Balancing walled garden and open platform approaches for the Internet of Things:

A case study of Husqvarna Group

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Abstract

The term “Internet of Things” (IoT) was first introduced by a technology pioneer Kevin Ashton in 1999. Although the term is relatively new, the idea of making networks and computers communicate in order to track and manage devices has been around for many years. As of now IoT is a rising topic in technical community. Some specialists are anticipating that by 2025 there will be around 100 billion connected IoT devices with a worldwide economic impact of more than $11 trillion. On the other hand, Internet of Things emerges significant challenges. Currently the organization around world use two main approaches when entering the IoT market. First one is an open platform and is represented by interoperability and collaboration with devices from different vendors. Second one is a closed platform, or a “walled garden” approach. A “walled garden” approach is characterized by building “fences” around the user. In other words, the service provider has control over applications, content and media and also restricts the non-approved content to reach the customer. Therefore, the research set out to explore these approaches and show the benefits and limits they can have on an organization. The research was conducted in collaboration with a Swedish manufacturer of outdoor power products called Husqvarna Group. In order to fully acknowledge the organization’s approach, 4 interviews were conducted with managers, back end developers and consultants hired by Husqvarna Group. From the findings, some things should be taken in consideration. First, IoT involves big data being collected, therefore security and privacy are crucial when developing devices and systems. Second, it is essential for an organization to have the same views when taking a new direction. Third, when discussing Internet of Things, it means that things connect, devices to sensors, sensor to gateways and gateways to system. And there shouldn’t be a delimitation from a vendor to another. Therefore, open platform approach is seen as the way to diversity and innovation.

Keywords: IoT, Walled garden approach, Open platform approach, interoperability, compatibility, communication model, security and privacy.
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1 Introduction

This master thesis has the purpose to inform the reader about the research in the field of Internet of Things and its current ecosystem. The research was conducted during the last semester of the master’s IT, Management and Innovation program. First chapter will cover the subject of research, the problem statement & motivation for the research, the research questions, and the research objectives and delimitations as well. The purpose is to point out why this research was conducted.

1.1 Subject of the Research

According to Rowland, Goodman, Charlier, Light, & Lui (2015) Internet of Things is a technically driven field that addresses to the growing range of physical objects acquiring connectivity, sensing abilities and increased computing power.

When taking a look at the hype cycle of Global IT trends it can be seen that in the peak of inflated expectations of the curve is Internet of Things. According to Gartner (2015) big data and the cloud are becoming mainstream, while Internet of things has reached the height of its hype and should reach the plateau in 5-10 years (Figure 1). This meaning that in 10 years the Internet of Things will reach the mainstream adoption.

Figure 1 Hype Cycle for Emerging Technologies

A big part of early twenty-first century computing-history is presenting the human beings as wasting a lot of time by receiving information from one electronic device and re-entering into another one. Lucas, Ballay, & McManus (2012) give the example of a person reading the credit card number from her cellphone so just she could type them back into some other sort of computer. This example shows that there is already a
network in place. But as long as human involvement is required on communication level, the revolution to an IoT ecosystem will be postponed.

1.2 Problem Statement & Motivation for the Research

The Internet of Things was chosen as the subject of this study because of several observations that were made after analyzing the current ecosystem. To be more precise in several sources IoT is described as connecting the physical objects around us with the virtual world of the Internet. And according to Rowland et al., (2015) there are two critical principles of IoT that everyone interested in this area need to acknowledge: interoperability and interusability. On the other hand Lucas et al. (2012) refers to the same principles but introduces his own terms which are device fungibility and information liquidity.

If taking in consideration these principles and applying to where we stand today a lack of diversity can be seen. As a matter of fact, the critical principles of IoT are being avoided by using a set of techniques known as the walled garden approach.

Walled garden approach means that devices are simple avatars to their manufacturer so that even after the device is in its owner’s hands, the manufacturer still has ultimate controls over what software may the device run (Netanel, 2007).

As can be seen there is a gap between the current IoT ecosystem and the desired one. Therefore, it resulted in the desire to focus on this subject and find a solution that will close this gap.

1.3 Research questions

The purpose of this research is to answer the main question “Is an open platform a solution to the current “Walled garden” principle of the IoT ecosystem?”. The final answer will be found by answering the below listed questions.

RQ1: What IoT approach is currently applied in Husqvarna Group?

RQ2: What are the advantages and disadvantages of the Walled garden approach?

RQ3: How can an open platform approach benefit Husqvarna Group?

1.4 Research Objectives

The purpose of the thesis is to demonstrate that the transition to interoperable devices that are fungible between software and hardware, will be followed by an explosion of innovation.

The research is performed to be able to bring relevant recommendations and arguments for the designers and businesses, and to show that this kind of thinking lights the way toward an open, competitive marketplace of disruptive evolving groups of devices that collectively will deserve the label of an IoT ecosystem.

1.5 Delimitations

The study focuses on one specific empirical case in the IoT sector, to be more precise on the Husqvarna Group, a manufacture of outdoor power products. Also it should be mentioned that the case study only concerns two of the Husqvarna Group’s IoT initiative: The Gardena Smart System and the Husqvarna Fleet Service.

The company operates mainly in Europe, US and Asia. So the geographic focus is only on these regions. The Gardena Smart System is released only for the German market and some of the findings are in German, therefore might occur some misreading of the text.
The interviews were conducted over Skype and Google Hangouts and due to connectivity issues, there might occurred small misinterpretation.

1.6 Definitions

The terms of fungibility and liquidity are the basic concepts of the discipline of economics. Lucas et al., (2012) relates to how alike are economics and computing when it comes to complexity and how to manage it. Therefore, the authors introduce two terms: device fungibility and information liquidity. The definitions are as follows:

“Fungibility refers to the ability to freely interchange equivalent goods. An item is fungible as long as one is as good as another. Fungibility does not depend on physical similarity, on the contrary it’s the functional equivalence that matters” (Lucas et al., 2012, p.28).

“Information liquidity is the other side of the coin. It refers to the ability of information to flow freely where and when it is needed. And the flow of information from a web server to a user screen is nothing like that. It is highly controlled, and it contains prearranged data that is displayed in predetermined formats. Every website is like a discrete vending machine where we go to procure a certain particular kind of information. When we need a different kind, we move on to another machine” (Lucas et al., 2012, p.36).

The concepts of interusability that is used in this study, was established through literature review:

Interusability describes “The user experience across multiple devices(Denis & Karsenty, 2004) and cross-platform interactions” (Rowland et al., 2015).

In information technology, interoperability refers to:

“The ability for devices, applications, and services to interact with other devices, applications, and services from different vendors, regardless of hardware architecture or type of software” (Rowland et al., 2015).
2 Theoretical framework

This section covers the theoretical framework of this thesis. In the literature review the main themes were established: Origins of IoT, enabling trends and technologies, transformational potential, communication models and challenges of IoT. The applied methodology is presented in the 3rd chapter. The results of literature review are divided into three main parts: the first about Internet of Things, second about the Walled garden approach, the third about an open platform approach.

2.1 Literature review on Internet of Things – Main themes

While conducting the literature review, several general topics were identified: Origins of IoT, enabling trends and technologies, transformational potential, communication or connectivity model used by IoT implementations and challenges IoT might raise.

2.1.1 Origins of IoT

According to Rowland, Goodman, Charlier, Light, & Lui (2015) the term “Internet of Things” (IoT) was first used in 1999 by a technology pioneer Kevin Ashton, while suggesting supply chain management improvements to his at that time employer, Procter & Gamble. Ashton’s vision was to use radio-frequency identification (RFID) to identify and track products. This improvement would save a huge amount of human work entering manually data into computers.

Holler et al., (2014) suggests that although the term “Internet of Things” is relatively new, the idea of merging networks and computer in order to track and manage devices has been around for decades. In the 90s “machine-to-machine” (M2M) solutions were used on a broad scale in enterprise and industry. However, many of this early solutions were based on closed built systems or industry specific standards, rather than Internet Protocol or Internet standards.

As stated by Rose, Eldridge, & Chapin, (2015) the first Internet “device” was an IP-enabled toaster that could be turned on and off over the Internet- was featured at an Internet conference in 1990. This turned out to be the starting point of a research field called “smart object networking”, which laid foundation for the present Internet of things (Arkko, McPherson, Tschofenig, & Thaler, 2015). The Trojan Room coffee pot is another example of connect devices. It was a coffee machine located in the University of Cambridge, England in 1991. Its purpose was to avoid the disappointment to find the coffee machine empty, so a camera was set up, and was streaming live on all the desktops on the office network. It can be seen that the concept of making devices communicate to each other is not recently discovered, but why is then Internet of Things such a popular topic in present?

2.1.2 Enabling trends and technologies

According to Rose et al., (2015) the convergence of the technology and the market trends is making it possible to connect different size devices more inexpensive and easier. The authors identified the following trends and technology:

- Ubiquitous Connectivity—Low–priced, fast emerging, widely spread connectivity, this makes almost any device connectable.
- Widespread adoption of IP–based networking— IP turned out to be the most influential global standard for networking, which provides a well–defined platform of software and tools that can be integrated into a broad spectrum of devices quickly and affordable.
- Computing Economics— this trend is based on Moore’s law (1965) which states that “the number of transistors per square inch on integrated circuits doubles every two years”. With today industry’s investments in R&D and manufacturing, this law continues to be relevant to present situation. Every year are developed products with higher computing power and less cost.
• Miniaturization— today’s innovation in the computing sector allows manufacturing and deployment of very small devices and sensors. Matched with greater computing economics it resulted in the improvement of small and low-cost sensor devices, which supply many IoT systems.

• Advances in Data Analytics— development of new algorithms, accelerated development in the fields of data storage, computing power and cloud service empowers the collection and analysis of big data. Making it easier to extract useful knowledge.

• Rise of Cloud Computing— Cloud computing advantages computing resources to analyze, manage and save collected data. This permits devices to communicate, with the ability to analyze and control the data.

From this perspective, a wide range of industry sectors are considering the potential for incorporating IoT technology into their products and services.

