

Open Innovation Strategy:

Open platform-based digital mapping; as tools for  
value creation and value capture - case study of  
OpenStreetMap and Google maps

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**KTH Industrial Engineering  
and Management**

Master of Science Thesis  
Stockholm, Sweden 2017



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### **Abstract**

Open innovation has been rising in popularity as an alternative to traditional model for organizations to enhance innovation in their products or services. In the past, the innovation processes was time-consuming and costly. It has now become significantly efficient and effective, supported by the advancement of today's IT such as Internet, Cloud Computing and Big Data. Open innovation has changed the aspect of the innovation source; from closed internal R&D to fully utilization of consumers' collaboration.

Decision to shift towards open innovation strategy has been lying on several areas including motivation, financial direction, and preference of the innovation strategies and business models that fitting the organizational core strategy. This research studied the relation of these areas and its effect; it determined the way IT-organization creates and captures value that were done by opening its product platform.

This thesis was conducted to analyze the open innovation approach in an open digital navigation platform, featuring two platforms as case study: Google Maps and OpenStreetMap. The investigation emphasized the utilizing of the open innovation strategy to build its platform where crowdsourcing and open source software as objects highlighted in the research.

The data was collected from secondary sources. Research findings suggested that crowdsourcing and open source software strategy are the main strategies of open innovation implemented in IT digital mapping platform to create and capture value. While these strategies have been practiced in both platforms, circumstances (motivation, financial direction, and business strategy) that hovering around the internal aspect of organizations affected the application of those strategies. The implementation results are differ according to preferred business model.

The result of this research suggested that a non-profit based organization tends to utilize open innovation to improve the value of their product through consumer collaboration, while a profit based organization adopts open innovation to generate additional pool of revenue through customers' feedback and input data. The open innovation leads to creation of a new business model as the foundation of innovation.

### **Keyword**

Open innovation; open platform; crowdsourcing; open source software; collaboration; Google maps, OpenStreetMap; Business model.

## **Acknowledgement**

We hereby would like to express our deepest gratitude towards everyone who helped us in the completion of our thesis. First of all, we would like to express our sincere appreciation to our supervisor Serdar Temiz for his unwavering support with constructive motivation and constant mentorship throughout this project. We would like to extend our big appreciation to our programme director, Dr. Terrence Brown for all of his comments and guidances that have been very valuable for us to complete the programme. In addition we would like to thank Gregg Vanourek for his comment, suggestions, and feedback given during the presentation of this thesis. Without their guidance and persistent help, this thesis completion would not have been possible.

We are truly grateful for the Swedish Institute for the contribution and support so that we could have the opportunity to study at the prestigious KTH Royal Institute of Technology.

Furthermore, we would like to express our gratitude to our peer-review partners Morteza and Christopher Wood for giving us constructive feedbacks to our thesis.

Last but not the least we would like to thank all our family and colleagues for their unconditional support.

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## List of Terms and Abbreviations

<b>API</b>	Application Programming Interface
<b>GDP</b>	Gross Domestic Product
<b>ICT</b>	Information and Communication Technology
<b>IoT</b>	Internet of Things
<b>OI</b>	Open Innovation
<b>OSM</b>	OpenStreetMap
<b>OSS</b>	Open Source Software
<b>R&amp;D</b>	Research and Development
<b>SDK</b>	Software Development Kit

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## CHAPTER ONE

### 1. INTRODUCTION

#### 1.1 Background

In the fierce competition over the market nowadays, organizations are required to stay innovative in order to stay relevant amidst high competition in the market. Innovation itself is a time, resources and cost-consuming activity required to create, capture and deliver value to customer. In the last decade, research studies revealed the phenomenon when more and more companies has shifted their paradigm on obtaining and commercializing industrial knowledge which given birth to open innovation paradigm (Chesbrough, 2003a). The open innovation arises as the alternative to traditional model of managing innovation where companies realize that internal R&D department become less effective in terms of more time and resources needed to generate valuable ideas that can successfully enter the market (Chesbrough and Crowther, 2006). Open innovation has increased in popularity both in theory and practice due to benefits it offers shorter product life-cycle, the abundance of external resource that bypass internal limitations, and shortage of costs.

Nowadays, the act of opening up the innovation process has become increasingly popular especially in the tech industry (Gassmann et al., 2010) which progressively transform from completely close to fully open (Chesbrough, 2003b). In the area of IT software industry, the act of developing software in the window of collaborative public is known by the term "open source software". The open innovation and open source software has rigid dichotomy in the eyes of academic literature. Open source software concept was born long before Chesbrough introduced open innovation in 2003. It was initially labelled as "free software" in 1983 by Richard Stallman, a researcher at MIT as the reaction to the uprising software vendors emerging in the '70s. It is claimed to offer superior benefits compared to traditional proprietary software model such as lower cost, security, no vendor "lock in", and better quality according to survey provided by Open Source Business Conference (Rothwell, 2008). Although open innovation and open source software stand independently in theory in the sense that both concepts were brought into conception in different era, there are many studies conducted around the domain between these two concepts which advocates their similarities in term of collaboration and sharing as the key principle. In his research, Letellier advocates that open source or free software is a way to innovate in software industry and it is an exemplary and very effective platform of open innovation, along with open source projects or communities that act as innovation intermediaries (Letellier, 2008).

The benefit offered in adopting open source software strategy in terms of efficiency, interoperability and innovation has attracted major IT firms to consider adopting OSS in their environment (Vaughan, 2016). Open source software projects has been thrive in recent years with cloud, big data, content management, databases, operating systems, development tool, mobile technologies becoming several major tech areas where OSS is being successfully adopted. This phenomena has undoubtedly driving IT tech firms to moving towards OSS in their IT environment or to running their business. According to research conducted by BlackDuck Software, it has reported that there are over 180,000 open source projects running since 2016 in the IT technology realm nowadays which shows massive interest in OSS (Vaughan, 2016). In the US where the pioneer of forefront technology adopter reside, 65% of the US-based companies are contributing to OSS project and almost all top software giants such as Google, Microsoft, Apache and many more are moving towards OSS (Vaughan, 2016). Since open source software continues to be a critical part in modern areas of IT, there has been shifting in its key of openness in OSS, from traditional source code into API (Application Programming Interface) as the point of interface and integration leveraging efficient use of cloud computing and service-based infrastructure (Lyman, 2012). During the course of innovation, APIs has transformed drastically from a term understood only by software professionals into strategic tool that can contribute to organizational profitability. This phenomenon is called API economy (Columbus, 2017).



The circumstances behind the initiative to embrace open source software are diverse depends on the purpose of the firms. The decision could be driven by commercial intention (Fletcher, 2015) or idealism to the OSS principle for the purpose of value creation only. There are organizations that enticing the benefit of open source software strategy to seek contribution from outside to propel innovation process, while others use it to reach new market segment that they never reach before.

## **1.2 Research Problem**

In prior research regarding open innovation industrial practice, it has been argued that “while open source shares the focus on value creation throughout an industry value chain, its proponents usually deny or downplay the importance of value capture” (Chesbrough, 2005: 3). Prior research regarding open innovation has been focused heavily in the study of value creation process while the mechanisms of organization to generate profit (value capture) are traditionally discussed in the different context which is business model. Instead of looking from the value creation standpoint, this research will tackle the research gap relates to the firm’s circumstances in embracing open innovation approach and its relation to the preference of strategies to accumulate innovation and creation of new business model. Additionally, this research will complementing previous research by providing case of open innovation practice in modern IT software industry practice instead of that in prior research which discussed open innovation practice in traditional big tech firms.

In this research, two IT digital mapping platforms, Google Maps and OpenStreetMap has been chosen for the case studies representing commercial and noncommercial purpose respectively. Both platforms has gaining success in advancing its technology proven by millions of subscribers of the services by utilizing open innovation since their early development. Furthermore, each platform has enormous base of open source community.

## **1.3 Research objective and question**

This research aims to help highlight knowledge into the circumstances that motivate IT digital tech organization to embrace open innovation strategy to their platform and how by adopting these strategies can influence the way the organizations create and capture value, given that collaborative effort is essential to sustain the platform development. Emphasize will be put in open source software and crowdsourcing strategy to see how firms can capture value from sharing their APIs to the community. The advancement in IT leverage the creation of new value proposition based on open innovation. Firms such as eBay and Expedia has generated nearly 60% and 90% portion of their revenue respectively from the APIs business with developers as their customers (Murphy et al., 2016).

Based on the above statements, this study will investigate the following research questions:

- *What is the circumstances (motivation and financial direction) that driving firm to open its platform and implement open innovation?*
- *What types of open innovation strategy used in IT tech firm to create value?*
- *How firm capture value from open innovation strategy, given that open innovation business model involving external collaboration as part of value creation?*

## **1.4 Delimitations**

Delimitations refer to self-defined characteristics that limit the scope and boundary of the research study. The delimiting factors could be the research questions, theoretical aspect the researcher adopts, circumstances of time, or population researchers choose to investigate (Simon, 2011).

This research emphasizes open innovation approach in an open digital navigation platform; featuring Google Maps and OpenStreetMap utilizing the open innovation strategy to build its platform where crowdsourcing and open source software as objects highlighted in the research.

Due to time constraints, our research was limited to the open platform from provider's perspective. The research does not discuss the platform's third-party perspective which includes the external developers that use APIs and SDKs to develop their own apps. Furthermore, the researchers only collect secondary data. Thus, primary data collection would be needed for further studies.

This thesis mainly discusses the circumstances behind the firm's decision to embrace open innovation and its relation to how they can create and capture value from external collaboration without indicating organizational and management perspective. Another limitation to this study is the absence of cost figures to implement open innovation in the open platform provider. The cost structure is important considering it is related to the open platform provider's business and financial health. The cost structure limitation was due to no clear data and information released for public.

## CHAPTER TWO

### 2. LITERATURE REVIEW

The topic in this thesis would be limited to the open innovation practice in the digital IT company, which includes its open innovation characteristic and behaviour in relation to the utilization of external ideas and knowledges from the communities. Further investigation about their business model would also be described as the tool for capturing value from third parties. The companies that are chosen for this research case study have different characteristics and motivations, thus this research would distinguish their open innovation business model. Furthermore, this research would be expected to provide a better understanding about the practice of open innovation phenomenon in the digital mapping industry, which is an open platform model including open source software and crowdsourcing.

This section would explore about the existing topics and research about open innovation, knowledge transfer, and business model. The theories reviewed in this section would serve as an approach to analyze the open innovation characteristic adopted by both companies in the case study.

#### 2.1 The Origin of Open Innovation

The invention and innovation used to take place inside the boundary of organization particularly in R&D department of a company. Internal R&D was perceived as a strategic asset and barrier to competitive entry in many industries (Chesbrough, 2003a). Thus, firms needed to build a protection wall around their Intellectual Property with patents. This traditional paradigm of innovation is called closed model. Today, this paradigm is considered irrelevant due to drawbacks of closed model paradigm; the limitations of information, ideas, and knowledge only from inside of the firm.

Many companies are now shifting their innovation process to open innovation approach. This approach support the notion in which innovative ideas are not coming only from the inside of companies but also from the outside. The followings are several factors that drive the trend towards increasing adoption of open innovation (Chesbrough, 2003a; Gassmann, O. and Enkel, 2004; Dahlander & Gann, 2010):

1. Globalization of market that enables increased labor division and specialization in a given industry.
2. The growing mobility of specialized personnel. The skilful professionals are no longer attach to a company for a long period of time as they often move dynamically. This phenomenon becomes the challenge for firms because when employees leave, they take their tacit knowledge and core competences with them. Therefore, ideas are currently stay outside the firms' boundary and open innovation enable firms to access the pool of external resources to retain their competencies.
3. The rapid development of ICT, such as IoT, cloud services, social media and so on, has affected the way companies collaborate and communicate the innovation.
4. Technological changes trigger faster product's development cycle and eventually shorter time to reach market.
5. The rising number of market institutions, such as venture capital (VC) that encourages the establishment of SME (Small and Medium Enterprises). It has affected market share, which increases competition and restructuring of industry.

