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Value creation from an In-Vehicle Infotainment Perspective: A Case Study

Bachelor of Science Thesis in Software Engineering and Management

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Abstract

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Infotainment in the automotive industry is moving to a new level with different customer expectations and a demanding market. This paper set out to investigate what values that could be added by using a infotainment platform with these characteristics. This is approached with a case study at a big automotive company. The study presents which values that could be created by using a new infotainment platform. The paper serves as a report to give a view of values that can be created by using an open source infotainment platform in the automotive industry.

Keywords: *In-Vehicle Infotainment, Open Innovation, Value Creation, Volvo Car Corperation*

1 Introduction

The automotive infotainment industry is currently pressured by the demands from customers' expectations of the same functionality of their infotainment platform as they currently have in their smart phones (Macario et al., 2009). While there are several platforms that may be used in that fashion, this study focuses on one such platform. The open source platform MeeGo (MeeGo, 2011) is thus used to investigate the value creation that a platform may provide for an automotive company. According to West (2007), a relating element to recent abstract of a business model is value creation. Value creation can help with identifying customer segments and values related to them, also the way a business model can provide this.

Research has started to recognize how open innovation provides one such new opportunity (cf. Chesbrough, 2004; Morgan and Finnegan, 2008). According to Tapscott and Williams (2005) it is hard for companies to reach these new demands by using their internal innovation and therefore open innovation could be a suitable approach. So companies look for ways to bring the latest technological breakthroughs into products. Thus, open innovation may become part of research and development in two ways (Chesbrough, 2004). One, use external ideas within the company. Two, use external ideas and feed the results back to the market. For the automotive industry, infotainment platforms are in a position to support open innovation by for example allowing end-user development of applications. This is already done in several mobile phone platforms such as, Android[1] and iPhone[2]. The two following motives thereby acted as foundation for this study: the advances in mobile and infotainment platforms, and open innovation as a means for creating value.

This study used a literature review to define specific aspects of value creation related to what MeeGo (as an open innovation platform) may provide for Volvo Cars. Three aspects of value creation are defined through this: (i) product value, (ii) customer perceived value and (iii) relationship value. Using an exploratory case study (Easterbrook et al., 2008). These aspects of value creation are used to answer the question; *which values may be observed by assessing the potential of an open innovation based platform in the automotive industry?*

The contribution applies in two ways. From a practice perspective, which values could be captured by using an open innovation platform such as MeeGo in the automotive industry and more specific in Volvo Cars. From a research perspective, which values assessed can be applicable in the automotive domain.

The paper is organized with the following sections: section II presents the related work of the paper, section III explains the research method, section IV addresses the results, section V discuss the collected data with the problem, section VI concludes the paper and present the contribution done in this paper.

2 Related Work

Different motivations can exist for companies based on their needs and the innovation they are adopting. These motivations are also from the characteristics of the addressed innovation, which provide value creation for the companies and

[1] Android is a mobile platform developed and maintained by Google.

[2] Iphone is a mobile phone manufactured by Apple and uses their own developed operating system iOS.

the customers (Morgan and Finnegan, 2008). Also, there are values to improve the efficiency of business processes. On the other hand West (2007) brings up the customer expectation of a rich product as a value, where the ability for customization, integration, and support are important to the customer. Another value is the ability to shape the product based on the market needs. Since the mentioned researchers focus on open source software, there are aspects such as quality, reliability, security and performance which are considered to facilitate value creation. In this study considering an open source platform, existing values that are defined are customer values, development values, cost values which further on the study which have narrowed down (Morgan and Finnegan, 2008).

Morgan and Finnegan (2008) investigate the value creation, value capture, and value network for companies while adopting an open innovation and in this case open source software. Based on MeeGo being an open source platform, the study is built on this existing literature while focusing more on specified values concerned by a car manufacturing company. In this section related work about the topics value creation, value capture, value network and value chain and open innovation is presented.

1 Value Creation

Based on Barney (2007) a firm has a profitable revenue stream when value creation occurs. One way to create value is time to market. When a product is released in a time duration accepted in the market and with an acceptable quality among competitors, there is a time to market value created. Both the company and the customers can gain benefits from this value. However the high speed nature of software technology introduction causes the companies to adapt their production flow to that speed. Thus time to market as a value to the companies is revealed from another dimension. Nevertheless, value creation becomes an important factor when the product development process becomes as important as the product itself.

There are three different values defined according to Barney (2007). (i) Product value which is the advantage of the developed product, comparing to the same products in the market. While creation of products, services and processes from a software development perspective can create values (Biffl et al., 2006). (ii) Customer perceived value however, is influenced by the customer's needs and expectations from the product. The product should be able to fulfill those expectations for a reasonable price in order to produce profit for the customer. This means that the product should create the same amount of values that the customers are paying for (Barney, 2007). (iii) The third definition, relationship value, is the relationship between the customer and the company (Barney, 2007). Messerschmitt and Szyperski (2004) illustrate how software companies may derive added value when the product can add up to the customer's requirements while creating values for the company in the market. On the other hand and based on Song et al. (2005) a company by means of data from individual customers and building relationship based on those data, can improve its marketing policies and achieve measurements to attract new customers while keeping the old customers of the company. Companies can increase profits and eventually create values by keeping a steady and consistent flow on this relationship. Ramzan et al. (2009) also define the value for software companies based on the fulfillment of requirements. According to Messerschmitt and Szyperski (2004) and Ramazan et al. (2009) stakeholders, like customers and companies, have an important role in value creation. This definition exists based on the Barney's resource-based theory(1991).

Regarding different products based on previous studies and since there is uncertainty both in technical and market aspects in value creation, it is not easy to predict a precise value creation process for different companies (Chesbrough and Rosenblum, 2002). However, mapping between the economic and technical domains can provide possible ways to create value. For example if a company chose to use a new infotainment platform other than their own in-house developed system, both the economic and technical aspects of this change should be considered. An impact on the economy of the company can be visible due to changes in development cost caused by the new platform. This is a result of change in development process.