Manyika, Chui, Bisson, & Woetzel (2015) describe in their report the wide range of applications where IoT is expected to create value for industry and users.

Table 1: Settings for IoT Applications (Source: McKinsey Global Institute)

<table>
<thead>
<tr>
<th>SETTING</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUMAN</td>
<td>Devices attached or inside the human body</td>
<td>Devices (wearables and ingestible) to monitor and maintain human health and wellness; disease management, increased fitness, higher productivity</td>
</tr>
<tr>
<td>HOME</td>
<td>Buildings where people live</td>
<td>Home controllers and security systems</td>
</tr>
<tr>
<td>RETAIL ENVIRONMENTS</td>
<td>Spaces where consumers engage in commerce</td>
<td>Stores, banks, restaurants, arenas – anywhere consumers consider and buy; self-checkout, in-store offers, inventory optimization</td>
</tr>
<tr>
<td>OFFICES</td>
<td>Spaces where knowledge workers work</td>
<td>Energy management and security in office buildings; improved productivity, including for mobile employees</td>
</tr>
<tr>
<td>FACTORIES</td>
<td>Standardized production environments</td>
<td>Places with repetitive work routines, including hospitals and farms; operating efficiencies, optimizing equipment use and inventory</td>
</tr>
<tr>
<td>WORKSITES</td>
<td>Custom production environments</td>
<td>Mining, oil and gas, construction; operating efficiencies, predictive maintenance, health and safety</td>
</tr>
<tr>
<td>VEHICLES</td>
<td>System inside moving vehicles</td>
<td>Vehicles including cars, trucks, ships, aircraft, and trains; condition-based maintenance, usage-based design, pre-sales analytics</td>
</tr>
<tr>
<td>CITIES</td>
<td>Urban environments</td>
<td>Public spaces and infrastructure in urban settings; adaptive traffic control, smart meters, environmental monitoring, resource management</td>
</tr>
</tbody>
</table>
2.1.3 Transformational Potential

While the number of network-connected devices increases, the amount of traffic generated will rise as well. Cisco estimated that the Internet traffic generated by non-PC devices will increase from 40% in 2014 to 70% in 2019. They also estimate that the M2M connections (including IoT ecosystem) will grow from 24% of all connected devices in 2014 to 43% in 2019 (Index, 2015).

According to Lucas, Ballay, & McManus (2012) in ten years we could be the witness of a shift of information centricity. From the information being in the machine to the applications, people, environments and devices being “in” the information. As of now the web experience can be characterized by the users downloading and generating content trough their computers and smartphones.

IoT on the other hand can lead to a shift in thinking. It can lead to a “hyperconnected world”, where there are no boundaries for devices or services that can make use of technology.

2.1.4 Communication models

Arkko et al., (2015) outlines a framework of four common communication models used by IoT devices. This models will be described as follows.

**Device-to-Device Communication**

This model represents the communication between two or more connected devices. The interaction between these devices is possible by using distinctive types of network, as for example IP networks. Beside this, they can start a direct connection by using protocols like Z-Wave, ZigBee or Bluetooth, as can be seen in Figure 2.

Figure 2. Example of device-to-device communication model.

These device-to-device networks are frequently adopted in settings like home controllers, the devices and sensors used in these systems mostly communicate through small amounts of information. IoT equipment like thermostats, light bulbs and light switchers usually forward to each other small data packets of information.
Oftentimes the communication protocols for this model, are not suitable. From the customer’s perspective, it often can limit the user’s ability to choose between vendors. For instance, ZigBee devices are not compatible with Z-Wave family of devices.

**Device-to-Cloud Communications**

According to Arkko, McPherson, Tschofenig, & Thaler(2015) in a device-to-cloud communication approach, the hardware is connected directly to the Cloud service. This model regularly uses the classical networks, like Wi-Fi or Ethernet, to create a connection among the device and the IP network, that ultimately connects to the Internet cloud service. This can be seen in Figure 3.

![Figure 3. Device-to-Cloud communication model diagram.](image)

This communication model is applied by companies and their products like the Nest Labs and its thermostat, also Samsung and its SmartTV. In the matter of Nest Labs, the thermostat passes on the collected information to a database located in the cloud, where the data will be processed. Eventually this data is used to evaluate the home energy consumption. Additionally, the cloud connection grants remote access to the users over devices, via an app or a Web interface. In the case of Samsung technology, the SmartTV records the user’s watching habits and voice and transfer that data to Samsung, by using Internet connection.

Nonetheless, interoperability issues can emerge during connection of devices created by different producers. In case proprietary data protocols are involved, the user might be forced to use a certain cloud provider, the one that is compatible with the device. This frequently is called “Vendor lock-in” (T. Eisenmann, 2008).

**Device-to-Gateway Model**

Also called the device-to-application-layer gateway(ALG) model, the gadget or the sensor connects to a cloud service by using ALG service as a pipeline. Briefly, it means there is an app running on a local hardware and it is a transitional level between the device and the cloud. This intermediary can act also as a data translation and protocol converter (Ark ko et al., 2015). This model is shown in Figure 4.
Oftentimes, in the role of a gateway is a smartphone using an app that connects with the device and collects relevant info, as a result the stored data is directly sent to the cloud service. This approach is regularly applied in devices like personal fitness trackers (Arkko, McPherson, Tschofenig, & Thaler, 2015). The trackers usually depend on a smartphone app to connect the tracker to the cloud.

Another form of this communication model is the recent evolution of so called “hub” devices. Besides being the local gateway between the devices and the cloud, the “hub” also act as a bridge between different family devices. For instance, the SmartThings hub has Z-wave and Zigbee detection transceivers built in, that way the user can access different families of devices with just one app and a network connection.

**Back-End-Data-Sharing Model**

This communication model allows the user to merge data from different sources and evaluate it. Also, this is a communication architecture that enables the user to share the data with third parties.

In order for a back-end data model to be effective, it should enable the user to move their data when they switch between IoT services, breaking down data silo barriers. (Arkko et al. 2015) recommend a so called “federated cloud service” approach. This approach merges the resources of different cloud providers, in order to fulfill a bigger business goal. This model suggests that cloud applications programmer interfaces (API) are needed to achieve interoperability of smart devices. This design is shown in Figure 5.
2.1.5 Challenges of IoT

As stated by Castillo & Thierer (2015) the next step for technological innovation will be creating devices embedded with miniature computing devices, and connect them. This will represent a major transformation of how customers interact and are affected by the Internet. Any kind of disruptive innovation raises new issues across user privacy and security, technology and policy (K. Rose et al., 2015). Additionally, IoT will allegedly effect economies and regions, introducing both opportunities and obstacles around the world.

Security

In the Internet of Things environment, each device that is connected might be a potential threat, as it could be a doorway to the IoT framework or personal data (Li, Tryfonas, & Li, 2016). A user is supposed to trust a certain environment; therefore, security is a critical factor for IoT.

According to Rose, Eldridge, & Chapin(2015) as the number of connected devices to the Internet increases, new chances to exploit possible security breaches appear. IoT devices with inferior security could act as opening point for cyberattacks, while poorly designed devices might disclose consumer information to unauthorized third parties. For instance, a refrigerator that is missing malware protection might send hundreds of spam emails to different receivers around the globe, just by connected to the local Wi-Fi network (Starr, 2014).

Another factor to consider is that many IoT devices operate in a manner where the user has no real visibility into working process of the device or the data this device produce and share. When the user doesn’t acknowledge what functions does the device perform and how much information is collected, it can result in security breaches.

Privacy

Internet of Things refers to a large network of connected devices, usually developed to collect data about the surrounding environment, which periodically includes users as well. The collected data provides business value to the device manufacturer and supplier as well. This is where the privacy has to be taken in consideration, because different people have different privacy expectation regarding its scope and the following use of data collected(Perera, Ranjan, & Wang, 2015)

Rose et al., (2015) make an example of smart TVs or video game devices. These type of products possess features like voice and video recognition, and as a consequence some of the gathered data is transferred to a cloud service for processing, which sometime might include a third party.

These kinds of privacy problems are critical to address because they affect a user ability to trust the Internet.

Interoperability/Standards

Connected devices means common technology standards. Getting devices communicate to each other is a big enough challenge, as there are many different network standards (Rowland et al., 2015).

According to Vermesan & Friess (2011) in order for an ecosystem to be entirely interoperable , all IoT devices should have the means for connecting and communicating to alternative device or system smoothly. Well-performing device interoperability can stimulate modernization, promote alternative business models and frame economies of scale.

Manyika, Chui, Bisson, & Woetzel, (2015) in their report state, “on average, interoperability is necessary to create 40 percent of the potential value that can be generated by the Internet of Things in various
settings.”. The report goes on, “Interoperability is required to unlock more than $4 trillion per year in potential economic impact for IoT use in 2025, out of a total impact of $11.1 trillion across the nine settings that McKinsey analyzed.” Although some organizations apprehend competitive advantages in adopting “walled garden” approach, however economic growth might be restricted when building a market based on the silo effect.

Rose, Eldridge, & Chapin (2015) introduce interoperability, standards and protocols as key points to be taken in considerations in the early design and embrace of IoT devices. Some of this key points and challenges are listed below:

- **Proprietary Ecosystems and Consumer Choice.** As stated before, a few hardware producers perceive market advantage in designing proprietary ecosystem where the devices are compatible. This is so called “vendor lock-in” or “walled garden”. This approach allows the manufacturers to restrain device fungibility exclusively to the devices and sensors within their own product spectrum. The “vendor lock-in” can be accomplished by raising the switching cost, so the user wouldn’t switch to a competitor in the future.

D. Rose (2014) claims that interoperability covers also the ability of IoT platform to collect data and handle it. The main advantage of a IoT ecosystem is the capacity of connected devices to communicate with services through using the cloud and in return it produces valuable information based on that data. Although this function is highly effective, it might as well raise issues for the user, if she decides to switch to a rival service. Even if the users can get access to the data generated by their devices, it will be pointless, as long as the data is in a proprietary format. The customer will be able to switch to a rival service just in the case if the data is in an open standard format.