The definition of open innovation is a distributed innovation process that involves purposively managed knowledge flows across the organizational boundary (Chesbrough & Bogers, 2014). Knowledge is no longer proprietary to the firms; instead the company opens up its knowledge to suppliers, partners, customers, universities and global communities. Companies create the architectures, systems or platforms while they adopt open innovation and integrate those with internal and external ideas (Chesbrough, 2003a). The creation of the required platform is determined by company's desired business model, on how a firm wants to create and capture its value.

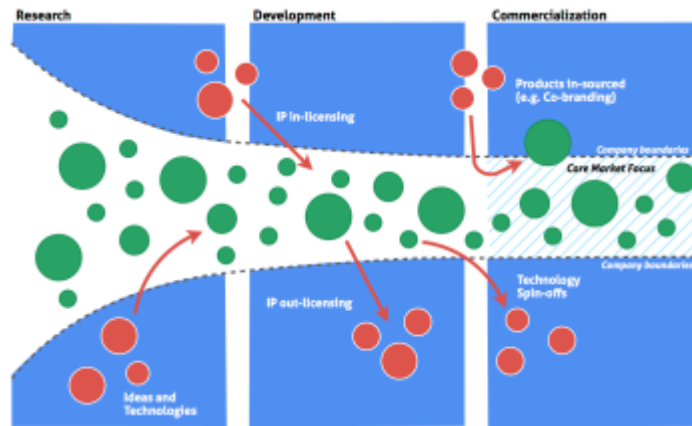


Figure 1. The Open innovation Paradigm (Mortata et al. 2009)

Based on the illustration, the firms are no longer monopolizing knowledge. Internal research department is not only responsible to generate ideas and projects but also to access ideas from external boundary of firms. Thus, the open innovation approach has changed the role of R&D department, from idea generator to idea connector (Chesbrough, 2003a).

The open innovation model is likened to an open funnel where firms commercialize both their own ideas, knowledges or technologies within their silos as well as innovations from other firms, then bring its in-house ideas to market through deploying path outside its current business (Chesbrough, 2003b). In this open model, the firms do not rely fully in external technology and the role of internal company's R&D is become obsolete. In fact, firms' R&D retains the company's value and their core competence while simultaneously tap into knowledge disseminated outside the company. The R&D department acts as a central gate that aligns activities of external path of the firms to the value preferred to be created and captured by companies.

However, the process of shifting from close to open innovation model has never been an easy task for companies. It always comes with risks and costs, especially for a long established company. One of the reasons is the transition process that would involve substantial changes in the structure of organization within the company. IBM would be a perfect example in this case when they experienced an imminent death along the transformation effort of the innovation paradigm, in order to face competitive pressure from other microcomputer vendor in the period between 1980 and early 1990s. During this period, IBM had to lay off thousands of employees along the transition (Chesbrough, 2003). Nevertheless, despite the laid-off and write-off, IBM's experience proves that even a giant corporation that was born from closed innovation age can become far more open in their approach to innovation (Chesbrough, 2003a). In order to get a better understanding about the fundamental difference between closed and open innovation model, the following table will describe further.

Closed Innovation		Open Innovation
The source of knowledge comes from the smart individuals in our field work for the company	<b>Source of Innovation</b>	Not all smart people work for the company. Firms realize that they should work with them inside & outside the company
Firms must initiate, develop, and deliver the ideas to the market in order to	<b>Role of Internal R&amp;D</b>	External R&D creates significant value while internal R&D retain the company's
The company that gets an innovation to the market first is the winner	<b>Business Model</b>	Designing a better business model is important than entering to the market first
Firms must control their IP to prevent their competitors from gaining profit from it	<b>Business Model</b>	Firms should generate profit from licensing out their IP and they should purchase others IP whenever it advances firms' business
The company will overcome global competition if it create the best ideas in the industry	<b>Characteristics</b>	Companies can win if they use internal and external ideas
Firms that own a research themselves will get to the market first	<b>Characteristics</b>	Firms don't have to originate the research to profit from it

Table 1. The differences between closed and open innovation principles

## 2.2 The Open Innovation Classification; the direction of innovation

As open innovation is currently being practiced widely by organizations of various scale, it is important to understand how an organization engaged in open innovation strategy. The basis of preference of the practice is different and is associated to the desired value that would be created and captured by the organization. Since 2003, various examples of cases underline a way firms have started to experiment with variety of practices on how they harness internal and external knowledge in their innovation process (Huston & Sakkab, 2006). The range of open innovation practices spanned from creative co-creation, R&D services, IP licensing, spin-off activities, joint venture, crowdsourcing (Afuah & Tucci, 2012), donation, and etc. According to Gassmann and Enkel (2004), the concept of direction of knowledge flows in open innovation can be classified into two main core activities: transfer knowledge from outside into inside the company (inbound), and transfer knowledge from inside to outside the company (outbound). Many companies often combines these two main core activities and this combination is commonly called couple model. The following section will describe more about these three main core activities.

### *Outside-In/Inbound*

Outside-in or inbound process can be described as the company's ability to explore and exploit knowledge from external surroundings of the firms, from suppliers, customers, competitors, research institutions, consultants and even competitors. This process is able to enrich company's knowledge base that leads to improvement of innovative capabilities (Enkel et al. 2009). The Inbound process emphasizes the importance of innovation network and thus, it offers competitive advantages for companies without the needs to create and develop the ideas or knowledges themselves (through internal R&D department). The most common forms of this inbound approach in digital tech industry practice include contracted R&D, licensing in, joint R&D agreements, acquisitions, customer co-creation, informal networking, and crowdsourcing.

### *Inside-Out/Outbound*

Organizations can open up their innovative ideas and technologies to be used by others outside their boundary with the purpose of revenue generating or for not-for-profit. This activity is called outbound open innovation. The most common outbound practice in the digital tech industry is selling or licensing out its intellectual property (IP), commercializing their own technologies, and selling projects to other organizations (Enkel et al. 2009). The increasing trend of outbound innovation practice leads to the proliferation of new company's business model such as creation of spin-off companies.

### *Coupled Open Innovation Practice*

Coupled process is a combination between the practice of inbound and outbound innovation. In this approach, companies execute inside-out activity by opening their knowledge silos to the market and then jointly develop projects together with communities. The common coupled open innovation activity involving co-creation with partners which takes form in alliances, cooperation, and joint ventures.

After understanding more about the concept of technology and knowledge transfer proposed by Enkel et al. (2009), the researchers considered the theory would be able to support the analysis process of open innovation characteristics conducted by both organizations in the case study.

## **2.3 Financial direction**

The option of practices of inbound, outbound or combination of both are applied based on whether they use these practices to generate profit or not. For knowledge flows in non pecuniary model, there is no compensation or direct financial reward for contributors from outside organization associated with underlying practice. It aims to explore innovation. On the other hand, in pecuniary model, organizations exploit knowledge, ideas and technologies with the purpose to gain profit and exchange the contribution with compensation for involved partners. Furthermore, several motivations behind the usage of inbound and outbound innovation considering from the aspect of financial nature of the firms can be described as follow.

- *Revealing (non-pecuniary outbound innovation)*  
In this type of open innovation, organizations share their resources with other partners free of charge but with no instant financial reward. It can lead to the creation of new business model.
- *Selling (pecuniary outbound innovation)*  
The organizations open their inventions and technologies for commercial use with the intention to generate profit through selling or licensing it to third parties.
- *Sourcing (non-pecuniary inbound innovation)*  
This type of open innovation allows organizations to use all available external knowledge freely as the source for internal innovation. Internal R&D of an organizations plays important role to search for possible solutions existed in external environment and absorb these solutions for internal interests.
- *Acquiring (pecuniary inbound innovation)*  
In this type of open innovation, organizations obtaining innovation from external partners through technology acquisitions, licensing in, and other similar procedures involving financial transaction in the process.

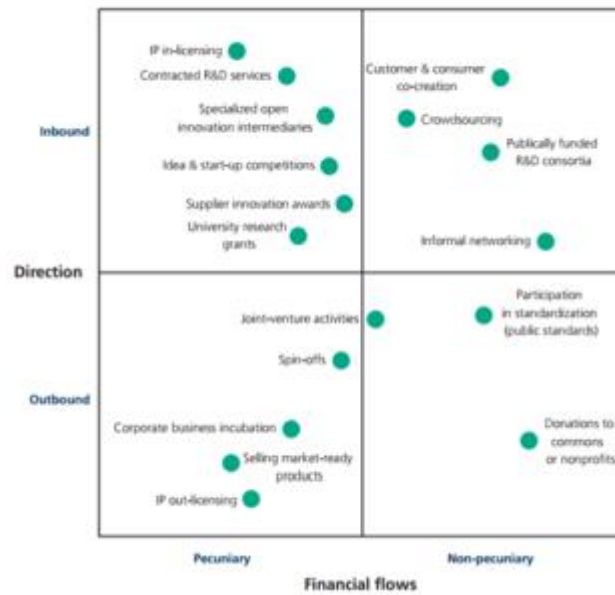


Figure 2. Classification of open innovation models (grassmann and Enkel, 2004)

## 2.4 Open innovation model: Product Platforming and Networking

Although there is no standardization and theory for OI models in the academia world yet, Marais, S., (2009) mentioned that there are five generic models of open innovation models based on the practice in the industry. These models maximize the innovativeness of an organization by providing linkages to customers.

- **Product platforming:** This approach involves and developing and introducing a partially completed product with the purpose to provide a framework for contributors to access, customize, and extend the product platform's functionality while increasing the overall value of the product for everyone involved (Marais, 2009). Software products such as Software Development Kit (SDK) and Application Programming Interface (API) are the examples of this model. The characteristic of this model is the strong network effects in the market where demand for the framework like online apps increases with number of developers that are attracted to use the platform.
- **Idea competitions:** This model utilize a framework that encourages competitiveness among contributors through rewarding successful submissions. This approach offers the large quantity of novel ideas while providing insight into what customers really want. Hackathon events held that usually in the collaboration between companies and universities are fall into category of this model.
- **Customer immersion:** This approach involves extensive customer interaction through the employees of the organization. Through this method, firms allow customer to involved closely in the product design and development cycle.
- **Collaborative product design and development:** The approach of this model is similar to the product platforming where organization incorporates contributors into product development. What distinguished between this model and platforming is that the framework is still being controlled and maintained by the organizations while the eventual product is developed by contributors.
- **Innovation networks:** It is similar to idea competition model where organizations harness the network of contributors in the design process in exchange of financial rewards. The difference is that the contributors engage in providing solution to identified problem instead of creating a new product.

From the description of five generic models above, product platforming is the most closely related to this thesis regarding the utilization of open innovation by opening the platform for value creation and capture in digital navigation platform. The digital technology industry's product platforming can be found in form of open source software sharing (OSS), and collaboration product design and development in form of crowdsourcing strategy. Hence, the following section will discuss further about product platforming open innovation model.

### 2.4.1 Product platform

In closed innovation paradigm, it is a common thing that a company closes its source to external resource, including its platform. However, as the competition becomes tighter, a company needs to keep innovative by shifting their paradigm to open innovation paradigm. This paradigm enables an interdependence network between the organization and external source to collaborate for innovation process within the platform system (Gawer & Cusumano, 2002). Therefore, as the process of innovating the products and services development becomes massive, the number of actors involved in the innovation network will also become higher.