2 Value Capture, Value Network and Value Chain

Morgan and Finnegan (2008), defines value capture as the ways values are extracted from the value creation. Value chain on the other hand, is partially considered as the relationship between the customer and company or suppliers, while value network has the description of company, the third party companies and surrounding elements related to them (cf. Morgan and Finnegan, 2008; Chesbrough and Rosenbloom, 2002). This description matches with the third type of value defined by Barney (2007). According to West (2007) and previous studies, value creation, value capture and value network are considered as three base aspects of the business model. A business model should also explain how a company could capture values from the value creation.

3 Open Innovation

Open innovation is the activity to use external ideas internally in a company(Chesbrough, 2004). This innovation could be both inside-out or outside-in, which means that innovation works both ways. A company can either bring in external ideas or take out internal ideas to other companies or to the general market. For example an automotive company can bring in an innovation by using an external infotainment platform. Tapscott and Williams (2005) also explained that earlier innovation happened inside the business but Chesbrough (2004) describes that a paradigm shift is going on, and closed innovation is moving to open innovation. The open innovation must use external ideas to be called open, but this could work in two ways, either you bring the idea in to the company or you bring your idea to the market. Of course

these two approaches could be joint together when a company bring an external idea and share the work afterwards to the market. For instance a company can develop their infotainment system by means of an external innovation and after customizing it they can share it within the automotive industry. West and Gallager (2006) identified three fundamental challenges for firms applying open innovation, “finding creative ways to exploit internal innovation, incorporating external innovation into internal development, and motivating outsiders to supply an ongoing stream of external innovations” (West and Gallager, 2006:391). Though it should be noted that open innovation does not have a connection to open source, an external innovation does not have to be an open source software.

4 Systems

This study targets In-Vehicle Infotainment(IVI) and Mobile platforms in order to capture values created by them and investigate how they could be applicable for an IVI platform. For mobile platforms the researchers have chosen to use iPhone and Android, the reason is to give a broad span of mobile platforms. In the IVI segment the study look into Ford Sync, MyFord Touch, iDrive, IQon, Sensus. Sensus is the infotainment platform for Volvo Cars, further on in the study it is referred to as Volvo current.

Mobile platforms

With the fast growing pace of mobile phone usage the phone related industry is rushing to keep up with the same speed to fulfill the customer expectations(cf. Oliver, 2009; Lin and Ye, 2009). This paper aimed to bring the attention to two main competitors of this field, iPhone iOS and Android. Each of the two have their own characteristics and specifications.

There are advantages to open source platforms like Android as mentioned by Cho et al. (2010). According to related studies the openness of the platform gives the pool of developers freedom and this saves time and cost for the company by reduction of development duration. This leads to lower cost of the platform which can rise the number of customers. Also, Android application developers can access the system core applications and all the API’s and the user can choose to permit the developed application’s access to the data from other sources(cf. Yu and Liu, 2010; Butler, 2011). Unlike Android iOS with quite limited access of outside developers, gain other advantages such as control over the platform and also the ability to sell the product. But on the other hand the user has no control over the access of application to the system resources which are set by Apple. The two mentioned platforms provide the consumers with the "AppStore" and "Android Market". The difference can be seen where Apple controls the application publication strictly and Google has the open publication of applications without any reviews(cf. Cho et al., 2010; Butler, 2011). On the other hand a disadvantage with openness of "Android Market" is that the quality of the applications are not guaranteed to be high and it is up to the user to find a high-quality application (Butler, 2011).

The revenues in smartphone industry comes from customers and goes up to service providers, device vendors, application developers, and content providers. The closed OS on the iPhone leads the stream of this revenue to Apple by full control on the device, applications development, and the content while the iPhone OS is highly dependent on its hardware (cf. Lin and Ye, 2009; Oliver, 2009).

In-Vehicle Infotainment platforms

Although, according to Macario et al.(2009) the customer expectations of In-Vehicle Infotainment are moving towards specifications and functionalities of what smartphones has, there are some characteristics based on previous studies. These characteristics are mainly having their focus and concerns on the driver distraction but they also mention the specifications of an in-vehicle infotainment system.

Wheatley’s (2000) discuss some of the challenges to put in consideration while developing an IVI. These challenges are based on the user safety and at the same time a comparison to the desktop systems. Where the usability of the system regarding the interaction of the driver to the system is important, putting thoughts in the ease of use and operational environment is another aspect of infotainment systems in vehicles. There are also several factors to deal with like the consistency of the systems which the user has interaction with. In this study the case is the consistency of the user interface between the smartphone and the infotainment system in the car. Another important factor is the use of voice and touch controls instead of buttons, like in a desktop computer. On the other hand according to Wheatley the cost and user value which relates to the functionalities are based on the customer expectations.

In addition to the user safety and taking into account the fact that customers of the automotive industry’s demands get more close to usage of communication and information tools in their cars, the product development time and cost reflections of the product are in a high level of importance to the automotive industry (Boehm-Davis et al., 2003).

The coming paragraphs are short introductions to the systems used in this study. MeeGo is a collaborative project between Intel and Nokia based on a Linux platform (Haddad, 2011). MeeGo is a platform that supports several devices like Smartphones, Netbooks and In-Vehicle Infotainment. It has characteristics similar to Android and iPhone and it is an open source initiative with third party developers involved. The licensing policy of MeeGo gives the acqurirer the opportunity to use the software and develop on the top layer of the platform. This means that the acqurirer will have full control of the system developed and could make it a proprietary product. However, Meego is open source and it is following the GNU licensing (MeeGo, 2011). MeeGo IVI platform supports features like touchscreen, speech recognition, text-to-speech and technologies like support for social communication and customer customization (cf. Haddad, 2011; Schroeder, 2010; MeeGo, 2011).

Other elements discussed further on in the paper are as the following, (i) Ford Sync is an infotainment platform developed on Windows Embedded Automotive(WEA) and supports for example speech recognition, text-to-speech and button interaction. (ii) MyFord Touch is an infotainment platform built upon Ford Sync and uses the same base which is WEA. An

additional feature is that the platform has touchscreen interaction (Ford, 2011). (iii) iDrive 4th generation is BMW newest infotainment platform which supports button and voice interaction. (iv) IQon is an infotainment platform built upon Google Android by Saab, it is a prototype and is not yet released. IQon has third party support and touchscreen interaction. (v)Android is a mobile platform developed by Google and is adapted by a big range of mobile phone manufacturers such as HTC, Sony Ericsson and Samsung, (vi) iPhone is a mobile phone manufactured by Apple, the operating system on iPhone is called iOS and has third party support, touchscreen. The biggest difference from Android is that Apple both manufacture the device itself and develop the operating system.