- **Technical and Cost Constraints.** During the process of designing and developing IoT devices, the manufactures might face several restraints. A few devices are limited from a technical aspect like limited processing memory or battery life. According to Gaglio & Re (2014) manufacturers are constrained by the production cost of the hardware, therefore they try to reduce the unit cost. Rose et al. (2015) indicate that organizations are conducting cost benefit analysis in order to determine if the benefits of implementing standards are worth the extra costs. If in short range, it might be more expensive to design device fungibility features into a device. Sometimes the most inexpensive path to market would be to use proprietary protocols and platforms. Nonetheless this should be analyzed in contrast with the long-term product lifecycle benefits provided by interoperability.

- **Schedule Risk.** Organizations strive to gain the first mover advantage by introducing a competitive product and occupy a significant segment of the market, and IoT device manufacturers are not an exception. Issues emerge for IoT device fungibility when the manufacturer’s schedule outruns the introduction of interoperability standards. The absence of confidence in standards implementation schedules might be perceived by the organizations as a risk to be averted (West, 2003). This can turn manufacturers towards alternative approaches like “walled garden”, especially in the short term.

- **Technical Risk.** When a company focused on IoT appliances have the intention to develop a device, they have to take in consideration the technical risks of protocols during the design and
implementation phases. Applying current and verified standards into the device will result in a lower technical risk than if implementing proprietary protocols. Using open and broadly adopted standards, as for instance the Internet Protocol suite can have several advantages, such as, already existing software, less expensive development costs and a vast talent pool (Arkko et al. 2015).

- **Devices Behaving Badly.** As stated by Sundmaeker et al. (2010) the absence of standards and documented guidelines can have considerable effect on IoT than just technical restriction of the devices. The lack of certain standards can result in misbehaving of IoT devices. Basically in the absence of standards and guidelines, the manufacturers of IoT hardware occasionally develop products that function in damaging manner on the Internet without taking in consideration their impact. In case these devices are badly configured, they might have obstructive impacts on the network resources they are connected to or even on the Internet (K. Rose et al., 2015).

- **Legacy Systems.** Newly designed IoT devices faces several challenges, one of them being backward compatibility with already existing and fully functional systems. This is applicable to the industries and ecosystem that have already implemented networks of devices. This was the IoT back end and front end developers are required to preserve the compatibility feature with legacy systems and at the same time continuing on accomplishing better device fungibility by using standards Rose et al. (2015).

- **Configuration.** According to Gaglio & Re(2014) one of the main Autonomic Computing feature is self-configuration, this meaning that the system is able to self-configure in accordance with the instructions provided by the user. Otherwise the customer will experience difficulties in operating a wide range of IoT devices. As claimed by Rose et al. (2015) when put in the situation of configuring several distinct devices, it will be crucial to have friendly layout and common policies and standards when it comes to configuration tools interfaces and methods.

- **Proliferation of Standards Efforts.** As stated by Lawson (2014) as IoT is emerging, new industry coalitions have appeared. Their main task being to enlarge attempts to develop and harmonize standards and policies when it comes to IoT. Some of the Standards Developing Organizations(SDOs) are IETF, ITU and IEEE. Also recently joined SDOs such as Internet Consortium, Open Interconnection Consortium, ZigBee Alliance and AllSeen Alliance (K. Rose et al., 2015).

- **Feature rush.** According to Ezechina, Okwara, & Ugboaja (2014) IoT is critical for human progression. On the other hand, IoT faces several challenges. One of them is the rush for features in IoT devices. The focus is not on making devices useful but make them connect, although sometimes these devices have no benefits for human beings. IoT should represent a shift from the classic PC with capacity and memory to smart IoT devices.

### 2.2 Walled garden approach

A closed platform or a walled garden represents a software system where the manufacturer or the service provider has control over applications, content and media and also restricts the non-approved content to reach the user. On the other hand, a system or a platform is considered “open” when there are no constraints on collaboration, marketing or application of a certain product. Eisenmann (2008) introduces the term of Platform-mediated networks and usually there are several actors involved:

- Demand-side platform users – also called “end users” or customers.
- Supply-side platform users – usually are independent actors working in collaboration with the main platform.
- Platform providers – serve as the customer’ first encounter with the platform or the product.
- Platform sponsors – are the ones who own the IP rights and are deciding which of the actors can participate in the developing of the technology.
The author brings as examples the most used operating systems in the world, and also the iPhone technology, in order to show how Apple company adopted a walled garden approach to model their organization.

According to Eisenmann et al. (2008) in 2008 Apple’s iOS was closed regarding three out of four roles, and was arguably open towards some demand-side users. So for example in the United States, a user could purchase an iPhone just in case he or she was an AT&T subscriber (1st role). The other roles had restricted access in the iPhone network. As a result, the mobile apps are only available in the Apple’s iTunes Store. Therefore, Apple decides if to refuse third-party apps according to their own concerns (2nd role). Also, only Apple is in charge of manufacturing and distribution processes (3rd role) and Apple exercise rights and responsibility for this technology (4th role).

Apple represents a four distinct and wealthy companies incorporated into one organization. So, it produces hardware and software, also offer services and does retail. The majority of IT related organization can handle one or two of these segments and Apple Inc. is the only one that embraces all four sectors (T. R. Eisenmann et al., 2008).

Parker & Alstyne (2013) claim that Apple is vertically integrated. This meaning that the organization controls the main crucial entities in charge of manufacturing and selling the final product. Apple designs high-quality hardware and software. The software is adjusted for that hardware, connects it to iTunes and iCloud, and ultimately sells them through their retail shops.

Mehra (2011) has a different view on the term of “walled garden”. The author claims that a closed platform can be a creative paradise as much as an open platform. He recommends to see the “walled garden” as not a community surrounded by boundaries or limitation for users, but more as a multitude of user-generated data and he refers to it as “user dynamism”. Therefore, the “walls” are there to protect the so called “user dynamism”, which as a result creates business value for internet-based platforms.

2.3 Open platform approach

Eisenmann et al. (2008) states that a platform is “open” when:

- there are no constraints whatsoever applied to the design, marketing, retail or use processes.
- there is no discrimination when it comes to technical standards and paying licensing fees. They are the same for all participants.

The authors compare an “open platform” approach to horizontal strategies of a firm. The so called horizontal strategies applies to company’s current and forthcoming competitors. In this circumstances, applying the “open platform” approach means:

- building hardware and software that is interoperable with the rival’s ones
• collaborating directly with competitors in the commercialization and development of products.

Three strategies for open platforms are taken in consideration:

• **Interoperability** represents cross-platform transactions between two or more company’s users. For instance, mobile carriers from United States would provide text-messaging services that were not compatible with each other. In 2002 the carriers finally came to an agreement and the users could exchange messages. Therefore, whenever two platforms adopt interoperability, they become more liberal, thus subscribers of platform A can communicate freely with platform B’s subscribers. According to David & Bunn (1988) this can be achieved by using adapters or gateways, more general known as convertors. On the other hand, Farrell & Saloner (1992) debate that in order to accomplish interoperability, some technical compromise should be taken, thereby cross-platform processes might endure some quality degradation.

• **Licensing New Providers.** Another strategy to avoid an “walled garden” approach would be licensing new providers. Licensing is more interesting at the point when the new suppliers can present disruptive versions of products and not copying the existing ones. As the industry grows, users develop diverse needs. Eisenmann et al. (2008) describe the example of Palm, a company that served as exclusive OS provider for various years, it licensed its operating system to Sony and Samsung, companies that prior dealt with device manufacturing.

• **Broadening Sponsorship.** Another way for a company to unlock a fixed and closed platform is for the organization to accept collaboration as a way to success. Eisenmann et al. (2008) identifies several advantages of broadening sponsorship. From a financial point of view, the original sponsor can split the costs with secondary sponsors, therefore reducing the costs for research and development processes. Secondly, combining forces will probably result in a higher quality of the products.

3 Research Methods

This chapter will cover the methods applied to the research process of this thesis. In the further subsections will be depicted the case study, data collection and analysis methods used in the literature review.

The main focus of this thesis is to analyze the IoT ecosystem and see which of the two major approaches is more beneficial to the organization and the final user. In order to come up with an adequate and suitable solution a qualitative approach is chosen (Yin ,2003). The issues is handled through an exploratory single embedded case study (Yin ,2003).

3.1 Literature review

According to Webster & Watson (2002) it is indispensable to examine any previous work related to the subject, before conducting the research itself. The literature review was constructed based on the approach introduced by Webster & Watson (2002), therefore the author used keyword, forward and also backward searching for the data selection. The search was done via four databases: Sage, ProQuest, Emerald and JU library. Three main keywords that were used during the search process are “Internet of Things”, “Walled garden and closed platform” and “Open platform”.

During the revision process, the results of the search, were selected based on how relevant and suitable they were to the subject. The next step was going through the abstract of the articles or the summary of the books and saved for a more detailed review. The articles were stocked and managed by reference manager Mendeley. Following that, the selected papers were studied more detailed. Through the studying process
the backward search was conducted. In case a certain reference looked relevant to the subject of the thesis, it was searched in the above presented databases. The forward search was performed by choosing the most cited and adequate papers, that appeared in future works. The search analysis of the literature can be seen in Table 2.

**Table 2: Search results table**

<table>
<thead>
<tr>
<th>Databases</th>
<th>Sage</th>
<th>ProQuest</th>
<th>Emerald</th>
<th>JU library</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Keyword Results</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet of Things</td>
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<td>16</td>
<td>3</td>
<td>14</td>
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<td>41</td>
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<td>Backward search</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Forward search</td>
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</tr>
<tr>
<td>Reviewed articles</td>
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<td></td>
<td></td>
<td></td>
<td>47</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Keyword Results</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walled garden/ closed platform</td>
<td>115</td>
<td>82</td>
<td>187</td>
<td>235</td>
<td>619</td>
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<tr>
<td>Selected</td>
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<td>2</td>
<td>8</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Forward search</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
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<tr>
<td>Reviewed articles</td>
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<tr>
<td><strong>Selected</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Keyword Results</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open platform</td>
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<td>12</td>
<td>251</td>
<td>179</td>
<td>767</td>
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<td>4</td>
<td>9</td>
<td>3</td>
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</tr>
<tr>
<td>Backward search</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward search</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Reviewed articles</td>
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<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td><strong>Selected</strong></td>
<td>23</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3.2 Case study

According to Yin the case study is just one of methods to conduct social science research. Other methods would be experiments, histories, surveys and analysis of archival information. Overall a case study is used when “how” or “why” questions are asked. In our case the main question is “How can an open platform approach improve IoT?”.