In addition to that, Dahlander and Gann (2007), proposed that the degree of openness can be related to different forms of Intellectual Property control. They mentioned that it is not “the more openness, the better” since the innovation process can be costly, meanwhile the company needs fundings to finance the project. Thus, a company should choose an appropriate approach to the openness in coherence with the open innovation strategies and innovative performance in the context of a balance between costs and benefits. The smaller degree of openness, the more probability of a company to protect their IP and more benefits/profits from selling its IP patent through licensing out.

As suggested by Gawer & Cusumano (2002); Dahlander & Gann (2007); the open innovation activity in an organization is often influenced by degree of openness. Furthermore, there is one thing in common about the way an organization protects its intellectual properties, which is adjusting the level of openness to the public through selling patent or licensing out its intellectual properties to public for free or with a certain amount of price.

By opening its platform, a company is required to set a permission at a certain level of degree for external source to have the access to the company’s platform. For instance, iOS (Apple’s operating system) only allow the chosen third-party developers to work with its internal developers to develop their platform, while Linux operating system freely accepts all submissions. These are the just some examples of varying degree of openness that need to be considered when designing an open innovation.

After conducting an assessment on the case study using the hypotheses and matching the specified examples above, it can be concluded that the degree of openness of the two organizations is as follows:

Platform's aspect of openness	OSM	Google maps
Demand-Side use (End-user)	Open	Open
Supply-Side use (Application-developer)	Open	Semi-Open
Platform provider (Hardware/OS Bundle)	Open	Closed
Platform Sponsor (Design & IP rights)	Open	Closed

Table 2. Aspect of openness of a platform (Thomas et al., 2008)

According to Jiao et al. (2007), product platform is defined as a set of components, technologies, subsystems, processes or interfaces that is shared to develop a number of products to maximize commonality and minimize individual performance deviation. In the software industry, product platforms consist of tools, application packages and infrastructures that enable third-party developers to design and deploy Internet applications and are provided by the platform sponsors (Iansiti, 2009).



The open platform uses crowdsourcing and open source software (OSS) approach to attract developer communities to contribute on the sponsored platform. The term Crowdsourcing was proposed by Jeff Howe and Mark Robinson (2006) as the act of organization to provide open calls to a large network of prospective workers of people to perform a function collaboratively. The cultivation of crowdsourcing in its platform aims to solve the challenge with solutions from external sources.

Meanwhile, the concept of open source software strategy is a strategy that opens its platform publicly by sharing its licensed source codes so that everyone can learn, change the code, use, or re-distribute it for any purpose (West & Gallagher, 2006). In digital technology industry, a sharing licensed source code can usually be found in the form of Application Programming Interfaces (APIs) and Software Development Kit (SDK). These are tools provided by sponsors (inbound process) for external developers to gain programmatic access into the proprietary software applications or web services (outbound process).

Both crowdsourcing and OSS strategy are creating dependence between both party which is called the network effect. According to Ballon (2009), "A platform needs a mass of adopters and a mass of complementary software" to build up its network. In open platform, there are at least two networks involved: external developers and end-users. Both are important for a company to build an open platform ecosystem.

Suggestion from several strategic management theories as described by Gawer (2000); Gawer & Cusumano (2002); and Gawer & Henderson (2007) mentioned that business model strategy should aim to develop a platform that controls system module of the external innovators in order to build a range of complementary products. Thus, companies can yield the benefits from the network effects (Ballon, 2009). However, there is a challenge for the business model to generate interests to all parties within the platform. The following section will discuss about the business model and how a company could capture value from it.

#### **2.4.2 Business Model**

Osterwalder & Pigneur (2010) defined business model as the method of an organization to create, capture and deliver values. It means that a company would able to create and deliver values by incorporating new invention into their current business, or by licensing technology to other. Nevertheless, neither invention nor new technology contains any economic value until it is commercialized in some way.

The commercialization of innovation using different ways can yield different returns. For instance, an innovation can employ current business model that is already familiar to a company. In other case, companies can create a new business model that make use of innovation through licensing strategy for example. It is a challenge for a company to improve their knowledge in order to find an appropriate business model to capture the utmost value from an innovation.

As organizations incorporate open innovation strategy within their business strategy, the current business model itself has to be innovated so that the organizations would obtain value from various kind of knowledge inflows and outflows. In open innovation, a business model can be defined as a framework that balances the needs of the process of value creation and value capture. A business model becomes a central part in the process of transferring value from provider to receiver (Tapscott, 2001).

In order to reap the maximum benefit from the innovation process within the open platform, it is suggested that organizations should open their business models through actively looking and exploiting ideas. This model expects that the unused technology that was previously developed internally to flow outside the company, thus the other party could unlock the unused technology's economic potential (Chesbrough, 2007). Open business model helps companies to become more effective in creating and capturing values by harnessing resource, position and asset not only from organization's own entity but also in other company's businesses.

From previous discussion, there are two important key points to be highlighted in the open business model of open platform: a process of value creation through collaboration and value capture within the platform.

Considering the industry the case studies involved, and the open innovation approach they took, the researchers feel that the closest concept to the practice of the case studies is the open platform business model concept proposed by Tapscott and Williams (2008), which is called “wikinomics”. The following section will discuss more about how an organization’s approach could capture their value using various business model.

### **Wikinomics: value capture through a collaboration platform**

The utilization of internet in daily life leads to a significant transformation in communication and information exchange. A company in any industry must be ready to catch up with today’s trend in technology, either to perform mundane tasks or improve processes in order to stay ahead of the competition. One common way of a technology company in exchanging information and knowledge is through collaboration with internal and external resources. As a mass collaboration grow bigger, the economic structure is also shifting to become more compatible with the collaboration environment from capitalist to society economy. This situation was introduced by Tapscott & Williams (2008) as “wikinomics”.

Wikinomics can be defined as a movement that is bringing people together on the internet to create a value through mass collaboration. The most common example is Linux that was developed by one of the largest software development community in the world (It has no employees, stock options, or corporate organization).

Wikinomics is based on 4 ideas: openness, peering, sharing, and acting globally. Openness is related to the degree of transparency, freedom, and access to company’s intellectual properties within the platform. Peering is a form of lean hierarchy that occurred in the collaboration process within the platform. Sharing means a condition where a company seizes or creates opportunities by exploiting external innovation and creativity by opening their intellectual properties. All these approaches could lead to new business model to the industry. In general, Tapscott and Williams introduced seven wikinomics business model as follow:

- *Peer pioneers*: Self-organizing, voluntary, non-profit communities that collaboratively produce open source goods and services.
- *Ideagoras*: Generating ideas for innovations with the help of social networking platforms that bring together questions and solutions to problems.
- *Prosumers*: Based on the principle of user generated content and products. Companies see customers as co-creators of products. This means, the consumers are also the producers. The platform should designed in a way that allow the user to design, input data, and share them self.
- *New Alexandrians*: Collaborative activity using the production of scientific knowledge. In this business model, a company make a collaboration with universities and researchers in an open project.
- *Platforms for Participation*: Create a partnerships by opening its platform using open source software via an application programming interface (API) or a Software Development Kit (SDK). By creating a collaboration with other parties, a company’s product will reach wider market so that new customers will be attracted. This means a possibility of new source of revenue stream.
- *Global Plant Floor*: Creating a modularized physical products which produced globally using third party, so that the product is co-created by many actors. This will increase the product quality, while the production cost will be decreased.
- *Wiki Workplace*: Using blogs, wiki websites, forum, chat rooms, peer-to-peer-networks, podcasts, etc. in order to break the organizational boundaries to collaborate and form communities.

## CHAPTER THREE

### 3. RESEARCH METHODOLOGY

This research aims to study on the utilization of open innovation in digital technology organization, in which the researchers formalized into these three research questions: a) What are the circumstances (motivation and financial direction) that driving an organization to open its platform and implement the open innovation strategy, b) how does circumstances determine preferred usage of specific types of open innovation strategy, namely open source software and crowdsourcing, c) how an organization could capture value from open innovation strategy within their platform, given that open innovation business model involving external collaboration as part of value creation. An interpretivist research paradigm was conducted in order to achieve this purpose and finding possible answers from analyzing empirical evidences. The complexity of the topic and the research questions are being considered by the researchers the use of interpretivist paradigm in this research.

Open innovation is a broad concept introduced by Chesbrough in 2003. It appears in many different forms and has been studied in multiple perspectives (Dahlander & Gann, 2010). Even though the phenomena of open innovation has been occurred in many industries, there are no standard of codified knowledge amongst the academics on how should an organization implement open innovation strategy hence capture could value out of the innovation. Therefore, the phenomenon of open innovation practices in the industry is often surpass the corridor that is predicted in academic literature theory (Vanhaverbeke & Roijakkers, 2013). The lack of plausible theory might be the reason why a research in open innovation studies is often heavily built on qualitative empirical case studies.

This research is using exploratory case studies and considering the nature of this research, a qualitative approach is appropriate for comparative study between the case studies. Furthermore, as it is suggested by several numbers of scholars, the qualitative approach is a very powerful method that provide a stronger ground of theory building that requires the capability of “how” and “why” questions (Yin, 2009). Additionally, it also provides better accuracy due to broader investigation of research question (Eisenhardt & Graebner, 2007).

The findings from the investigation and interpretation from the perspective of the platform would provide insight into the phenomenon of open innovation in digital technology industry, especially in the digital mapping industry.

#### 3.1 Research Method

This thesis paper is using case study research as an overall methodological approach, which is ideal for in-depth investigation (Collis & Hussey, 2013) and it is suitable to help the researchers to gain in-depth knowledge on the phenomenon, issue, event that occurred in real life by using different types of protocols to control the behaviours and the perspectives of the phenomena (Yin, 2009). The case study method is often used in exploratory research, where typically the narrative should consist of rich qualitative data that will be compared with the theory to create a bridge between the empirical evidence and the theory research (Eisenhardt & Graebner, 2007).

In this research, there are two platforms featured as the case study. These platforms represent a digital mapping project in digital technology industry nowadays. The first one is Google Maps, a digital navigation service developed by Google that represents a profit-oriented company, and the other one is OpenStreetMap, a free web-based mapping service that allows collaboration to edit the maps. OpenStreetMap is representing a platform developed by a non profit-oriented organization. The difference in motivation and financial direction between these two platforms would be deeply analyzed in order to understand how the innovation process could help an organization to capture value and what is the particular strategies used to achieve it.

An unstructured approach was applied to the research in order to help researchers to keep focus on the open innovation phenomena in digital mapping industry. This approach facilitates researchers to understand the empirical data processing that produces specific analysis, generalizations, and comparability for validity and contextual as well as evaluative understandings. In order to prevent the research process from drifting away from the original objective, three areas of classification related to the open innovation practice was highlighted and examined:

1. The *motivation and financial* direction behind the open innovation strategy
2. The *value creation and capture*
3. The business model and the degree of the *openness* in the OI strategy related to commercial purpose

The use of case study approach is effective for a research that has the questions related to the “how” and “why” questions as mentioned above (Yin, 2009). Therefore, qualitative empirical evidences were collected from secondary source for this research. The evaluation process was then required to prove the validity of the empirical data in order to avoid misinterpret about the OI practice in the industry (Marshall et al, 1999).

### **3.2 Data Collection Method**

In overall, the data that is used in this research was secondary data. The secondary data were gathered through two methods: empirical observation and an in-depth and systematic data analysis from several sources. The data analyzed in the research were sufficient and collected from the organization’s website, official executives blogs, official company’s blog, and trustworthy mainstream media. The data includes the history of the project, motivation behind the open innovation, and financial direction, and the strategies of open innovation used in practice (the innovation’s direction; inbound-outbound). In addition, the is data also including all value capture activities conducted by the organization to finance its project. Thus, these methods are suitable to gain a better understanding about the platform’s business and open innovation activity.

