Master Thesis

Value creation in activity tracker platform-ecosystems: an analysis of Fitbit and Apple Watch

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Executive summary

Activity trackers are rapidly gaining popularity and offer the potential for generating valuable health data and to enable citizens to participate in their own care. However, users are reportedly losing interest in the devices after a few months. These high abandonment rates indicate that users do not perceive the value that is created by the activity tracker as sufficient. This study aimed to find out how platform leaders' strategy on openness impacts the creation of network effects and therefore value creation in the activity tracker ecosystem. To do so, case studies on the Apple Watch and Fitbit ecosystems were executed. Value in ecosystem is created by the complementors that surround and create additional products and services to the platform product. It was found that although the value networks of the two platform leader companies look largely the same, there are differences in strategy that impact the various network effects. Strategy on openness was analysed toward four distinct ecosystem roles; demand-side users, supply-side users, platform provider and platform sponsor. Where the differences in strategy were on the demand-side user and hardware supply-side user. It was found that the closedness of Fitbit towards hardware suppliers had negative impact on network effect. The second finding is that despite the closedness toward demand-side users of Apple, they still manage to create network effects to create value in their ecosystem.

In order to create a theoretical base for the thesis the literature of value creation in ecosystems, platform-ecosystems, platform network effects, platform openness, ecosystem roles, and value networks were explored. For the case studies data was gathered through secondary sources like magazines and news articles. To enrich the data found through this desk research, 9 interviews were held with industry experts. After the data gathering, the first step in this research was to write down the cases in narratives and map the value network to understand which actors are present and the activities they perform. From this process became clear on which complementary roles were taken in-house, how network effects manifest in the ecosystems and to which roles the platform was opened or closed.

Keywords: Platform-ecosystems, activity trackers, value creation, network effect, openness, platform leader strategy, value network

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Core definitions

Smart Wearable	A device containing advanced circuitry, wireless connectivity and at least a minimal level of independent processing capability (Smart) that must be worn on the user's body for period of time, enhancing the user's experience (Wearable) (Chen & Shih, 2014).
Activity tracker	Devices within the smart wearable definition that allow the user to track activity, exercise, sleep and more in real-time and which are worn around the wrist.
Ecosystem	An economic community supported by a foundation of interacting organizations and individuals (Moore, 1993).
Platform-ecosystem	Products, services or technologies developed by one or more firms, and which serve as foundations upon which a larger number of firms can build further complementary innovations in the forms of specific products, related services or component technologies (Gawer & Cusumano, 2014).
Platform leader	Drives industry wide innovation for an evolving system of separately developed pieces of technology (Cusumano & Gawer, 2002).
Openness	The extent that there are fewer restriction on participation, development or use across the distinct roles within the ecosystem (Eisenmann et al., 2009).
Network effects	Positive feedback loops that grow exponentially as the adoption of a platform grows and more external adopters in the ecosystem that create or use the complementary innovations making the platform more valuable (Cusumano, 2010).

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1. Introduction

Smart wearable devices have enabled their users to adopt a quantifiable lifestyle, by allowing them to track information about food consumption, sleep patterns, heart rate and stress levels, blood chemistry, moods and menstrual cycles amongst other things. Smart Wearables (from this point onwards: wearables) are defined as a device containing advanced circuitry, wireless connectivity and at least a minimal level of independent processing capability (Smart) that must be worn on the user's body for period of time, enhancing the user's experience (Wearable) (Chen & Shih, 2014). Activity trackers are in this research defined as the devices within the smart wearable definition that allow the user to track activity, exercise, sleep and more in real-time and which are worn around the wrist. Within this definition both wristbands and smart watches are included. These devices allow the user to synchronize their tracked information to their phones or tablets via mobile applications, which makes it possible to track their progress. The data that is synchronized to the complementary phone or tablet devices are stored and visualized so that users can receive incremental feedback. The data can also be shared with other users on a social platform (Shih et al., 2015). Users can download various different apps that are offered by the activity tracker provider or by third parties that facilitate the possibility for visualization or sharing.

Activity trackers have the potential surpass smart phones and laptop computers in performance and hence can replace these technologies in the future (Mahdokt, 2017). Industry experts believe that the number of activity trackers shipped yearly will be almost doubled from 119 million in 2017 to 213 million in 2021, which concerns 80% of the total smart wearable market (IDC, 2017). Furthermore, activity tracker devices offer the potential for generating valuable health data and to enable citizens to participate in their own care. These aspects make it an interesting phenomenon to study because of the commercial potential.

Existing literature on activity trackers focuses mostly on the use and adoption challenges associated with technical- or device- related issues and respective work around strategies (Shih et al., 2015). This can be divided into two main subjects, the technical features of the product and research on high abandonment rates. The technical features of the product that are researched are for example like validity and reliability (e.g. Kooijman et al., 2015; Evenson et al., 2015). This stream of research is focussed on opportunities in the medical applicability of the devices in for example healthcare institutes. The other stream is on the commercialization of the product. Nowadays there is low consumer adoption and high abandon rates. While the popularity of activity trackers is growing, the ownership of such devices is very low (Patel et al., 2015). Multiple authors (e.g. Gilmore, 2016; Finkelstein et al., 2016) report that as much as half of the users who own an activity tracker reportedly lose interest after a few months. For the producers of the activity trackers, the initial value lies in the sale of the product. However, to create long-term value, the device must continue to be used on the long-term and drive health behavioural changes in the user. High abandonment rates indicate that users do not perceive the value that is created as sufficient and literature does not cover this issue.

While existing literature on activity trackers does not cover the topic of value creation, other comparable technologies where value is created by collaboration with other players, like the smart phone, are often studied in an ecosystem context (Kenney & Pon, 2011; Koch & Kersenbaum, 2014). The ecosystem literature covers the value creation logic where the integration and use of outside parties play an important role. Because little is known about the value creation in an activity tacker context, there is a need to deepen the understanding of the ecosystem for value creation by activity tracker platform leaders.

A trend of a shift away from independent success and towards a world of greater collaboration has

been noticed over the past two decades and is leading to companies becoming actors within a broader ecosystem (Adner, 2012). This means that value of activity tracker devices is determined by the network of organizations that exists around it (Gawer & Cusumano, 2002). Moore (1993) defines the business ecosystem as "*an economic community supported by a foundation of interacting organizations and individuals".* After the work of Moore (1993) the ecosystem concept gained traction, leading to the inception of various types of different ecosystems (Aarikka-Sternroos & Ritala, 2017). The type of ecosystem that is applicable in the activity tracker concept is that of platform ecosystems. This ecosystem is called platform ecosystem because of the network of interrelated and interdependent firms that form themselves around the platforms resulting in third-party platform extensions (Thomas et al., 2014). Platform-ecosystems are defined by Gawer & Cusumano (2002) as: *"A foundation technology or set of components used beyond a single firm that brings together multiple parties for a common purpose or recurring problem".* From this can be understood that In the platform ecosystem the emphasis lies on the multi-sidedness of the market and the impact the platform leader can have on the ecosystem (Aarikka-Sternroos & Ritala, 2017). Apple with its Apple Watch and Fitbit are the subjects of the study and are two platform leaders in the activity tracker wearable market. As platform leader their process of strategy has impact on value creation within platform-ecosystems, from which this research focuses on strategy on openness for the stimulation of network effects.

Little is known about the impact of strategy of platform leaders on value creation in the platform ecosystem in a activity tracker context. Therefore this work aims to analyse the ecosystem of two platform leaders in the activity tracker ecosystem; Apple and Fitbit. This will be done based on the value network theory. The analysis of the activity tracker ecosystems allows a view on the different strategies on openness of the platform leaders. From the value network can be determined how open the platform is as certain roles and activities were kept in-house and how this impacts how network effects are stimulated through the attracting of users and complementors. Two case studies were conducted based on secondary data from news articles, websites and magazines, combined with additional information extracted from expert interviews. The results present insights on the roles in the value network, and different strategic actions in terms of openness.

This is leading to the central research question of this thesis:

"*How does the platform leaders' strategy on openness stimulate network effects to impact value creation in their activity tracker platform-ecosystem*?"

This research contributes theoretically by creating a greater understanding of value creation in activity tracker platform ecosystems, by creating an activity tracker value network map, and identifying strategies regarding openness. This research gives a focused insights on the specific roles within the activity tracker wearable platform-ecosystem and differences openness strategy to create value, therefore contributing to literature on activity trackers as a platform ecosystem. As both activity trackers and platform ecosystems are gaining increasing interests in literature, this research could function as the basis of further research on these topics.
Understanding how value is created in platform ecosystems might also show relevance in a practical way for managers of platform leaders in the ecosystem, trying to manage and create value from their role in the ecosystem. A deeper understanding of how strategic actions influence the value network may give managers valuable information on how to be able to create long term value. This could create a handhold for managers in positioning their company within the market, and for mapping new opportunities. Ultimately this may lead to increased firm performance of better products though

enhanced knowledge of value creation in the ecosystem. As far as the author knows, no research on the ecosystem op activity tracker wearables is conducted before.

This master thesis proceeds as follows: in the theoretical framework in chapter 2 will be elaborated on value creation in platform-ecosystems, platform network effects and openness as value creating tool for platform leaders and the value network for analysing the various ecosystem roles. The third chapter contains the research methodology used in this research. The findings will be discussed in chapter four and chapter five the result will be discussed. The last chapter gives the theoretical and practical contributions, limitations and further research.

2. Theoretical framework

This section introduces how value is created in platform-ecosystems and how this relates to the empirical situation of activity trackers. To gain a more in-depth and detailed understanding of platform ecosystems, network effects and openness are discussed. These two dimensions are used for the analysis of value creations in platform ecosystems in case of activity trackers. In the second paragraph the theory about roles and value networks for analysing the business ecosystem will be introduced.

2.1 Value creation

According to Allee (2000) the question "how is value created?" is traditionally answered with "through the value chain". However, nowadays this notion of the value chain, which is rooted in the industrial age production line model, is being superseded by the new enterprise model of the value network or value web. This shift from value chain to value network was accompanied by a shift in perspective that the focus of value creation should be on cooperation rather than competition (Gadde et al., 2003). In other words, value should not be created by outperforming competitors but together with interdependent business partners. The capability to strategically position a product relative to an industry's competing forces have been considered vital in traditional strategy literature (e.g. Porter 1980). Traditional strategic positioning logic like cost leadership or product differentiation are based on a static perspective towards markets assuming clear industry boundaries and players. This view on strategy making has not been able to explain strategic conduct in markets where the environment is turbulent and evolving with an actor's strategic moves (Sambarmurthy et al., 2003). Current markets are becoming increasingly complex and dynamic because current business environments are in continuous flux. Therefore, one should think of markets and strategy on the system level rather than on the organizational level (Vargo et al., 2017). This system thinking is already reflected in the literature focussing on business networks. The value or business network refers to networks where value propositions are offered by a group of companies which are mutually complementary (Claysse et al. 2014**)**. Even though business networks is well suited for system thinking, it mainly considers close range actors and therefore neglects more indirect actors that contribute to the creation of value. To include more distant peripheral actors, that are essential in understanding, business ecosystems can be considered a valuable conceptual tool. According to Aarikka-Sternroos and Ritala (2017) business ecosystems can be considered an extra layer on top of business networks which "shows promise for examining management that spans value chains, networks, and industry boundaries" (p. 31). In the activity tracker ecosystem, various complementors play an important role in the value that is created the keystone player's initial offering. These peripheral actors do so by creating additional products and services for the end-consumer. Complementors do not lie on the direct path of value-creation (Adner, 2012), therefore value creation of activity trackers is researched in a business ecosystem context. The direct value creation path is seen as business partners where the focal actor can exert influence upon. More distant value creation actors are therefore the actors which can be influenced only up to a certain extent. For example, through app stores players can set rules for creating apps, but they have a limited influence on which apps actually will be created.

Ecosystems

The concept of ecosystems has originally been borrowed from natural systems. Moore (1993) stated that natural ecosystems were self-reinforcing systems that consist of different interdependent species and translated it to the traditional business domain. Moore (1993) stated that firms cannot innovate in a vacuum, rather they depend on other parties to collaborate with them. This collaboration goes beyond industries or traditional supply chains. Moore (1996) defined a business ecosystem as "*an economic community supported by a foundation of interacting organizations and individuals*" (p. 26). After the concept gained substantial traction, Moore (2013) summarized the development of the approach. He suggested that an ecosystem approach allows the investigation of *"a new form of organization that shows promise in achieving shared purposes, sharing value among many contributors and in bringing the benefits of technology to a range of people, cultures and problems far beyond what earlier systems have achieved"* (p.3). In an ecosystem, members deliver value to end customers as an interrelated system of interdependent companies rather than individual companies and is deviated from the traditional value chain model where firms follow a linear value creation process (Iansiti & Levien, 2004). Adner (2006) indicates that business ecosystems allow firms to create value that no single firm could create alone. In these ecosystems the cooperation value of the industry ecosystem is greater than the sum of the individual parts**.**

In literature various types of ecosystems are identified (Aarikka-Sternroos & Ritala, 2017), from which this research focuses om platform-ecosystems. Thomas et al. (2014) find in their literature review that platforms have been given a range of different meanings and within this literature stream they identify four main platform typologies; organizational, product family, market intermediary and platform ecosystems. The platform ecosystem typology is defined as a combination of two typologies, the product family and the market intermediary. To create a deeper understanding of the platform ecosystem, the two underlying concepts (i.e. product family and market intermediary) will be discussed before discussing the platform-ecosystem concept itself.