3 Research method

There are essential aspects in selecting a research method such as available resources, access to subjects and opportunity to control the variables of interest (Easterbrook et al., 2008). The researchers were provided with interviewees from Volvo Cars. The important values that were interesting to the addressed company were extracted, while there were defined values in hand based on the literature. In order to understand the phenomena of open innovation and define the values in theoretical terms to clarify our understandings, structured questions are used. The results from interviews provided the study with evidence that are measurable and the related work with evidence to prove the validity of the measures (Easterbrook et al., 2008).

There is an intention to investigate how value creation with an open source software occur in a real life context. By this investigation, proposition are derived and the researchers chose to use a case study method (Easterbrook et al., 2008), where Volvo Cars acted as the case of study.

To be able to get proper data in the study, it was important to define the unit of analysis and data sources before choosing the data collection technique (Easterbrook et al., 2008). Since the field of this study is categorized in software engineering group, the unit of analysis was a team of developers Volvo Cars. This team contained both developers and managers in contact with the system of analysis.

1 Research process

The research process of this study was splitted into four phases, which are (i) define values from previous work, (ii) elicit elements and constructs for the repertory grid, (iii) perform repertory grid with the identified elements and constructs to collect data and perceived values within the elements, (iv) discuss the data from phase three and connect this to the related work from phase one. This process gave the study both a structured way of working as well as a good structure of the paper.

First a literature review on related and previous work is presented to extract values from value creation and open innovation research. After this the researchers elicited elements and constructs from personnel provided by Volvo Cars, the reason to thiswas to provide the study with relevant constructs for Volvo Cars. The elicited elements and constructs were set as part of the repertory grid performed at Volvo Cars. Volvo Cars provided the researchers with six interviewees that this study perform repertory grid on, the repertory grid has been done both in face-to-face interviews and in a web-based form.

2 Data collection

We used a repertory grid technique to collect data from Volvo Cars. The repertory grid helped the study to collect data on how different infotainment platform potentially can create value (Tan and Hunter, 2002). The repertory grid technique was structured in the following way. First, two interviews were used to elicit the constructs for the grid. The first interview was used to come up with the core of the construct and the second to evaluate these constructs and add more necessary constructs. Secondly, three interviews were performed where the interviewees ranked the different constructs of the different platform called elements on a scale of one to five. Our data collection method, repertory grid with a statistical nature, can be considered quantitative. However semantic reviews on the result of the analysis leads to qualitative analysis. Thus the fact that the developers perspectives have direct influence on the data, this study tend to have an interpretative theme (Seaman, 1999).

3 Data analysis

Based on Seaman (1999) there are two methods to analyze the data. The hypotheses can be grounded in the data or evidence can be built in order to confirm the hypotheses. In this study the value creation with open source software was grounded in the data gained from the developers at Volvo Cars.

The values definitions statements were extracted from the data. With refinement and modification on those statements and establishing relationships, a description of the value creation in adopting open source software was provided (Seaman, 1999). The analysis of the data started simultaneously with the data collection (Seaman, 1999). The questions of the interviews were categorized with specific domains based on the values defined by elicitation using repertory grid technique. In the analysis phase the same domains were used as labels to the collected data. Afterwards discoveries on the value definitions and creations which are based on the data, were noted by the researchers. Seaman (1999) calls these notes as field memos. The data is also analyzed to find similarity in the patterns based on the area of concern. In this stage the field memos were used to base the patterns on and also as reminders to relate to later on (Seaman, 1999). Where as more described in Analysis and Discussion section the patterns consists of construct poles of grids and aspects related to literature.

In this study a tool called WebGrid5 was used for analysing the repertory grids, this is a quantitative approach of analyz-

ing the data. However, the collected data in WebGrid5 were analyzed in a qualitative manner to see the connection between the different elements and constructs. This is further explained on a lower level in the Result section.

4 Result

This section presents the data collected from the repertory grid. The constructs were elicited from an expert at Volvo Cars and proved by interviewee number two. The result is extracted from the interviews in the second stage in the interview process. The interviewees in the results, are refereed to with numbers.

Stage one of interviews consist of interviewee one and two, where most of the constructs were elicited from interviewee one. The constructs are related to the elements mentioned before (Sensus, iPhone, Android, MyFord Touch, Ford Sync, iDrive, IQon). Figure 1 is the construct elicited from interviewee one and figure 2 is elicited from interviewee two.

Open system, add functionality	Closed system
Open App-system	No expansion for the customer
Price worthy for the customer	Less price worthy for the customer
Easy configurable home screen	Static home screen
Self-fulfillment	Basic needs
Surprise and delight	What you expect is what you get
Low degree of third party support	High degree of third party support
Low degree of tool support	High degree of tool support
Positive feedback	Negative feedback
Image-enhancing	Undistinguished
Polished	Unfinished
Integrated connectivity	Stand-alone system
Smartphone interaction(voice and touch control)	Button interaction
Style established	More of the same
Extending platform	Working from scratch
Exclusive accessories	Standard equipment
Short Pre Implemention time	Long Pre Implemention time
Simple to understand	Hard to understand
Integrated environment	Disparate functions
Stylish	Plain
Fast in response	Slow
Proprietary format	Branch Standard
Free and available	Supplier negotiation
Differentiated customer offer	One size fits all
High production cost	Low production cost
Rapidly developed	Intensive development
Great support of filetypes	Limited support of filetypes

Figure 1: Constructs elicited from interviewee one

Easy configurable home screen	Static home screen
Short Pre Implemention time	Long Pre Implemention time
Simple to understand	Hard to understand
Great support of filetypes	Limited support of filetypes

Figure 2: Constructs elicited from interviewee two

Stage two is the result from the interviews with interviewees three, four, and five to eight. The first two interviews in this stage is presented individually, these interviews were performed face to face and the interviews were recorded. The remaining four interviews, interviewee five to eight is presented as a group and the data were collected through a web form. This will give the study a broader understanding of all the elements because the interviews presented as a group contains more elements and the interviewees in the group represent different roles in the company. The interviewees however were asked to do the grids based on the systems that they knew best or had experience working with.