The reasoning behind the preference of secondary data for data collection was due to adequate availability of the data; Google is a well recognize public company, and OpenStreetMap is a non-profit organization which its operation is supported by a foundation. Both of them are infamous open source mapping project. Thus, this condition allowing researchers to disclose some portion of data that were needed for this research has available widely. Another important advantage behind secondary data analysis selection in relevance to time limitation was that it offers pre-established degree of validity and reliability which need not to be re-examined by the researchers who reusing the data (Onwuegbuzie et al, 2016).

#### **3.2.1 Secondary data**

The source of secondary data collection were gathered through desk research from relevant academic literature, journal articles, press release, related company’s websites, credible mainstream media, and previous doctoral or theses research.

In order to have a well-defined purpose of research, the data was collected is the one that is related to motivation and ideation of the platform initiation (history behind the creation of the platform), licensing strategy of the platform (APIs strategy), and the mechanism to acquiring resources from the external source. The selection began with the case of Google Maps and continued to OpenStreetMaps case study. The selection has made purposively based on researcher’s judgement and objective of the research, given that the selected organizations are well involved within the open innovation practice.

#### **3.2.2 Case selection**

Two digital mapping service providers (Google Maps and OpenStreetMap) were selected because the platforms are two most commonly used platforms for daily activities of their users. While OpenStreetMap has been servicing over 4 million registered platforms users worldwide, and with support from three millions of contributors (OpenStreetMap Foundation), Google maps service reaches one billion active users (Pichai, 2017) and with the support of 30 millions of local guide’s contributors (Tarantola, 2017). These two platforms also implement open innovation strategy in their innovation activity, which is the value creation

process. Furthermore, the open innovation strategy they have been implemented has a high relevancy and can be a good representative of current open innovation activity since both platforms are having a good popularity and credibility in the industry.

Additionally, both organization have different motivation and financial direction behind the implementation of the open innovation, which would be an interesting topic for further studies.

### **3.2.3 Data Analysis**

When analyzing qualitative data, the researchers use an exploratory approach to do in-depth investigation about the phenomena in real-life context (Yin, 2003). The in-depth investigation focused in both case studies behaviour behind the open innovation phenomenon. The use of multiple case studies in the research requires a defined research protocol in order to make a clear comparison between the collection of empirical data of the case studies. The protocol that is used in the analysis process if the empirical data collected can be seen in the following:

1. General information: Introduction, history, and objectives of the project
2. Motivations: Contains the organization's background of the reasoning behind its decision to the application of open innovation strategy in their platform.
3. Direction of knowledge: Contains the information about the mechanism of the organization to creating value by absorbing the innovations or knowledges.
4. Financial direction: Contains the degree of openness behind the exploitation of its intellectual property in exchange of compensation from involved stakeholders.
5. Business model: Contains how's the organization could capture value from their platform.

These five protocols are important to find affiliates among different entities within the same context. In this research, these protocols were used to determined the open innovation behaviour between the two platform, with the assumption that these companies have different motivations which lead to different utilization of business models.

### **3.2.4 Validity**

The use of interpretivism paradigm in this research may create the possibilities of personal bias in the findings, and the results of this study may differ if the research is repeated with different method and perspectives (Collis & Hussey, 2013). Therefore, during the research process, the internal validity was considered by having two researchers involved in the process of data collection, and several method was conducted such as peer reviewing, repetitive investigation and data analysis, discussion in the findings. These methods were conducted in order to accurately draw the participant's perspectives and to prevent biases assumptions.

Since the secondary data was collected only from the organizations' perspectives, there would be also a possibility of one sided story that influenced the analysis on the organization. Therefore, the empirical data was collected and carefully selected from trustworthy mainstream media. Moreover, in order to validate the finding, repeated investigation of the findings were occurred by searching for the same or related information from other mainstream media sources. However, the interpretations of data and information from various literature may cause biases.

### **3.3 Ethical and sustainability consideration**

Secondary data refers to data that was collected by someone other than the researchers of this research (Schutt, 2011). There was no interview conducted, no request of permission needed from the interviewee to display the data gathered from online source, thus the use of secondary data is a highly ethical practice. During the course of this research, the researchers follow the common practice of ethical guidelines. The researchers collected data in adequate amount and acknowledged the ownership of the original data that was gathered freely from Internet, books, and other forums. The correct citations and referencing were put into attention while conducting the research.

The subject of open innovation is a relevant topic these days, considering the rapid development of technology due to the utilization of open innovation. Nevertheless, there is no agreement among the researchers about the literature that could be deemed and represented in real life situation. This research was conducted to investigate the activities on the open innovation phenomenon that has been taking place in real life by taking a sample from an open platform strategy.

The growth of product platforming technology that utilizes the open innovation strategies could open up the opportunities for an organization to create and capture the value added from the platform they create. This research was intended to give more insight and information for an organization that would or currently opens its platform. As the researchers put sustainability consideration into the account, this research could act as a reference for further study about the open platform technology.

## CHAPTER FOUR

### 4. CASE STUDIES

Following the literature review and theoretical framework used in this study, in this chapter researcher, present the specific strategies applied by each company described in two different cases to acquire new technology or innovation through open innovation approach and how they create and capture value from that innovation. Data collected from secondary data is analyzed in theme.

The first case study is OpenStreetMap, the largest crowd-sourced mapping platform in the Internet. The second is Google Maps, a mapping product owned by a giant tech company, Google. These platforms were chosen based the data availability and fit the criteria that both technologies were initiated originally using open innovation strategy and keep expanding in scale in terms of functionality and features benefitted from collaboration with external parties.

#### 4.1 Case 1: OpenStreetMap (OSM)

OpenStreetMap is a crowdsourcing online mapping project to create free usable and editable map in the world. The platform itself is community-driven alternative to commercial map product like Google Maps. OpenStreetMap was founded in 2004 by Steve Coast in the United Kingdom when he was working at the computer laboratory at Cambridge University. The project initiation was inspired by the success of Wikipedia and highly restrictive use of map information due to predominance of proprietary map data in the UK and in the world. Mapping data was owned by the governmental agencies and affordable only to big company at that time.

The map's development and infrastructure are entirely built from donated resources and volunteers. The platform has been servicing over 4 million registered users worldwide.

#### OpenStreetMap stats report run at 2017-07-19 00:00:09 +0000

Number of users	4048923
Number of uploaded GPS points	5769192290
Number of nodes	3982811187
Number of ways	424538569
Number of relations	5103484

*Figure 3. OpenStreetMap user statistic. Source: OpenStreetMap user statistic report (July 19, 2017).*

*Note. Adapted from OpenStreetMap user statistic wiki (2017), retrieved from <http://wiki.openstreetmap.org/wiki/Stats>*

#### Findings

##### OpenStreetMap ideation and motivation in open innovation

The first effort of data mapping and ideation of OSM was started from a humble beginning and single-handedly catered by Steve as following interview in 2014 with TechCrunch.

*The original idea was way simple. I had a GPS unit attached to my laptop and there wasn't very much you could do with it because there wasn't any data. You could download a picture of a map, but if you wanted to do anything like have the computer figure out what roads you were on or do turn-by-turn navigation or anything that's kind of useful, you couldn't do it because there wasn't any map data. So I just thought: why don't we create some map data? When you have a GPS, you can just drive or bike or walk around all the streets, all the roads, all the footpaths and use that information to create a map. I build a little bit of the map where I live and you build a little bit of where you live and we build this thing like a jigsaw puzzle — and incidentally give it away for free. Just like Wikipedia was building an encyclopedia in a very similar way, I copied many of the ways*

*Wikipedia was built with — like open licensing, the ability for anybody to contribute and so on.*  
(Lardinois, 2014)

### **Their financial direction**

OpenStreetMap has been supported and operated under a UK-based non-profit organization called OpenStreetMap Foundation (OSMF). OSMF is a global mapping effort that manage over two million volunteers around the globe. It was established with the objective to support and enable the development of freely-reusable geospatial data. It is primarily dedicated to encouraging the growth, development and distribution of free geospatial data and to providing geospatial data for anyone to use and share.

### **Licensing**

OpenStreetMap holds two types of license over its data according to copyright page in OpenStreetMap website. Firstly, OSM data is open data and licensed under the Open Database License (ODbL) by the OSM Foundation. In this type of license, users can freely share, modify, use, and republish the data without restrictions of patents, copyright or other mechanisms of control while it is required that customers should use the credit “© OpenStreetMap contributors”. Secondly, the cartography in the map tiles and the documentation is licensed under Creative Commons Attribution-ShareAlike 2.0 license (CC-BY-SA). In order to use the map tiles, following is the policy excerpt from the copyright page of OSM website:

*You must also make it clear that the data is available under the Open Database License, and if using our map tiles, that the cartography is licensed as CC BY-SA. You may do this by linking to the copyright page. Alternatively, and as a requirement if you are distributing OSM in a data form, you can name and link directly to the license(s). In media where links are not possible (e.g. printed works), we suggest you direct your readers to [openstreetmap.org](http://openstreetmap.org) (perhaps by expanding 'OpenStreetMap' to this full address), to [opendatacommons.org](http://opendatacommons.org), and if relevant, to [creativecommons.org](http://creativecommons.org).*

(OpenStreetMap, “Copyright and License” Openstreetmap, retrieved from: <https://www.openstreetmap.org/copyright>)

OpenStreetMap has adopting the principle of open source and thus it is openly inviting software developers to develop the core platform of OSM itself encompassing application server, database, and web frontend. One method contributors can use to gain access and manipulate database is through APIs. API is the only method of changing OSM data in the live database (OpenStreetMap, 2017). Taken from the API Usage policy page in OSM Foundation website, the API in OSM is related to *data-editing API* and not for read-only purposes or projects. The usage of OSM APIs is bounded by restrictive policy because its usage is directly affecting the service level of others and the excessive use of data might possibly corrupt the data. The OSMF Working Group (OSWG) are the team in charge for API Usage policies for OSM services.

### **Strategy to acquire innovation and where does the sources of innovation direction come from**

Data collection in the OSM platform always relies on crowdsourcing to overcome the limitation in database collection. If the platform does not use crowdsourcing, the data collection process will require a large amount of resources investment to create its own data set from scratch. The OSM platform is to focus to become playing field for everybody and thus, it emphasizes on data aggregation rather than consumer experience (Lardinois, 2014).

In the beginning of the attempt to soliciting contribution, OSM founder started to form a community and build mailing lists. It started by conducting an event for the enthusiasts of OSM called “mapping parties”, which the idea is to get together to do some mapping, socialize, and chat about making a free map of the world. It took a while and it was challenging to convince people especially during the early days, but it got to the point where it was self-sustaining. Mapping parties was a big aspect that getting OSM off the ground. Majority of the outset contributors are cyclists who survey with and for bicycles, charting cycle routes and navigable trails (Haklay et al., 2008).



There are over four millions contributors of OpenStreetMap to date worldwide according to the users statistic displayed in OSM website. OpenStreetMap has been opening its platform in two ways for the community of users and developers specifically to involve into the project. Contributors can involve in Mapping Projects, to collaboratively map a particular territory throughout the world or to improve mapping for various topics such as census, administrative boundaries, government, humanitarian relief, infrastructures, places of worship and many more. Further technical projects derived from Mapping Projects (Wiki.openstreetmap.org, 2017) including:

- WikiProject Cleanup (managing and updating information released in OSM Wiki)
- WikiProject Pictograms (creating and improving icons used on maps, particularly icons for point features)
- WikiProject Semantics (improving terms, classifications and ontologies used within OpenStreetMap)
- Routing (tagging to support routing by many transport modes)
- Indoor Mapping (mapping the interiors of buildings and structures)

**Collaboration with other firms to enrich map data**

The source of resources are also coming from external organizations. In an interview session with Steve Coast (2014) about how the community around OpenStreetMap changed revealed that many companies involved in order to improve the mapping experience.