“The distinctive need for case studies arises out of the desire to understand complex social phenomena” (Yin, 2003).

Histories, case study and experiment are answering to this questions.

- Histories are the recommended strategy when there is no access or control. It basically means dealing with the dead past (no relevant persons are alive to report).
- Case study is preferred in examining contemporary events, but when the relevant behaviors cannot be manipulated. The case study relies on many of the same techniques as a history, but it adds two sources of evidence not usually included in the historian’s repertoire: direct observation of the events being studied and the interviews of the persons involved in the events. Case study’s unique strength is its ability to deal with a full variety of evidence – documents, artifacts, interviews, and observations beyond what might be available in a conventional historical study.
• Experiments are done when an investigator can manipulate behavior directly, precisely and systematically.

According to Rowley (2002) a case study is used when a “how” or “when” question is being asked about modern circumstances, over which the researcher has little or no control. For a case study, five components of research design are especially important:

• A study’s question
• It’s propositions, if any
• It’s units of analysis
• The logic linking the data to the propositions
• The criteria for interpreting the findings

A case study approach was selected as a relevant method of research, based on Yin (2003). Several companies were contacted, focusing on different sectors of IoT:

• Smart Homes
• Human devices
• Factories
• Vehicles manufacturers

The main goal was to find a company that is driven toward innovation, wants to deliver products that bring the customer more value and has a clear organizational structure. The main ideas of the thesis were presented to Ulf Axellsson, Director IT Architecture and Digital Solution at Husqvarna Group, and the company agreed to collaborate.

Husqvarna Group is an original equipment manufacturer of outdoor power products including robotic mowers, garden tractors, chainsaws and trimmers. Beside that Husqvarna won the IoT Project of the 2015 Year award in Sweden for its initiatives including:

• The Smart Garden – interconnected products (automatic watering systems and a robotic lawn mower)
• Gardena Smart System – includes Gardena Smart sensor, Gardena Smart Water control and Gardena Smart Sileno. The sensor produces live data, for example on soil moisture, outdoor temperature and light intensity. The data is transferred to the smartphone app via Gardena Smart Gateway connected to the home router.

The case study for the empirical research is based on the guidelines by Yin (2003). The design of the research is that of a single case study.

3.3 Data Collection

The data collection for the case study is based on interviews and documents received from the Husqvarna Group. The interviewees were selected based on a judgmental sampling strategy. This allowed to capture the complexity of the Gardena Smart System as seen by the creators and developers, who had direct impact on the project.

The data collection started with a preliminary meeting with Lars Olofsson, IT System Architect at Husqvarna Group. After the subject of the thesis was discussed, Lars explained the organizational structure of the IT department in Husqvarna and the initiatives that Husqvarna Group has toward Internet of Things. Lars, then suggested that Gardena Smart System is a recently released initiative from Husqvarna Group and they would be the perfect fit for my thesis.
Table 3: Analysis of data collection

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Analyzed entity</th>
<th>Interviewees/Type</th>
<th>Duration(h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview</td>
<td>Husqvarna Group</td>
<td>IT system architect</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Husqvarna Group/DSS</td>
<td>Back end developer</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Cybercom</td>
<td>Back end developer/consultant</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Cybercom</td>
<td>Back end developer/consultant</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Husqvarna Group/ GSS</td>
<td>Head of software development</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical artifacts</th>
<th>Husqvarna Group</th>
<th>Husqvarna Group website</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Social Media pages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Annual Report 2015</td>
</tr>
</tbody>
</table>

The interviewees were recommended by Lars Olofsson. Three of the respondents are a part of Gardena Smart System (GSS) team, two of them are employees of Cybercom, a consultant company hired by Husqvarna Group. The forth respondent is a part of Digital Service and Solution department, a member of Husqvarna fleet service team, focused on enterprises and professional consumers. Prior the interviews, all the respondents received a short introduction to the subject of the thesis and the questions. This was done for the respondents to feel comfortable with the subject and search for supplementary information if needed.

The meeting with IT system architect, Lars Olofsson, was conducted in Husqvarna Group head office. The rest of interviews were carried via Skype and Google Hangouts, considering the geographical location of some of the respondents. In the first place the interviewers were asked for approval to audio-record the interviews. Eventually, the recordings were transcribed for analysis.

3.4 Data Analysis

The analysis of collected data will be conducted in several steps:

- Organizing the content
- Content analysis
- Creating the report

3.4.1 Organizing the content

Initially the collected physical artifacts had a major role in creating a general idea about the organization mindset and its structure. The data collected from interviews was stored and managed using Microsoft Word and Excel. The answers were transcribed into Excel sheets.

3.4.2 Content analysis

The second step the author followed the method proposed by Graneheim et al. (2004). To be more precise, the process begun by spotting the meaning units and storing them in a Microsoft Word table, consisting of one to two sentences. Afterwards the meaning units were shortened to 2-4 words and added in another column of the same table as condensed meaning units. Following that, each condensed meaning unit was attributed with a code. Finally, they were assigned to essential categories. An example of the final version can be seen in Table 4.
Table 4: Example of the collected content analysis

<table>
<thead>
<tr>
<th>Meaning Units</th>
<th>Condensed meaning units</th>
<th>Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am a back end developer and designated lead back end developer.</td>
<td>Designated lead back end developer</td>
<td>Back end developer</td>
<td>Husqvarna</td>
</tr>
<tr>
<td>I am employed by Husqvarna Group.</td>
<td>Employed by Husqvarna Group.</td>
<td>Employed by Husqvarna</td>
<td>Husqvarna</td>
</tr>
</tbody>
</table>

The final version of qualitative content analysis was forwarded to the respondents, in order to avoid any misinterpretation.

3.4.3 Creating the report

The report was created using the previous conducted theoretical framework and the created categories emerged from the content analysis. The major categories were used as the spine for creating the structure of the case report.

3.5 Quality evaluation of the research

As suggested by Yin(2003) in order to evaluate the quality of a research design, relevant tests should be taken. Some of the quality criteria that will be used:

- Construct validity – usually is assured by the use of multiple sources of evidence (interviews, questionnaires, documents) and it refers to how well an experiment is done. As it can be seen in Table 3, the author used more than one sources to gather data. Also, as stated earlier the final version of qualitative content analysis was forwarded to the respondents, in order to ensure the accuracy and relevance of the gathered data.
- Internal Validity – Yin (2003) suggests to use a pattern matching strategy. It refers to how well an experiment is done. The data was gathered from employees assigned to different teams and even employees of different companies. As a result, the answers are alike and do complement with each other.
- External validity – the use of the theory is the advised approach to increase the external validity. Meaning to which extent the results of a study can be generalized to other situations and to other people. The external validity was accomplished by looking into literature related to hardware and software companies and the approach applied to their business, either it was a closed or an open platform.

3.6 Research ethics

The interviewees are always asked if they are comfortable with the digital recording. The recordings were transcribed verbatim to assure that no relevant data is lost.
4  Results: Case study of Husqvarna Group

The following chapter will cover the results of the case study. First step will be to present in a more generic way the chosen organization and the industry it operates in. The source of this information is multiple collected sources, as the annual report and the interview with the IT system architect of Husqvarna Group. Additionally, the information collected from the interviews is outlined and separated into sections.

4.1  Business ecosystem: Consumer durables segment

Husqvarna Group operates in the industry of consumer durables. A durable represents a division of products that are considered to last for a longer period of time, therefore the customer doesn’t need to acquire them regularly. Some of these products are outdoor power products for forest, park and garden care.

As of now the consumer durables industry is estimated at SEK 150bn. The forest and garden market are attractive and can be considered a mature market with a solid rise. Europe and North America represents an important segment of the world’s forest, park and garden areas. In terms of business value these two regions represent about 80% of the global market. Brazil, Russia and China are seen to become some of the next coming up markets with the most attractive potential.

4.2  Organization background: Husqvarna Group

The organization in focus is Husqvarna Group. It is a worldwide manufacturer of outdoor power hardware for forest, parks and garden care. The products cover chainsaws, trimmers, robotic lawn mowers and ride-on lawn mowers. Husqvarna Group is as well the European Leader in watering hardware for gardens and a leader in cutting equipment and diamond tools for the construction and stone industries. The company has collaboration with different brands, therefore the group’s hardware is sold under brands like Husqvarna, Gardena, McCulloch, Poulan Pro, Weed Eater, Flymo, Zenoah and Diamant Boart in more than 100 countries. According to Husqvarna Group’s annual report the net sales in 2015 were in amount of SEK 36bn and they have branches in more than 40 countries with around 13,000 employees.

The group’s business encompasses for divisions (Appendix 2):

- Husqvarna (Appendix 3) – represents a leader with a large range of high-quality outdoor products like chainsaws, trimmers and mowers for forest, park and garden care. The hardware and solutions are sold to professional customers through dealers in over 100 countries, including brands like Husqvarna, Zenoah and Jonsered.
- Gardena (Appendix 4) – is a European leader in garden watering and hand tools. The division offers innovative solutions based on consumer driven design and a powerful brand recognition around devoted gardeners. The hardware is usually sold at leading retailers around Europe.
- Consumer brands – the products from this division are sold particularly in North America and Europe. It targets wider customer segments in the forest and garden area. Brands like PoulanPro, McCulloch, Flymo and WeedEater.
- Construction - in charge of developing construction products and diamond tools for cutting and drilling in concrete, natural stone and other hard materials. The core brands of this division are Husqvarna for the construction products and Diamant Boart for the stone industry.