1 Analysis

The process of analyzing the result is done by using a web based statistical analysis tool called WebGrid5, where the tool was fed by the data from the interviews and the result was further more presented in form of cluster based on the FOCUS cluster algorithm(Tan and Hunter, 2002).

In order to get sense making groups of constructs from the statistical result of the WebGrid5, we chose to set two filtering rules and apply them to reach the preferable result. These group constructs can refer to the field memos mentioned in section 4.3. Since the relations that the tool defines may contain unrelated constructs, the researchers remove the groups of the constructs that are relevant by reviewing and after setting the cutoff boundary of the cluster. As shown in the figures the lines connecting the constructs are showing the cutoff boundaries. The readers must be aware that the WebGrid5 tool change the order of the elements and constructs based on the result, so they differ in each figure. While the cutoff boundary is set to 100 there are some groups defined which based on the filtering rules will be defined. These filtering rules consist of first purifying the result by decreasing the cutoff boundary from 100 to 90 and then to 80.This gives different group constructs in each level, as moving from the highest which is 100 to the lowest which is 80. The second rule is to continue until 80 as the cutoff boundary to be able to define the unique constructs that are not in anyway related to the other groups. This will be more clarified while analyzing the actual result. The phase explained below is the process of reviewing and group selection and naming the constructs, based on the mentioned rules. The naming is done to provide the reader with a clearer picture of what the groups describe and the naming of the constructs explains all the constructs in the group. Next section is dedicated to present examples on the most relevant group categorization.

2 Group catagorizing

The second interview stage consists of two individual interviewees and four other which has been grouped together for a broader perspective. It should be mentioned that the first two interviewees have done the grids based on their domain of knowledge on iPhone, Android, and Volvo current system. Their interviews have been in person and with tools for audio recording. However the group of the four other interviewees have done the grids in a web-form and with additional elements from the previous interviews, these are MyFord Touch, Ford Sync, iDrive gen 4, IQon. This is a result of the selected interviewees knowledge of the systems. The group construct are named in the following way, for example (GC1:1) GC stands for group construct, 1 for the number of the group construct and the next 1 for the interviewee identifier.

(GC1:3)«Holistic support»

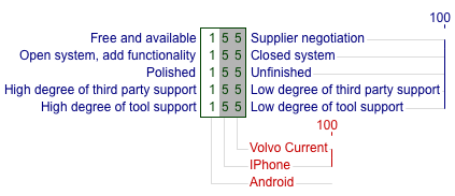

Figure 3: (GC1:3)Focus grid holistic support

The above grid is the perceived value creation of holistic support extracted from interviewee three in stage two. This explains the characteristics of the three systems. As visible in the grid Android has a higher degree of third party support and tool support, it is also explained that Android feels more polished than the other two systems. Based on the motivation of the interviewee iPhone is considered unfinished because it uses its own technical specifications and not the branch standard.

(GC2:3)«Trend-setting & Appearance»

Figure 4: (GC2:3)Focus grid trend-setting and appearance

Figure 2 explains the trend-setting ability and appearance of the systems, as seen iPhone and Volvo's current system has exactly the same rating. This means that the interviewee perceive Volvo being likewise trend-setting and style established as iPhone this because of the HMI of Volvo's system. Android is considered being more at the other side of the grid which means that Android was perceived by the interviewee as a system that is a smart-phone platform with the same characteristics as iPhone. According to the interviewees argument, since Android is adaptable for different devices it is hard to chose the minimum or maximum rating.

(GC3:3)«Integration & Feedback»

Figure 5: (GC3:3)Focus grid integration and feedback

The constructs in figure 3 are considered in the same group since the positive feedback is based on how integrated the environment is. All three system is considered being integrated and has received positive feedback at the release according to the interviewee. However, the interviewee mentioned that Volvo current system has a high learning curve but when the customer familiar itself with it, it is easy to use.

(GC4:3)«Price worth & Expectations»

Figure 6: (GC4:3)Price worth and expectations

Figure 4 focus on the group related to customer expectations and presents the price worthiness of the platforms. As shown in the figure all platform has a rating that is in the middle for the mentioned constructs which means Android and Volvo current have an normal state in this aspects. It can be noticed that a platform that fulfills the customer expectations it is worth the cost which the customers spend.

(UNI3)Unique constructs interviewee three

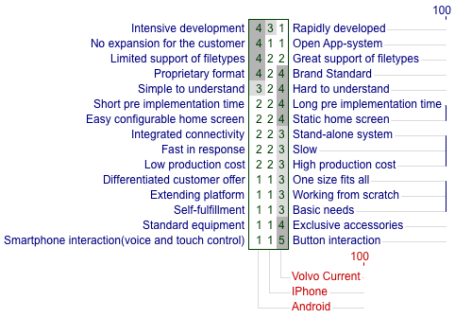

Figure 7: Unique constructs

The above figure presents the constructs that are unique and don't seams to fit together in the same sense that the earlier group constructs does. It can be seen though that Android and iPhone is similar from the construct pre-implementation time and the rest constructs coming under that. The pattern is visible considering the ratings for each of the mentioned platforms. This can tell that these two platforms are very much alike. The platforms are not alike regarding how they support file types and expansion for the customer but in the rest of these unique constructs they are very much alike.

(GC1:4)«Development tactic & Integration»

Figure 8: (GC1:4) Focus grid development tactic and integration

This derived group construct explains the development tactic and the level of integration of the systems. «Extending platform – Working from scratch» and «Integrated connectivity – Stand-alone system» being the two construct grouped together. The conclusion that the researchers can draw by this is that because iPhone and Android being to the left side against extending platform the developers of these platform will have more time to integrate connectivity into the platforms. Furthermore, Volvo Current is in the middle on both aspects in this group construct meaning that Volvo Current is not an Extending platform nor a platform you have to develop

from scratch. Another conclusion you could draw is that if the platform is to the left side to extending, it could be easier to extend the platform with connectivity such as other devices.