Platform-ecosystems

The *product family stream* typology refers to the platform as a stable common asset at the centre of a product family. The product family is a concept where products are focussed on a niche group of customers and designed for easy modifications into derivatives for market niches through the addition, substitution and removal of features (Thomas et al. 2014). Research of Gawer and Cusumano (2014) makes a distinction between internal and external platforms, where internal platforms are similar to the product family typology of Thomas et al. (2014). Internal platforms are mainly used in the context of new product development and are defined as incremental innovation around reusable components or technologies. There are also other works that define similar understandings of internal platforms to that of Gawer and Cusumano (2014) and Thomas et al. (2014). Other works often use the classification of product platforms. The work of Wheelwright and Clark (1992) describes the product platform as entailing more product and process changes rather than introducing untried new technologies or materials that lead to breakthroughs. These types of platforms offer improvements in for example cost, quality and performance over proceeding versions of the initial product (Wheelwright & Clark, 1992). These definition lead to the conclusion that the focus of internal platforms or product platforms often lies within single firms and encompass a set of functionalities or components that can be used across different versions of the product. An example of the product family stream are the Nespresso coffee machines. Nespresso has a lot of different sorts of coffee machines, which all include a water compartment and are able to make a cup of coffee. However, the coffee machines have various different designs and prices ranges to be able to serve various market segments.

In the *market intermediary* stream typology, the platform acts as an interchange between multiple markets. Through its product or service architecture the platform leverages one or more markets so that the platform owner profits from additional value created through market intermediation (Thomas et al., 2014). These platforms are also called multi-sided-platforms in for example the work of Evans

(2003). He describes multi-sided platform markets as markets that have two or more interdependent customer groups and need both these groups on board of their platform for their business to succeed. An example of this platform type is the company Airbnb, which connects home owners to tourists or travellers, letting the home owners rent out (a part of) their homes to tourists or travellers. Another commonly used example in literature is that of videogame consoles who connect video game developers to video game players (Evans, 2003). He states that multi-sided platforms can exist when three conditions are met; 1) there are distinct group of customers, 2) a member of one group benefits from having his demand coordinated with one or more members of another group and 3) an intermediary can facilitate that coordination efficiently. From these insights can be concluded that in the market intermediary steam the focus lies on the mediation between various players in the ecosystem.

Thomas et al. (2014) explain the *platform ecosystem* as a set of shared core technologies and technology standards underlying an organizational field. These support value co-creation through specialization and complementary offerings and incorporates both product family and market intermediary influences. On the one hand the platform is a system of separately developed pieces of technology, on the other hand it facilitates the coordination of the efforts of buyers and sellers and acts as a hub of value exchange. The ecosystem participants leverage complementary assets accessible through the platform ecosystem to enhance their own performance (Iansiti & Levien, 2004). Other similar work regarding platform-ecosystems is that of external platforms, or industry platforms by for example Gawer & Cusumano (2014). These external platforms are defined by Gawer & Cusumano (2014) as *"products, services or technologies developed by one or more firms, and which serve as foundations upon which a larger number of firms can build further complementary innovations in the forms of specific products, related services or component technologies"* (p.4). together, these parties are referred to as the industry (Gawer & Cusumano, 2002) or the ecosystem (Gawer 2009b). Aarikka-Sternroos and Ritala (2017) found in their literature review that platform-ecosystems are characterized by the central platform leader who owns the ecosystem and connects various sides od the market to facilitate exchange and value creation. From these different works on platform-ecosystems can be noticed that there are three recurring distinctive characteristic. First of all, the platform itself provides a basis upon which complements can be developed. Secondly, the platform-ecosystem multi-sidedness. Lastly, the role of the platform-leader is central to value creation.
Platform leadership enables companies to exert influence over the direction of innovation that is taking place within their industry. In a platform-ecosystems various design choices are impacting the ability of the platform leader to create value (Tura et al., 2018). Despite these various aspects that impact value creation in platforms multiple authors regard network effects as a fundamental mechanism of how platform value is created (Tura et al., 2018; Thomas et al. 2014). Therefore network effects are use in the research as it is an important determinant for value created in the platform-ecosystem. One of the design choices that platform leaders can influence, that has an impact on network effects is that of openness (Ondrus et al., 2015). The following paragraphs will delve into network effects and how they are impacted by strategy on openness.

2.1.1 Platform network effects

The success and value of the industry platform is for a large extent dependent on the variety of complements that surround the platform, and the innovation speed of the complementors (Gawer, 2009). This effect is called network effects in the work of Cusumano (2010). These network effects create positive feedback loops that grow exponentially as the adoption of a platform grows with more external adopters in the ecosystem that create or use the complementary innovations making the platform more valuable (Cusumano, 2010). Network effects are divided in direct and indirect network effects.

Direct network effect or same-side network effects is a phenomenon that occurs between the platform and the user of the complementary innovation. An early work that lies at the basis of this concept was that of Metcalfe (1980). He stated that the value of a network product is proportional to the square of the number of users (Odlyzko & Tilly, 2005). An example of a direct network effect is Facebook, which needs many users that also use Facebook to be of value to other users. These network effects are reinforced by technical compatibility or interface standards (Gawer & Cusumano, 2014) or high switching costs that makes switching from one to another platform costly (Gawer & Cusumano, 2014). Direct network effect are observed in the growing number of complementary services or product that are made available from platforms (Cusumano, 2010).

Indirect network effects are consumption externalities, or also called cross-side externalities (Hagiu, 2014). This entails that the value to customers on one side of a platform typically increases with the number of participating customers on the other side (Hagiu, 2014). An example of this network effect is advertisers that become attracted to the Facebook platform because a lot of potential buyers are active on this platform (Gawer & Cusumano, 2014). For example, indirect network effects for Facebook can be observed by the overwhelming number of application developers, advertisers, content creators adopting the platform. This form of externalities can be stimulated by complementors as new functionalities can be appealing to an entire new group of customers (Cusumano, 2010**).** Many if not most markets with network externalities are characterized by the presence of two distinct sides whose ultimate benefit stems from interacting through a common platform (Rochet & Tirole, 2003). Van Alstyne et al. (2016) state that the larger the network, the better the matches between supply and demand and the richer the data that can be used to find matches. Greater scale generates more value, which attracts more participants, which creates more value (Van Alstyne et al., 2016). This often leads to the commonly called "chicken and egg" problem. In order to attract users on one side, the other side has to have a significant number of users, but those users would only be interested in joining if there were enough users on the first side (Caillaud and Jullien, 2003).

2.1.2 Platform openness

Platform leaders provide an integrated architecture of hardware and software standards as a basis on which third-parties can build complementary offerings. The most successful platforms were owned by proprietary sponsors that controlled platform evolutions and appropriated associated rewards (West, 2003). Openness and closedness is therefore important for the value a platform can deliver to its end-users as it allows a firm to harness external innovation as complement to internal innovation (Parker & Van Alstyne, 2017). In this thesis the description of openness of Eisenmann et al. (2009) is followed. He describes openness as the extent that there are fewer restriction on participation, development or use across the distinct roles within the ecosystem. Therefore, closedness is understood as the restrictions a platform leader puts on participation and development.

The platform leader is unlikely to have the resources or capabilities in-house to provide all the useful applications and services that make platforms so compelling for users (Cusumano, 2010). To meet the needs of heterogeneous users and to exploit indirect network effects, platform owners often seek to encourage complementary third-party innovation from resources located outside the firm, ranging from customers, research companies, and business partners to universities (Linder et al., 2003). The platform leader must therefore have a strategy to open their technology to complementors to allow their technology to become and industry wide platform. Opening a platform can speed up adoption by the different actors in the ecosystem by allocating more freedom to complementor to create value and harnessing network effects (Tura et al., 2018), reducing the user's concern about lock-in and stimulating production of differentiated goods that meet the needs of user segments (Eisenmann et al., 2009). At the same time, opening a platform is typically disadvantageous as it reduces the user's

switching costs and increases competition among platform providers, making it more difficult for them to make profits from the platform. Strategy on openness can create economic incentives like free or low licencing fees or financial subsidies (Cusumano, 2010). These incentives are necessary for other firms to join the same "ecosystem" and adopt the platform technology as their own (Cusumano, 2010). In the work of Eisenmann et al. (2009) it is found that strategy regarding openness can be open or closed in respect to several distinct roles in the platform ecosystem. These roles include the 1) demand-side platform users which are the end-users, 2) supply-side platform users which are the parties who offer complementary products or services on the platform, 3) Providers which provides for example the operating systems for the platform but can also be the party that provides the platform to the end user and 4) platform sponsor who exercise property rights and are responsible for determining who may participate in the platform. (Eisenmann et al., 2009).
Ondrus et al. (2015) conducted a research where they aim to find out how opened or closed strategies in a platform-ecosystem determine the potential to reach a critical mass and ignite network effects. In their work this effect is called market potential. Building on the work of Eisenmann et al. (2009) they propose four levels of a platform; sponsor, provider, technology and users, from which they focus on the latter 3. Openness on the provider level concerns whether additional providers are allowed to the platform. Technology openness concerns whether the platform is interoperable of incompatible with other platforms and related technologies. The user level concerns in the platform is open in in-discriminant ways to new users. They find that for opening the platform at the provider level for both additional firms from the same and different industries has a positive effect on market potential. Furthermore they find that opening at the technology level and user level also leads to greater (or at least equal) market potential. This would mean that for this research that the activity tracker platform leader who applies a closed strategy, would limit the potential for the platform to harness network effects.

2.2 Ecosystem roles

Literature on roles is analysed to create a deeper understanding of roles that might be found in the activity ecosystem. By understanding which roles are present in the ecosystem will help determine how and toward which roles the platform leaders applies an open or closed strategy. Dedehayir et al. (2016) define roles as "*a characteristic set of behaviours or activities undertaken by ecosystem actors*" (p. 1). Dedehayir et al. (2016) conducted a literature review on ecosystems and identified several key roles, which they divided into four groups; leadership roles, direct value creation roles, value creation support roles and entrepreneurial ecosystem roles.

The role that belongs to the category *leadership roles* is that of the ecosystem leader, also called by different names like keystone (Iansiti & Levien, 2004) or platform leader (Cusumano & Gawer, 2002) or platform sponsor (Eisenmann et al., 2009). In a platform context the platform leader drives industry wide innovation for an evolving system of separately developed pieces of technology. *Direct value creation roles* contain three roles coming from the traditional value chain; suppliers, assemblers and users and one role new in the innovation ecosystem approach, complementors. The complementors are extending the core offering of the suppliers and assemblers because its actors do not lie on the direct path of value creation (Adner, 2012). Complementors deliver key complementary offerings by accomplishing compatibility with the platform, utilizing the design of the ecosystem's other offerings or meeting customer specifications (Dedehayir et al., 2016). This role was also identified in the platform literature and was explained as a role that makes ancillary products that expand the platform's market (Cusumano & Gawer, 2002). Eisenmann et al. (2009) call this role the supply-side platform user. The user as a direct value creation role creates its value by defining a problem or need. The user of a platform is called the demand-side platform user in the work of Eisenmann et al. (2009).

Value creation support roles provide indirect value by delivering support elements (Dedehayir et al., 2016). In this group, two types of roles are defined; expert and champion. The expert role is in the literature often associated with actors such as universities and research institutes who generate knowledge, inventions and discoveries. These roles deliver for example consultation activities or expertise that can be used by actors that adopt a direct value creation role during the development of products and services (Dedehayir et al., 2016). The champion role builds connections and interacts with carious partners in the ecosystem. This role is often embodied by individuals tasked with the process of the inception of a new product idea to the commercialization.
The last group of roles is called the *entrepreneurial ecosystem roles* group, this group exists of three roles; the entrepreneur, the sponsor and the regulator. The entrepreneur role is usually adopted by an individual or a start-up firm. These actors seize unnoticed business opportunities that contribute to the value creation of the whole ecosystem. The sponsor role in this group ensures financial support and provides help in the form of co-development of products or purchasing them in new ventures like that of the entrepreneur. The last role mentioned by Dedehayir et al. (2016) is that of the regulator. The regulator is to create favourable economic political and regulatory environments for the start-ups.

