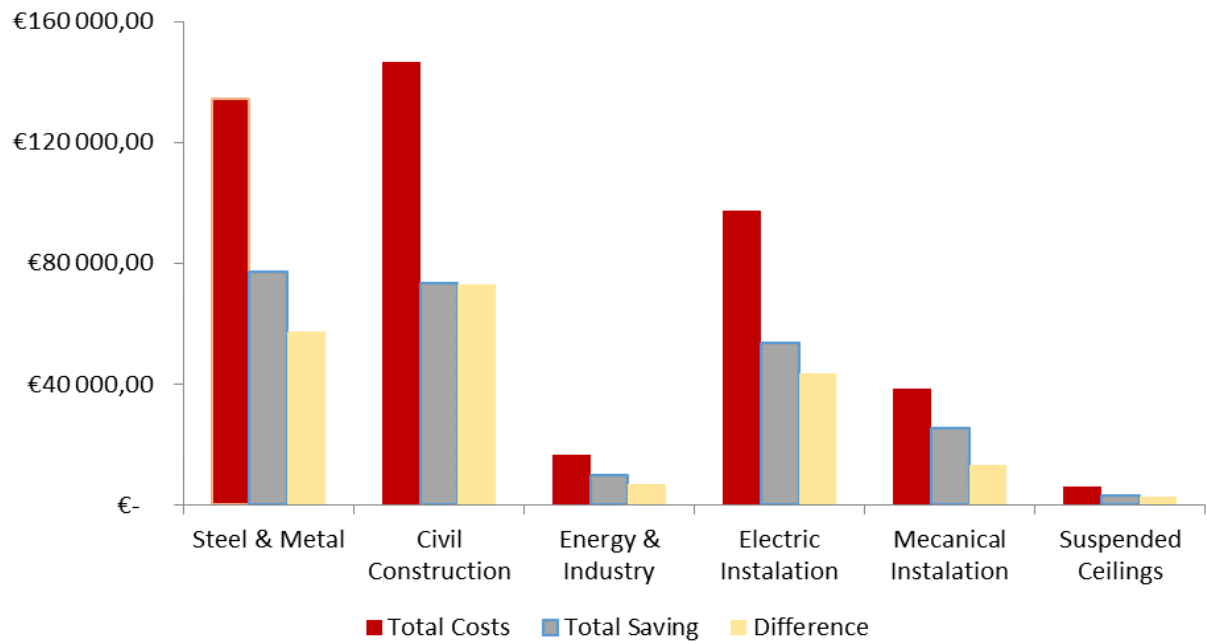


Figure 14 - Comparison of Actual Costs and Potential Savings

5 PSS Design Contributions

Considering PSS characteristics previously developed in literature review, this research made use of several and, once again, specific tools to increase the design of the service under study. One of the particularly of being a complex system, which involves a lot of stakeholders, to extract information from them, the best hypothesis was using tools that required group dynamics.

On the other hand, the graphic representation of the information provided from the group dynamics, revealed to be the best way to show and display the outputs of the meetings because it is a common language to everyone.

It was used a tool - mind map - to understand how all the stakeholders are present and how they are divided in the company (Sternberg, 2010). This stakeholder's map helps to understand the dimension and the present stakeholders, you can see the main stakeholders of the service in study inside the company. There all the intervenient that contribute to the company and consequently to the service, normally the group of stakeholders are bigger than the group that are considered users (Edvardsson et al., 2014). The needs of customers, referred before in literature review, are fundamental ingredient for a new SD and therefore much of data collection and fieldwork went through a large observations and analysis of these needs.

5.1 Stakeholders Map

To have a global view of the stakeholders of the company and OT it was made a stakeholder's map of the company, then focusing on OT PSS. The first map (**Appendix G: Hilti Stakeholders Map**), shows all the present stakeholders identified around the company, it is divided in nine great clusters, which are even more subdivided. After identifying all of them, it was made a focus to OT in order to understand all the intervenient around the PSS as you can see in the image (**Figure 15**) they are also divided in clusters which are subdivided.