(GC2:4)«Openness & Integration»

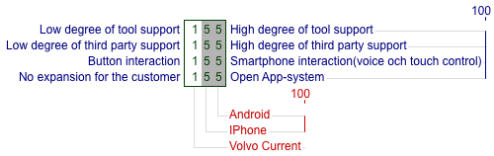

Figure 9: (GC2:4) Focus grid openness and integration

As it is presented in figure 9 iPhone and Android have completely the same values, these two has both a value of five to the right side in this group construct. This means that iPhone and Android are considered to have a high degree of both tool and third party support based on interviewee. These two platforms are both open platform in the sense that they have an "App-Store" and “Android Market”. This gives that the platform also have an higher degree of support from both tools while developing and from third parties. Furthermore about the interaction with the platforms, it should be noted that because iPhone and Android are smartphones it would be strange if they were not on this side of the construct. Thus, this gives the picture how far Volvo stands from the touch and voice control interaction at the moment. And also, the degree of tool and third party support is low because the system is closed, which shows the interviewees opinion on closed system of Volvo.

(GC3:4)«Configuration & Openness»

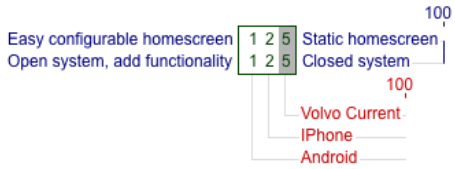

Figure 10: (GC3:4) Focus grid configuration and openess

Figure 10 contains constructs with the level of how configurable the platforms are regarding user customizations. In the grid it can be seen that the level of platform’s ability to be configured, goes hand in hand with how open it is. If the platform is open in the sense that user can add functionalities to it, clarifies the openness of the system. Where if the homescreen leans more towards being static it is much harder to be able to add functionalities to the system.

(GC4:4)«Responsiveness & fulfillment»

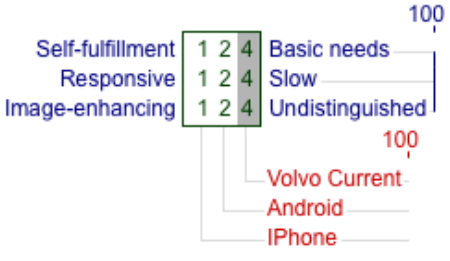

Figure 11: (GC4:4) Focus grid responsiveness and fulfillment

The grid in figure 11 shows that iPhone enhances the image of the brand while most of the customers choose iPhone on desirable purposes rather than just satisfying their basic needs. The grid shows that the interviewee believe the platforms that are image-enhancing and is bought to fulfill the customer is also more responsive than a platform that is more towards the undistinguished side.

(GC5:4)«Expectations & Price worth»

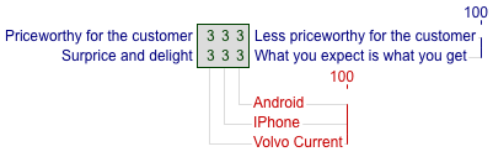

Figure 12: (GC5:4) Focus grid expectations and price worth

Interviewee four rates all the elements on the same level when it comes to customer expectations of the system and price-worthiness of the three platforms.

(GC6:4)«File support»

Figure 13: (GC6:4) Focus grid file support

The figure 13 presents how supportive the three platforms are regarding the different file types. Interviewee described that if the platform has a great support of file types it follows a proprietary format. This could be that the branch standard is limited or when using own file types as proprietary is the file support can be greater because the developers themselves own the rights to follow their own standard. Volvo is now to the limited support and branch standard side, they follow the branch standard but not the whole standard i.e it is just to a limited extent.

(UNI4)Unique constructs interviewee four

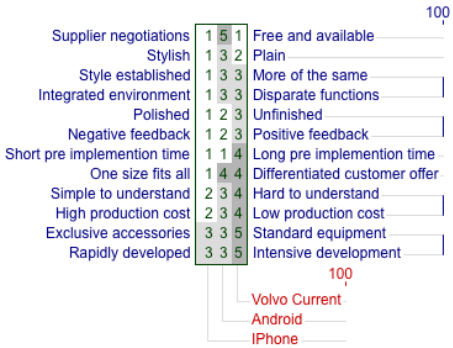

Figure 14: (UNI4) Focus grid unique constructs interviewee four

As presented in figure 14 the Android rating is fairly to the right side of the grid except Exclusive accessories and Rapidly developed constructs on which there is a middle rating for Android. However iPhone regarding the polished system, receiving negative feedback and also short pre-implementation time stands on the right side of

this grid. Interviewees point of view also shows that Volvo current system is considered to be plain rather than stylish comparing to Android and iPhone.

(GC1:5-8)«Style established & exclusive»

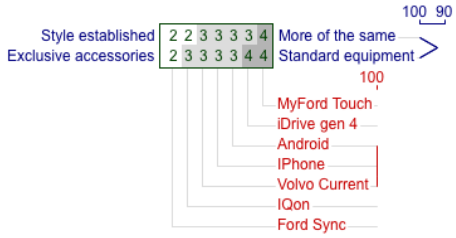

Figure 15: (GC1:5-8) Focus grid style established and exclusive

The figure(No.) shows that Android, iPhone, and Volvo current have the same status regarding an established style and exclusive accessories and they all stand in middle comparing to rest of the platforms.

(GC2:5-8)«Understandability & interaction»

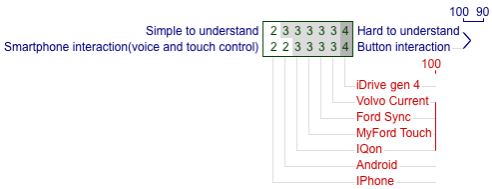

Figure 16: (GC2:5-8) Focus grid understandability and interaction

As seen in the above figure no. the pattern it follows is that the more to the smartphone interaction the platform has the simlier it is. For example Android and iPhone being to the left side in the grid and these platforms has the rating closest to the two construct and are the simplest to understand because the fact that they use smartphone interaction. In the other hand the four platforms Volvo current, Ford Sync, MyFord Touch and IQon has the same rating meaning that these platforms are in the middle. The reason that these system are in the middle of the grid could be that they uses a interaction representative in both ends in the grid.