2.2.1 Value networks

A business ecosystem can be analysed by the means of the value network concept that describes and analyses a platform-based product or service offering (Ehrenhard et al., 2014; Kijl et al., 2010; Peppard & Rylander, 2006), and is used to create a visualization of the roles within the activity tracker platform ecosystem. Although the linear value chain has retained a key role within platform-ecosystems, in term of the production of the hardware activity tracker device, the locus of value creation, has migrated to those companies that are surrounding the platform product. Peppard and Rylander (2006) define a value network as a "set of relatively autonomous units that can be managed independently but operate together in a framework of common principles and service level agreements (SLAs)" (p.132). The value network concept is based on the notion that the organisation no longer creates value as an isolated unit, but value is created in relationships which is key to understanding the competitive environment in the network economy. Through collaboration in a value network, firms exploit their interdependencies and have a competitive advantage over isolated companies which internalise all components of a value chain (Iansiti & Levien, 2004). Companies in a business ecosystem co-evolve their capabilities and roles and tend to align themselves with the directions set by the platform leader. In the value network is analysed how different the different roles like, suppliers, partners and customers work together to co-produce value (Peppard & Rylander, 2006). By understanding the relationships that a firm has with other ecosystem members, it can be better understood how openness and closedness of the platform affects the ecosystem. From the previous paragraphs can be concluded that in analysing openness and to be able to understand it's impact on value creation for in platform ecosystems actors play an important role. It is therefore that by mapping the value network, these concepts and the strategy that is handled by the platform leaders can be identified (Müller, Kijl, & Martens, 2011)

3. Methodology

In this chapter the methodology that is used to answer the research question is described. First the research design will be introduced, after which the two research methods of the multiple-case study and interviews and associated data collection processes are discussed. Lastly this chapter closes with the description of the data analysis method.

3.1 Research design

The research subject is to investigate how platform leaders in the activity tracker platform ecosystem use strategy on openness to create network effects and influence value creation in their ecosystems. Two different research approaches are identified by Saunders, Lewis and Thornhill (2009), the deductive and inductive research approach. The deductive approach takes existing literature as a starting point to subsequently start data collection based on that theory. The inductive research approach starts with data collection and subsequently continues into formulating theory based on the data collected. This work follows a inductive research approach. The activity tracker as a commercial product is fairly new, and the theory available on ecosystems, platforms, roles, value networks, network effects and openness has not been applied to it yet. Using a inductive approach created a knowledge base that helped to identify the actors and their activities in the value network and network effects and openness features from the case studies and interviews.

As there is relative little work on the activity tracker ecosystem in a business setting, this research has an exploratory approach and no propositions were drawn up (Yin, 2013). An exploratory approach entails that is aiming to find out new insights, ask questions and to assess phenomena in a new light. This is a useful approach for this research as it aims to find out how strategy in terms and openness have an impact network effect for creating value in the platform-ecosystem. The research contains a descriptive part as well. In descriptive research a situation is describe in its current state. This is applicable to this research because of the visualization of the value network of both companies, which describes what the ecosystems looks like during the time the research is conducted.

As value from platform products is dependent on the variety of complementors and users around it (Gawer, 2009), the unit of analysis for this study is the ecosystem of activity tracker wearables platform leaders. The activity tracker product is seen as an ecosystem because it offers a technology platform, from which many stakeholders can benefit. The analysis of the ecosystem will show the which roles are present and which roles the platform providers have taken on themselves showing the firm boundaries. Furthermore, from studying and visualizing the ecosystem it can be derived how open or closed the platform is toward certain roles (Eisenmann, 2009; West, 2003)) and how network effects manifest (Gawer, 2009).

3.2 Research method and data collection

The research method of this thesis follow a two-step qualitative approach, including a multiple case-study and semi-structured interviews. The case study is a suitable method for ecosystem research for its ability to study a complex phenomenon within its context (Baxter & Jack, 2008). The interviews were held to create a more thorough understanding of the cases and to gather supplementary information on the platform leader companies. Furthermore, are both strategies are a common used research method for mapping the value network (E.g. Ehrenhard et al,.2014; Nieuwenhuis, et al., 2017). The value network approach has been used before to identify ecosystem openness and network effects (Müller et al., 2011). To stay in line with these researches, the same methods are used. Using a mixed method research allowed a collection of a richer and stronger array of evidence than could be accomplished by any single method (Yin, 2011), which is important for understanding how platform leader use strategy to influence the value creation in their platform-ecosystem.

Case studies

Cases were chosen with purposeful sampling of the largest players in the industry. It is observed that in the fourth quarter of the year 2017 there are three players that together own almost 50% of the market share in the wearables market. The largest one is Apple who owns a market share of 21%, second largest is Fitbit with 14% (Statista, 2018). This research will two largest companies in the industry. The use of only two cases will allow to clearly see the similarities and dissimilarities and allowed for a more thorough investigation to be completed in the limited time frame of this research. These company's main products are wearables worn around the wrist, all with functionalities that can be classified as activity trackers. By using companies that sell a similar product, the cases were expected to have literal replication. The use of multiple case studies also increases external validity of the research (Saunders et al. 2009). Data about the companies was gathered through desk research of documentation data sources like magazines, websites, product information and other available materials, which enabled the author to gather context around the cases. Databases and websites that were used for gathering this data sources were LexisNexis News and LexisNexis Web News. Google Scholar, Above Avalon Podcast and Google were used to find other news articles that could not be found using LexisNexis. In the process of gathering the data, the method of Hartley (2004) was used. He points out steps that could be followed for systematically collecting data in case study research. The first step in data collection was to create a general understanding on the (internal) structure of the company by searching for historical information. Second part of the data collection was to map the external partnership and other stakeholders in the ecosystem. In gathering this data, a structural approach was used by using a predetermined set of search terms, and consistently using these search terms in all used data bases. Search terms that were used are: "Activity tracker", "Apple Watch", "Fitbit", "Apple Watch AND Partners". "Apple Watch AND Ecosystem", "Fitbit AND Partners", "Fitbit AND Ecosystem". This led to the collection of a total of 29 news articles published between November 2017 and May 2018, and 1 older article published in 2015 and 1 research paper published in 2015. The articles and the corresponding search terms can be found in Appendix A. After data analysis, some additional sources needed to be found. Search terms for the missing information were more specifically focused on the type of missing information. Search terms used here were "Fitbit Partners", "Fitbit Operation System", "Fitbit AND Hardware", "Fitbit strategic focus" and "Activity tracker timeline". With these search terms an additional 5 new articles were found.

Interviews

Additional data was gathered to enrich the information found in the case studies through 9 interviews with industry experts, like researchers, app developers and founders of the Quantified Self movement in the Netherlands (See table 1). Using interviews for enhancing the data found in the case studies leads to data triangulation which helped strengthen the construct validity of the case research (Yin, 2013). Interviews were either held face-to-face, phone calls or through video call services over the internet. To prevent participation bias, a maximum amount of time for the interviews was set to 45 minutes. The interviews were held in a semi-structured setting. Interviewees were asked question regarding 4 subjects, roles in the ecosystem, changes in the ecosystem, network effects and platform openness. The outline of interview questions can be found in Appendix B. Examples or question that were asked are

- Could you give a description of the partners in the activity tracker network (of Fitbit or Apple Watch)?
- Are the indirect partners who are important for value creation?
- Would a description of partners would be the same if this interview was held 4 years ago?

- Which functionalities make that more users buy an activity tracker product?
- To what extent are the activity tracker platforms open or closed?

Participants were picked by a maximum variation sampling to ensure that a wide range of data could be gathered. Sample selection criteria for the maximum variation sampling were on basis of job descriptions and functional and educational backgrounds of the interviewees. Because of the high level of specialism required from interviewees in addition to the maximum variation sampling, a snowball method was used to find more respondents. To ensure the respondents privacy the results are anonymized.

#	CURRENT JOB OCCUPATION	EDUCATIONAL BACKGROUND
1	Researcher	Human movement sciences
2	Blogger/journalist, Founder of the QS movement in the Netherlands	Journalism and innovation sciences
3	Health oriented entrepreneur	Data science
4	PHD student	Human movement sciences
5	Software consultant, Founder of the QS movement in the Netherlands	Chemistry
6	Assistant professor	Industrial design
7	Researcher, entrepreneur	Business Information Technology
8	Research and development in medical rehabilitation	Human movement sciences, Mechanical engineering
9	Lector Business Service Innovation, professor Business and IT	Electrical engineering and Computer science

Table 1 Interviewee information

3.3 Data analysis

Data analysis of the case studies was done with the help of the Software program Atlas.ti. which is a tool for qualitative research analysis. In this program the information that was collected is tagged and linked. This analysis in Atlas.ti helped structuring the information so it could be written down as narratives. (Hartley, 2004). As the subjects of this study were the two market leaders in the industry, multiple-case synthesis can help discover similarities or dissimilarities in ecosystem actors and their strategy on openness towards them. The tagging was done one the basis of returning subjects in the interviews and on subjects identified in the theoretical framework. After all the documents were tagged, the taggs were compared to see if one case had information, which the other case lacked. For the missing information new data was gathered by going over the already gather documents and interviews, and by finding new articles online. This was done to ensure that both cases had the same amount of information. These extra articles were also documented in the systematic literature review in appendix A.

The first step in the analysis of the interviews was to transcribe them. After the transcription the interview were categorized on the basis of the subject that were discussed and secondly on the basis of returning subjects in the interview. In the third step the data was tagged after the interviews were uploaded into the Atlas.ti software program.

The results of the cases and interviews were subsequently be used to create a value network, which allows to visualize all the roles that are present in the activity tracker ecosystem. Various researchers

have devoted attention to the process of creating and analysing the value networks. Peppard and Rylander (2006) created the network value analysis where they aim to generate a comprehensive description of where value lies in a network, focussing on the focal actor in that network. For identifying all the actors in the network their method takes the standpoint of the network focal and identifies all the actors that influence the value the network focal delivers to the end-consumer. In the platform ecosystem the platform leader can shape the ecosystem with their strategic actions, making it an important actor in the ecosystem. After the identification of actors in the value network the work of Peppard and Rylander (2006) aims to define the activities between actors to define the value each entity perceives from being a network member. They created a five-step plan for creating a value network analyses which will be followed in creating a value network for the activity tracker ecosystems of the Apple Watch and Fitbit. The first step was to create boundaries for the analysis. The boundaries were to include all the roles found in the work of Dedehayir et al. (2010). Secondly. from the case various roles are identified (step 2) and specified into actors and activities (step 3). Subsequently in step 4 value linkages were created to show the value creating relations between the actors. Step 5 concerns the creating the complete value network visualization and drawing conclusions (Peppard & Rylander, 2006). Network effects are analysed by judging the available information in the cases in combination with the identified features of direct and indirect network effect from the theoretical framework. For each of the roles identified in the work of Eisenmann et al. (2009) is determined to what extend Apple and Fitbit implement strategy in regard to openness or closedness.

4. Findings

This chapter presents the results of the Apple Watch and Fitbit cases that are a combination of desk research and expert interviews. In the first paragraph the two cases will be set out as narratives, where the focus lies on identifying the ecosystem roles, network externalities and openness features. After the narratives, the roles and activities are specified and presented in a table. Subsequently visualizations of the value networks were created. After doing this for the individual cases, in paragraph 4.2 a cross case analysis was executed, where the findings are compared.

4.1 Case studies

4.1.1 Case 1: Apple Watch

Apple was founded on April 1st, 1976. In the first 30 years Apple focused on personal computers and has known ups and downs. Apple's biggest victory was the introduction of the iPhone in 2007. Nowadays Apple has a wide range of products like their iMacs (PCs), iPhones (Smartphones), and iPads (tablets). One of Apples recent addition to their product family is the Apple Watch. This Apple Watch was introduced for the first time in 2014, and is a smart wearable worn around the wrist. The Apple watch allows its user to track heartrate, steps, calories burned and sleep amongst other things. Furthermore, the Apple Watch is lets users listen to music and shows notifications. The newer versions are also waterproof and have their own connection to the internet (Apple, 27-07-2018a). Currently Apple is selling five versions of their product; Apple Watch series 1, Apple Watch series 3, Apple Watch Edition, Apple Watch Nike+ and Apple Watch Hermès (Apple, 27-07-2018b).

In 2016, Apple was the third biggest wearable vendor, thanks to the successful introduction of the Apple Watch to the smartwatch market. Continuing into 2017 Apple kept growing and taking market share from their biggest competitors. Apple continued to decisively take control of the market for smart-wearable devices, after achieving a success with their third-generation line of the Apple Watch in 2017. In the last quarter of 2017 Apple's shipments jumped 58% to 8 million from 5.1 million a year earlier. This resulted in an accompanying market share growth from 14.4% percent in Q4 2016 to 21% in Q42017. This makes Apple currently the market leader in the smart wearables industry (IDC, 01-03-2018).