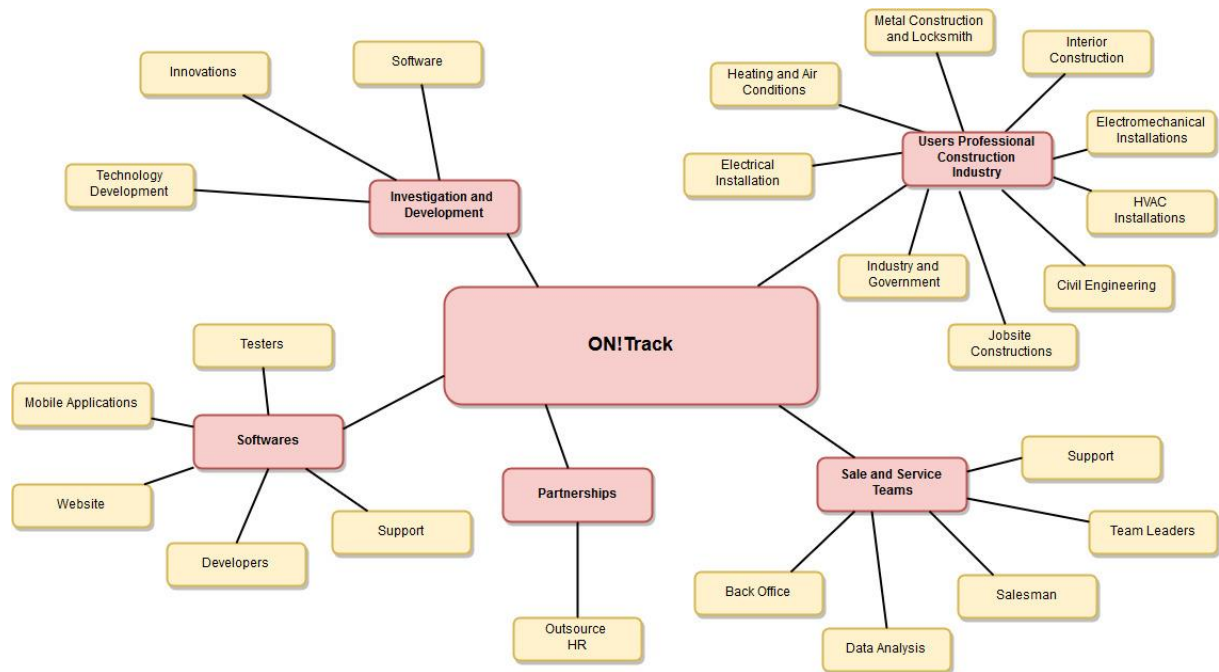


Figure 15 - On!Track Stakeholders Map

5.2 Mind Map

The tools used were to understand some daily problems from the sales force as well as internal OT processes. So, the researcher observed some daily routines at the company to map some business processes. This allows reaching the maximum information possible about the company. Using different methods and activities to understand and provide feedback for a service design or re-design is recommend, because neither of them cover enough to absorb all the necessary information (Teixeira, 2010).

5.2.1 Customer Profile

Based on Actors Map, to represent the main system of actors and their relationships (Nicola; Morelli & Tollestrup, 2006). The introduction of a new innovative service like OT requires teaching the Sales Team. It was explained the service and to fit it to the market there was a need to identify the potential of the industry and customers. Nothing better than make a meeting with the Sales Team to understand what is happening in the field and what could be the characteristics of the potential clients. The team was composed by fourteen elements with masculine gender. They work in national territory and in several market segments, such as Building and Construction, Industry and Government, Interior Construction and Electromechanical Installations. Regarding academic formation there are two great areas, Civil Engineering with four elements and without superior formation six elements. The others have formation superior in other courses, such as Politic Science, Management and Informatic (Figure 16).

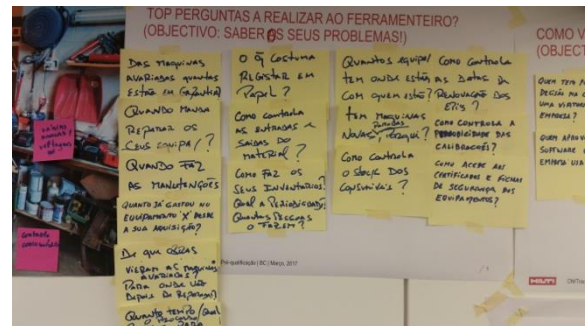


Figure 16 – Brainstorming Session

After showing key elements/topics and images already known from the consumers' companies' structures, the participants wrote what they thought that could be important to notify. Therefore, a brainstorm was used to allow the team to be creative and allow discovering other characteristics. All the outputs provided from the Sales Teams were documented in photography (**Appendix H: Brainstorm Session**).

In-depth analysis of brainstorming result the data was analysed and segmented by categories and it allows making a Customer Profile as you can see in the table below (**Table 2**). The first three columns are the main characteristics identified by the Sales Team. Each one has a main theme; Warehouse - characteristics, Warehouse Manager - what are the processes used, and Decision Maker - how to discover who is. The fourth column refers to the characteristics that were considered with more importance to identify a potential OT user.

Table 2 - Customer Profile

Warehouse	WarehouseManager	Decision Maker	Costumer
Characteristics	What do I WANT to know?	How to discover?	Identification
Papper • Registration • Important Documents Equipments • Broken • Control In/Out • Usability • Inventory • Conformity Consumables • EPIs • Control • Stock Desorganization • No Equipments Identification	What is important to regist? • Inventory? • From whom to whom? • From where? To where? • In/Out equipments? • How many here? and in job site? How many? When? How much €? • Broken Equipments • Maintenance • Calibrations • Certifications • Consumables purchases How many? Where are? • Equipments • Purchases • Vehicles • Employees Organization • Equipments Distribution • Stealed/Missed Equipments • Responsabilization	Influence Person • Who buys? High values (ex: 20.000€) • Who rents? • Who approves? • Who hires?	• Clear "Needs and Pains" identified • Decision Maker identified • Decision Maker knows "N&P" • Other Departments know "N&P" Key Identification Points • Uses papper to manage the warehouse ◦ In/Out ◦ Responsibility ◦ Inventory ◦ Consumables stock ◦ Receipts • Lost too much time looking for objects: ◦ Equipments localization ◦ Important documents • Do not have idea of: ◦ How much spent in repairs/maintenance ◦ How much lose in equipment steals/misses ◦ Who is responsible ◦ When need to renew documents • Organize equipments for teams ◦ Distribution ◦ Purchases ◦ Manage equipments vs Demand(teams) • Vehicles ◦ Documents • Employees ◦ Documents

5.2.2 Internal OT Process

About the actual OT process, it was made a session to identify bottlenecks, good and bad steps/tasks, responsibilities and lead-time. The Service Team, composed by six elements, three elements have formation in Civil Engineering, other has in Management, other in Economy and other without formation. The functions of the elements are Back Office, OT Specialist, Service Team Manager, Marketing Manager and the researcher. The team was challenged to identify the good and improvement points in a brainstorming. Each one gave ideas of what could be discuss. This informal meeting took 4 hours. Then it was made the identification of how is going the OT service process As-Is (**Appendix D: Process On!Track As-Is**), who is responsible for each task, potential bottlenecks and lead-time.

The objective was to determinate the To-Be process, what could be done to reduce the bottlenecks and mainly the lead time, also to identify the responsibilities and main tasks. The outcome provided from the meeting was a clear identification of the process As-Is and To-Be, with the main tasks and responsibilities, as mention before. The principal improvement to the process was the creation of a new function Business Developer Service (BDS) to centralize all the information and responsibilities as you can see in the **Appendix E: Process On!Track To-Be**. With these suggestions, it allowed to reduce the lead time from around one hundred and seventy to thirty days.

To represent both tables, it was used an adaptation based on PSS board. The structure of the PSS Board was designed to represent the intrinsic interactions among components and customer activities (Lim, Kim, Hong, & Park, 2012). Here the customer activities were substituted by the activities/tasks and the components by responsible of activities, following a workflow approach of sequence of events. For the company was important to know who makes the tasks and how many time one customer is inside the process and reduce it.