*In the beginning it was very much around open source ideology. “Data wants to be free” and so on. But as the project grew, it’s got much more diverse. There are lots of companies involved now that want to improve the mapping experience. There is a huge variety of people now involved that wasn’t there in the beginning — and that’s a good thing. (Lardinois, 2014)*

Among the notable contribution from several organizations, following are the several that play the important role to help OpenStreetMap achieve ground truth of their map during the early initiation of the project.

Date	Description
2006	Yahoo! provide its aerial photography as a backdrop for map production (Coast, 2006).
April 2007	Automotive Navigation Data (AND) donated a complete road data set for the Netherlands and trunk road data for India and China to the project (Haklay, M. et al., 2008).
July 2007	The first international State-of-The-Maps was held in 2007 and Google, Yahoo! and Multimap were among the sponsors of the event.
October 2007	OSM received US road dataset from US Census Bureau, TIGER (Willis, 2007)
November 2007	Microsoft Bing allow the use of their satellite imagery for creating maps (Boeing, G., 2017)

Table 3. OpenStreetMap's timeline  
 Note. Adapted from OpenStreetMap news archive (2017), retrieved from [http://wiki.openstreetmap.org/wiki/News\\_Archive](http://wiki.openstreetmap.org/wiki/News_Archive)

### **Collaboration with other firms to improve customer experience**

The recent agenda in OpenStreetMap Project is to focus on working to improve end-to-end consumer experience over the map platform. It is what Steve Coast (2014) perceived to transform the considerably massive amount of collected data into a navigable solution.

*We've got tile servers and people are doing that, but the reason I joined Telenav was to get navigation working. We've had the ability to use OpenStreetMap as a display map for quite a while now. You look at it and it looks great, but it's much harder to make it navigable. And that's really what you need to make the end-run to the consumer experience. You have to be able to get from A to B. (Lardinois, 2014)*

In 2013, Steve Coast decided to tying a partnership with Telenav, a leader in personalized navigation in the US. The goal is to deploy navigation solution to OSM platform which will improve consumer experiences in using the platform. The extract of his interview for TechCrunch regarding the partnership with Telenav can be seen as follows.

*It was fascinating to observe over time how the team developed the technology that allows OSM to work well in a navigation environment — a task that is much more complicated than just providing a display map. Moreover, the community benefit of adding billions of GPS data points into the map-editing process is exactly how I had hoped that the crowd-sourcing process would evolve. (Lardinois, 2013)*

### **Financing OpenStreetMap Project**

The costs structure to build entire OpenStreetMap platform is not as high as it was predicted. Initially, it was a self-funding project born from the idealism of the founder as shown in the interview with TechCrunch in 2014:

*The costs were actually very low. There were a couple of computers and bandwidth that was needed. There wasn't actually a lot of infrastructure that was needed. I just convinced the university to host it and at the university where I was [University College of London at that time], they had great Internet connectivity. So the cost were actually pretty minimal. But to answer your question more directly: the money that we did need would typically come from conferences. We'd run State-of-The-Maps conference and sell t-shirts and we could buy a couple of servers every now and then. (Lardinois, 2014)*

Since the OpenStreetMap project is operated under a non-profit foundation, the process of gaining capital resources to offset operation costs is acquired voluntarily by the foundation through various fundraising and donation activities. OpenStreetMap Foundation gathered resources via different channel such as consortia, hold a conference, selling their merchandise to their users (Lardinois, 2014), and open up membership opportunity to join the foundation in charge for certain amount of annual fee.

### **Business model of OpenStreetMap**

**Key Partners and Key Resources.** OpenStreetMap is a community-driven online mapping platform. The platform is open for those from individual to firm's level that are willing to use and contribute to the platform. The licensing of OSM data is attributed to the contributors of the platform. In one hand, communities, firms who has the interests from OSM platform, third party developers from various parties are the important elements in the key partners building block in the collaboration-based business model which they co-creates the value proposition of the platform. On the other hand, those parties are also serve as customer segments benefited from the functionalities of OSM platform and their contributions are driven by either commercial or non-commercial motivation. Apart of contribution in the form of data, OSM have their IT infrastructures established due to donation of time, hosting space and hardware by its partners as it can be seen in their thanks page dedicated to organizational partner of OSM.

Resource	Partner
Hosting support for OSM Web	UCL, ByteMark Hosting, Imperial College London
Data servers and network connectivity	Blix Solutions, Exonetric, GRNET
Domain and site builder	Bluehost
Tile servers	CARNet, Jump Networks, OSUOSL, NCHC
Map data	Individual and various organizations

Table 4. Partnership with external resources (source from [openstreetmap.org](http://openstreetmap.org), 2017)  
 Note. Adapted from [OpenStreetMap.org](http://OpenStreetMap.org)

**Key Activities.** The engagement with the community is a critical activity especially in open innovation where value creation of the platform is relied on the participation from external talent pool. OSM Foundation is responsible to support OSM project and maintain proximities with the external stakeholders of the platform. Several key activities of the foundation quoted from OpenStreetMap website including:

- Acts as a legal entity for the OpenStreetMap Project.
- Acts as custodian for the IT infrastructures and services necessary to host the OpenStreetMap platform.
- Responsible for organize fundraising activity and allocate the donations to OpenStreetMap project activities.
- Organizes the annual conference called State of The Maps (SoTM)
- Supports and communicates with the working groups, such as communications, licensing, etc.

**Value Capture.** OpenStreetMap does not retain some portion of percentage of value from each of the service delivered to customers like any profit-oriented business model. OSM foundation does organize sort of conference events to attract customers but it is not with the purpose to earn profit from selling the product platform or service. In fact, the aim of these activities is to encourage participation among other mappers, businesses, government agencies, and non-profit around the world to collaborate and to support OpenStreetMap project in order to improve the value rather than capture it. During an interview session with Steve Coast (2013), he mentioned that OSM project is entirely volunteer-based on donations. The main spending lies on the server hosting and therefore, the cost of operation is low. Firms are not bound to prior business agreement to exploit OSM platform even for commercial purpose.

*We don't have a way to track companies that have downloaded OSM, but I'd be surprised if it wasn't thousands. There's no licence in the traditional sense. You just download and use it. You don't have to sign an agreement with us. Then you can do whatever you like with it, you don't have to pay us. We also provide services, like you can search or display a map. Things that cost us resources we tend not to give away to everybody because it would be prohibitive to do so. (Gill, 2013)*

Nevertheless, OpenStreetMap Foundation offers a feature such as membership facility to contributors who are willing to support OSM project for long term. The effort is one of the foundation's attempt to acquire capital to fund OSM project. Table below describes the detail of the membership plan of OSMF.

Normal Member	Associate Member	Corporate Member
<ul style="list-style-type: none"> <li>• Annual Fee : £ 15 per year</li> <li>• For individual</li> <li>• Entitled to influence the direction of OSM by being able to vote in elections for officers of the foundation</li> </ul>	<ul style="list-style-type: none"> <li>• Annual Fee : £ 15 per year</li> <li>• For individual</li> <li>• Entitled to vote like normal member but subject to condition as follow:               <ol style="list-style-type: none"> <li>1. Appeals from expulsions by the board</li> <li>2. The appointment of directors</li> <li>3. Decisions of the meeting as to whether to adjourn</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>• Annual Fee : Supporter level (€500 /year), Platinum level (€20,000 /year)</li> <li>• For companies or organizations</li> <li>• No voting rights</li> </ul>

Table 5. Detail of membership plan of OSMF  
 Note. Retrieved from <https://join.osmfoundation.org/>, 2017

## 4.2 Case 2: Google Maps

### General information; Introduction, history, objectives of Google maps

Google maps is a mapping application service developed by Google. The service offers a navigation route planner for travelling by foot, bicycle, public transport, or car. The service is also equipped with satellite imagery, 360° panoramic street views, real-time traffic condition, and many more. Today, Google maps service can be used in web based and mobile application platform.

### Findings

Google Maps project was started by acquiring several companies prior to engineering development process. In September 2004, Google acquired ZipDash, a company that provided real-time traffic analysis (Bazeley, 2005). A month later, Google acquired Where2, a Sydney-based company, which developed a web-based maps service, and Keyhole, a California-based company that developed geospatial data visualization (Kiss, 2009).

The main reason of Google Maps acquisition was to bridge the technology gap within Google existing technology (Bret Taylor, who was a Product Manager of Google). Taylor was working on a product called "Search By Location" in 2003, and it was Google's first effort that is related to mapping (Gannes, 2015). He then acknowledged the limitation in Google search technology, which is technically for indexing the web over the Internet. The attempt for location searching was initially using Google search technology that allows users to fill basic information such as address or zip code, and Google would find web pages according to the information provided. The result given by the search engine was a data duplication of something that possibly not related to the initial keyword. For example, if a user wants to search for "java coffee" keyword, the search result might be, Sun Microsystems, Inc. a software company that produces a well-known computer language program "java". The less sensitive, incomplete, and inaccurate search engine might cause a misleading information to the user.

### Motivations behind its decision to the application of open innovation strategy in order to support collaboration with other parties within their platform.

In general, Google Maps opens its innovation funnel through two activities: implementation of crowdsourcing and open source software strategies. Both activities have their own purpose in order to improve the performance of the platform. The following paragraph will describe these activities.

### Findings

In case of crowdsourcing, Google maps using the strategy to complete the map's content (data and information) using participation from the users/contributors all around the world. Public can contribute by participating as a member at Local Guide, or being a freelance contributor for the platform. Local Guides is a good example of Google maps' mechanism to generate external knowledge in order to enhance the use of crowdsourcing strategy by giving the contributors opportunity to provide some information, review,

photo of a specific location, place, or object in Google maps (Perez, 2015). The company says, they improved the platform's ability so that all users and community could add missing places, edit the existing business or landmark information on google maps apps.

*This lets people contribute new and updated information to Google Maps from more places whether they're searching for a new restaurant on Google.com or looking for a nearby convenience store while on the go. (Google, 2015)*

In addition to that, Jen Fitzpatrick (2016), an executive leader of product and engineering efforts for Google's local products (including local search and google places), in her interview with Business Insider mentioned:

*Our ultimate aspiration is to build the richest, deepest, most detailed understanding of the real world that's ever existed and to share that back to our users. You are the community that's helping us build that understanding. (D' Onfro, 2016)*

The use of crowdsourcing within the platform allows Google maps to create more cleaner, more detailed information of points of interest and faster updates to the map which helps Google maps to map the whole world in a short time. Manic Gupta, a Group Product Manager of Google Maps, stated:

*Today, we've reached our 50th Ground Truth country with the addition of five new countries: Taiwan, Malaysia, Poland, Romania, and the last regions of Russia. We're also rolling out Google Map Maker and Report a Problem our crowdsourcing map tools to Taiwan, Russia and Malaysia, giving anyone in those countries the ability to share and contribute their local knowledge directly to Google Maps. (Gupta, 2014)*

Along with the development process and data information collection through crowdsourcing, Google maps also applied open source (sharing APIs strategy) with the initial aim of the strategy in which they want to improve innovation and add more value to the platform. Google was surprised to find out that many developers around the world create their own value by exploiting Google Maps, using a variety of ways that are ethically and normatively acceptable or otherwise. Some methods that are against the law such as reverse engineering that the programmer had been using the Google Maps Code to abuse or copy the platform.