The group offers several products, which can be seen in Table 5.
Table 5: Husqvarna group’s offerings

<table>
<thead>
<tr>
<th>Categories</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheeled products</td>
<td>Riders, garden tractors, zero-turn mowers, lawn mowers, tilers and snow throwers.</td>
</tr>
<tr>
<td>Electric products</td>
<td>Robotic mowers, electric- and battery-powered handheld and wheeled products.</td>
</tr>
<tr>
<td>Handheld products</td>
<td>Petrol-powered chainsaws, trimmers, clearing saws, leaf blowers and hedge trimmers.</td>
</tr>
<tr>
<td>Watering and hand tools</td>
<td>Water-hoses, couplings, sprinklers, water controls, pumps and hand tools.</td>
</tr>
<tr>
<td>Accessories</td>
<td>Accessories and parts such as cutting equipment, lubricants, safety equipment and clothing.</td>
</tr>
<tr>
<td>Construction products</td>
<td>Power cutters, demolition robots, drilling equipment, wall- and wire saws, tile saws, floor grinders and all related diamond tools. Diamond tools for stone.</td>
</tr>
</tbody>
</table>

The Husqvarna Group points out that as the middle class is rising, they are moving into cities, therefore it is expected that the interest in caring for parks and forests is expected to grow. Green spaces have an essential role in the urban ecosystem, contributing by having positive health effects and improving air quality. Comparing to other areas in a city, green spaces need constant care and regular maintenance, so the community could gain from it.

Based on the group’s annual report, the organization has a vision of a world, in which people appreciate a well-maintained garden, parks and forests. Husqvarna Group’s role is to develop innovative hardware and solution for green spaces, so professionals and consumer around the globe could benefit from it. The company demonstrates respect for the environment and people as well. A big concern for the company is creating energy-efficient products and battery-powered products, resulting in lower emissions. Also, creating hardware that would produce lower noise and less vibrations.

4.3 The interview respondents

In the next table, Table 6, are introduced the respondents, their position and the year they became a part of Husqvarna Group or it partner.

Table 6: List of respondents

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Position</th>
<th>Company</th>
<th>Employed in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lars Olofsson</td>
<td>IT system architect</td>
<td>Husqvarna Group</td>
<td>2013</td>
</tr>
<tr>
<td>Anders S Johansson</td>
<td>Back end developer</td>
<td>Husqvarna Group</td>
<td>2015</td>
</tr>
<tr>
<td>Tobias Wahlstrom</td>
<td>Consultant on back end issues</td>
<td>Cybercom</td>
<td>2014</td>
</tr>
<tr>
<td>Oskar Christensson</td>
<td>Back end developer</td>
<td>Cybercom</td>
<td>2014</td>
</tr>
<tr>
<td>Marcel Mueller</td>
<td>Head of software development</td>
<td>Husqvarna</td>
<td>2015</td>
</tr>
</tbody>
</table>

Based on the interviews with the respondents, the author established meaning units, shortened them and created codes. The interview results are presented in the following sections.

4.4 Husqvarna Group’s Back end developer
Anders S Johansson is a back end developer and he is employed directly by Husqvarna Group. He is a part of Husqvarna Fleet Service Team and they are in charge of developing products for the professional customers, maintain them and help them use Husqvarna’s devices as efficient as possible. Anders is a part of a small department called DSS (digital service and solution), focused on developing back end systems for IoT, where the work is divided between scrum teams composed of 8 employees plus 20 consultants and the results are reported to a scrum master.

The purpose of the team “is to care for our professional consumers like for instance Jonkoping kommun, they have a lot of our products, and they want to maintain them and they want to use them efficient.”

4.4.1 Communication

This subcategory describes the communication model used in the devices developed by the Husqvarna Fleet Service Team. Anders mentioned the applied model would be device to gateway (see Figure 4). If for instance the customer owns a brush cutter which is equipped with a sensor and the operator has an operate tag connected to him, therefore it can be seen who is using it and the way they use it. All the processes are monitored and as a result the system provides recommendations for the operator. Also the system can measure the machine vibrations and give warnings to the operators, like “You shouldn’t work so much with this machine because you get exposed to vibrations”.

The communication protocol used by Husqvarna Fleet Service is a proprietary protocol. The sensor and the gateway were developed in collaboration with another company. The name of the protocol is J2 and the used internet standard is IPv4.

To be more precise, the process as explained by Anders is as follows, the operator utilizes the tool for one day, after the working day is finished the hardware is stored in a tool store. In the same tool store the gateway is located. So, when the gateway and the sensors from the hardware come close, they start synchronizing. As a result, the gateway is responsible for collecting the information from the sensors and forwarding it to the cloud.

As of now there is no direct communication between the gateway and the sensor. The information is stored until the end of the working day and it is offloaded to the gateway. Following that, the collected data is analyzed and processed and in short time the operator can receive a report regarding the device and the way he works. Therefore, the operator can change his routine in order to improve and optimize his working process.

4.4.2 Security

In this subcategory the author tries to emphasize on the role of security when developing interconnected devices. Anders mentions that security is a big concern when creating new devices and sensors in the DSS (digital service and solution) department, although they haven’t experienced any security issues so far. On the other hand, Anders acknowledges it as a major issue to take in consideration "This fleet service is very old, it’s like 7 years old right now. And the sensor and the gateway are not secured at all.”

4.4.3 Compatibility

This subcategory will cover the compatibility of Husqvarna devices with other brands and with its older versions. According to Anders the sensors connected to the operator is a magnetic device, so it works with Husqvarna products and also competitor machines, therefore backward compatibility is taken in consideration when designing and manufacturing new Husqvarna fleet devices.

The organization’s vision regarding compatibility is as follows, Husqvarna cannot impose only their products, therefore the customers have a fleet of various devices. Anders was addressing the devices created by different vendors as alien machines. Obviously Husqvarna cannot offer the same interoperability
between their sensors and alien machines, as it offers among its own devices, but Husqvarna still wants to provide the best service possible and help its customers. This can be done by introducing compatibility with the alien machines and backward compatibility with an older legacy system or hardware.

4.4.4 IoT approach

This section covers the IoT approach applied by Husqvarna Group. The types of approaches are based on Eisenmann et al. (2008) research work (Figure 6). According to Anders, everyone is allowed to purchase Fleet service products. Although there is one geographical restriction, as of now Husqvarna has around 10 markets, mainly located in Europe. It cannot be bought in Africa for instance. Husqvarna is closed when it comes to the supply side user. The devices and software are developed by Husqvarna Group. The platform provider is in house as well. The IP rights also belong to Husqvarna Group.

Anders also shared what could improve the IoT approach applied in Husqvarna. According to him communication between devices is the essential factor. Creating some sort of mashed networks, where devices from different vendors could communicate, would be the perfect solution. “I think we need to work more there. We need to be more connected.” If someone approaches with their mobile phone to the auto mower and it supplies with internet connection, the smartphone can start working as a gateway for that device.

So, in order to have a fully functional IoT environment, interoperability must be taken into account. And it doesn’t apply only to Husqvarna, the whole industry should be more open.

Anders also pointed out the importance for different departments to be on the same page and have the same vision. As of now, there is a struggle between the product team and the DSS (digital service and solution) department. DSS tries to enable things in a different way, adding new features and devices. But the product team wants to build cheap things and have more profit. Basically, product team sees costs and DSS sees possible income.

4.4.5 Internet of Things

In this section will be presented opinions of the interviewees about Internet of Things in general. When asked what is the biggest risk associated with IoT, Anders looked at this question from two perspectives. From the client perspective, the biggest concern would be the privacy and also to make the user acknowledge the data they are sharing and what is it used for. From the organization point of view, a concern is the big range of standards applied for certain markets. Thus, if talking about Husqvarna Group, which operates in several markets, confirming with every rule and standards can represent an issue. Therefore, a set of common rules and standards applied to IoT environment would be recommended.

As stated by Anders, IoT is very important for the organization itself and the DSS (digital service and solution). Even the CIO of Husqvarna Group stepped down from his position in order to work on the new digitalization strategy, which covers future IoT directions of the company. According to Anders “So it’s a lot of focus in Husqvarna. We are an old company selling products, but when it comes to services, we are quite young. Just started. We have a journey in front of us.”

4.5 Consultant on back end issues at Cybercom

Tobias Wahlstrom is a consultant at the company called Cybercom. He focuses on back end issues, infrastructure and architecture. According to them Cybercom is an innovative IT consulting company enabling companies and organizations to benefit from the opportunities of the connected world and to enhance their competitiveness. Husqvarna Group hired several consultants from Cybercom in order to work on the Gardena’s division project called Gardena Smart System.

Tobias has been working on GSS (Gardena Smart System) project from the start. The first lines of the code were actually written by him. Although this is the first IoT project Tobias is working on, he has experience in other IT related projects, for example prior to that he was working on a e-locker project.
According to the interviewee there are several back end developers, one dedicated tester and one dedicated developer. Currently the team is merging with a team from Switzerland. Marcel Mueller, who will be interviewed later, is currently leading the project from the IT perspective.

4.5.1 Communication

The communication model used in GSS is Device to gateway, afterwards the gateway connects through VPN to one back end and there some caching is done and transported to the company's back end, so the organization receives a flow of events. The communication protocol used for the Smart Garden solutions is Lemonbeat. A protocol created by a German company called RWE.

As stated by one of the RWE representative “Lemonbeat is the answer: we have created a generic, easy to use language for IoT-devices, suitable for multiple industries and geographic regions, and have now opened it up (our application layer has been presented to W3C as the basis of a possible standard). We offer the necessary hard- and software solutions to assist companies and quickly implementing Lemonbeat within their devices.”

As of now, Lemonbeat support only some frequencies and although it still is a proprietary protocol and the customers have to pay the license fee, RWE is trying to make it an open standard of communication between IoT systems.

4.5.2 Security

According to Tobias, security is a big concern for GSS (Gardena Smart System). The department looks at the security perspective all the way from devices up to the system and gateways. As a proof of that, Tobias described how new standards are used for communication in between devices. Standards like IPv6 is used on the device level (Device to gateway). Although the communication between the gateway to data center is based on IPv4, the connection is smooth because a bridge from IPv6 to IPV4 is used.