Apple is designing its own key hardware, like processors and screens but outsources the manufacturing, mainly to companies in China. They do this to minimise the risk hurting it's bottom line with manufacturing slipups. (Agency Staff, 19-03-2018). This hardware includes the S Series processor which can be found in their Apple Watches (Cybart, 20-12-2017).
The software used on the Apple Watch is Apple's own built WatchOS, making it compatible only with Apple's iPhone smart phones. The WatchOS is similar to the iOS operating system, which is used on other Apple devices. Apps that are on an user's iPhone are automatically transferred to the Watch, if a compatible version is available. Apple Watch users can download the Apple Watch app from the general Apple store located on their iPhone. Additional Apple Watch apps and watch faces can be downloaded via a separate Apple Watch app store located in the Apple Watch app. Around 10.000 apps and watch faces were already available in September 2015 (Costello, 07-04-2018). Multiple interviewees talked about how the Apple Watch only being compatible with other Apple devices, leads to the Apple Watch platform-ecosystem being part of a larger Apple Ecosystem. One of the interviewees stated it like:

"The Apple Watch only being compatible with the iPhone is a smart strategic decision of Apple. This makes the iPhone market more attractive because the Apple Watch can be offered as a complementing technology. This is smart capitalization of their already existing ecosystem"

Apple gives third party developers the opportunity to create apps and watch faces for their Apple Watch product. However, regarding watch faces, developers are limited to tiny complications if they want to extend functionality beyond their app (Simons, 07-02-2018). Apps for the Smart Watch also have to go through a strict quality control.

in 2015 Apple began partnering with designers like Hermès to allow them to capture a broader market of luxury consumers interested in the appeal of heritage fashion brands. Since then, designers including Coach, Kate Spade, and Nike have also partnered up with Apple to create trendy bands at high price points. Prices of Apple Watch Hermès range between $1999 and $1399 while an Apple Watch series 3 costs between $329 and $399 (Apple, 08-08-2019).The partnerships have allowed Apple not just to claim more physical retail space but expand to a new market of consumers who might not buy into Apple as a luxury fashion product on its own (Riley, 04-04-2018).

Apple's strategy with the Apple Watch has seen significant changes since its inception on the market. The company's initial goal for Apple Watch was to redefine a smartwatch as a fashionable piece of luxury. However, with the release of newer models, Apple has taken a decidedly different route with Apple Watch. In this new route fitness and health were given a much greater focus (Cybart, 06-10-2016). One of the interviewees confirmed this by stating:

"At the introduction Apple's strategy was focussed on luxury brands, a single watch could cost up to $8000. Nowadays they changed to a strategy that is more focused on daily use, and sports and health. Making the watches a lot cheaper as well."

Apple began its foray into health with its Health app and fitness tracking via the Apple Watch. Since mid-2016 Apple has begun to push more into healthcare with for example partnerships with the company HealthGorrilla and the acquisition of the digital health company Glimpse, which collects and integrates patient data and allows patients to share it via a private online portal (CB Insights, 20-09-2017; Lie, 20-02-2017). Other parties that Apple partnered up with in the Healthcare sector is for example the insurance company UnitedHealthcare. UnitedHealthcare creates goals for their customers that use Apple Watches. When the users reach these goals each day, they get a small

monetary compensation (Al-Heaty, 07-03-2018; Comstock, 06-03-2018).
Furthermore, Apple created their own healthcare app called Apple Health. The Apple Health app that is available on the iPhone is connected to the user's Apple Watch, visualizing its health data. Apple Health also gives users the option to combine health records from multiple care providers (For example MyFitnessPall, or data from other sensors) in one place. The Apple Health app is described by one of the interviewees as:

"Apple Health is the healthcare app of Apple that shows all the data that is gathered from the activity tracker sensors of the Apple Watch. It also allows users to upload data from other data sources like for example from a smart scale. In the Apple Health app, everything comes together"

Research institutes have also been showing interest in conducting research concerning the Apple Watch. Subjects of research are for example accuracy of the smart watch device tracking sensors and applicability of the device in medical settings. Apple also created a research kit which is a tool that supports researchers by making it easier for participants to enrol and conduct studies (Apple, 20-07-2018a). This led to for example researchers developing a tool for the Apple Watch that lets users sensing an impending seizure launch the app by tapping a custom complication on the Apple Watch, after which the accelerometer and heart rate sensors are triggered, and an alert is automatically sent to a designated family member of caregiver. By analysing this data researchers hope to eventually be able to help predict seizures before they happen through the smart watch (Apple, 30-07-2018b).

Summarizing this case, it becomes clear that the Apple Watch ecosystem is part of a greater Apple ecosystem. the decision of Apple to make their Watch compatible only with iPhone devices, creates a connection to their already existing infrastructure. This created certain platform standards, which resulted in app developers being already familiar with the development tool that Apple offered and also allowed smooth transferability of iPhone or iPad apps to the Apple Watch. Furthermore, with the Apple Health app, Apple created a platform where the health data generated on the Apple Watch can be combined with various other data sources.

Direct and indirect network effects
The characteristic of direct network effects in the Apple Watch ecosystem in the social aspect that is made possible for Apple Watch users. Users of this Watch are given the possibility to share and compare their activity results with friends and other people in the community. Apple makes use of gamification by introducing the Apple Circles, which are daily activity goals you can compete on with friends.

The first indirect network effect shows through Apple's market leader position in the smart wearable Industry. Because of the increasing number of consumers purchasing an Apple Watch device, it became more interesting for app developers to create apps for this platform. The other way around, there being more apps made it more attractive for users to buy an Apple Watch device, as this led to more functionalities. One of the interviewees explained it as follows:

"This effect works like Metcalfe's Law, the value increases when there are more app developers. This makes the product more interesting for user because of the increased opportunities the consumer can be served better. Which again makes it interesting for app developers if there are many people using Apple Watches, they will have a large market for their app. Hardware and apps have reinforcing effect on each other, making it very difficult for competitors to interfere. "

Several industry experts explained that indirect network effects are stimulated through the WatchOS operating software. This software creates technical standards regarding the creation of apps that are very similar to that of the iPhone and iPad. Making it easy for third party developers to create complementary services for the Apple Watch. Because of the integration of the smart watch

ecosystem with other Apple hardware device, app developers that already created apps for other Apple hardware, can easily transfer their apps to a smart watch version of the app. This was stated by one of the interviewees who said:

"There are a lot less app developers for Fitbit applications than there are for the Apple Watch. The Apple Watch is an easy platform for developers because you can take a lot of skills with you from the iPhone applications you already made."

Also indirect network effects are stimulated through the smooth connectivity between the various Apple products. When a user is already in the Apple ecosystem, by using other Apple hardware devices, it is attractive to start using an Apple smart watch as well. Multiple interviewees mentioned this type of indirect network externalities. One of them explained this effect by stating:

"The established Apple infrastructure allows the user to download apps for an iPhone or Apple Watch from for example their Mac Book. The App store that was created for the iPhone is now available on all Apple's products. Because this infrastructure has been proven to be of good quality in the past, has gained the trust of users."

Although this smooth connectivity is no self-contained indirect network effect, they are policies created by Apple to stimulate network effects and are therefore important to be included into this case. The results of these strategic decision might lead to increased users and/or developers. This again leads the "chicken and egg" situation, more users make it attractive for app developers, more app make it attractive for users to buy to product due to more functionalities.

Openness and closedness

The first characteristic of openness of the Apple ecosystem was mentioned as the option to combine various types of health data gathered with non-Apple hardware in the Apple Health app. One of the interviewees argued for openness of the Apple Watch ecosystem by saying that Apple allows users to combine different data sources;

"It doesn't matter which step counter you have, it will probably be compatible with the Apple Health app. Apple at least gives its users the possibility to use hardware of different producers. These days it is possible to switch from Fitbit to Apple and take your data with you, but that's not the case the other way around"

Furthermore, one of the interviewees explained Apple Watch openness as being able to get all the high-resolution data out of the device. With high resolution data was meant all the data that you put in the device, for example your heart rate per minute, instead of average heart rate for each day.

"From a developer perspective Apple Watch gives you the opportunity to get all the information you put into the device, out of it. For this you need another app, for example the app called HIP Bone, allows you to stream all your health data to Dropbox. This streamed data can subsequently be used to run analyses on, which in my opinion is more user-friendly than the Fitbit API."

One of the interviewees talked about the balance between openness and closeness in the App Store for Apple Watch Apps. This industry expert explained that with openness on the one side of this balance is meant the opportunities third party app developers are given to create app on the Apple Watch platform. On the other hand, the closeness entails the quality control but also the proprietary protocols Apple handles for their security of for example the communication between the iPhone and Apple Watch.

"Apple created a market with their App Stores where third parties can develop apps. However, apps do

not easily get accepted into these stores, first they have to pass the Apple "police" which takes care of the quality control. They created an optimal balance between openness and closeness of the platform"

As closedness of the Apple Watch ecosystem was mentioned relatively often was that the Apple Watch is only compatible with other Apple products.

4.1.1.1 Value network analysis of Apple Watch

The value network of the Apple Watch consists out of 13 roles. 1) Platform provider, 2) Hardware suppliers, 3) Software suppliers, 4) App developers, 5) Retailers, 6) Healthcare partners, 7) Fashion partners, 8) Research institutes, 9) Internet service providers, 10) Distributors, 11) Complementors, 12) Users 13) Infrastructure provider.

1) *The platform provider* in this case is Apple. They are the provider as the Apple Watch as a physical product and created the Apple Health platform. Also, they provide the existing broader Apple ecosystem consisting out of all their other product offerings like the iMac and iPad. 2) The role *hardware suppliers* exist out of two types of actors. The first type of hardware supplier is Apple self, with them designing key hardware components like processors and screens. The second type is the external supplier who supplies other non-key components. 3) *Software supplied* for the Apple Watch is all provided by Apple. The operating system for both the Apple Watch and the needed smart phones are created by Apple. 4) The *app developer's* role also exists out of two types of actors. On the one hand Apple creates their own apps as a service for their customers like the Apple Health and Apple activities app that are connected to the Apple Watch. On the other hand, Apple also allows third party developers to create apps for the Apple Watch. 5) *Retailers* are the intermediary between the platform provider as the provider of the hardware product and the customers. Retailers can be either online or offline retail stores and can be Apple stores[1] or other consumer electronics retailers like MediaMarkt or Amazon. 6) *Healthcare partners* are partners that are either partners that act as complementors to the Apple Watch platform by offering complementing/additional functionalities or parties that are offering their own customers healthcare solutions via the Apple Watch hardware as a product. Additional functionalities are provided by partners like Glimpse who create the connection between Apple watch users in their role as patients to doctors. Partners who offer the Apple Watch hardware as a healthcare solution to their customers are insurance companies like UnitedHealthcare, whose customers are encouraged to reach certain activities goals each day in exchange for monetary compensations. 7) *Fashion partners* provide the Apple Watch with a new market segment for tech-savvy customers that do not see Apple as a self-contained luxury product. They can function as a retailer by selling the product in their own stores, being the supplier of the Apple Watch product to the end consumers. On the other hand, they are also on the supply side by integrating the Apple Watch into their own collections. 8) *Research institutes* conduct research about for validity and accuracy, behavioural changes and reason for abandoning activity tracker and smart watch devices. This research is the implemented by Apple into the design or software of their products. 9) *Internet service providers* enable the smart watch devices to have a connection to the internet without the use of a smart phone. 10) *Distributors* distribute the hardware device to the retail stores. 11) *Complementors*, are providers of hardware devices that are compatible with the Apple watch device. Apple allows data gathered by the Apple Watch device being combined with other data sources through the Apple Health app. Examples of complementary devices are pedometers, other heartrate sensors, sleep sensors and smart scales. 12) *Users* provide Apple with product feedback in for example the form of reviews. 13) The

[1] Apple owning their own retail stores is not displayed in the firm boundaries in the visualization of the value network.

infrastructure provider is identified as a role in the Apple Watch ecosystem because of the tight integration of the Apple Watch with the iPhone and other Apple hardware. The infrastructure that is leveraged in that of for example the app store, which provides easy transferring existing iPhone apps to the Apple Watch App Store.

All roles and their corresponding actors and activities are summarized in table 2 and are visualized in figure 1.