*Google was in dilemma, whether to sue these individuals or open its doors for more creativity. It decided to open up its application programming interfaces (APIs) to harness external ideas, talent on mass scale. (Ryder & Madhavan, 2013)*

This decision has become a turning point for Google and created significant results in terms of revenue generating through licensing business as well as developing their innovation through collaboration. However, there are some consequences that should be taken into account by Google when imposing a fee for the license; the company should work harder to provide more complete map with better quality geocoding, data and information availability, since a better service would a consideration for the developers before they pay the Google maps service. Andrew Turner (2011), a former Chief Technology Officer at FortiusOne stated that:

*Now, with a very direct pay requirement being imposed this will dramatically change the adoption of Google maps. Developers will have to consider very carefully how they will afford the potential and optimistically likely fees that the service will require as it becomes successful. (Arthur, 2011)*

Even though the direct pay requirement become one of the consideration for the external developers, the level of Google maps' APIs adoption rate is slightly high until this day. According to Google Developers website (2017), the APIs of Google Maps are implemented by more than one million of apps and sites

worldwide, and they became the central groundwork for some recent highly successful apps such as Uber, Whatsapp, AirBnB, Trulia, Expedia and many more to support their business. Google Maps opens their source (APIs) to support the external developers, business owners, etc., and build a better interface by integrating Google Maps in their mobile application or website. With the use of Google Maps plugins in other companies, Google Maps could expand their customer reach through these companies.

### **Google maps direction of knowledge flow**

The motivation behind the innovation of Google emphasized that Google maps' development process of innovation was not happened in a short time. From the investigation, the researchers found out that there are multiple knowledge transfer process occurred within the development and innovation process of Google maps in the last decades. The innovation process in Google Maps project was not only involving their internal employees, but also resources from outside the company. In this section we will discuss about this direction of knowledge in open innovation process that has occurred in the Google maps project.

### **Findings**

#### *Direction of knowledge from outside to inside of the company*

Looking back to the journey of Google Maps' innovation process, there were several methods of technology and knowledge transfer process occurred in the beginning stage. As mentioned in previous section, the mapping technology was acquired from an Australian company called "Where2". After the acquisition process, Google developed the platform internally before it was finally launched its Google maps application for web browsers. On top of that, Google successfully integrated this mapping technology with the geospatial data visualization (earth viewer) into an application; Google earth, an application that is integrated with google maps (Wang et al., 2013).

As known from previous observation, Google is opening its platform for crowdsourcing to collect more data and information from its users all around the world. By making Google maps as an open platform, every user has the access to contribute to fill the information and data about a specific location or building in the platform.

For example, a contributor who wants to provide or write a new or additional data, information, review, and image about a restaurant, shopping mall, tourist spot, etc., should pin and upload the data and information in the Google maps platform before waiting for Google's approval. By applying this strategy, all sides generates benefits; Google receive information and data that enriches their database of knowledge for free, while the member of Local Guides and the contributor receives benefits according to their contribution portion and contributor level. In the end, these collaboration between Google maps and the contributors could provide a positive impact for the end users.

*For Google Maps end users, the rollout of the new program could see Google's reviews becoming more useful than they were in the past, as often the reviews section is something consumers only hit up when they have a problem or complaint with a business. The motivation to log in to leave more positive or even neutral reviews can be low, which is something Google clearly hopes to change with Local Guides. (Perez, 2015)*

While the practice of licensing in and crowdsourcing contributes the technology and knowledge transfer from external sources of the company, the opposite happened to open source strategy (APIs sharing). By sharing its APIs publicly, the process of innovation were becoming faster due to the use of external resource through several collaboration with developers and partners.

The phenomenon of today's rapid growth of the mobile application in the android platform and the use of Google Maps' API in the websites, shows that there are a significant impact from Google's outbound OI strategy. The API strategy could create an ecosystem that is beneficial for their company by enabling third-party developers or other companies to use Google Maps API in their platform; applications, websites, software, etc. (Taylor, 2005).

Looking from the other perspective, the observation from online source discovered that the external developer could take benefits from using Google Maps APIs to create their own platform by using Google maps as their core service. In particular, one of the APIs adopter, Ed Bindl and Jacinda Shelly (2017), a senior software engineer and a Lead Platform Engineer respectively, who works for Doctor on Demand mentioned: *“Google Maps makes our user experience much more satisfactory, which means that patients will use our services again.”*

### **Google maps financial direction**

There are some usage limits that allow to generate by the use of Google maps APIs (for example; for standard web plan, the usage is up to 25,000 map loads/day). More than the free usage limit, developer will have to modify their subscription plan by purchasing a maps APIs premium licence. In addition to that, in order to gain a feature that give the developer a flexibility to editing the maps interface, they also have to paid some amount of money to purchase the license. More detail information about Google maps' APIs licensing as a strategy to control its Intellectual Property will be described in the following paragraphs.

### **Findings**

In regards of Google maps, the company licensing out its standard APIs freely and accessible for anyone who wants to leverage the API for their application or website to facilitate their business (Willmott, 2015). Today the use of standard APIs is free for under 1,000 requests/day for android and iOS, and free under 25,000 loads/day for web (Google maps for developers website). By purchasing these plans, everyone such as business owners, developers, blogger, etc., could infuse Google Maps in their applications or websites. The APIs sharing helps business to create new value within their platform (mobile and web application) by generate their own map and host customized map tiles.

Google maps' standard APIs type are very limited due to Google copyrights. Google Maps constrained the maps on the websites or apps that use Google Maps free public API so that it cannot be modified. Additionally, the users cannot customize the interface, and use the component such as icons (buildings, cars, vehicles, bike, shops, restaurants, etc.), according to the owner desires (as it is). In terms of technical support, this plan is also limited to the 24/7 technical support service.

After measuring the stage of openness in Google maps APIs policy through its premium subscription plans (from official Google Maps APIs for developers website), there are some differences between these two plans: in premium plan, the pricing is based on the volume required. There are also some limitations due to Google Maps copyrights in the standard APIs plan. The user needs to purchase Google Maps API licenses for more features such as some copyrights to native APIs codes, bigger data loads, and customize the map (colour, view, interaction, etc.), create a new map, use their own icons for vehicles, buildings, comment boxes, 24/7 technical support, etc.

Nevertheless, the APIs license strategy helps the developers to customize the maps inside the applications and websites according to their style preference. Therefore, it would give a better end-user experience in their platform and create new values to their business.

### **Business model of Google Maps**

According to the observation from online source, Google Maps is using different business models in accordance with each strategy applied. In crowdsourcing, Google Maps applies in-application advertising business model, as it adopts Local Search ads within the search result. Along with the development of Google Maps applications and its increasing number of the application's user, Google began to look for an opportunity to generates revenue from Google Maps.

### **Findings**

Up until today, Google Maps is using several clear business models in their APIs strategy, but it is still undefined in the crowdsourcing platform. This undefined and always changing characteristic of the business model is part of Google's strategy to adapt their innovation strategy. This strategy aims to ensure the

survival ability of the company by creating a sustainable business model (Steiber, 2014). Recently, Google CEO, Sundar Pichai, hinted a potential way for Google Maps to generate revenue from ads (Pichai, 2017).

*I'm sure you have noticed changes in Google Maps with the last few months. If you open Google Maps, you're traveling or out on a Friday evening, we start surfacing a lot more info about what you can do, places to eat and so on. So those are beginning to get good feedback from users and I think that gives us an opportunity to add value there overtime as well.* (Oreskovic, 2017)

From this point, Google Maps will likely use local search ads to help local business to be more visible when the consumers are searching through Google Maps (especially on a mobile device) for some place to eat or shop. This includes the plan to infuse Promoted Pins within the maps (brand company logo in the map), list of in-store promotions, coupons, customizable business pages through local extensions (store address, phone number, ratings, opening hours, reviews, store pages, photos, profile, etc). Until this thesis paper is written, this feature is still in the experimentation and development stage.

However, with these features Google intends to support local store to promote their business to pedestrian consumer near the store location. It seems that Google Maps will use the in-app ads in the near future. With this business model, Google Maps that currently has one million user is expected to increase its revenue by 50% next year, which approximately would likely hit \$1.5 billion in incremental revenue in 2017 (Stanley, 2016).

In APIs strategy, Google Maps business models can be divided into two forms based on their user. Firstly, Google Maps is applying freemium as its initial business model for basic/standard users in open API strategy; it is unlimited free for iOS and android platform developers, and it is free until the quota limit is reached for web and web service platform developers. The standard plan was intended for developers that develop applications or websites that are free for anyone to use. The standard plan, allows Google Maps to generate revenue through advertisements: Google adwords is used for websites, and Google admob for in-application advertising.

Secondly, premium plan was intended for applications or websites that require an end user or organization to pay a fee for download or access (an apps or websites that are using business model to generate financial benefits, e.g. freemium, OEM or subscription) in apps store. In this plan, Google Maps is using premium subscription business model by licensing out their APIs to third party companies who want to use its maps as a core business in their platform. (free up to 1,000 requests/day for android and iOS, and free under 25,000 loads/day for web). In this plan, there are more features that are not included in standard plan, such as the developers could share the apps license with Google, 24/7 technical support, service level agreement (SLA), guaranteed ad-free and enhanced API features. The following table will show the differences between these two plans. All table taken from Google maps APIs website

Standard	Premium
<ul style="list-style-type: none"> <li>• Free, external, and publicly available implementations</li> <li>• Unlimited, free usage of Google maps Android API and Google Maps SDK for iOS</li> <li>• Additional charge for above usage limits (pay-as-you-go for higher quotas)</li> <li>• Individual API pricing based on usage limit</li> </ul>	<ul style="list-style-type: none"> <li>• Licenses for internal, OEM, private apps/websites that have restricted access to public, and asset tracking implementations</li> <li>• Annual contracts with enterprise terms</li> <li>• 24/7 technical support</li> <li>• Service Level Agreement (SLA)</li> <li>• Guaranteed ad-free and enhanced API features</li> </ul>

Table 6. Differences between Google maps APIs standard and premium plan features  
 Note. Retrieved from <https://developers.google.com/maps/pricing-and-plans/>, 2017



Android	Standard	Premium
Google maps Android API	Unlimited free usage	Pricing based on volume required/usage
Google Place API for Android	Default 1,000 free request/day, increased to 150,000 free request/day after identify verification. Free uplift for complying applications.	-----

Table 7. Pricing detail for Google maps Android deployment  
 Note. Retrieved from <https://developers.google.com/maps/pricing-and-plans/>, 2017

iOS	Standard	Premium
Google maps SDK for iOS	Unlimited free usage	Pricing based on volume required/usage
Google Place API for iOS	Default 1,000 free request/day, increased to 150,000 free request/day after identify verification. Free uplift for complying applications.	-----

Table 8. Pricing detail for Google maps iOS deployment  
 Note. Retrieved from <https://developers.google.com/maps/pricing-and-plans/>, 2017

Web	Standard	Premium
Google maps Javascript API	Free up to 25,000 map loads/day	Pricing based on volume required/usage
Google Static maps API	\$0.50 USD/1,000 additional map loads, up to 100,000 daily, if billing is enabled.	Premium enhanced features: - Guaranteed ad-free - Image size up to 2048 x 2048 pixels
Google Street View Image API		
Google maps embed API	Unlimited free usage	-----

Table 9. Pricing detail for Google maps Web deployment  
 Note. Retrieved from <https://developers.google.com/maps/pricing-and-plans/>, 2017

Web Service	Standard	Premium
Google maps Directions API	<p>Free up to 25,000 map loads/day</p> <p>\$0.50 USD/1,000 additional map loads, up to 100,000 daily, if billing is enabled.</p>	<p>Pricing based on volume required/usage</p> <p>Premium enhanced features:</p> <ul style="list-style-type: none"> <li>- Query-per-second</li> <li>- Enhanced distance Matrix API and Roads API capabilities</li> </ul>
Google Static maps distance Matrix API		
Google maps Elevation API		
Google maps Geocoding API		
Google maps geolocation API		
Google maps Roads API		
Google maps Timezone API		
Google Place API web service	<p>Default 1,000 free request/day, increased to 150,000 free requests per/after identity verification</p>	<p>Pricing based on volume required</p>

Table 10. Pricing detail for Google maps Web service deployment  
 Note. Retrieved from <https://developers.google.com/maps/pricing-and-plans/>, 2017

## CHAPTER FIVE

### 5. DISCUSSIONS AND CONCLUSIONS

In this chapter, the case studies were analyzed by using theories and concepts stated in the literature review of the research. All collected data around open innovation and business activities in two digital mapping providers are used to address the research questions and to ensure the validity of the research findings. After discussing the findings, the following conclusions are made and recommendations for future research are presented.