(GC3:5-8)«Pre implemention time & extendable»

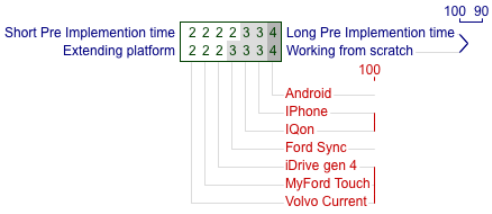

Figure 17: (GC3:5-8) Focus grid pre implementation time and extendable

While IQon seems to be similar to iPhone when it comes to pre-implementation time and also extending platform based on figure(No.), there is still difference in ratings of them which means that iPhone is more flexible for further implementation with the base of the current platform. However Volvo current, MyFord Touch, and iDrive gen 4 stands much more closer to the iPhone ratings side and with the same ratings.

(GC4:5-8)«Connectivity & Polished»

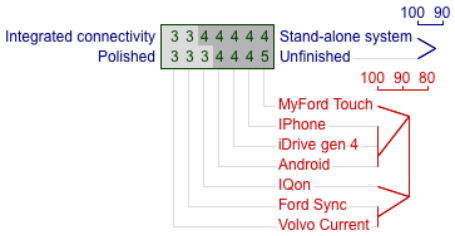

Figure 18: (GC4:5-8) Focus grid connectivity and polished

Figure 18 present the constructs integrated connectivity and if the platform is polished or not. At the leftmost side at the grid Ford Sync and Volvo Current with a value that represent the middle rating in the constructs. At the other side of the grid MyFord Touch is located which is a system according to the interviewees that is unfinished and a stand-alone system. Volvo current and Ford Sync at the other hand is perceived to the interviewees as a system that is not a stand-alone system nor a system with great support of integrated connectivity.

(GC5:5-8)«Image-enhancing & Feedback»

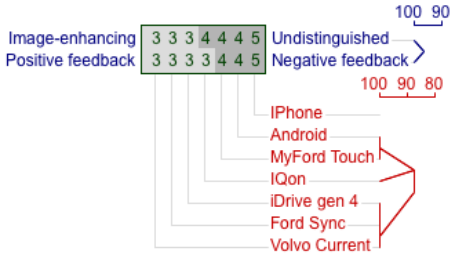

Figure 19: (GC5:5-8) Focus grid image-enhancing and feedback

Figure 19 present the factor of how image-enhancing for the company and how the feedback was at release. The two poles in the figure is represented by at the left side Volvo current, Ford Sync and iDrive and at the right side iPhone. iPhone is perceived by the interviewees to not being image-enhancing and that it received negataive feedback. On the other hand it is not a clear seperation between the platforms because the ratings do not differ with a big value. As seen in the grid not even one system received a minimum value meaning that they were close to image-enhancing and positive feedback.

(GC6:5-8)«Third party & tool support»

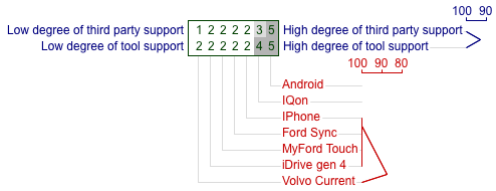

Figure 20: (GC6:5-8) Focus grid third party and tool support

As interviewees result shows other than Android and IQon the degree of negotiation with third part and also support of tools stands slightly towards the low side based on figure 20.

(GC7:5-8)«Expectations & Fulfillment»

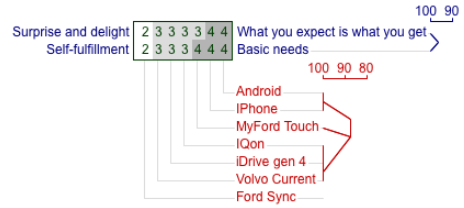

Figure 21: (GC7:5-8) Focus grid expectations and fulfillment

Figure 21 presents the data where Ford Sync platform resembles surprise and delight for the customer and the user does not only want the device based on the needs but also to satisfy the self desire.

(GC8:5-8)«Configurable & Priceworth»

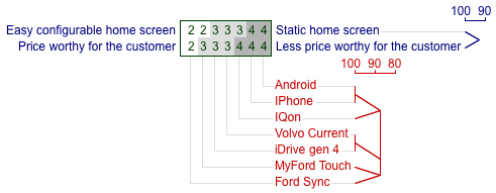

Figure 22: (GC8:5-8) Focus grid configurable and priceworth

The above figure presents how configurable and price worthy the platforms are, as seen the ratings varies from two to four meaning that no platform has a minimum or maximum value. This group construct also presents that if a platform is static and not configurable the platform is less price-worthy for the customer. Volvo's current system received a ranking in the middle in both constructs so the platform is not static nor configurable.

(GC9:5-8)«Openess»

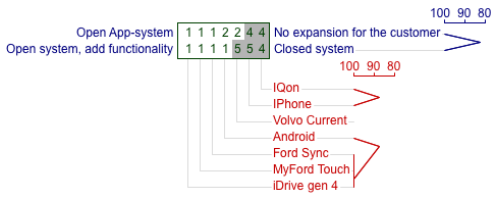

Figure 23: (GC8:5-8) Focus grid openess

According to figure 23 Volvo current is not connected to the rest of the systems and it shows the system being closed in terms of adding extra functionalities and on the other hand the interviewees considered the system an open App-system in the sense that the customer can have demands on adding new expansions to the system they are paying for.

(UNI5-8)«Unique constructs interviewees five to eight»

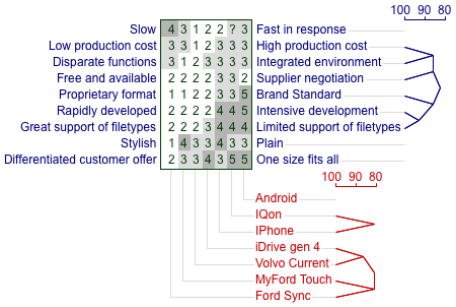

Figure 23: (UNI5-8) Focus grid interviewees five to eight

Figure 23 contain the constructs that doesn't seem to be strongly connected, as seen in the grid the constructs are connected but not with a high value. The construct that has the biggest seperation according to the ratings in this grid is the construct Proprietary format – Branch standard, at the left side in this construct we have MyFord Touch and Ford Sync and at the right side Android. So MyFord Touch and Ford Sync follow the proprietary formats in files and Android follow the Branch standard.

5 Discussion

In this section based on the related work and systems sections we will discuss the values of concern for a automotive company which can be created by using an open source platform. The discussion aims to provide the readers with a perspective of customer and development in value creation, by relating the previous studies and the data collected in the case study.