	Roles	***Actors***	***Activities***
1	Platform provider	Apple	Provider of the hardware product the app store and of the Apple Health platform. Manage the wide Apple ecosystem.
2	Hardware suppliers	i) Apple ii) External suppliers	i) Designing key hardware components ii) Supplying remaining components
3	Software suppliers	Apple	Provides the WatchOS operating system which runs on the device. Also provides the iOS operating system which is necessary to run the smart phone which connect to the smart watch.
4	App developers	i) Apple ii) 3rd party developers	i) Creates own apps to serve customers better, like the Apple Health app ii) Are allowed to create apps as complementary services for Apple Watch users
5	Retailers	Apple resellers, online web shops	Mediating party that purchases devices from the platform provider and sells it to the end consumer
6	Healthcare partners	i) Complementary service providers, e.g. Glimpse ii) Insurance companies e.g. UnitedHealthcare	i) Create complementary services for Apple Watch users ii) Offer the hardware as a healthcare solution to their customers
7	Fashion partners	Hermès, Nike	Create a new market segment for tech-savvy customers who do not see individual Apple devices as a luxury product Function as retailers, by offering the hardware products in their own stores
8	Research institutes	Universities and private research businesses e.g. John Hopkins University	Conduct research about technical features and medical applicability of the Apple Watch
9	Internet Service providers		Provide the connectivity of the Apple devices to the internet
10	Distributors	Logistics companies	Distribute the hardware product to retailers
11	Complementors	*i) Apple* *ii) 3rd parties*	i) Creates its own complementary product like the iPhone, iPad and Air Pods ii) Create complementary hardware that can be connected to the Apple Health platform
12	Users	End-consumers	Provide the providing company with product feedback that can be implemented into the design and functionalities

13	Infrastructure provider	*Apple*	Provides complementing infrastructure

Table 2 Apple Watch value network roles, actors and activities

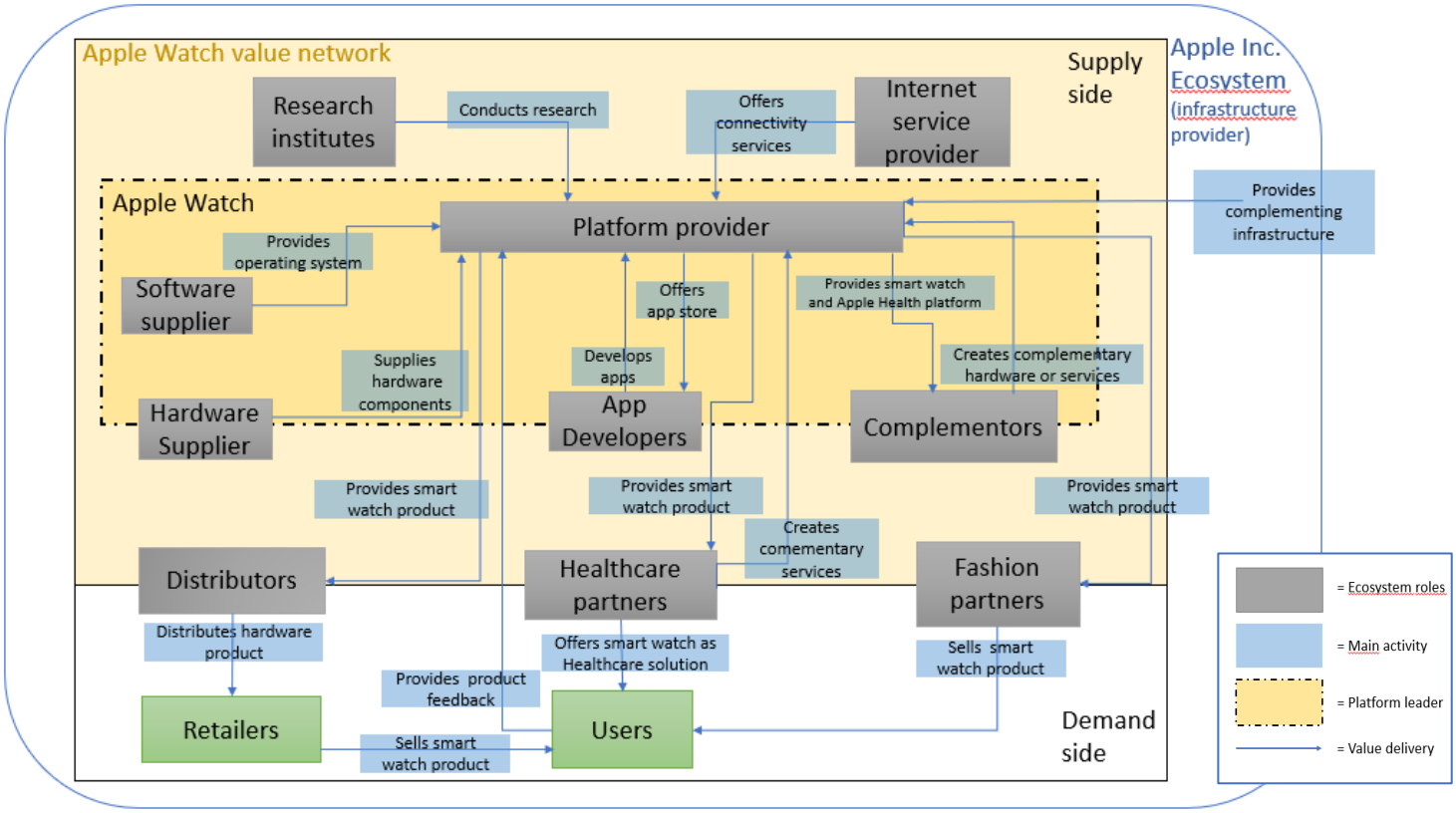

Figure 1 Apple Watch Value Network

4.1.2 Case 2: Fitbit

Fitbit was founded in 2007 when the two founders saw an opportunity in the recent advancements in sensors and wireless technology. In 2008 they launched their first product, a clip-on deivce able to measure and record the data of steps taken by the wearer. After the collection of the data, the user could then share the information. Fitbit continued to bring various clip-on activity trackers to the market, until 2013, when they introduced the Fitbit Flex. This was their first activity tracker worn around the wrist. The Flex model had 5 led lights to indicate the progress the user made towards the goal number of steps walked and could also measure sleep patterns. In 2014 the Fitbit Surge was released as the first activity tracker that also was a smart watch (Comstock, 11-05-2015). Over the years Fitbit continued to bring different variations of their products on the market. The most recent additions to their product range were the Versa smartwatch and Ace wristband for children in 2018. Currently Fitbit is selling two types of smart watches; Versa and Ionic, and five types of activity tracker wrist bands; Charge 2, Alta HR, Alta, Flex 2, and the Ace (Fitbit, 23-07-2018).

With a strong presence in the health and fitness wearable market, Fitbit was a leader in the wearable industry since early 2014, when the company held about 45 percent of the market share. Fitbit sold over 10 million wearable devices in 2014 alone and shipped about 22 million units worldwide in 2015. Fitbit's market share of wearable device unit shipments was 34.2 percent in the first quarter of 2015, yet that share has shrunk to 14.2 percent in the latest quarter of 2017. Currently, Fitbit is the 2nd largest provider of smart-wearables (IDC, 01-03-2018).

Fitbit uses a strategy where they create their own hardware design but outsource the production to manufacturers in China. Components like chips and screens and sensors are purchased from external manufacturers. Fitbit used to create a bespoke OS for every device they release. Since the introduction of the Ionic smart watch the software used by Fitbit is its own FitbitOS operating system (Cipirani, 16-04-2018). Fitbit made the decision of creating their own operating system because the already existing Android Wear limited their freedom in terms of hardware and design (McGarry, 21-08-2017). The Fitbit devices are compatible with Android, Windows phone and Apple devices. Users download the Fitbit app from the app store on their mobile phone app store platform. In the Fitbit app the user can enter the Fitbit App Gallery, from which they have a choice from around one thousand apps or watch faces (Gallery, 02-08-2018). Fitbit has no quality controls on the apps that are uploaded onto their app store platform.

Fitbit's focus has from its inception been providing customers with fitness-oriented devices (Cooper, 07-05-2018). However, Fitbit has also followed Apple in partnering with designers like Vera Wang and Tory Burch to make their watches more appealing (Riley, 04-04-2018).
Since the introduction of the Iconic and Versa smart watches Fitbit is trying to push more into the healthcare world, turning their devices into monitoring devices rather than simply fitness trackers (Cooper, 07-05-2018). Fitbit's CEO James Park announced in an earning call in February 2017 that:

"Our 2015 growth in the U.S. and in 62 other countries around the world, demonstrated that people desire for data, inspiration, and guidance in pursuing their fitness journeys is a worldwide movement. While Fitbit is known as a consumer brand, the real potential of our brand and technology is to become a digital health platform that improves people's health and integrates into the healthcare ecosystem. (LiDe, (26-02-2017)"

This marked the moment where Fitbit changed from not only being a hardware supplier but also to wanting to be able to integrate with healthcare providers, provide personalized coaching and improving their users' health through preventive care. As the company transitions into a platform business, it expands the value creation to provide that data to healthcare providers and third parties such as insurance companies. As a repository of health data, Fitbit will be able to not only sell more devices but also charge subscription fees to health providers and employers (LiDe, 26-02-2017).

With this new vision in mind Fitbit engaged in several new partnerships. The first is with Google's Cloud for Healthcare, allowing users to send health data to doctors, who then will be able to monitor both electronic and real-time health data (Business wire, 04-30-2018; Zieger, 07-05-2018). Another partnership is with the insurance company UnitedHealthcare. UnitedHealthcare offers it's customers monetary compensation when they reach various goals each day using a Fitbit device (Fitbit Press Release, 01-03-2017). The acquisition of the company Twine Health is another step towards the healthcare world. Twine Health centrepiece is a health coaching platform that helps users manage chronic conditions such as diabetes (Lovett, 07-05-2018; TAStaff, 01-05-2018). Furthermore, Fitbit rolled out of a diverse set of apps and clock faces to help people to better manage their health. Fitbit was the first connected health and fitness company that offered a completely open API, providing its community with the opportunity to create apps, products and services that integrate with the Fitbit platform (Business Wire, 21-10-2015).
Complementary products are created by solely by Fitbit. They created the Flyer wireless headphones and the Aria smart scales, which have to possibly to be connected to the activity tracker devices (Cipriani, 16-04-2018).

Research institutes took interest in the activity tracker from an early stage since its introduction. Work on activity trackers in early stages focused for example on the reliability and validity of these early devices (e.g. Noah et al. 2013 who research reliability and validity of the Fitbit and Fitbit ultra). Work on Fitbit activity trackers can be found dating back to as early as 2009.

Users play an important role for Fitbit. The users of Fitbit devices generate a lot of health data, like number of steps taken, distance travelled and heart rate but also location data and usage information. Fitbit stores this data and uses it to improve their product. They use the data to provide and maintain their services and to improve personalize the services, perform data analysis and testing, conduct research and surveys and develop new features services (Fitbit, 24-05-2018). One interviewee explained that:

"The moment you start using a Fitbit device you will give them the rights to use the data for their own purposes. They are allowed to do research with your data, as long as it is anonymized."

Summarizing the case it can be noticed that the Fitbit case is characterized by that from Fitbit's inception their hardware design went through a lot of changes. Their transition of selling simple activity tracker wristbands to selling smart watches went hand in hand with them transforming from a value chain to a platform business. Their compatibility with both Android, Windows Phone and Apple smart phones makes it possible to reach a wide range of consumers and app developers. The reverse of this wide compatibility is that Fitbit cannot guarantee their third developers with technical standards. Fitibit's open API and there being no quality control on the app store makes it easy for third party developers to create new products and services based on Fitbit data, and get it up and running on the platform. Fitbit however does not give their users the possibility to combine their data gathered with non-Fitbit devices.

Direct and indirect network effects

One direct network effect is identified in the Fitbit ecosystem because of the social aspect in the accompanied Fitbit app. Fitbit users are able to share and compare their activities with other users, and engage in competitions of who is most active.

Direct network effects play an important role in Fitbit's transition to a health-oriented platform. As mentioned in the case description, Fitbit collects the data generated by their users, to create or improve their services. More Fitbit users leads to the collection more user health-data, which leads to company improving its understanding of behaviour patterns. Furthermore, this will allow healthcare providers to benchmark physical activity across different populations and analyse how people respond to different incentives (LiDe, 20-02-2017).

Fitbit stimulates indirect network effects through the compatibility with diverse operating systems. Fitbit activity trackers hardware can be connected to smart phone that run on Android, Apple or Windows phones, which makes Fitbit a possible option for all smart phone users.

Openness and closedness

The first characteristic of the Fitbit ecosystem openness is the API that is offered by Fitbit. The API offers the developers access to data from the activity trackers as well as from the Aria smart scales. This allows the developers to access and modify a Fitbit user's data on their behalf (Fitbit, 2-8-2018). Multiple interviewees confirmed that that Fitbit offers an open API for developers. One of the interviewees explained the Fitbit openness as follows;

" From an user perspective Fitbit is open because they offer an API. With the right technical knowledge this API allows you to extract a lot of data."

Another characteristic of openness in the Fitbit platform is the possibility to connect the Fitbit hardware to different smart phone operating systems. Owners of Fitbit hardware can connect it to both Android. iOS and Windows phone devices.