#### 5.1 Discussions

##### **5.1.1 The purpose of utilizing opening platform is to encourage innovation acceleration in IT digital technology industry**

According to Letellier, F. (2008), an open source specialist advocates that open source or free software is a way to innovate in software industry and it is an exemplary and very effective platform of open innovation, along with open source projects or communities that act as innovation intermediaries.

Following the concept, OpenStreetMap (OSM) and Google Maps practice open source software strategy. The organizations made their platform accessible for everyone with the purpose to seeking contribution from external resources to help them collect the world's information as detail as possible. This strategy was adopted in favor to match economic principle; getting a maximum result with minimum investment cost, in the case of these platform: faster improvement of the functionality of the platform.

In complement to the strategy, they adopt various open innovation strategy to acquire resources, ideas, and contributions by threading collaborations with external parties consist of communities and other firms which act as proponent to outside value creation of the product. One of the strategy is collaborating with the crowd. The utilization of this mass collaboration and philosophy of openness has been made possible thanks to the facility of easy and affordable access to communication through Internet technology (Castells, 2000).

Through application of open innovation strategy to harness ideas from external resources, both organizations has been successfully advancing their platform in relatively short time in terms that they are able to complete the content of the map in just over 10 years (Gannes, 2015) and capture millions of users submitted to their services. These condition is not only give benefits for the map provider, but also for the end user. More complete data, content, and information in the maps will help the end user to understand about their neighborhood, and will provide better insight about how to travelling quickly and efficiently without getting caught in a problem (traffic, accident, local disaster, etc) on their journey. This condition will leads to a better user experience.

##### **5.1.2 IT digital mapping firms harnessing knowledge from multi directional source for value creation process**

According to data collected by the researchers, OSM is using outbound OI strategy of open source software strategy. It implies that the OSM open its licenses and allow customers to use, reuse and distribute the data and APIs for any purpose for free while users can also act as co-creator to develop a new platform. On the other hand, crowdsourcing of inbound OI strategy are applied to harvesting maps' data and content from communities.

OSM has acquired abundance of up-to-date mapping data amount to the high level of detail of path especially those engraved by hikers or cyclists communities which is hardly difficult to achieved by other commercial mapping software. During the journey of its development, OSM gain traction from many parties such as the communities of cartographers, education institutions, governmental projects, and other incumbents in technology industry to support this project. The scope of resources they received is extended beyond data submission which is including donation of server infrastructure, satellite imagery data and

even financial assistance. Recently, OSM also involved in joint-venture activity with Telenav with the objective to embed realtime navigation solution into the map platform.

The same feat of involving network collaboration for value creation is can also be found in Google maps. From the case study, Google maps superior technology was not originally developed by Google. It was acquired through series of acquisition of variety of startups which were Where2 which provide mapping platform, Keyhole for geospatial data visualization and Zipdash for its real time traffic analysis. In addition, more detailed physical information such as street, terrain, and traffic condition has been acquired through licensing-in of particular country's geospatial data from governmental institutions and submission from its network of communities (crowdsourcing) through several Google's programs such as Local Guides and Street View.

Google is not totally depends on single direction of innovation (outside-in innovation) to create value. Despite, the firm obtain innovation from external source of the company and then temper it in internal R&D to align innovation with company's internal core strategy or business strategy. The current developing Sidewalk Labs project for example, is a spin-off that combine the functionality of Google Maps and Waze aiming to provide future solution for urban infrastructures issues such as cost of living, efficient transportation, and energy usage (McCormick, 2016).

### **5.1.3 The difference of strategy of open innovation depends on the financial nature of the firms**

Open Source Software movement began in the IT software realm as a response to the limitation of proprietary software. It refers to computer software with its source code being made available with license which copyright holder provides the rights to study, change and distribute the software for any purpose to encourage mass collaboration (St. Laurent et al., 2004). Google Maps and OSM platforms are built under open source as its core strategy. The difference lies on the financial nature motivation of those two organizations.

Instead of creating Google maps internally from scratch, the firm acquired leading technologies from other firms, develop new product out of it and opening some of its source codes in the form of API with expectations to improve its product and harvest public knowledge to stay innovative. Google has developed Google maps to diversify their web-based product portfolio (LeMay, 2005) apart of their search engine which now acts as revenue generator for the company.

Looking from these facts, the financial nature of Google developing Google maps is pecuniary where the company generates profits from knowledge, ideas and technologies exploitation. However, in terms of methods to acquiring innovation, Google Maps using both pecuniary (acquiring) and non-pecuniary (revealing, sourcing) strategies as classified in the open innovation model matrix defined by Chesbrough & Brunswicker (2013) for value creation. One of revealing strategy in Google Maps is the sharing of platform for local business users which those group of customer may use the map to pinpoint their business location for free but after being viewed for some point, it would incurred charge for each view. Through these observations, it shows the implication that the exploitation of external intellectual properties by using open innovation strategy in Google maps has a tendency of different purpose on crowdsourcing and open source in general. The finding exposes that Google maps' open innovation process leads to creation of new business model.

In contrast with Google Maps, OpenStreetMap's financial motivation is non-pecuniary. The platform born out of inspiration following the path of Wikipedia. OSM project is registered under a non-profit organization and unlike Google maps, it release modifications of the platform to open source community. It implies that value creation obtained by outside mass collaboration is attributed to communities rather than OSM itself. OSM has been licensed under Open Database License (ODbl) and thus, the organization embrace open innovation strategy especially open source totally for purpose of improving the platform's technology hence value, and ignore value capture along their value chain.

#### **5.1.4 The emphasize of open source software strategy either for value creation or value capture is based on the firm's business model**

Open innovation business model should be like other business model which give business advantage against competitors in terms of making enough profit, to stay in business. Business model expresses the firm's rationale for creating, delivering and capturing value, according to Osterwalder & Pigneur (2013). Open source community is an important element in business model that harnessing open source strategy for value creation. OSM platform depends fully on participation from open source community for the purpose of cost sharing and development agility reason because it is non-profit oriented project and thus, it does not emphasizing value capture.

Based on data in the findings, OSM platform is licensed under creative commons which enables unlimited free use and distribution of the copyrighted work. It implies that the platform was designed in such a way that enable users to shape, design and remix all by themselves. The users can access OSM's servers, in order to support the development process of the platform and use its APIs for free. The platform see the customers as co-creators of the products and hence the value. Considering the importance of the involvement of community to shape OSM platform, the foundation has been organizing annual conference called SoTM (States of The Maps) to gather communities with similar passion to map the world and also to gain donation for the operation of the platform. It can be concluded that OSM is an open platform that using open source strategy to create and increase value of the product.

Meanwhile, in the profit-based platform, revenue stream might be the most important component in the business model canvas (Osterwalder & Pigneur, 2013). It is understandable since the innovation processes are costly, the organizations require fundings to finance the project. Revenue stream represents earnings the business make from value capture process. In Google maps, open source sharing community is the potential target market from whom the organization can capture value rather than being a part of the platform's value creation. Google Inc. releases maps APIs in limited features to open source community for multi mobile operating system types which can be used for various purposes, for instance to embed Google Maps features into mobile apps.

In the basis of the platform's openness, Google Maps indeed benefitted from communities-generated data such as real-time traffic, navigation, road condition, etc. for the maps. The strategy to soliciting contribution from users is made through Local Guides and Street View programs involving rewards in exchange of the contribution ranging from free trial for Google's new release products to invitation to Google exclusive annual conference event free of charge.

Google maps indeed has received the benefit from openness but while assessing the theory of open source software strategy, Google Maps is more inclined to closed software instead of open source because; (1) there are little to no network effects (Economides et al., 2006) that increase the value of the product and, (2) the value of the product is derived from its technology superiority. Google maps keep their APIs themselves as their IPR and sell it as market-ready product.

As the way of value capture, it can be seen that Google Maps APIs is bundled within freemium business model where communities can use the APIs to build their own platform under iOS, Android or HTTP web services framework for free in limited features but need to pay to unlock free usage of Google Maps Android API and Google Maps SDK for iOS as well as for 24/7 technical support and ad-free feature.

There are other numerous way on how Google maps could commercialize their technology by targeting multi customer segment. Local business users is one of among Google Maps target customer for its promoted pins feature where customers can advertise their business by putting its local shops, restaurants or cafes position on the Maps for promotion purpose. The charge begins after 2500 click/day for the business ad pinned on Google Maps. Therefore, APIs licensing, in-app advertising, and promoted pin are source of revenue channels of Google maps.

It is concluded that Google Maps has opened its platform to harvest real time mapping data by harnessing network effect to enrich the platform's data but not necessarily to accelerate development of the platform's technology. In profit-based platform like Google maps, open source strategy is not being looked

after for value creation rather it's become a strategy to find new way to commercialize technology which led to the conception of new business model.

## 5.2 Summary of discussions

To summarize the analysis above, the following table describes the relationship between motivation, financial direction of the firms, business model, degree of openness to how firms create and capture value.

	Google maps	OpenStreetMap
<b>Motivations</b>	Create a new web-based product platform apart from existing search engine along with the Google's product portfolio	Create a community-driven alternative to commercial map, it is free as long as users of its services attribute the credit to OSM and its contributors
<b>Financial direction and OI practice</b>	<ul style="list-style-type: none"> <li>• Pecuniary <i>inbound</i> (acquiring): IP licensing-in, acquisition, specialized open innovation intermediaries (user-generated data), crowdsourcing</li> <li>• Pecuniary <i>outbound</i> (licensing): IP licensing-out, selling market-ready products, spin offs, open source software strategy</li> </ul>	<ul style="list-style-type: none"> <li>• Non-pecuniary <i>inbound</i> (sourcing): crowdsourcing</li> <li>• Non-pecuniary <i>outbound</i> (licensing free): open source software strategy, customer creation</li> </ul>
<b>Degree of openness</b>	<ul style="list-style-type: none"> <li>• Demand-side use: open</li> <li>• Supply-side use: semi-open</li> <li>• Platform provider: closed</li> <li>• Platform sponsor: closed</li> </ul>	<ul style="list-style-type: none"> <li>• Demand-side use: open</li> <li>• Supply-side use: open</li> <li>• Platform provider: open</li> <li>• Platform sponsor: open</li> </ul>
<b>Value creation for company</b>	<ul style="list-style-type: none"> <li>• Complete mapping and navigation solution acquired through technology acquisitions from other forms</li> <li>• Community based data generation through google maps local guides and street view program</li> <li>• Increased participation/ collaboration with third parties, external developer, and other companies</li> </ul>	<ul style="list-style-type: none"> <li>• Customers are the co-creators of the products and values</li> <li>• Community-based data generation</li> <li>• Contribution and donation from open source community to sustain and improve the , data collection, functionality and performance of the platform</li> </ul>
<b>Value proposition for customer (open source adopters)</b>	<ul style="list-style-type: none"> <li>• Provision of complementary service (24/7 technical support, training, etc)</li> <li>• The business users can create novel value proposition including for commercial purpose</li> <li>• Typical APIs &amp; SDKs users are the organization that is in digital travel industry that needs a real-time data traffic</li> </ul>	<ul style="list-style-type: none"> <li>• For the business users, it is a cost effective alternative due to low switching cost (because the platform is completely free)</li> <li>• The business users could create a novel value proposition for commercial or non-commercial purpose (community purpose).</li> </ul>
<b>Value capture</b>	New revenue channel through licensing-out APIs, promoted pin, 24/7 technical support, built in in-app advertising (Google Ads and Google Mobs)	Financial donation from open source community and big companies

Table 11. Differentiation of create and capture value process between a profit and non-profit based Open platform

## 5.3 Conclusions

The research was conducted with the purpose to contribute knowledge into the circumstances that motivate a firm to open its platform publicly, the particular type of open innovation strategy practiced in the area of IT digital technology industry as well as its associated business model. The research aimed to investigate how could these organizations create and capture value from various open innovation strategies in IT industry, given that external resources are the part within business model.