The findings from the related work and the systems has been categorized in two perspectives, customer and development. The motivation behind this categorization was to first find a pattern to be able to relate the collected data and the previous studies. Secondly, the constructs that were used in the data collection were elicited from the company and they were addressing customer and development values. The customer perspective is based on Volvo Cars developers´ insight. This also was the purpose of the study to put the focus on the mentioned two perspectives. However, there are fields that can fit in both categories depending on the relation to the data result.

The following tables in section, Customer and Development, are presented to show the aspects mentioned in section 2 and the relation of them to the construct poles from section 4. The labels are represented to clarify the interviewees point of view in comparison to the related work aspects. There are aspects in the literature that are mentioned from different references and eventually from different dimensions. But it seems that based on the result of the interviews, the constructs related to the mentioned aspects are connected. This connection can be seen in the tables where one construct from a category may relate to different aspects. With this description the link between the aspects with the same construct can be more clear. The connection of the construct poles and aspects are set based on the interviewees interpretations and comments on the girds.

1 Customer

Customer				
No.	Aspects	Reference	Constructs Pole	Label
1	Customer expectations (Personalization, integration, support)	West (2007)	• Customer Expectations	GC4:3,GC5:4,GC7:5-8
			• Stylish	GC2:3,UNI4, UNI5-8
			• Image-enhancing	GC2:3, GC4:4, GC5:5-8
			• Integration	GC3:3, GC4:4, GC5:5-8
			• Positive Feedback	GC3:3, UNI4, GC5:5-8
			• Ease of configuration	GC3:4,, UNI3, GC8:5-8
			• Differentiated customer offer	UNI3, UNI4, UNI5-8
2	Shape product to market needs	Morgan and Finnegan (2008)	• Integrated connectivity	UNI3,, GC1:4,GC4:5-8
			• Exclusive accessories	UNI3, UNI4, GC1:5-8
3	Open Software	Morgan and Finnegan (2008)	• Open app system	UNI3,, GC2:4,, GC9:5-8
			• Open system	GC1:3,, GC3:4, ,GC9:5-8
3	Reasonable price for customer	Barney (2007)	• Price worthiness	GC4:3,, GC5:4, GC8:5-8
4	Customer relationship to company	Szyperski (2004), Song et al. (2005), Ramzan et al. (2009)	• Style established	GC2:3,,UNI4,GC1:5-8
5	Quality of added app(Open system)	Butler (2011)	• Open app system	UNI3, GC2:4,GC9:5-8
6	Consistency of devices	Macario et al. (2009), Wheatley (2000)	• Smartphone interaction	UNI3, GC2:4, GC2:5-8
			• Simple to understand	UNI3, UNI4, GC2:5-8
7	Ease of use	Wheatley (2000)	• Responsive	UNI3, GC4:4, UNI5-8
			• Simple to understand	UNI3, UNI4, GC2:5-8
8	Voice and touch control	Wheatley (2000)	• Smartphone interaction	UNI3, GC2:4, GC2:5-8
9	Functionalities for customer expectations	Wheatley (2000)	• Self fulfillment	UNI3, GC4:4, GC7:5-8
			• Support file types	UNI3, GC6:4, UNI5-8
			• Add functionalities	GC1:3, GC3:4, GC9:5-8
10	Communication and information in systems	Boehm-Davis (2003)	• Open app system	UNI3, GC2:4,GC9:5-8

Table 1: Table containing development aspects and constructs poles

As illustrated in the table the construct pole *Customer expectations* relates to the same construct group as *Price worthiness*. This implies that the interviewee's result puts them in the same category while the values related to them are defined separately based on literature.This holds for different interviewees. Other construct poles like *Stylish*, *Image-enhancing* and *Style established* are also in the same category and they relate to *Customer expectations* and *Customer relationship to company* value creation aspects. However, since the aspects on the table are extracted from both value creation related literature and systems section, a link between the two can be clarified by reviewing the common construct poles among them. *Customer expectations* as an aspect of value creation related to the construct pole *Customer expectations* has the same group as *Self fulfillment* construct pole. This construct pole is having a link with *Functionalities for customer expectations* which relates to characteristics of the system. The link can provide us with a value creation based on the characteristics of the system and customer expectations. On the other hand *Ease of use* and *Functionalities for customer*, which are system aspects, addresses construct poles *Responsive* and *Self fulfillment*. These are in the same group as *Image-enhancing* and *Integration*. This, links the mentioned system aspects to the *Customer expectations* consisting of personalization, integration and support which is binds with value creation. Another interesting relation is directing us to the *Ease of configuration*, *Open system*, and *Add functionalities* construct poles. These poles are categorized in same group according to the interviewee and clears a connection between values such as *Customer expectations* and *Open software* with the system characteristics *Functionalities for customer* expectations. Looking through other group constructs and their places in the table, we can see same patterns as link between *Customer expectations* and *Reasonable price for customer*. There are also uncategorized construct poles which brings up even more links and directs the values to the characteristics of the system and the constructs to consider while value creation. Other noticeable construct pole *Open app system* stands in three different places in connection to *Open software* value creation aspect, *Quality of added app in open systems* as characteristic of system and also communication and information apps as features of the system. Based on the group constructs related to *Exclusive accessories* and *Style established* the two values *Shape product to market needs* and *Customer relationship to company* are directed together. Further on after review of the development table some relations between values related to customer and development are illustrated.

2 Development

As in the table 1 the division of the table is related to the aspects from the related work and the construct poles of the grid results. However the domain of the aspects in this table is on development.