Hence, security is well covered. GSS even got a second party consulting company to describe their system and find if there are any wick points within their IoT system. For instances, if a user communicates with GSS API, he is locked down to a specific IP address, so even if someone is eavesdropping, they cannot use the information unless they have the key. So, according to Tobias “So we try to lockdown, but still we try to offer the usability to the end user.”

4.5.3 Compatibility

When it comes to compatibility, GSS uses an adapter so it’s devices could communicate to other IoT systems. One of the initial requirements was for the GSS hardware to be able to connect with different IoT devices from other providers. Lemonbeat stack allows that. It includes a state machine which has the role to check new devices and allow their communication with a common gateway. Another great future of the Gardena hardware is that even if you cut the battery power the devices will still work in offline mode.

In Tobias words” From a back end perspective, it’s a generic way to express new logic and push down configuration. Even if online the system will continue to behave accordingly.”

4.5.4 IoT approach

The IoT approach applied in GSS is the same as the one applied for the whole Husqvarna Group. The demand-side user is open, meaning that there is no restriction for users, anyone can buy the GSS hardware. The supply-side user, as of now is closed, but GSS haven’t market it a lot. Therefore, the department wouldn’t be against of second parties’ companies who want to develop apps for the GSS hardware. The so called platform provider, hardware provider in our case, is Husqvarna Group exclusively. The IP right belong as well solely to Husqvarna Group.
4.5.5 Internet of Things

When asked which factor will accelerate the most the benefits of IoT, Tobias said that one thing would be creating standards for keeping down the number of gateways required in a household. Also the interviewee mentioned that Husqvarna Group should focus in the near future more on IoT, because of constantly increasing competition and the market value IoT will reach.

Also, when it comes to IoT devices, the battery life is a crucial factor. Tobias works with Lemonbeat and it has an offline mode, therefore from an IT side you can add new behaviors. As a result, the system will work in offline state, going to be more and more connected, that might add value as well. Tobias brought up a scenario as an example “If you are on vacation and have no connection, you would like for your garden and the devices in it to behave”.

The offline behavior is a big concern. IoT assumes connection at all time, but what about the behavior of the system and of the devices in the offline mode. Offline mode should be taken in consideration always because of geographical restrictions, for instance regions where there is slow connection or no network at all.

4.6 Back end developer at Cybercom

Oskar Christensson is a consultant with Husqvarna Group. He is employed by Cybercom, the same as the previous interviewee. He is a consultant in the Smart Garden project, working with GSS (Gardena Smart System) division.

He has been working with Husqvarna Group for a year and a half and in Cybercom for two years. Prior to that Oskar was working in the German automobile industry related to IoT as well. The consultants main job is to establish and create Smart Garden solutions and they have been doing this for 2 years now. The focus of the team is the backbone of the system. The task is to take the data created by sensors and every event created by the devices and transform it to customer values. So, the team’s work is in the middle layer between the client facing app and the IoT system.

The team is formed of 5 people. But there are also subprojects within this team, therefore there are also devices team, administrations teams and support teams. All together there approximately 40 people working on the Smart Garden solutions project. Currently merging with a team from Switzerland.

4.6.1 Communication

Like the previous interviewee, Oskar said the communication model is device to gateway. The communication protocol is Lemonbeat. To be more precise over 866 MHz frequency, so it’s not using regular Wi-Fi. As presented before, Lemonbeat was developed by a German company called RWE. Although Lemonbeat covers several frequencies, the Smart Garden solution is using data on 866 MHz frequency. The internet standard used in GSS is IPv6.

4.6.2 Security

According to Oskar security has always been a big concern. If talking about Lemonbeat stack, it is quite secure, when it comes to encryption between devices and gateways and also acknowledging that each event is sent. On the GSS side the user information is not stored, except an ID reference.

Oskar also shared what are some of the practices to make IoT devices more secure:

- Hardware – there are standards that companies should align to when developing devices. There are also standards when it comes for communication protocols that organizations must comply with.
- Software – when it comes to coding, there are OWASP guidelines that developers must conform with. Basically, OWASP is a generic coding style guidelines for security and privacy.
From a user perspective, when it comes to IoT systems a big quantity of data is collected. That of course is done because of the business value it represents. The organizations are aiming to offer the best user experience possible and that can be done by collecting data and finding behavioral patterns. The critical part is that the customer needs to acknowledge the data that is collected and accept it. As stated by Oskar “So this has been a discussion within the Smart Garden project for a while.”

When it comes to GSS, they handle it by just having ID references, so in case an ID reference is removed or if the master data gets removed, then the ID reference is not pointing to anything that exists anymore. As claimed by the interviewee. “You can never be 100% secure. But you can make it harder for security breaches to happen.”

4.6.3  Compatibility

Compatibility is important for GSS, since it has several systems which should be able to contact each other. According to Oskar” So this version A works with this version B, and this version B works with this version A, and this is a process in itself. This is a very big process and it needs to be a master data, what version works with what version.” The system within GSS is actually build in a way that they can handle and translate between multiple types of versions of client and different type of IoT devices on a specific backend. The division can even handle multiple different IoT backend. Therefore, GSS has a generic receiver part that can take data in one format and translate it into the required format.

4.6.4  IoT approach

When checking with the platform-mediated network theory proposed by Eisenmann et al. (2008) , GSS is open only on the Demand-Side User segment and the rest three roles, Supply-Side User, Platform Provider and Platform Sponsor are closed.

As of now GSS is a closed system. Oskar argued that he would also recommend an open approach and open standards, so everything can connect to each other. “I think you can create a lot of nice things but in the end, as Tesla did with the patterns, they were like "Ok, we have a nice thing, here everybody use this and let’s go to Mars.”

4.6.5  Internet of Things

When asked about IoT, Oskar had a different perspective then others. “I think that IoT is bad.” Oskar specified what he meant. According to him we can witness now a feature rush within the Industry today. In some cases, it results in features or products that are useless and not safe. Companies are rushing for more features in their devices, because in the best case scenario it results in more sales, therefore more profit.

The negative side is that manufactures don’t spent a lot of time to do tests or not a lot of time to standardize the ways to work with security in IoT. It doesn’t seem to be an issue for Gardena Smart System, as security is a big concern.

As stated before the biggest risk associated with IoT is the feature rush. The only way to avert this, is to create some sort of open standards and organizations would align with. Feature rush has advantages of course; the constant developing technologies is one them. But, organizations have to keep in mind that the products created by them have to be secure and qualitative.

According to Oskar, the IoT industry should slow down. There are already so many devices and the cost for them is already so low. The cost for creating a sensor is really low, so it’s not about costs anymore. The main feature the organizations should focus on is interconnection. As concluded by Oskar it’s crucial “To make sure that all the devices can connect, even though one device might not be able to talk Bluetooth, but it should be able to communicate through some intermediary gateway or some kind of translator”.

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4.7 Gardena Smart System’s Head of software development

Marcel Mueller is the head of software development of Gardena Smart System. According to Marcel, Gardena is organized in four categories. The first three categories are producing watering and handheld tools. The fourth one is Gardena Smart System with a focus into the IoT space.

Prior to that, Marcel was a part of a company called Kubaci, which is an IoT start up that was founded five years ago and based in Zurich. The company was purchased by Husqvarna Group about a year ago. So, the interviewee has been working with Husqvarna since July 2015. He has been in charge of the software developer team responsible for the smart system.

Before Kobaci, Marcel was creating banking software, like risk management tools for banks and financial institutes. Afterwards, he decided to make the shift to an IoT organization, because “I think one motivation was to work on some tangible product, something that at the end you can take in your hands, also see it in the stores.”

The team’s work is both task and project oriented. Gardena already has released products, but they also have three more products in the pipeline right now and these products are kind of projects where several team are involved, from design and production, manufacturing, sourcing, but also software and hardware. Then there is Gardena Smart System on the market, which is always improved. Therefore, the team is both task and project oriented.

The team for the Smart System is consisted of about 10 individuals, 5 of them being full time employees and other being external consultants from a Swedish company called Cybercom. Gardena Smart System started probably 18 months ago being build, most of that work was done in Sweden, by the Smart Garden IT team, which was mostly external consultants.

4.7.1 Gardena Smart System products

It is called Smart System for a reason. Gardena uses system as they can always add new devices and features. It is smart because it has a common connector that make the devices work together. The future direction might be actually called The Garden of the future. The devices are focused on outdoors, customer’s terrace and garden.

In 2016 the division released 3 products. Currently those 3 products, the water control, the mower and the sensor can be controlled remotely. As of now, the devices don’t interact directly with each other, only through the gateway, but it is one of the goals. According to Marcel “As a mid-term goal Smart Watering is something Gardena wants to achieve and something that moves away from having the responsibility of when and how long to water. We want to take that responsibility into the system and have common garden knowledge and code it in the system so that even users who don’t have that garden knowledge can have a better watering happening in their garden.”

4.7.2 Communication

The communication model used in these products are device to gateway. The internet standard used is IPv6. The communication protocol is Lemonbeat. Like stated previously, the devices could talk to each other, but currently they communicate with the gateway. The team is also taking in consideration offline mode. The devices should run without internet connection as well, based on a previous programmed schedules.

4.7.3 Security

As stated by others interviewee, currently there are security reviews conducted by external companies, but Marcel is not a part of that team, therefore he did not have knowledge or facts about the result of that analysis.
4.7.4 Compatibility

Compatibility is one of the features that GSS is constantly trying to improve. As confirmed by Marcel “The system should expand and it has to be compatible.” Therefore, the IoT systems should shift to new common standards, because the users no longer want to have a gateway per system or per provider, they want higher integration without restrictions. Another concern for GSS would be to remain backward compatible. Even if the division does a major shift to new devices, they cannot afford not to be backward compatible.

As a result, GSS wants a bit more semantical rich interoperability, an example could be Apple HomeKit. That’s an approach that shows a higher capability level in IoT devices, where a developer can write a generic client that would allow to manage devices from different vendors.