However, one of the interviewees mentioned there is also a closed side to the Fitbit platform. Despite the possibility to connect to various operating systems, Fitbit does not give users the opportunity to combine their Fitbit data with data that is not collected by Fitbit devices. An example of this closedness is that choice of Fitbit to not integrate their app with the Apple Health data hub (Comstock, 11-05-2018). Regarding Fitbit ecosystem closedness one of the interviewees stated that:

" Fitbit's ecosystem is very closed when talking about input data, unless you use devices that are of the Fitbit brand. If you want to use the Fitbit platform to combine different data sources you will have to use other Fitbit devices or convince Fitbit that they have to accept these type of devices, perhaps through partnership, but this will be a very long process"

4.1.2.1 Value network analysis of Fitbit

From the case analysis became clear that over the years, Fitbit's hardware device went through some stage changes. It is therefore interesting to show the changes Fitbit went through by creating two value network analysis. The first value network analysis will be of Fitbit before their transition to a platform business model, the second of Fitbit as a platform business.

Fitbit ecosystem during wrist band products

The basis of the Fitbit value network was created when their activity tracker were still a wrist band. This value network exists out of 8 roles; 1) Activity tracker provider 2) Hardware Suppliers, 3) Software suppliers, 4) App developers, 5) Research institutes, 6) Distributors, 7) Retailers and 8) Users

1) The *activity tracker provider* here is Fitbit as they are the provider of the activity tracker hardware product. 2) *Hardware suppliers* all external manufacturers who build the necessary components for the activity tracker product. 3) *Software suppliers* have two types of actors. The first software supplier is Fitbit as they created a bespoke operating system for each separate product, the second actor for this role are the operating system for smart phones that are required to be connected to the activity tracker. 4) The only *app developer* for the activity tracker pipeline product was Fitbit. They created the apps that you could download from app stores on smart phones, no third party app were available yet (Cipriani, 16-04-2018). 5) App store provider, are Google with the Google play store for Android devices, the Apple store for Apple devices and the app store on the Windows phone provide that the app store platforms from which users can download the Fitbit app to connect to their activity tracker wristband device. 6) *Research institutes* were interested in the applicability of the activity trackers for an early stage, from the introduction of the activity tracker various different aspects have gained interest of these research institute, e.g. if activity tracker contribute to a more active lifestyle. 7) *Distributors* distributed the hardware products to retailers. 8) *Retailers* can be either online or offline retailers who sell the product to the end-consumer. 9) *Users,* provide Fitbit with product feedback by for example writing reviews

All roles and their corresponding actors and activities are summarized in table 2 and visualized in figure 2.

	Roles	Actors	Activities
1	Activity tracker provider	Fitbit	Provides that activity tracker hardware
2	Hardware suppliers	External manufacturers	Supply Fitbit with the necessary hardware to build their activity tracker wrist bands
3	Software suppliers	i) Fitbit ii) Android, Windows phone, Apple iOS	i) Fitbit created bespoke operating system for on their devices ii) Providers of mobile phone operating systems that are necessary for the Fitbit devices to be able to connect to an user's smart phone
4	App developer	Fitbit	Creates own apps for data visualization on smart phones
5	App store provider	Google play store, Apple store, Windows phone app store	Provide a app store platform from which Fitbit users can download the Fitbit app
6	Research institutes	Universities and private research institutes e.g. Hanze Hogeschool Groningen	Conduct research about technical features and medical applicability of the Fitbit
7	Distributors	IngramMicro	Importing the devices from the manufacturers and distribution to retailers.
8	Retailers	e.g. Amazon, Media Markt	Intermediary for selling the activity tracker products, providing customers with advice and customer service.
9	Users	End-consumers	Provide product feedback in the form of e.g. reviews

Figure 2 Fitbit wristband value network

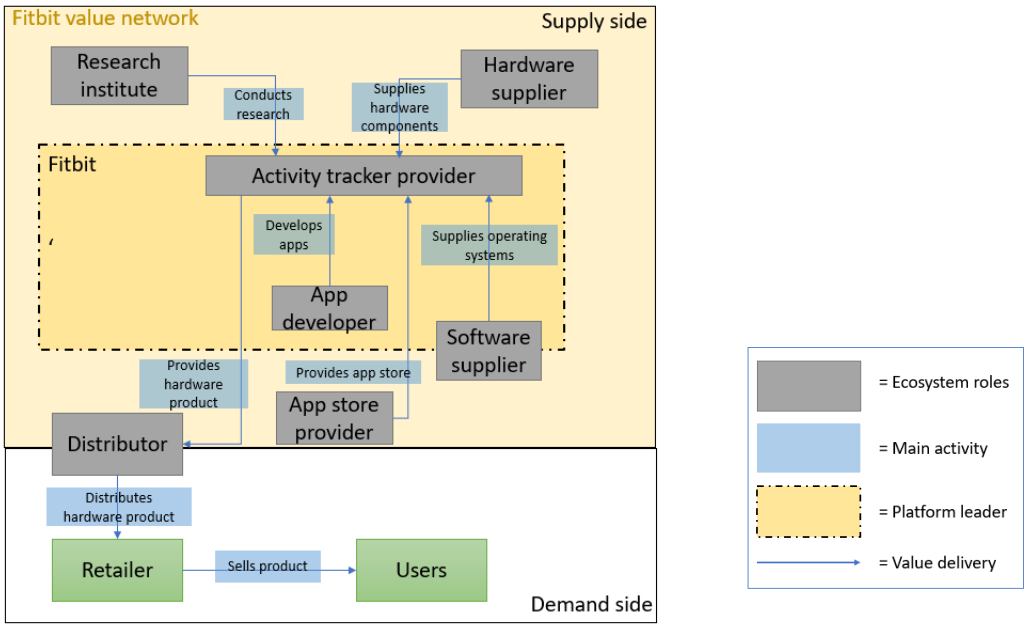

Table 3 Fitbit wrist band Roles, Actors and Activities

Fitbit ecosystem during smart watch product

With Fitbit venturing into the Smart Watch design, three more roles were added to the ecosystem. 1) Healthcare partners, 2) Fashion Partners and 3) Complementors. Also, other roles changed in terms of actors or activities.

1) Activity tracker provider changed into *platform provider.* Fitbit's hardware product now has a larger ecosystem of complementary products and services and has its own app store were third party app can be downloaded from, making it a platform product. 2) The *hardware supplier* role did not go through any significant changes. 3) By the time of the introduce
tion of the Fitbit Ionic smart watch Fitbit had created its own FitbitOS operating system that they could leverage across multiple Fitbit devices. Android, Windows phone and iOS stay the operating system that are compatible with Fitbit devices. 4) External *app developers* were also given the opportunity to create apps for the Fitbit smart watch devices. *App developers* can now be divided into two different types, the first type provides the Fitbit users with connectivity and social network platforms where they can for example share their work out or compare their activity with friends. The second type are apps created by third party developers that try to improve the users' health. 5) *Research institutes* like the Hanze Hogeschool Groningen stayed interested in activity tracker research. Fitbit is implementing scientific research into their products by for example improving their algorithms. 6) *Distributors* role did not go through any significant changes. 7) *Complementors* are a new role in the value network. Although Fitbit is not compatible with non-Fitbit devices, they do create complementary products themselves, like the Flyer wireless headphone or the Aria smart scale. 8) *Retailers* did not go through any significant changes. 9) With the introduction of the smart watch Fitbit started focussing more on healthcare, leading to several healthcare partners joining the value network. *Healthcare partners* can be divided into two types of actors. The first one is complementary service providers who create complementary services for Fitbit users like Googles cloud for healthcare which allows users to send health data to doctors, who then will be able to monitor both electronic and real-time health data. The second actor are health insurance companies who use the Fitbit device to set goals and reward clients for achieving that goals. 10) *Fashion partners* implement Fitbit's activity trackers into their own product portfolio by redesigning the hardware design, creating a new market for the Fitbit product. 11) Users create massive amounts of health data which Fitbit now uses to improve, personalize and develop their services.

All roles and their corresponding actors and activities are summarized in table 3 and visualized in figure 3.

	Roles	**Actors**	**Activities**
1	Platform provider	Fitbit	Provides the hardware product and the app store
2	Hardware suppliers	External manufacturers	Supplying hardware components such as screens, processors and sensors
3	Software suppliers	i) Fitbit ii) Android, Windows Phone, Apple IOS	i) Provides the FitOS operating system ii) Providers of mobile phone operating systems that are necessary for the Fitbit devices to be able to connect to an user's smart phone
4	App developers	i) Fitbit	i) Creates own apps for data visualization on smart phones

		ii) Thrid party developers e.g. Decom, Fitabase	ii) Create apps and clock faces as complementary services for Fitbit users
5	Research institutes	Universities and private research institutes e.g. Hanze Hogeschool Groningen	Conduct research about technical features and medical applicability of the Fitbit
6	Distributors	IngramMicro	Importing the devices from the manufacturers and distribution to retailers.
7	Complementors	Fitbit	Provides other hardware devices like smart scales to be connected to the activity tracker devices
8	Retailers	e.g. Amazon, Media Markt	Intermediary for selling the activity tracker products, providing customers with advice and customer service.
9	Healthcare partners	i) Complementary service providers e.g. Google's cloud for healthcare ii) Insurance companies e.g. UnitedHealthcare	i) Create complementary services for Fitbit users ii) Offer the hardware as a healthcare solution to their customers
10	Fashion Partners	Vera Wang, Tory Burch	Creating additional demand for Fitbit as a fashion product
11	Users	End-consumers	Providing Fitbit with data to improve, personalize and develop their services.

Table 4 Fitbit's platform value network roles, actors and activities

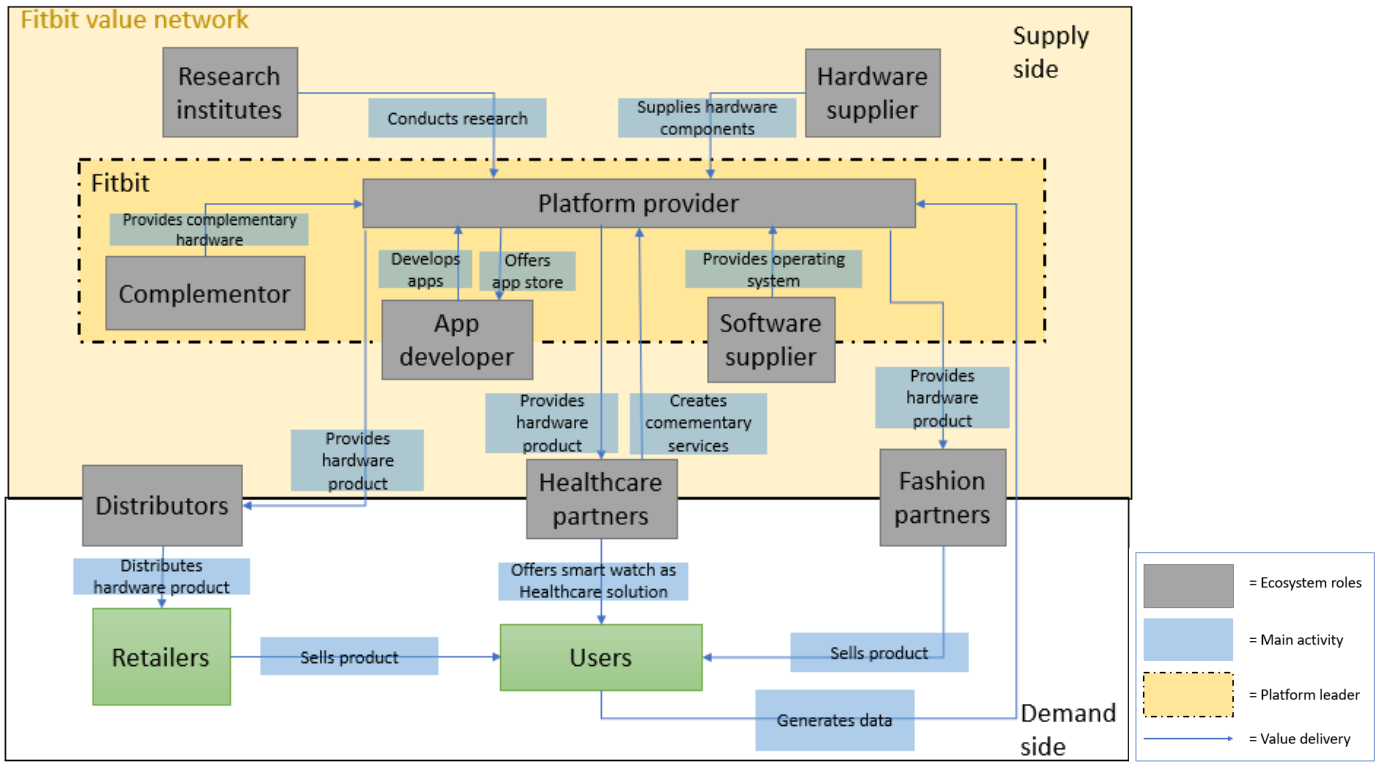

Figure 3 Fitbit smart watch Value Network

4.2. Cross case analysis

In this paragraph the results of the individual cases will be compared an analysed in terms of differences in similarities (4.2.1), direct and indirect network effects (4.2.2.) and openness and closedness (4.2.3).