Development				
No.	Aspects	Reference	Constructs Pole	Label
1	Time to market	Barney (2007)	• Rapidly developed	UNI3,UNI4,UNI5-8
2	Economical and technical development cost	Chesbrough and Rosenblum (2002)	• Rapidly developed	UNI3,UNI4,UNI5-8
			• Pre-implementation time	UNI3,UNI4,GC3:5-8
3	Third party (Value network)	Morgan and Finnegan (2008)	• Degree of tool support	GC2:3,GC2:4,GC6:5-8
			• Third party support	GC1:3,GC2:4,GC6:5-8
4	Use external innovation	Chesbrough (2004)	• Extended platform	UNI3,GC1:4,GC3:5-8
5	Decrease development cost	Cho et al. (2010), Yu & Liu (2010), Butler (2011)	• Low production cost	UNI3,UNI4,UNI5-8
6	Control over system (Functionalities and apps)	Cho et al. (2010), Butler (2011)	• Tool support	GC2:3,GC2:4,GC6:5-8
			• Third party support	GC1:3,GC2:4,GC6:5-8
7	Quality of added app(Open system)	Butler (2011)	• Open system	GC1:3,GC3:4,GC9:5-8
8	Full control(Device, app development, content)	Lin & Ye (2009)	• Closed system	GC1:3,GC3:4,GC9:5-8
9	Dependency on physical device	Oliver (2009)	• Integrated environment	GC3:3,UNI4,UNI5-8
10	Voice and touch control	Wheatley (2000)	• Smartphone interaction	UNI3,GC2:4,GC2:5-8
11	Functionalities for customer expectations	Wheatley (2000)	• Self fulfillment	UNI3,GC4:4,GC7:5-8
			• Support file types	UNI3,GC6:4,UNI5-8
			• Open system, add functionallity	GC1:3,GC3:4,GC9:5-8

Table 2: Table containing customer aspects and constructs poles

This second table in this section explains the development aspects and constructs poles from the result. As seen in the table constructs poles is related to several aspects in some cases. For example the aspects *Time to market* and *Economical and technical development cost* is both linked to the construct pole *Rapidly developed*. Furthermore, the construct pole *Third party support* you could argue is a construct that is important for both the customer in the Table 1 and for development in this table. One interesting observation is the aspects *Quality of added app* and *Full control* where you have *Open system* and *Closed system* linking each of them,

this presents that if you want openness in your system you have to give away some control of the system. The aspect of *Voice and touch control* is linked to *Smart-phone interaction*, this is important because this study earlier explained that customers expecting the same functionality of their infotainment platforms as they have in their smart-phones. As the result of this study found some of the infotainment platforms already done this transformation and the researchers believe that this is a trend more infotainment platforms will follow. Another important factor to discuss is that some of the constructs poles is represented in the same group constructs identified in this table by the Label identifier. For example the aspects *Functionalities for customer expectations* and *Control over system* is linked to the constructs poles *Open system, add functionality* and *Third party support* is both represented in the group construct with the label *GC1:3*, this gives that these aspects could be closely connected. The aspect *Third party(Value network)* is linked to both *Degree of tool support* and *Third party support* and as seen in the group constructs identifiers in the label column these two constructs poles is represented in the same group by interviewee four, so these characteristics is often something you get together when using an open source platform.

3 Changing value creation approach

This section aims to introduce examples on where the result from the grids can be used. The constructs which will be addressed are selected from the group constructs where Volvo current system had a significant different with one or more elements. Since Volvo current system stands on a closed system side, there is a possibility to move towards more openness by choosing an open platform. This can give both development and customer values by first make the development time shorter and secondly give the customer the ability to add more functionalities to the system. However the closeness of the system gives the company more control on the functions or apps that are going to be add and also the access of them to the core parts of the system (cf. Lin and Ye, 2009; Oliver, 2009).

Volvo's ratings in *Exclusive accessories* and *Style established* are close to iPhone in most of the results. If the company aims to keep the same rating it is important to put into considerations values such as *Shape product to market needs* and *Customer relationship to company* based on this study. The satisfaction of old customer who are used to the style of the product on one side and shaping the product to satisfy the demands set in market of competitors on the other side can both create relationship values (cf. Szyperski , 2004; Song et al., 2005; Ramzan et al., 2009).

As another dimension to value creation customer and development values can be created with adding some constructs like *Add functionalities* and *Ease of configuration*. This leads to more customer satisfaction and support of specification of system like applying functionalities based on customer expectations.

Bringing these examples and considering specifications of MeeGo, there are two main contributions identified, in which MeeGo can create values for companies.

1. Based on the licensing of MeeGo and according to the discussion section the openness of a platform can help with value creation for the customer and the development. However it should be put into consideration that MeeGo gives the users the facility to be able to control the developed part based on licensing and architecture (MeeGo, 2011). This can lower down the development time and thus the time to market for the product which can lead to a lower production cost (Chesbrough and Rosenblum, 2002).
2. MeeGo with the specifications like ability to personalizing the platform, gives the customer the opportunity to fulfill their expectations of customization. Also it gives a consistence feel as well as easiness in learning by the same look and feel as other devices like smartphones. It also can give the customer file support with a more variety of file formats along with apps for social media. This is where the value creation for the customer occurs.

4 Perception at Volvo

When analyzing the results the researchers realized that the perception at Volvo's current system differed between the interviewees. The overall perception of their own system is very positive but it is a contradiction about the perception between personnel at Volvo Cars. This could be because of that the people at Volvo had different roles in the production of the system and they were working with the development of different parts. However, the review of the result gives a view of the Volvo current system being close in some aspects to iPhone. This gives a better picture of Volvo current system being dependent to its hardware device while having a very closed system in terms of third party negotiation. On the other hand the result shows that ratings of both systems are rather the same regarding the trend settings and appearance, which is shows the view of the developers of Volvo of their system.

6 Conclusion

This case study was set to investigate the possibilities of value creation considering an open innovation based platform in In-Vehicle Infotainment development. We identified the aspects of value creation based on previous studies and also defined characteristics of systems like Mobile and IVI platforms. By means of interviews we extracted the company of study's point of view on their system. Values from the related work and the results from interviews were linked together based on the analyzes of the result and the interviewees comments. Also, we clarified a connection between the values and characteristics expected from platforms. The main contribution was to detect existing values by using an open source infotainment platform. However, there has been thorough observations on the results from the collected data in order to provide an insight of the perception of Volvo's current system Sensus. The result of the study shows that fulfill-

ing customer expectations, adapting the product to the market demands, and having an open source platform can create values both for the customer and the company. Nevertheless, some characteristics like a closed system may create values for the company. First, giving the control of the product to the company which leads to a better quality of the system and eventuality higher revenue stream. As a next step to this study, a deeper investigation on economical and management aspects of value creation can be done. It is also interesting to research the possibility to consider open sourcing the current platform of Volvo Cars or any other company in the automotive industry.

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