4.7.5 IoT approach

Right now, Gardena Smart System follows a walled garden approach. Not necessarily as a set strategy, but rather as a first step. It is only open on the Demand-Side user leve. Lemonbeat, the communication protocol, is being currently standardized and that’s nothing GSS would be afraid of or try to prevent. Marcel concluded “So from that perspective I thinks it shows that we don’t want to be a closed system. So we are happy if more products start supporting this Lemonbeat, because only if you have a certain mass your system has a chance to survive. So that’s why it’s probably trying to open up, because really fully closed won’t survive.”

The future IoT directions for Husqvarna Group and Gardena Smart System should be investment on the server side. Creating a proper garden knowledge base, would help in creating a system that can offer expertise related to gardening. That way, the user can broaden his knowledge and become a better gardener.

4.7.6 Internet of Things

When asked what would be the biggest risk associated with IoT, Marcel answered with creating a product that doesn’t really add value and has no practical use. As explained by the interviewee “I mean everybody does something connected right now, but we really don’t know if that is a need of a bigger population. Which is try out a lot of things and you’ve might of build a product that there is no real need for that.”

First step in order to accelerate the benefits of IoT, would be to have communication standards. That a user could have one device per household and everything would connect to it. Also, an application standard that would result in higher interoperability, so the user wouldn’t need to access different apps for various devices. This can help for the devices to interact in a smart way.

5 Analysis

In this section, the analysis of the results is conducted. This was done by responding to the research questions and comparing patterns established in the case study and the ones in literature review.

5.1 IoT approach applied in Husqvarna Group

*RQ1: What IoT approach is currently applied in Husqvarna Group?*

In order to answer the first research question, the author looked into various segment of Internet of Things within Husqvarna Group. To be more precise we will focus on the communication model, security and compatibility. All of them being crucial parts of a fully functional IoT environment.

The first step was to find an appropriate model in literature, that would describe the approach of an organization towards IoT. The author chose the Platform-mediated networks approach(Figure 6) introduced by Eisenmann et al. (2008). There are so called Platform-mediated networks and these platforms include several different types of participants like end users, supply side user, platform providers
and platform sponsors. This approach can be easily adapted to any platforms or IT organizations. Thus, an organization can see how open they are with respect to all four roles. When the interviews were conducted, Husqvarna Group’s employees found it easy to apply this approach and its roles to their organization. Therefore, it was easy for them to see if Husqvarna Group adapts an open or closed approach.

5.1.1 Communication Model

In seeking to understand Internet of Things and which approach would benefit the most an organization, we must find out which communication model is used in a certain organization.

In the interviews there were employees and consultants hired by Husqvarna Group, which were working in various divisions with different targets. Although the interviewees were from different teams it helped a lot in creating an overall picture of how Husqvarna Group operates. Anders is a part of Husqvarna Fleet Service Team and they develop products for professional customers (b2b). Tobias, Oskar and Marcel are employees and consultants working on GSS (Gardena Smart System) project, focused on b2c clients.

Like the author mentioned before, although they work on different products, all of them agreed on the same communication model used currently by Husqvarna Group and it is Device-to-Gateway model (Figure 4) introduced by (Arkko et al. 2015). The only difference are the names of used protocols. In Husqvarna Fleet Service the used protocol is called J2, a proprietary protocol, and it uses IPv4, while GSS uses Lemonbeat protocol and IPv6 standard. The major difference between them is, as of now there is no direct communication between the gateway and the sensor when it comes to HFS (Husqvarna Fleet Service) products. While, every device and sensor in GSS can communicates to the gateway. Anders from HFS acknowledges that it is an issue and they have to improve their communication protocol in order to keep up with the emerging technologies.

As stated before J2 is a proprietary protocol developed in-house, while Lemonbeat has been developed by a German organization called RWE and they are putting a lot of effort in making it an open standard of communication between IoT systems. Holler et al. (2014) point out the importance of open communication between sensors, electronic tags and other devices in the physical world.

5.1.2 Security and privacy

As explained by Perera et al. (2015) Internet of Things “enables data collection on a large scale”, while the extraction and manipulation of this information can lead to privacy issues and security breaches. The interviewees agreed on how important security is when it comes to big data and that is the case of IoT. According to Tobias and Marcel, Husqvarna Group has even hired an external consulting company to perform a security test, in order to see if there are any weak points. Anders puts the focus on security as according to him the fleet service has been around for 7 years now, and it might be able to resist to a security breach. On the other hand, Oskar a consultant within Husqvarna Group came with solutions to that like, there are standards that companies should align to when developing devices and there are OWASP guidelines related to security and privacy that apply to software developers.

When it comes to users Oskar emphasizes on the importance of the user to acknowledge the data that it is collected and what it is going to be used for. That of course is done because it represents business value, but still the customer has to be informed and agree with what personal data he or she might share. Same ideas are determined by Golbeck & Mauriello (2016) who have pointed out that an average Facebook user has no idea or seriously underestimate the quantity of data they allow to be shared with third-party companies. As a conclusion, an organization who handles big data has to ensure a safe ICT infrastructure, which will benefit the users and provide value-added services.

5.1.3 Compatibility

Compatibility is seen as the most crucial feature of a fully functional IoT environment. According to Rose et al. (2015) compatibility can be seen from 2 perspectives, interoperability is the propriety of IoT devices to connect and communicate to alternative devices or systems smoothly. And the second one is backward
compatibility, it refers to device or entire systems that can interact with previous versions of the same system or alien systems. When analyzing the results of the interview same patterns were found as in literature, the interviewees were looking at compatibility from the previous presented perspective.

According to Anders, back end developer, the sensors developed within HFS (Husqvarna Fleet Service) do communicate with previous released products and competitor machines as well. Obviously Husqvarna cannot offer the same high interoperability between their sensors and alien machines, as it offers among its own devices. When it comes to GSS (Gardena Smart Solution) division, one of the initial requirements was for the hardware to be able to connect with different IoT devices from other providers. It was accomplished by using an adapter so GSS devices could communicate to other IoT systems. This adapter can handle and translate between multiple versions of clients and devices on a specific backend. Besides that, the communication protocol used on GSS devices, called Lemonbeat, which includes a state machine which has the role to check new devices and allow of possible their communication with a common gateway.

5.2 Walled garden approach

RQ2: What are the advantages and disadvantages of Walled garden approach?

Concerning the second research question, the author will provide facts and patterns from literature and will compare them with the results from the interviews with Husqvarna Group.

As stated before, a walled garden represents a system where the manufacturer or the service provider has control over applications, content and media and also restricts the non-approved content to reach the user.

Kärger & Siberski (2010) look at walled gardens from Social Networks perspectives. Although a walled garden approach offers great privacy for the user, the privacy options of social web applications are restricted and has pre-designed categories, either of objects or people who could access it (Figure 7).

![Figure 7. Example of categories in the privacy settings of social networks. Facebook (upper left), Orkut and Skype (right) (Source: Kärger & Siberski 2010)](image)

According to the authors the biggest issue is that social networks hide privacy information behind so called “walls”. As it can be seen the user data is enclosed in proprietary silos and this is addressed as the “Walled Garden” of the Social Web. The authors explain how important it is to implement some type of an open standard for social networks. When interviewing the back end developers of Husqvarna, majority of them mentioned how crucial it is to create open standards for communication and security, in order to assure a fully functional IoT environment. According to Oskar, consultant for Husqvarna Group, a walled garden is currently more secure, but it doesn’t offer the freewill for the users to decide which devices to use. As it can
be seen, although different segments of IT, Social Network and IoT face the same issues and dilemmas when deciding which approach do apply.

Mehra (2011) argues that a “Walled garden” can be an innovative environment and refers to iPhone example. Although it is considered as a closed platform, it creates great user experience and user dynamism. One of the interviewees, Anders, a back end developer for Husqvarna Fleet Service team, mentioned although their sensors do work with alien devices, it doesn’t offer the same interoperability as in-between their own devices. Therefore, an advantage of a closed platform is that the in-house devices are easier to be handled when it comes to working processes then it would be with devices from different vendors.

Netanel (2007) discusses how Digital Rights Management (DRM) can be used to build the “fences” for a closed platform. DRM is seen as the solution to handle and protect access over digital content. The author focuses on the Apple-AT&T walled garden approach, which made iPhone and iTunes be attainable solely to AT&T customers. If singing the contract, the user would be locked with AT&T for at least two years. The author warns of the possibility that various mobile carriers might apply the same approach and in order to prevent that, the author suggests open and common standards. For mobile industry, the Open Mobile Alliance’s DRM standards should be applied to insure “service interoperability across devices, geographies, service providers, operators, and networks, while allowing businesses to compete through innovation and differentiation” (Watson, 2003).

The same can be applied to IoT environment. According to one of the consultant with Husqvarna Group, in order to create interoperable devices, organization should align to. For example, standards when developing devices and there are OWASP guidelines related to security and privacy that apply to software development.

### 5.3 Benefits of open platform approach

**RQ3: How can an open platform approach benefit Husqvarna Group?**

Eisenmann et al. (2008) described a platform as being open when:

- there are no constraints whatsoever applied to the design, marketing, retail or use processes.
- there is no discrimination when it comes to technical standards and paying licensing fees. They are the same for all participants.

Bonaccorsi & Rossi (2003) analyze in their work the Linux kernel as an open platform scenario that became a great success. According to the authors an open platform approach success is based on collective action of the community and their motivation. The open source community proved that there is another way to do things and that in the case of open software the word “free” shouldn’t be received as in “free beer” but as in “free speech”. Anders, a back end developer with Husqvarna Group, mentioned collective action too, as a key factor for the company to succeed. In other words, there are teams within Husqvarna Group who focus on costs and there are teams that try to enable things in different way by adding new features and devices.