5.2.2.1 Care Program

After observed all the process, looking from another perspective, it was noticed a lack of procedures in the final step, Monitoring. Comparing, the activities currently existents (**Appendix D: Process On!Track As-Is**) against the activities previously thought (**Figure 17**) it can be suggested an improvement of the Monitoring process (**Figure 18**), that we can call “Care Program”. This process aims to support and improve the relationship between the customer and the PSS provider. Considering the PSS characteristics, from literature review, this Care Program is a key process.

First it was identified how the process is, As-Is (**Figure 17**). However, due to the short period of OT release there is not trusty data. Even though it was possible to identify some improvement points based in some feedback provided from a few customers and field experience from the employees of the company in study.

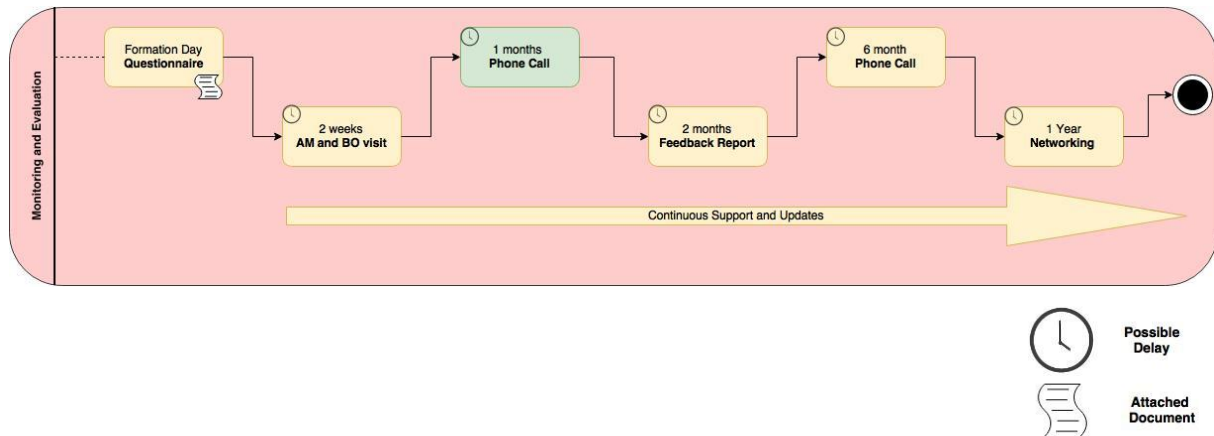


Figure 17 - OT Care Program Theoretical Process As-Is

Now, the Care Program has a questionnaire in Word/PDF in the day of the formation. The formation is to teach the customers to use the software. After two weeks, Account Manager and Back Office visit the customer to verify how they are using it and clarify all doubts. When the customers reach one month of subscription, one phone call is made to verify if all it is going as predicted. After two months, Back Office verifies the utilization level of the software and if it is low, an approach is made to increase it. Next, in six years mark other phone call is made to verify the solution, level of utilization and satisfaction. Finally, after one year, the partnership is celebrated through a networking session with the client. In addition, it is given continuous support and updates during the process.

After look to the actual Care Program and collect some information from the principal stakeholders of the process, some changes are suggested (**Figure 18**).

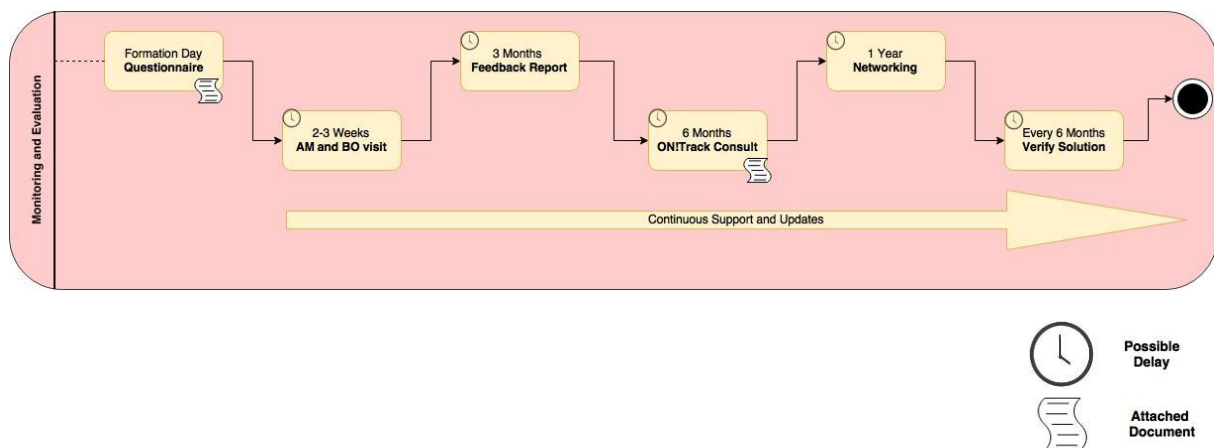


Figure 18 - OT Care Program Suggestion Process To-Be

Some steps were preserved or adjusted, others improved and others created. Regarding the questionnaire in the formation day, it should be done in Google Forms (**Appendix I: Google Forms**) to be faster and easier to collect the feedback provided from the customers. The creation of an audit in the six months of subscription, with a checklist document (**Appendix J: Audit Checklist Document**). The document helps the author to verify some important activities used in OT and write some comments about that. Also, it helps to verify the changes made and if the solution continues to fit the customer business model. Last but not the least, the introduction of a verification for the solution every six months. It can be made through phone call or visits. This verification creates awareness about the updates, new features and doubts to have a customer satisfied.

Briefly, the suggestion made has some adjustments in the timing of the tasks, modification of tasks and introduction of important documents to help the PSS provider to analyse some important touchpoints.