4.2.1 Differences and similarities in roles

The presented cases show that both value networks have largely the same roles. Roles that are identified that have similar activities in both cases are research institutes, distributors, retailers, healthcare partners, fashion partners, app developers, hardware suppliers, complementors, software suppliers and users. However, the way Apple and Fitbit strategy in shaping the ecosystems that creates differences in how the value network looks. It can be noticed that Apple keeps five value network roles under its control compared to four roles that are under control by Fitbit. The differences that can be found concerning the diverging firm boundaries and activities will be described below.

Hardware suppliers differ as Apple makes their key hardware components like processors in house, where Fitbit purchases all the hardware they need for their product.

Complementors, have a different function because Apple with their Apple Health platform allows users to connect their smart watch device to other non-apple data collecting devices while Fitbit is only compatible with other Fitbit hardware

Software suppliers, Apple creates all the operating systems they need in-house, this concerns the WatchOS operating system as well as the iOS operating systems that are needed for the compatibility with iPhone smart phones. In contrast to Fitbit who partly creates their own operating systems. They created the FitbitOS to run on their smart watch products, after a period of creating a new OS for every product they introduced to the market. Fitbit uses the external operating systems of Google, Apple and Windows for the connection between their products and smart phones.

Users, Apple does not automatically save the health data their users generate in their own databases. Health data generated by Apple users is only available on their own devices, and Apple does not use this data to create new services. Users of the Apple Watch can turn on the “Improve Health & Activity” or the “Improve Wheelchair” settings to send their health data to Apple, in return for increase personalization and effectiveness of the health and fitness features (Apple, 1-8-2018). Fitbit does automatically save the health data generated by their users, stores it in databases and uses it to create and improve the services that they offer to their users.

Furthermore, these are two roles that are identified in the Apple value network but not in the Fitbit value network are internet service providers and complementing ecosystems

Internet service providers, the recent Apple Watch series 3 product has cellular connectivity to the internet, which means no iPhone is needed for a connection to the internet. Therefore, the internet service provider has been included into the Apple Watch value network. Users have to take out a separate subscription to internet services for their Apple Watch product. Fitbit does not have any devices with cellular connectivity up to the present day.

Infrastructure provider, this is a role in the Apple Watch value network that provides the infrastructure with other Apple products, like the iPad and the iMac. Apple has created infrastructure compatibly across all of their products, leading to a larger Apple ecosystem. The Apple Watch value network is part of this larger ecosystem, giving it’s access to other services that are offered by Apple. Fitbit does not offer such complementary hardware products like smart phones or tablets that can be connected to their smart watch product, leading to not being a part of a larger Fitbit ecosystem.

4.2.2 Indirect and direct network effect

	Apple Watch	Fitbit
Indirect network effects	Product and OS standardization Smooth Apple ecosystem hardware connectivity	Compatible with various operating systems
Direct network effects	Social effects or competing or comparing results with other users	Social effects or competing or comparing results with other users More user-data, through more users

Table 5 Direct and Indirect Network Effects

Table 5 shows that both direct and indirect network effects are present in the Apple Watch and Fitbit value networks. Because both companies were able to create a large initial user amount with the sale of their hardware product, it became attractive for app developers to create apps in the app stores. Apple uses their existing app store infrastructure to make it more attractive for both users and app developers. On the one side they make it easy for app developers that already created an app on the iPhone to translate it to an Apple Watch app, increasing the amount of app developers on the Apple Watch Platform. On the other hand Apple makes it attractive for Apple hardware users to start using an Apple Watch by guaranteeing smooth connectivity between the various devices, leading to more users. They do this for example by offering the Apple Watch users the choice to install apps that are already on your iPhone, which are also compatible with the Watch. This strategy resulted into a few thousands of apps available for the Apple Watch.
Fitbit does not have such an existing infrastructure to rely on, so they took an other approach to attracting users to their platform. Fitbit made its hardware compatible with all smart phone operating system, as activity tracker users need a smart phone to connect to the activity tracker device. This makes it attractive for users that have one of these compatible smart phones to use the Fitbit activity tracker. However, this tactic does not include a strategy that offer app developers the easiness of transferring their existing apps to the Fitbit platform, causing app development to lack behind.
Summarizing the findings on indirect network effects, Apple succeeds in creating an attractive platform for both sides of their market, users and app developers, where Fitbit's strategy lacks behind in attracting the amount of app developers to their platform compared to Apple.

For direct network effects the cases showed that both platforms include a social aspect. Both products come with an option to share your activity progress and results and compare them with friends and family, or other users in the community. This produces direct network effects because this makes the product more valuable with more users using it. What can be noticed for Fitbit is that they also use the data that is generated by their users to improve and create new services. So, when there is one extra user on the Fitbit platform, this might lead to improved services for all the users, because more data will be available. Apple does not store the data of their users, but only uses personal health data to improve the individual services after consent of the user. So although Fitbit has one extra network effect visible in their value network, it is not a distinguishing service.

4.3.2 Openness and closedness

	Apple Watch	Fitbit
Demand-side user (End user)	Closed	Open
Supply-side user (Hardware complementors)	Open	Closed
Supply-side users (Software complementors)	Open	Open
Providers (Hardware/OS bundle)	Closed	Closed
Platform sponsor (Platform leader, design & IP right owner)	Closed	Closed

Table 6 Openness and Closedness

Table 6 shows the openness and closedness strategy of the Apple Watch and Fitbit ecosystems regarding the four ecosystem roles important to accessing platform openness according to Eisenman et al. (2009). The supply-side users is divided into software complementors and hardware complementors because there is a clear distinction in the cases. In both cases the platform provider and platform sponsor role are both occupied by the platform leader company.

Toward end users the Apple Watch is closed as the Apple Watch is only compatible with the iPhone. Fitbit on the other hand does not discriminate amongst users and allows all smart phone brands users to their activity tracker platform.
Regarding hardware complementors Apple's strategy is opened. Via their Apple Health platform, they allow their users to integrate their Apple Watch health data to data gathered from other sources or sensors that are not Apple products. Furthermore, Apple allows third-party developers to create complementary app through their App Store. Fitbit handles a more closed strategy by regarding hardware not allowing Fitbit users combine their data with data from other non-Fitbit hardware products. Fitbit does handle an open strategy regarding complementary software, by allowing third-party developers to create apps on their app store.
Apple and Fitbit both use a closed strategy as platform provider and sponsor. Both Apple and Fitbit are the only ones that manufacture and distribute the activity tracker product and both companies are solely responsible for the activity tracker technology in terms of design and intellectual property rights (Eisenmann et al., 2009).

5. Discussion

This chapter contains the discussion based on the findings of chapter 4.

Platforms have become a core feature of many emerging business models and are often used in the activity tracker sector. The ecosystem of the activity tracker is crucial for the value the product is able to deliver. In a platform-ecosystem, value is created by the complementors surrounding the platform. This study used an analysis and visualization of the value network to explore the interfirm strategy in the activity tracker ecosystem with a focus on the platform leader. As platforms are multi-sided markets, value is created by stimulating network effects to attract a critical mass of both complementors and users to the platform. This research set out to study how the openness strategy platform leaders in the activity tracker market impacts value creation, by creating a value network. Although Apple and Fitbit value networks look largely the same, it is their strategy process that create differences in how they are able to generate value for their end-consumers. Different openness strategies towards the ecosystem actors have shown to create differences in how the companies are able to stimulate network effects and attract customers to their platform.

Regarding openness and closedness the difference in the two cases lies on the demand-side user and hardware complementor supply-side user. First of all, Apple's ecosystem is closed in regard to demand-side user, where Fitbit's is open. Secondly, Apple has an open strategy towards supply-side hardware complementors where that of Fitbit is closed.

On the technology level Ondrus et al. (2015) find that opening a platform at this level by making it interoperable with other platforms results in a greater (or at least equal) market potential. In this study Apple has an open strategy leading to more complementary hardware product being compatible with the Apple Watch products, and therefore stimulating indirect network effects and attracting more value to their ecosystem. On the other hand Fitbit applies a closed strategy towards supply-side platform users, and complementary hardware is only produced by Fitbit self. This results is a lower variety of available complementary products, which has a negative effect on the creation of indirect network effect and therefore less value for the customer. This lower value is related to the customers not being able to combine their data gather by their Fitbit device with other data. Therefore, for both cases the finding or Ondrus et al. (2015) can be confirmed.

At the user level Ondrus et al. (2015) find that opening a platform at the users level leads to additional users results in a greater (or at least equal) market potential. This finding is in contrast to what is found in the Apple case. Apple handles a closed strategy towards the user side, allowing only Apple users to their activity tracker platform, while Fitbit's strategy is more opened. However, Apple is in terms of market share and amount of available apps on their platform, more successful than Fitbit is. Ondrus et al. (2015) assumed that a closed platform at the user level would limit the potential to gain market share. In contrast to their study were the closedness on users level was a bottleneck because of the small amount of users the possessed the right technology, Apple already established a large amount of users in their other platform ecosystems. The closedness increases the possibility for Apple to create product and OS standardization and smooth connectivity between devices, and subsequently lead to indirect network effect for Apple. Furthermore, closedness on the user level for Apple creates high switching costs, allowing them to keep Apple users locked-in within their ecosystem. Once their end-consumers bought a Apple Watch, they make it very unattractive to change smart phone brands, as that would mean the user could not use the Watch anymore (Parker & van Alstyne, 2013). The downside to this strategy is that this might increase the users' concern of that the lock-in effect might restrain them in their future product choices (Eisenmann et al., 2009).

The Fitbit case does confirm this proposition, as the openness at the user level increased the potential amount of users that Fitbit could attract. However, to take advantage of network effects in the platform ecosystem, both sides of the market need to reach a critical mass (Ondrus et al., 2015). Fitbits closedness on the technology level might have contributed to them not being able to leverage this openness as the amount of complementary services lack behind compared to Apple. In the Fitbit case, the positive side to their open strategy is that this reduces the users' concern of a lock-in effect and the down side is the lower switching costs (Eisenmann et al, 2009).

Another striking finding of this research is the difference in the Apple and Fitbit ecosystem regarding the Apple activity tracker ecosystem being a part of a larger Apple ecosystem. This might be able to explain why Apple can apply a closed strategy towards their demand-side user, and still is able to attract enough customers to their platform. From literature turns out that this is a familiar strategy for Apple. In the book The Wide Lens (2012) Adner analyses how Apple used it's iPod ecosystem to create a new successful iPhone ecosystem. He calls this process ecosystem carryover. This is defined *as "the process of leveraging elements that were developed in the construction of one ecosystem, to enable the construction of a second ecosystem."* (p. 194). Through this research the work of Adner can be extended from the iPod, iPhone and iPad to the Apple Watch. The analyses of Adner (2012) enables this research to create a new value blueprint and to visualize how Apple uses its old ecosystem to create a new successful activity tracker ecosystem, despite having a closed strategy towards demand-side users. The value blueprint is depicted in figure 5.

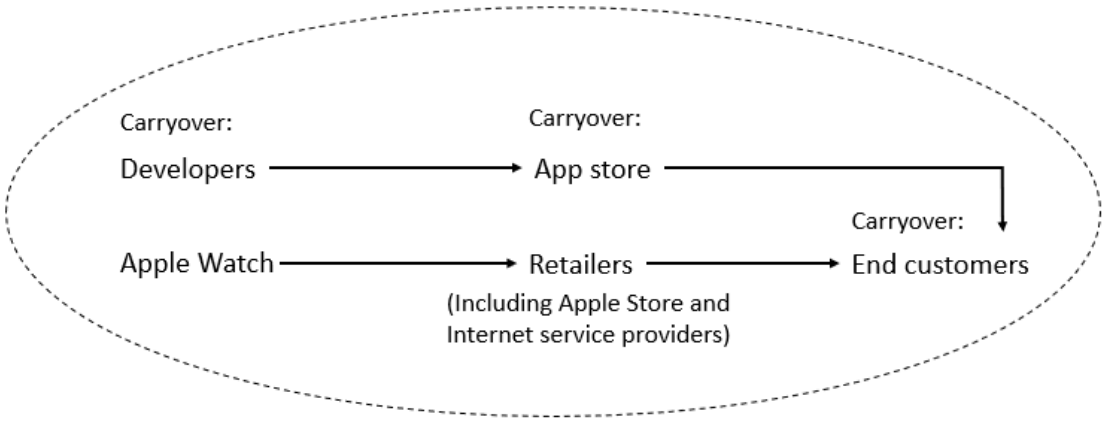

Figure 5 Value blueprint of the Apple Watch

Eisenmann et al. (2009) stated that dominant firms that otherwise are sheltered from entry by standalone rivals due to strong network effects and high switching costs can be vulnerable to an adjacent platform providers. This statement is relatable to the Apple and Fitbit case. Apple invaded the activity tracker market where Fitbit had been market leader for years, a position Fitbit was able to maintain due to high switching costs. Switching costs in this case are on the developer side, as the development costs to create activity tracker product is high and on the users side, in terms of the purchase price of the activity tracker device. Fitbit however did not harness network effects, as their product had not yet transformed to a full platform product yet. Apple was able to invade the market by offering app developers a tool that was similar to app creating for their iPhone and iPads, being able to create high supply of complementary services to their Apple Watch product. As value in a platform product lies in the amount of surrounding complementors, this created high value for Apple end-users. The merger of the activity tracker and smart phone market led to increased network effects for Apple, due to the additional functionalities and the increase in the size of the userbase.