Välimäki & Oksanen (2004) talk from the operating system software perspective as well. The authors claim that open source have modified the market in recent decades. Before that, Microsoft was a monopoly on microcomputer operating systems. While today, all organizations have applied an open approach into their strategy in one way or another. Marcel Mueller, the head of software development in GSS (Gardena Smart System), acknowledges that as of now the organization follows a “walled garden” approach and not necessarily as a set strategy, but rather as a first step. He claimed they do not want to be a closed system and a proof to that is Lemonbeat. Lemonbeat, the communication protocol, is being currently standardized and that’s nothing GSS would be afraid of or try to prevent. Therefore as stated by Välimäki & Oksanen (2004) each organization is applying an open approach in one form or other.

Other authors look at this matter from the organization point of view and the advantages it has. For example, Boudreau (2010) claims that “opening a system to complementary development plausibly affects innovation by drawing on diversity”. Diversity means a greater knowledge base, impartial methods of work and product selection. Of course a crucial factor is how motivated are third-party companies to contribute
to the final product. Oskar, Cybercom consultant working for Husqvarna Group, also recommends an open approach and advises organizations to follow Tesla Motor’s example. Once a great product is created don’t surrounded with “fences”, open the system and collaborate with patterns to achieve innovation and create exceptional things.

5.4 Conclusion

The data presented in the analysis can be summarized as follows:

- Although Husqvarna Group has four divisions, the communication model applied is the same, Device-to-Gateway model (Figure 4). The only difference are the communication protocols. HFS (Husqvarna Fleet Service) uses a proprietary protocol, developed in-house, called J2. While GSS (Gardena Smart System) uses Lemonbeat protocol developed by a German organization.

- Husqvarna Group take security and privacy very serious. The organization have hired external consulting company to perform security test in order to avoid security breaches. Some of the employees still see space for improvement, as some technologies have been around for almost a decade without significant improvement when it comes to security and privacy.

- When it comes to compatibility, not all divisions in Husqvarna Group are on the same page. Husqvarna Fleet Service sensors do communicate with competitor machines, but the interoperability is not as high as with their own devices. While for GSS, one of the initial requirements was for the hardware to be able to connect with IoT devices from other providers.

- The interviewees all agree that as of now Husqvarna chose a walled garden approach, but not as a set strategy. The employees mentioned how crucial it is to create open standards for communication and security. Also, standards like OWASP related to security and privacy that apply to software development.

- The teams within Husqvarna Group are not on the same page when it comes to creating IoT devices. There are teams who focus on costs and there are teams who try to enable things by developing new features and devices.

- The company does not want to be a closed system and a proof to that is the communication protocol used in GSS. Lemonbeat protocol is being currently standardized and Husqvarna Group is not trying to prevent it from happening.

- Open platform approach is seen by the employees as the way to diversity, therefore innovation and this will result in better and more secure products.

6 Discussion

6.1 Result Discussion

The goal of the thesis was to clarify the crucial elements of Internet of Things, and why it had reached the height of its hype (Figure 1), making IoT a Global IT trend. Also to investigate the existing IoT approaches and how they can benefit an organization.

In the theoretical framework of the thesis, several model were introduced. The communication model introduced by Arkko et al. (2015) and Platform-Mediated Networks introduced by Eisenmann et al. (2008). The models presented good applicability for the case study. Some of the question of the interviews were formulated based on the models.

Considering the second and third research questions, the literature review provided great insights to IoT environment and prior examples of IT companies that had already applied a certain approach to the way they conduct their business. This examples were discussed with some of the interviewees and came to the conclusion that an open approach concerning IoT is preferable.
6.2 Methods Discussion

The case study approach demonstrated to be a suitable choice. The data collection was conducted through methods like interviews and artifacts, like the Annual report 2015 of Husqvarna Group. Construct validity was assured by the use of multiple sources of evidence. Also, as stated earlier the final version of qualitative content analysis was forwarded to the respondents, in order to ensure the accuracy and relevance of the gathered data.

The interviews were conducted with managers, back end developer and consultants within various divisions of Husqvarna Group. Although the managers and the employees had different perspective sometimes due to their position in their company, the results were almost similar. The majority of the information was gathered from one organization, so the risk of a biased prospect might appear, but taking in consideration the interviews were conducted with Husqvarna Group employees and consultants hired by a third-party company, the risk wasn’t so high anymore.

6.2.1 Limitations

The main limitation of the case study is that no statistical generalization of the results can be made (Yin, 2003). The limited number of interviewees was limited, if taking in consideration Husqvarna Group has around 14,000 employees. Also a great benefit for further investigation would be an interview with the CIO of Husqvarna Group, which at that point was unavailable.

Related to construct validity, all guidelines suggested by (Yin, 2003) where followed, beside one, the author had no opportunity for field observations, as the interviewees were conducted remotely, either via Skype or via Google Hangouts.

6.3 Implications for practice and recommendations for Husqvarna Group

Even if the single case study does not permit generalization, it describes many Internet of Things practices within Husqvarna Group and its divisions. One of the division, in particular GSS (Gardena Smart System), has proven to be quite innovative with their solutions and it can represent an example for the rest of the divisions. One good example would be that GSS’s initial requirements was for the hardware to be able to connect with IoT devices from other providers, therefore creating interoperable devices.

As the data was collected from only two divisions out of four, the author would recommend Husqvarna Group to conduct a companywide survey about IoT practices and approaches in order to get a better overview of the current state. Finally, the role categorization in Platform-Mediated Network introduced by Eisenmann et al. (2008) can help managers better acknowledge the organization’s position towards their customers, supply-side users and platform providers when it comes to their IoT approach.

6.4 Future Research

Potential aspects for further research are listed below:

- The Husqvarna Fleet Service has been developing in-house communication protocol. It would be interesting to observe the shift to a more open protocol, as for example Lemonbeat, and analyze how this shift will affect the following versions of products.
- Investigate the influence of upcoming Internet of Thing trends on the company and how the Husqvarna Group’s IoT approach and strategy would be affected.
- If Husqvarna Group will decide shifting from a walled garden approach to an open platform approach, then it would be interesting to examine which strategy will be adopted. Either it will be applying interoperability, licensing new providers or broadening sponsorship.
- In case external factors will emerge, like open standards for communication and security, then it would be appealing to investigate how fast Husqvarna Group can respond to that and adapt to new rules imposed by IoT industry.
7 References


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8 Appendices

Appendix 1: Interview questions

1. What is your position in the company?
   a. To whom are you reporting the progress of your department/company?
   b. Is your work more task or project orientated?
2. How long have you been working here?
3. Why have you decided to focus your work on the Internet of Things?
4. Can you describe what is the main job of your department?
   a. How many employees are in your department?
   b. What do the devices and sensors, created by you, do? What is their purpose?
   c. Which communication model you use in your devices?
      ● Device to Device model
      ● Device to cloud model
      ● Device to Gateway model
      ● Back end data sharing model
   d. Which communication protocol you use?
      ● Bluetooth, Z-wave, ZigBee or your own created.

Security
5. Is security a concern when creating new devices and sensors?
   If yes:
   a. What do you think are the sets of best practices to use to design IoT devices to make them more secure?
   b. What training and educational resources are available to teach engineers and developers more secure IoT design?

Privacy
6. Could you describe the end-to-end process according to you? How do you think is the consumer handling these processes?

Interoperability
7. What are the standards (such as the Internet Protocol suite) that you use as building blocks for IoT devices and services?
8. Are you taking into consideration backward compatibility when designing new devices?
9. How do you think, what resources and standards are required to support the evolving needs of IoT? Given the importance of cloud-enabled services to the Internet of Things, what are the challenges related to cloud-to-cloud interoperability?
10. In your own opinion what is the biggest risk associated with the Internet of Things?

Walled garden approach (represents a software system where the manufacturer or the service provider has control over applications, content and media and also restricts the non-approved content to reach the user) or open platform?

10. Which approach do you apply? Why?
11. According to Platform-mediated networks theory, how open or closed are you with respect to the four roles?
Platform-mediated networks encompass several distinct types of participants, including end users, complementors, platform providers who facilitate users’ access to complements, and sponsors who develop platform technologies.

<table>
<thead>
<tr>
<th>Role</th>
<th>Participant 1</th>
<th>Participant 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand-Side User</td>
<td>Husqvarna</td>
<td>Combiq AB</td>
</tr>
<tr>
<td>(End User)</td>
<td></td>
<td>(Husqvarna’s supplier of sensors)</td>
</tr>
<tr>
<td>Supply-Side User</td>
<td>Closed/Open</td>
<td>Closed/Open</td>
</tr>
<tr>
<td>(Application developer)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platform Provider</td>
<td>Closed/Open</td>
<td>Closed/Open</td>
</tr>
<tr>
<td>(Hardware/ OS Bundle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platform Sponsor</td>
<td>Closed/Open</td>
<td>Closed/Open</td>
</tr>
<tr>
<td>(Design &amp; IP Rights owner)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) demand-side platform users, commonly called “end users”;  
2) supply-side platform users, who offer complements employed by demand-side users in tandem with the core platform (parties that can offer a compatible software application);  
3) platform providers, who serve as users’ primary point of contact with the platform (manufactures and distributes);  
4) platform sponsors, who exercise property rights and are responsible for determining who may participate in a platform-mediated network and for developing its technology.

12. What factor would most accelerate the benefits of the Internet of Things?  
13. What are the future IoT directions for your company?  
14. Do you want to add something or mention about IoT in your company?
Appendix 2: Husqvarna Group management structure
Reference: Husqvarna Group Annual Report 2015

Appendix 3: Husqvarna Division
Reference: Husqvarna Group Annual Report 2015
Appendix 4: Gardena Division
Reference: Husqvarna Group Annual Report 2015

Appendix 5: Interview 1 – Husqvarna Group – Husqvarna Fleet Service
- Meaning units removed -

Appendix 6: Interview 2 – Husqvarna Group – Cybercom consultant company
- Meaning units removed -

Appendix 7: Interview 3 – Husqvarna Group – Cybercom consultant company
Oskar Christensson/ Back end developer - 22.04.2016
- Meaning units removed -

Appendix 8: Interview 4 – Husqvarna Group – Gardena Smart System
Marcel Mueller/ Head of software development – 23.04.2016
- Meaning units removed -