6 Conclusions and Main Contributions

Considering the research objectives proposed, about the integration of a new PSS in the Construction Industry and the improvement of the On!Track (OT) internal process, the outputs provided from this study were achieved. With introduction of OT in the enterprise under study, this company “servitizes” even more its portfolio. Some improvements were made on the PSS by means of SD tools.

Beginning with participatory observation to a preliminary understanding of the company, it allowed participating in some activities and tasks. This method permitted to tackle internal processes growth. In a second stage of research, the integration with the Service Team, helped to understand the PSS in study. The same approaches were followed, but this time focused in OT activities.

Then, a more in-depth study was made supported by a Primary Source (RP) data gathering. It was analysed all OT data based available concerning commercial reports. This allowed to know the current reality of each customer. The onsite analysis has marketing insights, the sample is small and the customers are early adopters, this could cause a different evolution in the future. After collecting information about the size of the customers, principal needs and problems, self-assessment, current costs and potential savings, it is probably possible to increase marketing and sales as well as the service design itself. As this study showed, the dimension with more weight is the Transparency and Responsibility for two reasons: complains from the customers about this are high and the costs to accomplish these tasks are also high. Consequently, the savings regarding this dimension are higher too.

The stakeholders map helped to discover who the intervenient are. With this scheme, it was considered that the Sales Team and the Service Team have more impact in the PSS.

Moving to the next phase, which was Mind-Mapping, it was possible to join the Sales Team in a brainstorm session, that have a lot of experience in the field and contact every day with customers. We got information about a potential Customer Profile for OT, inside the construction industry. With this information, the team of Account Managers can be more effective in their visits to identify a potential OT customer.

Looking to the construction industry, the new technology-based PSS is influencing the behaviour of the companies. This OT PSS allows construction companies to have more control and become more digitalized.

However, there are some interesting findings regarding this theme and how this PSS can be affected in this specific environment. Considering the behaviour, we found some characteristics and constrains. These workers have low technology knowledge, they like the ownership feeling and they are resistant to change. Other interesting aspect is the data security.

Some other reasons were found about the less utilization of smartphones in jobsites, these places are very aggressive to some devices and the smartphone is an object, which all the people should be careful. So, Smartphone fragility (dust, drops ...) is a constrain in the field, dirty hands / gloves avoid the use of smartphones because it is impossible to touch the screen correctly. Companies give cell phones to employees and they do not care about the given cell phones.

These findings were reached during observations and other informal conversations between the researcher and several stakeholders.

The last step was about the OT internal process, through a brainstorming session, looking to each phase of the process. For each step, the participants gave ideas and points to improve or to adjust. The output from this meeting was the OT internal process As-Is and To-Be. From here, it was possible to verify who is responsible for each task, bottlenecks and lead time. The goal was to reduce the lead time from around one hundred and seventy to thirty days.

Finally, considering the suggestion to improve some points about the last task of the process, Monitoring and Evaluation, was presented in the dissertation. The great improvement points were the migration of the evaluation to Google Forms to better fill a survey about previous steps, change the timings of some stages because it is very tight and the creation of an audit check list to verify the good utilization of OT and if the solution continues to fit the customer needs and the business model.

Having made the research in an innovative company and inside Service Department, this study may support the development of this PSS and in other services. This may be a good starting point to a company that wants to have more than half of revenues in services sales.

6.1 Limitations and Future Research

Portugal is having a slow adoption of circular economy, this way Servitization is struggling to be implemented specifically in these fields like construction industry.

The limitations of this research, has to do with introduction of a new Product-Service System, with a small sample and scarce data available. Comparing to other markets, the OT PSS is having difficulties to be competitive because labour costs do not justify (construction managers point of view) the investment to improve performances. On the other hand, construction companies are not aware about their direct expenses.

A PSS is much more than a mobile application, it has processes, people and physical evidence (Bitner, Brown, & Meuter, 2000). Regarding this idea, a deeper investigation in other branch of research could involve the customer experience considering two phases: one in awareness of the PSS and another in the formal presentation to settle the business. So, the first would focus the initial moment that demands empathy between the offer and the potential customer. The second should focus on improving strategies to promote the sense of security, a clear understanding of the benefit-cost ratio and most of all increase the sharing between other customers of the service advantages. These are important touchpoints between the PSS provider and the customer and for that reason it should be necessary a deeper reflection.

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Appendix A: Observation Template



Observation Template



Observation Template nº: OB008

Date: _____ Local: _____ Company: _____
Trade: _____

Hilti employees: _____

Beggin: _____ End: _____

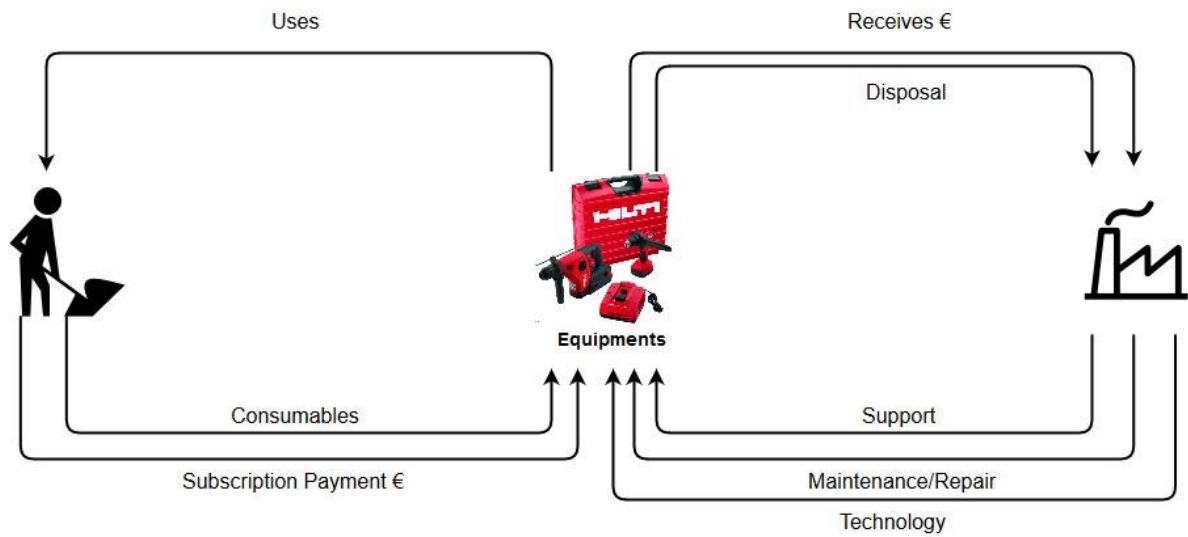
Task: _____

Activities:

Results Achieved:

Observations:

Appendix B: Fleet PSS Diagram



Appendix C: Part of Sampling													
Sample			Needs										
Team	Trade	Client	Transparency and Responsibility		Stock Optimization		Certification and Security Verifications		Reports and Controls		Speed up the registration process		
			Actual	Solution	Actual	Solution	Actual	Solution	Actual	Solution	Actual	Solution	
a	Electrician	1	National Company There is no uniformity in the process management Each localization has an independent registration Repetition of internal numbers Petrolgal warehouse has a good management system	Each location has its own process Some tools are stopped No responsabilization No registration Spend a lot of time looking for tools Resource solutions with increased costs	Easy to have a general view Give responsibility Optimize delivered tools Quick search	No control in the delivered EPs No inventory for EPs and uniforms	Creation of minimum stock for uniforms and EPs	Specific material needs calibrations Hard to know when is to calibrate Need of a fleet car management	Know every calibration and when is needed Management of cars Attach documents	Bad logistics to repair tools Need to have stock of tools No idea of number and value of reparations for tools/cars.	Fleet management optimize with all the tools Controlled costs	Repetition of information, paper and informatic Less productivity Same object different names	Quick transfer of responsibilities Reports of all movements Access at any time and place
	Electrician	2	Little information in Excel Own identification Paper registration	No registration No responsabilization Spend a lot of time looking for tools	Consistent Data base Give responsibility Quick transfer of equipments			Need of a fleet car management	Management of cars Know every calibration and when is needed Attach documents	No idea of number and value of reparations for tools/cars. No inventory	Controlled costs Quick inventory Reparation historic General view of tools, employees and location	Good registration in warehouse No diary registration because of slow process Less productivity Exchange tool without knowledge	Quick transfer of responsibilities Reports of all movements Access at any time and place
b	Construction	3	Uses Software Primavera Excel/Access	No registration No responsabilization Some tools are stopped Resource solutions with increased costs	Easy to have a general view Give responsibility Quick search			Need of a fleet car management Need of employee management Specific material needs calibrations Hard to know when is to calibrate	Management of cars Management of employees Attach documents Know every calibration and when is needed	Inventory outdated No control of consumables	Management of employees General view of tools, employees and location Integration with Primavera	Controlled costs Papper registration to become informatic Rarely done	Quick transfer of responsibilities Reports of all movements Access at any time and place Creation of a new internal process
	Construction	5	Own identification Excel/Access	No responsabilization Some tools go to construction non-operational No exclusivity access to warehouse Lost/stolen tools and equipments in construction	Easy to have a general view Quick search Exclusive access to warehouse Process to bring back unnecessary tools	Inventory outdated Actualization probably with errors No exclusivity access to warehouse No control on consumables	General view of tools, employees and location Control consumables costs Quick inventory Exclusive access to warehouse	Need of a fleet car management Need of employee management Specific material needs calibrations Hard to know when is to calibrate Several platforms for same information	Management of cars Management of employees Attach documents Know every calibration and when is needed			No registration about where and who have the tools Internal numbers in tools and equipments Several calls to get information about tools Less productivity Exchange tool without knowledge	Quick transfer of responsibilities Access at any time and place Reports of all movements
	Civil Engineering	4	Own identification Paper registration Access	No registration No responsabilization	Easy to have a general view Quick search Give responsibility Exclusive access to warehouse			Need of a fleet car management Need of employee management Specific material needs calibrations Hard to know when is to calibrate Several platforms for employees	Management of cars Management of employees Attach documents Know every calibration and when is needed	No inventory Lost/stolen tools and equipments in construction	Controlled costs General view of tools, employees and location Reparation historic Give responsibility		
	Civil Engineering	6	Excel/Access Uses software SAGE for management constructions Serial numbers and guarantees controlled	Central registration Spend a lot of time looking for tools Lost/stolen tools and equipments in construction	Easy to have a general view Quick search Access at any time and place			Need of a fleet car management Need of employee management Specific material needs calibrations Hard to know when is to calibrate	Management of cars Management of employees Attach documents Know every calibration and when is needed	Control maintenance Several platforms for information	General view of tools, employees and location Reparation historic Maintenance historic	Papper registration to become informatic No inventory	Quick transfer of responsibilities Access at any time and place Reports of all movements
	Construction	7	Excel/Access Uses software SAGE for management constructions	No registration No responsabilization No inventory No identification	Easy to have a general view Quick search Consistent Data base Warehouse Layout suggestion	No control of consumables No control in the delivered EPs No inventory	General view of tools, employees and location Control consumables costs Quick inventory Suggestion of deliver the used EPI to receive new one			Need of a fleet car management Need of employee management Specific material needs calibrations Hard to know when is to calibrate	General view of tools, employees and location Reparation historic Maintenance historic		
	Construction	8	No registration No identification Nothing	No registration No responsabilization No identification No exclusivity access to warehouse	Intention to hire someone for warehouse Quick search Warehouse Layout suggestion Exclusive access to warehouse	No control of consumables Redundant purchases Warehouse Layout suggestion Employee shopping without authority	Centralized stock in one warehouse Define and apply a good shopping process	Need of a fleet car management Need of employee management Specific material needs calibrations Bad mechanic management	Management of cars Management of employees Attach documents				
c	Construction	9	No registration No identification Uses Software Primavera for billing	No registration No responsabilization No identification	Easy to have a general view Quick search Intention to hire someone for warehouse Warehouse Layout suggestion Suggestion to create kits for each employee	No control in the delivered EPs No control of consumables No exclusivity access to warehouse	General view of tools, employees and location Suggestion of deliver the used EPI to receive new one	Need of a fleet car management Need of employee management Specific material needs calibrations Different brand of tools Do not match batteries and charges	Management of cars Management of employees Attach documents Fleet management optimize with all the tools				
	Construction	10	Papper Label to identify	Everyday someone distribute the tools Registration on board No responsabilization Excellent control of consumables	Consistent Data base General view of tools, employees and location Quick search			Random verification of car documents No control on costs of maintenance	Know every calibration and when is needed Management of cars			Daily registration of equipments Exchange tool without knowledge No informatic registration	Quick transfer of responsibilities Access at any time and place
	Construction	11	Uses Software Primavera Own identification Excel	Equipments are given to chiefs or location Interesting identification Exclusive access to warehouse	Quick search Access at any time and place Suggestion to create kits for each employee			Need of a fleet car management Need of employee management Information only in company server	Management of cars Management of employees Access at any time and place	No idea of number and value of reparations for tools/cars. Extended Excel Big constructions need good equipments reports	Reparation historic Maintenance historic Attached documents	Good control of consumables through Primavera Less productivity Registration on excel and paper Inventory incomplete and outdated	Quick transfer of responsibilities Access at any time and place
	Construction	12	No identification Uses Software Primavera Excel to control vehicles and employees	No registration No responsabilization No identification No exclusivity access to warehouse Lost/stolen tools and equipments in construction	No registration Warehouse Layout suggestion Suggestion to create kits for each employee			Need of a fleet car management Need of employee management	Management of cars Management of employees Attach documents	No idea of number and value of reparations for tools/cars. France bad reparations logistics (2months stop) Good vehicles costs control	Reparation historic Maintenance historic Attached documents Quick inventory		
	Construction	13	Uses software SAGE for billing	No registration No responsabilization Lost/stolen tools and equipments in construction No inventory	Easy to have a general view Quick search Consistent Data base Warehouse Layout suggestion	No control in the delivered EPs No control of consumables Redundant purchases	General view of tools, employees and location Suggestion of deliver the used EPI to receive new one Evaluate the consumption of each employee	Specific material needs calibrations Need of employee management Good fleet car management	General view of tools, employees and location Attach documents Know every calibration and when is needed Management of employees Reparation historic Maintenance historic				
	Heavy and Civil	14	No identification Uses software Filisoft for billing and HR Inventory outdated	No registration No responsabilization No inventory	Easy to have a general view Quick search Give responsibility	Exclusive access to warehouse No registration No control in the delivered EPs Hard to know where is borrow material	Control borrow material Suggestion of deliver the used EPI to receive new one	Filisoft employee manage Need of a fleet car management Specific material needs calibrations	Management of cars Attach documents Know every calibration and when is needed Reparation historic Maintenance historic				
	Make through	15	No identification Was made control but abandoned					Papper registration Need of a fleet car management Need of employee management Specific material needs calibrations	Management of cars Management of employees Attach documents General view of tools, employees and location	No idea of number and value of reparations for tools/cars.	Reparation historic Maintenance historic General view of tools, employees and location	No exclusivity access to warehouse No registration Inventory 1x for year	Quick transfer of responsibilities Access at any time and place Warehouse Layout suggestion
Make through	16	Uses software Elicaddata for RH Intention to extend it for jobsite and production Cartrack Own identification Excel for equipments and EPs	Central registration in 1 person Team leaders responsabilization Switch equipment without warning No inventory No information if responsible is out	Exclusive access to warehouse Good control on EPs Suggest to give responsabilization to employees Easy to have a general view Quick search			Employees management in Elicaddata Need of a fleet car management Intention to obtain ISO9001 No idea of number and value of reparations for tools/cars	Attach documents Reparation historic Maintenance historic		Duplication of registrations Peak hour, paper then informatic No control of tool in use/reparation	Quick transfer of responsibilities		
	Locksmith	17	Uses software PHC Manual transfer registration	No registration No identification Sign to have equipment Papper control	Easy to have a general view Quick search Access at any time and place			Need of a fleet car management Need of employee management Bad EPI control	Management of cars Management of employees Attach documents	No idea of number and value of reparations for tools/cars.	Reparation historic Maintenance historic		