6. Implications, limitations and further research

This chapter presents the theoretical contributions and the practical contributions and managerial recommendations based on the research. Secondly it presents limitations of the research, and finishes by giving possibilities for further research to continue the research presented in this thesis.

6.1 Theoretical and practical implications

Research on activity trackers previously focussed mainly on technical features and reasons for high abandonment rates by users, but did not recognize the role of the platform leader in this (lack of) value creation. This research contributes theoretically by creating a deeper understanding on how various strategic decision of the platform leader influence the value their product has for the actors in the ecosystem. It therefore holds value for both platform-ecosystem and activity tracker literature.

Literature on openness of platforms often treat platform openness like it is an unidimensional construct (Benlian et al., 2015). This study followed the approach of Eisenmann et al. (2009) who distinguish openness at various different levels of actor roles. This approach proved to be crucial in this research for analysing openness as the findings were not uniform on these detail levels, and therefore concurs to the notion that characterizing a platform as open without referencing to the relevant roles can cause confusion (Eisenmann et al., 2009). In this sense it theoretically contributes to the discussion of a multidimensional view on openness as a tool to measure the real-life constuct. Furthermore this research also adds to this discussion of Eisenmann on analysing openness on various levels, by dividing supply-side users in two parts; hardware and software. This means that even a more detailed distinction in roles is necessary to analyse platform openness, to be able to understand the various strategies that can be applied by platform leaders, and how this impacts network effects.

This research also theoretically contributes to the call of Ondrus et al. (2015) to extend and empirically validate their research with other complex multi-sided platforms in other industries. Furthermore, they state it is essential to understand which factors could make platforms more likely to succeed, as costly failures are made often. By discovering that ecosystem carry over could play a role in the choices for opening or closing the strategy towards the various roles, this work might improve the decision model that they propose as an assistant in decision making concerning the opening of a platform. In terms of ecosystem carryover this research contributes by extending the analysis of Apple by Adner (2012).

Practical implications for this research are for managers who are trying to maintain or targeting the position of a platform leader. This work might create clarity on the issue of strategic decisions on openness and how they affect the possibility to attract customers or complementors to their platform. Being able to make better understanding and therefore more informed decisions, which could contribute to better firm performance. Recommendations for managers are to analyse various possible strategies on their potential to attract both sides of the markets. To do so managers could use the five levels of actor roles proposed in paragraph 4.3.2 of the thesis. Assessing the platform openness on these levels could provide a tool to determine the effect that a certain strategy has on the possibility to attract both sides of the market and therefore stimulate network effects, and create more value for their platform product. There is no best practice as every company and every ecosystem is different, but by being aware of to which roles the company's and the competitors offering is open or closed, can contribute to a better understanding of the market, and therefore lead to better decision making.

6.2 Limitations

The first limitation of this research concerns the case studies. There is a possibility that some information about the companies was not available on the used sources, leading to inaccurate or incomplete information. Another limitation related to the case studies is the number of expert interviews that were completed. More interviews might have might have revealed more and new information on the case study companies. Furthermore, a predominant part of the interviewees were experienced in the field of human movement or healthcare sciences. The interviewees answered all the questions to the best of their knowledge, however as this research is more business focussed, some of the question might have been outside of the expertise of the interviewee.

Furthermore this research aims to understand value creation based on various platform characteristics identified in literature, but does not take into account value that can be influenced through other ways, like for example value propositions or revenue streams as identified in the work of Tura et al. (2018).

6.3 Further research

In existing research is found that users of activity tracker devices abandon the device as it does not offer enough value for the end user. These researches however mainly used activity trackers in the form of wrist band and do not use smart watch activity tracker devices as unit of analysis yet. From this research turns out that with the transition of wrist bands to smart watches, more partners are attracted and allowed to create value on the smart watch platform for the end users. Further research might focus on if there is also a high abandonment on Apple Watch and Fitbit Smart Watch devices or if the companies have accomplished to create more value. It looks like the change in value creation logic leads to additional value for the end user, as sales rates of smart watch devices are promising.

As this study has an explorative purpose, more research on other activity tracker platform-ecosystems in necessary to validate the findings of the value networks of the case studies in this research. As literal replication in was found, it might be possible to create a generic activity tracker platform ecosystem. Creation of a general activity tracker value network may subsequently be combined with existing generic platform ecosystems (e.g. Ehrenhard et al., 2014; Nieuwenhuis et al., 2018) which might contribute to a deeper understanding of value creation in platform ecosystems in general.

This research found that Apple was possibly able to maintain a closed strategy toward end-users by using ecosystem carryover. Further research on platform-ecosystems might focus on companies who use a carryover strategy in combination with strategy on openness. It might be interesting to understand if the situation in this case study is unique or whether there are patterns in the platform strategy a company applies, and which strategy towards openness is applied in combination. For example, do other companies that enter a market through carryover, also use a closed strategy towards demand-side users. This offers a possibility for quantitative research on strategy in platform ecosystems, and might create a best-practice strategy for platform leaders in deciding for which roles to open or close their platforms when entering new markets.

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Appendix A Case study search terms

Database	Search terms	Titles	Article date	Source	Author
LexisNexis News	Activity tracker	Watch'how your daily activity gets monitored	27-04-2018	The Star Phoenix	Jill Barker
	Apple Watch	A major update to the Apple Watch might be coming later this year - here's what we're expecting	20-04-2018	Business Insider	Business Insider
		Third-party faces might be more of a curse than a blessing for Apple Watch	16-04-2018	Macworld	Michael Simons
		watchOS 4.3.1 Beta Hints at Future Support for Third-Party Apple Watch Faces	16-04-2018	Macrumors	Tim Hardwick
		Fitbit Versa vs Apple Watch Series 1: Which budget smartwatch is right for you?	16-04-2018	Macworld	Michael Simons
		Apple Watch: What does the future hold?	02-03-2018	Macworld	Dan Moren
		5 ways Apple can stop developers from abandoning Apple Watch	07-02-2018	Macworld	Michael Simons
		Can the Apple Watch work without an iPhone?	30-11-2017	T-Break tech	Gary Marshall
		The Apple Watch has a secret weapon that helps it dominate the market	04-05-2018	CNBC	Tonya Riley
	Fitbit	Fitbit Adds Genuine Thermos® Brand to its Growing Roster of Works with Fitbit® Partners;	21-10-2015	Fitbit	Business Wire
		Wirecard's Boon Mobile Payment Solution Now Available on Fitbit Pay	24-04-2018	PaymentsAfrica	Staff reporter
		Fitbit Gains on Pact With Google Cloud for Health-Care Push	30-04-2018	Bloomberg	S. Wang & M. Bergen
		Google, Fitbit Partner For Healthcare Services	01-05-2018	TeleAnalysis	TA Staff
		Fitbit and Google Announce Collaboration to Accelerate Innovation in Digital Health and Wearables	30-04-2018	Fitbit	Business Wire
		Fitbit Unveils Apple Watch Clone And Fitness Tracker For Kids	13-03-2018	CBS Chicago	CBS Chicago
	Apple Watch AND Partners	-			
	Aple Watch AND Ecosystem	-			
	Fitbit AND Partners	-			
	Fitbit AND Ecosystem	-			
LexisNexis WebNews	Activity tracker	Fitness Tracker Market – Technology Breakthroughs & New Opportunities by 2025	15-05-2018	Garner Insights	Garner Insights
		Fitbit Gets Into the Diabetes Business	03-05-2018	Diabetes Self-Manage	Joseph Gustaitis
		Apple Watch can earn you money from just walking	07-03-2018	Cnet	Abrar Al-Heeti
	Apple Watch	Instagram joins parade of major apps to abandon Apple Watch (AAPL, FB)	03-04-2018	Business Insider	Jim Edwards
		Apple looks to wean itself off Samsung	19-03-2018	Techcentral	Agency staff
	Fitbit	Google And Fitbit Partner On Wearables Data Options	07-05-2018	EMR & HIPAA	Anne Zieger
		Fitbit adds Quick Replies to its smartwatch platform	07-05-2018	Engadget	Daniel Cooper
		Fitbit Rolls Out New Digital Health Apps with its Partners to Improve Overall Health	05-07-2018	Hit consultant	Jasmine Pennic
	Apple watch AND Ecosystem	UnitedHealthcare adds Apple Watch to Motion employee wellness program	06-03-2018	Mobi health news	Jonah Comstock
	Fitbit AND Ecosystem	DIGITAL HEALTH BRIEFING: Fitbit unveils new health solutions — Allscripts strengthens patient pl	07-05-2018	Business Insider	Laurie Beaver
	Apple watch AND Partner	-			
	Fitbit AND Partner	Fitbit announces new partnerships, focus on chronic disease management, overall health	07-05-2018	Mobi health news	Laura Lovett

Scopus	Activity tracker AND Apple Watch	-			
	Activity tracker AND Fitbit	-			
	Apple Watch AND Ecosystem	Assessing the Value Blueprint to Support the Design of a Business Ecosystem	2015	In International Confer	Almeida et al. (2015)
	Fitbit AND Ecosystem	-			
	Apple Watch AND Partner	-			
	Fitbit AND Partner	-			
Above Avalon	Apple Watch	Apple is going after Fitbit	06-10-2016	Above Avalon	Neil Cybart
		Apple Watch Is a Bridge to the Future	23-1-2018	Above Avalon	Neil Cybart
		Apple's Growing Bet on Hardware	20-12-2017	Above Avalon	Neil Cybart
Google	Fitbit partners	Fitbit partners	27-07-2018	Fitbit	Fitbit
	Fitbit Operating system	Why Fitbit Avoided Android Wear and Built Its Own OS	03-08-2017	Tom's Guide	Cailtin MaGarry
	Fitbit AND Hardware	A hard pivot: Fitbit repositioning from wearables to Healthcare platform	26-02-2017	Digitial Innovation and	LiDE
	Fitbit strategic focus	Fitbit CEO James Park talks about the company's past, present, and future	16-04-2018	ZDNet	Jason Cipriani
	Activity tracker timeline	Eight years of Fitbit news leading up to its planned IPO	11-05-2015	Mobi health news	Johan Comstock

Appendix B Guideline interview questions

Introduction

1. Could you tell me who you are, what your current function is and what your educational background is?
2. How do you encounter with activity trackers (on a daily basis)?

Roles in the ecosystem

1. Could you give a description of what partners there are in the activity tracker ecosystem/network?
    a. What partners do Fitbit/apple need to bring their product to the customer
    b. Upstream suppliers / Downstream complementors
    c. What are the crucial roles?
2. Are there parties that are not direct partners but rather indirect partners that are also important to value creation in the ecosystem?
3. What is the relationship between the different partners? Hoe do they together provide value for the end consumer?

Changes in the ecosystem

1. Would the description of the ecosystem you gave be different if you had to give this description 4 years ago?
    a. Different functions?
    b. Where are these changes coming from
    c. Changing roles?
2. Do you expect the ecosystem to change again in the coming four years?
    a. What roles become more important?
    b. What roles will disappear?

Network Externalities

1. Which functionalities make that more people buy an activity tracker?
    a. What caused the explosive growth in market share of Apple?
2. Which functionalities make the product more attractive for for example app developers?
3. What can you say about network effects in the ecosystems of Fitbit and Apple?
4. What impact do network externalities have on the ecosystem?
5. Do these network externalities get stimulated of discouraged by the platform owner?

Openness

1. What can you tell about the openness of the Fitbit ecosystem? To what extent does Fitbit let external parties build products/services on their platform?
2. What can you tell about the openness of the Apple Watch ecosystem? To what extent does Fitbit let external parties build products/services on their platform?
3. What is the impact of this openness/closedness on the value creation in the ecosystem?