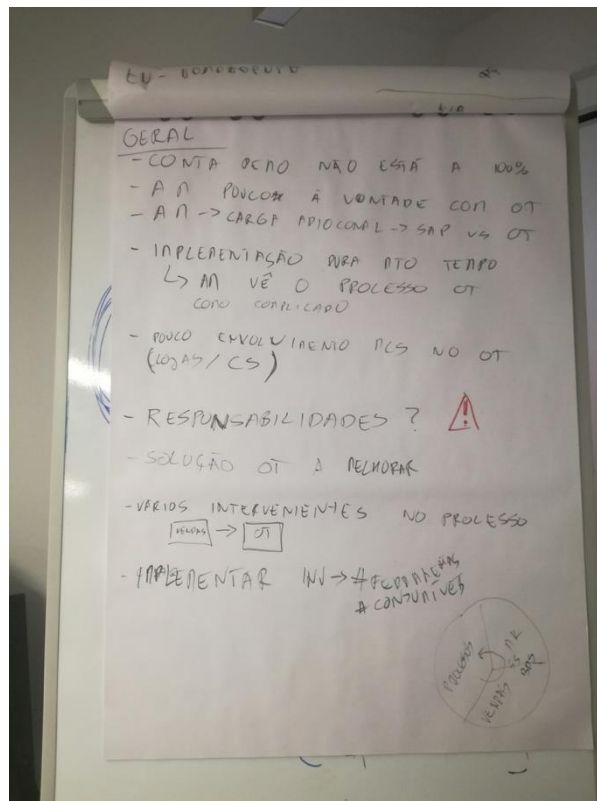
Appendix D:Process On!Track As-Is

Steps		Selection and Discovery			Board Meeting (BM)				Onsite Analysis			ONI Track Benefits	Price Offer	Contract Sign			Implementation								Monitoring			
Main Activities		Discover Potential Customer	Discover Decision Maker	Schedule B.M	Date Proposal	Execute B.M	Proposal Acceptance	Follow up and Signature	Schedule Onsite Analysis	Analysis Execution	Dess Preparation	Benefits Presentation	Proposal Presentation	Analysis Results - Solution Proposal	Signature of Contract	Follow up	Open Contract	Data Recall	Schedule Tagging day	Tagging	Implementation	Schedule Training	Training	Solution Delivery	Customer Visit	E-mail (new tools, doubts, ...)		
Intervients																												
Area Sales Manager		●	●	●		●	●	●	○	○					●	●												
Account Manager		○	○	●		●		○	○	○					●	●												
Service Manager						●	●	●		●				●	●	●				●		●	●					
OT Specialist										●		●				●			●	●		●	●		●	●		
Back Office				●	●				●		●						●	●	●		●	●			●	●		
Time (days)																												
Task Execution		3 visits/3h/3days		1 phone call/1 day							2										8							
Begin and End of task		45	30		1		indef. if not done		21	2						indef if not done				75								
● Responsible ● Help ○ Collaborate Drop Out High Drop Out Low																												
T execution: T calendar		3 45	+	1 30	+	1 1		+	1 21	+	2 2	+	8 75	=	16 174	Days Days												
		Discovery Customer		Schedule B.M		Prepare Execute B.M		Schedule Onsite Analysis		Make Analysis OT Presentation Proposal		Implementation Delivery																

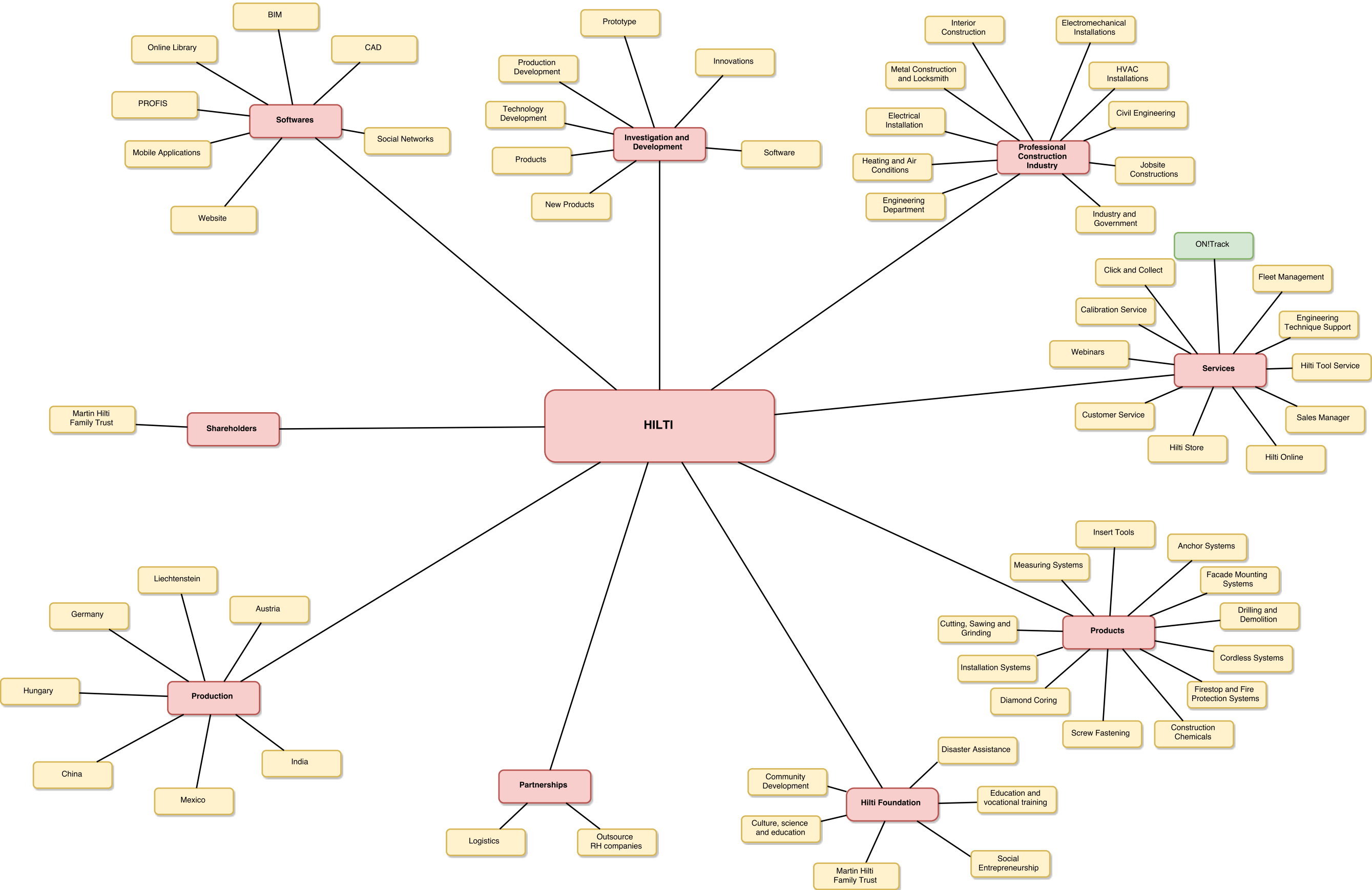
Appendix E: Process Ontrack To-Be

Steps	Selection and Discovery			Board Meeting (BM)				Onsite Analysis			ONITrack Benefits	Price Offer	Contract Sign			Implementation								Monitoring		
Main Activities	Discover Potential Customer	Discover Decision Maker	Schedule B M	Date Proposal	Execute B M	Proposal Acceptance	Follow up and Signature	Schedule Onsite Analysis	Analysis Execution	Docs Preparation	Benefits Presentation	Proposal Presentation	Analysis Results - Solution Proposal	Signature of Contract	Follow up	Open Contract	Data Recall	Schedule Tagging day	Tagging	Implementation	Schedule Training	Training	Solution Delivery	Customer Visit	E-mail (new tools, doubts, ...)	
Intervinents																										
Area Sales Manager	●				○	●		○	●					●	○											
Account Manager	○	○	○		○		○	○	●					○					●							
Service Manager					○	●		○	●					●				●								
OT Specialist					○				●				●				○	●	●					●	●	
BDS		●	●		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●	●	●	●	●	
Back Office			○	●				○		●						●	○	●	●	●				●	●	
Time (days)																										
Task Execution	3 visits/3h/3days			1 phone call/1 day							2		Critical Time - 15					8								
Begin and End of task							indef. if not done									indef. if not done										
● Responsible ● Help ○ Collaborate Drop Out High Drop Out Low																										
T execution:	3	+	1	+	1	+	+	1	+	2	+	8	=	16	Days											
T calendar:	14	+	1	+	2	+	+	3	+	3	+	10	=	33	Days											
Discovery Customer Schedule B M Prepare Execute B M Schedule Onsite Analysis Make Analysis OT Presentation Proposal Implementation Delivery																										

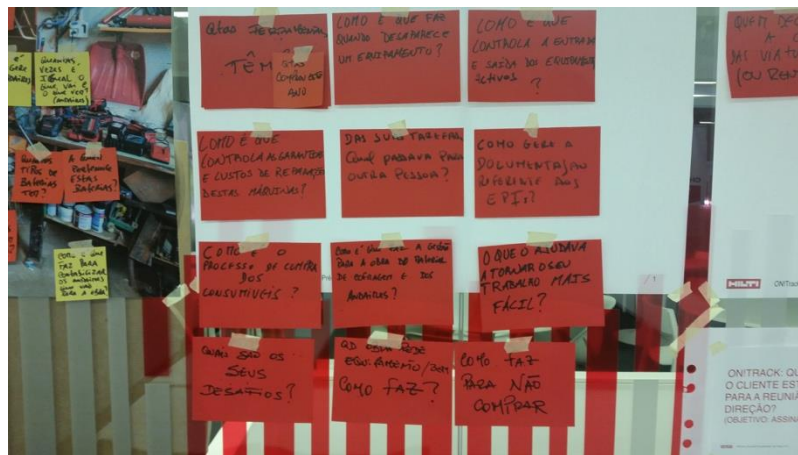
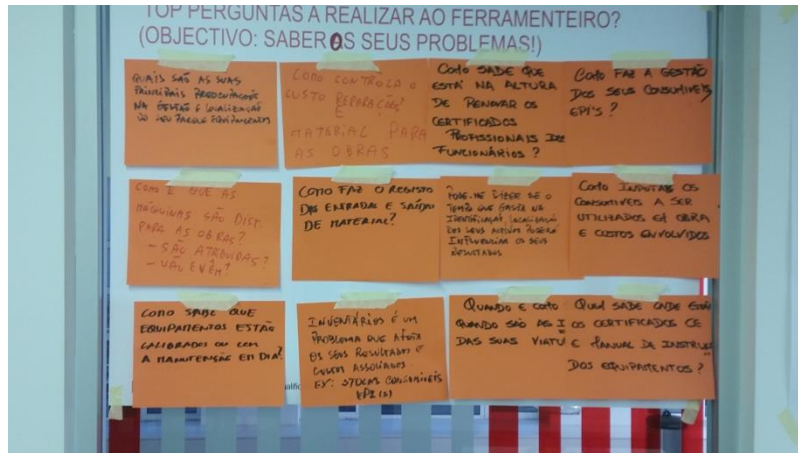
Appendix F: Mind-Map OT Process



Appendix G: Hilti Stakeholders Map



Appendix H: Brainstorm Session



Appendix I: Google Forms

The screenshot shows a Google Form titled "Departamento de Serviços Hilti Portugal". The form is in Portuguese and is part of a survey. It includes a header with "PERGUNTAS" and "RESPOSTAS" tabs. The form is divided into sections, with the first section titled "Secção 1 de 2".

Departamento de Serviços Hilti Portugal

Queremos agradecer-lhe o facto de ter confiado em nós ao adquirir um serviço que lhe vai permitir gerir os seus ativos de uma forma mais rápida e eficiente, garantindo desta forma o controlo total sobre os mesmos.

Este questionário serve para avaliarmos a sua opinião em relação ao nosso processo de implementação do serviço na sua empresa.

Com o vosso feedback pretendemos saber o que estamos a fazer bem e o que estamos a fazer menos bem, de forma a melhorar as metodologias utilizadas.

Qual é a sua função na empresa?

Texto de resposta curta

A análise foi uma mais valia, na medida em que me permitiu ter uma visão mais detalhada sobre a gestão atual dos meus ativos levando-me a tomar uma decisão mais fundamentada e consciente. *

1 2 3 4 5

Discordo Totalmente Concordo Totalmente

O processo de recolha de dados, da parte da Hilti, foi rápido e simples. *

1 2 3 4 5

Discordo Totalmente Concordo Totalmente

Appendix J: Audit Checklist Document**ON!Track Care Program****Are you ON!Track?**

Comapny: _____

Date _____

Activities to Verify	Comments	Company Responsible
Verify Notifications	_____	_____
Consistency of Nomenclature	_____	_____
Location Definitions and Actualizations	_____	_____
Inventory and confirmation of Equipment in one or more Locations	_____	_____
Introduction of new equipment acquired / equipment	_____	_____
Consumables Stock	_____	_____
Updating of Company Employees	_____	_____
Updating of Company Vehicles	_____	_____
Models	_____	_____
Verify Use of Services	_____	_____
Verify Use of Certificates	_____	_____
Verify Report Usage	_____	_____

Verify what changes were implemented according to the suggestions made in Report and verify if there were anothers significative changes.

Verify if the solution continues to fit the customer needs and business model of the customer.

Author _____

Company Signature _____

Appendix K: Images