The findings suggest that the decision of firms in adopting open innovation approach is due to benefits offered by collaboration with external network of the organization. It can be shown that the open innovation approach could motivate the firm from two perspectives: technological and business perspectives. From the perspective of technology, firms are motivated with the benefit offered by collaboration within open innovation approach which promote agility to the improvement of the platform's technology, shorten lifecycle path to the market, possibility to enrich the content in the platform as well as to novel value creation. In the perspective of business, open innovation allows distribution of the costs required to producing and improving the platform. Additionally, more evidence on the benefit of open innovation in the aspect of business from the case study is that the network which acts as contributors to the innovation, can also become potential customers where firm can capture value from.

The financial nature of the organizations was also discussed in the research which counted as circumstances since it determine the firms to absorb knowledge from either inside or outside sources using particular method of open innovation strategy. From these case studies, a profit-based organization invest in acquiring innovation from other firms during initial stage to achieve superiority of technology for the platform hence create value. The platform was developed through buying technology from startups, licensing-in IP, and specialized open innovation intermediaries project. In this way, organization prefer to own the intellectual property of the core platform and treated it as an asset. On the other hand, a non-profit based organization open its platform and let the power of community to temper the value and co-create the platform due to limitation of access to capital investment. Therefore, the platform's data and intellectual property are attributable to communities.

Despite of the difference of strategies in acquiring innovation, the research revealed that digital mapping platform is operated within open source software strategy and crowdsourcing. The IT digital mapping firm provide code repository in the form of APIs dedicated for open source community particularly for third-party developers to incorporate mapping features in their own applications or platforms. A non-profit based firm distributes the APIs for free while profit-based firm restrict some features to the APIs where customers need to submit for additional service plan involving financial transaction to unlock unlimited features to the APIs. In addition, crowdsourcing is used to harvest real-time users-generated data to complement maps platform.

To clearly answer the research question relating to how IT digital technology capture value out of open innovation, it can be answered by looking at how wide is the degree of openness of the platform and the business model preferred by the firm as founded in findings. According to the data in the case studies and relating it to the degree of platform's openness principle introduced by Thomas et al.(2008), a pecuniary-based platform is close in the aspect of platform sponsor where the firm protect the license of its core platform. The intention behind closure on platform sponsor side driven by the preference of a firm's business strategy. On the other hand a non-pecuniary based platform is deliberately opened all four openness degree (theory proposed by Dahlander and Gann, (2010)), to entice network benefit for value creation while distributing the cost to other stakeholders in order to produce the platform.

The primary factor of using open source software strategy is the advantage of cost savings (Linux Foundation, 2017). It can be indicated from how high the platform's openness degree because it is closely tied to the organizational business strategy. The higher the openness degree, the higher the dependence on the contribution from external network to create the platform and collaboratively bear the production and operational cost imposed for the sustainability of the platform (Dahlander and Gann, 2010). Therefore, firm does not need to design a strategy to commercialize platform's technology for the sake of seeking financial return of the investment.

On the other hand, firm which adopt open source software strategy but partially closed in one or more openness degree reveals that there is a point where development processes are being kept in-house. Although it receives benefit from external sources, a firm need to create a business strategy to gain financial return from what the firm developed internally. Thus, commercialization of the platform is sought after to capture value from innovation. In the perspective of business model, such platform is likely to operate on proprietary rather than open source that is contrasting the purpose of seeking open source strategy which is to saving costs.

In relation to business model, Tapscott & Williams (2007) defined a term “Wikinomics” business models as the mass collaboration-based business models that arise due to emergence of openness and mass collaboration phenomena which brought about the economic potential. From these case studies, open source software and crowdsourcing strategy is one mechanism that encourage participation from customers and third parties to submit data and information to the maps in order to improve or build the platform. This method of accumulation strategy is a characteristic of prosumers business model where customers act as producers that help organization to co-create the platform. In this business model, external network is the stakeholders and based on the business motivation underlying the firm and financial nature behind the creation of the platform, contributors could merely contributing to value creation or could become the subject of value capture.

In conclusion, IT digital technology in practice, can adopt open innovation with open source software strategy in particular to accelerate the platform improvement as well as innovation process, and also a way to capture value out of innovation depending on the motivation and financial nature of the firm.

#### **5.4 Limitations**

The main drawback of this research lies on the comprehensiveness of the topic discussed correlated to the case studies of Google maps and OpenStreetMap open innovation strategy. This thesis has represented only a fraction of open innovation strategies such as open source software and crowdsourcing amongst the magnitude open innovation approach. It is rather difficult to covers all aspect in depth due to broadness of the topic and lacking in time given to complete the research thesis. Considering the research was conducted in around 12 weeks duration. There was no interview conducted with the companies that are being used as case study during the research. This is due to the limited access and inability of the researchers to find someone that affiliated with the organization that would agree to be interviewed during the research process.

The use of interpretivism paradigm in this research, may occurred the possibilities of personal bias in the results, and the results of this study may differ if the research is repeated with different method and perspectives (Collis & Hussey, 2013). Since the secondary data collected only from open platform provider perspectives, there also a possibility to one sided story that influenced the analysis on the company. Therefore, we collect and carefully selected data and information from trustworthy mainstream media. Moreover, in order to validate the finding, repeated investigation of the findings were occurred by searching for the same or related information from other mainstream media sources. However, the interpretations of data and information from various literature may occur biases. Thus, the literature reviewers should always be critical on the research findings.

#### **5.5 Recommendations for future research**

The interesting subject around open innovation topic for future recommendation is to research about the cost of investment of open innovation and lead further to benchmark between investing in internal R&D or in open innovation.

Since the research was conducted only from the perspective of the open platform provider (Google Maps and OpenStreetMaps), it only discusses the possible strategy that has been done by the open platform provider, and what benefits and advantages they can derive from the strategy. Thus, it is only cover one side of perspective: from the open platform actors or providers.

The future research could dive deeper into the opposite perspective: from the adopter’s perspective, motives to contribute in open platform. It would be more comprehensive if there are motivations from external factors discussed such as social and economic condition that influence the adoption of open innovation strategy. Furthermore, technology acceptance model could be a useful and essential factor to determine whether the firms have the ability to identify values from open innovation, and formed towards external knowledge adoption (in this case: technology) to perceived value of the innovation. A quantitative



research on technology adoption as well as the innovation performance could provide more information to determine the success rate and factors behind the open innovation strategy in an effort of technology advancement.

## References

- Arthur, C. (2011, October 27). *Google puts a limit on free Google Maps API: over 25,000 daily and you pay*. [online] Retrieved from: <https://www.theguardian.com/technology/blog/2011/oct/27/google-maps-api-charging> [Accessed 24 August 2017].
- Ballon, P. (2009). *Control and Value in Mobile Communications: A political economy of the reconfiguration of business models in the European mobile industry*. PhD thesis. Brussels: Vrije Universiteit Brussel.
- Castells, M. (2000). *The Rise of the Network Society, The Information Age: Economy, Society and Culture Vol. I*. Cambridge, MA; Oxford, UK: Blackwell.
- Chesbrough, H.W., (2003a). *Open Innovation*. Harvard University Press, Cambridge, Massachusetts.
- Chesbrough, H.W., (2003b). *The era of Open Innovation*. MIT Sloan Management Review, 44(3), pp.35–42.
- Chesbrough, H., (2003c). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. 1st ed. Harvard Business Review.
- Chesbrough, H. (2005). *Open Innovation: A New Paradigm for Understanding Industrial Innovation*, in H. Chesbrough, W. Vanhaverbeke and J. West (eds.) *Open Innovation: Researching a New Paradigm*. Oxford: Oxford University Press.
- Collis, J. and Hussey, R. (2014). *Business research*. 1st ed. Basingstoke, Hampshire: Palgrave Macmillan.
- Columbus, L. (2017, January 29). *2017 Is Quickly Becoming The Year Of The API Economy*. [online] Retrieved from: <https://www.forbes.com/sites/louiscolumbus/2017/01/29/2017-is-quickly-becoming-the-year-of-the-api-economy/-2fcd4a3b6a41> [Accessed 5 September 2017].
- Dahlander, L. & Gann, D.M., (2010). *How open is innovation?* Research Policy, 39(6), pp.699–709.
- D’Onfro, J. (2016, September 14). *Why millions of people are helping Google build the most accurate maps in the world*. [online] Retrieved from: <http://nordic.businessinsider.com/google-maps-local-guides-2016-9>. [Accessed 31 August 2017]
- Economides, N., & Katsamakas, E. (2006). *Two-sided competition of proprietary vs. open source technology platforms and the implications for the software industry*. Management Science, 52(7), 1057-1071.
- Eisenhardt, K.M. & Graebner, M.E., (2008). *Theory building from cases: opportunities and challenges*. Academy of Management, 50(1), 25-32.
- Eisenmann, T. R., Parker, G., & Van Alstyne, M. (2009). *Opening Platforms: How, When and Why?* In A. Gawer, *Platforms, Markets and Innovation* (pp. 131-162). Northampton: Edward Elgar Publishing.
- Fletcher, G. (2015, February 2). *Microsoft's embrace of open source is driven by commercial practicality not principle*. [online] Retrieved from: <http://theconversation.com/microsofts-embrace-of-open-source-is-driven-by-commercial-practicality-not-principle-37068>. [Accessed 27 August 2017].
- Fossum, M. (2012, March 20). *Websites Bypassing Google Maps Due to Fees*. WebProNews/Business. Retrieved from: <https://www.webpronews.com/websites-bypassing-google-maps-due-to-new-fees-2012-03/> [Accessed 23 August 2017].

Gannes, Liz. (2015, February 8). *Ten Years of Google Maps, From Slashdot to Ground Truth*. [online] Retrieved from: <https://www.recode.net/2015/2/8/11558788/ten-years-of-google-maps-from-slashdot-to-ground-truth> [Accessed 5 August 2017].

Gawer, A. and Cusumano, M.A., (2002). *Platform leadership: how Intel, Microsoft, and Cisco drive industry innovation*. Harvard Business School Press, Boston.

Gill, S. (2013, February 6). *INTERVIEW: OpenStreetMap founder Steve Coast on the future of mapping*. [online] Retrieved from: [http://iq.pivotal.com/article/fxiiHRJManM/2013/02/06/interview\\_openstreetmap\\_founder\\_steve\\_coast\\_on\\_the\\_future\\_of/](http://iq.pivotal.com/article/fxiiHRJManM/2013/02/06/interview_openstreetmap_founder_steve_coast_on_the_future_of/). [Accessed 30 August 2017]

Haklay, M., & Weber, P. (2008). *Openstreetmap: User-generated street maps*. *IEEE Pervasive Computing*, 7(4), 12-18.

Hardware.openstreetmap.org. (2017). *Thanks*. [online] Retrieved from: <https://hardware.openstreetmap.org/thanks/> [Accessed 5 September 2017].

Join.osmfoundation.org. (2017). *OSMF Membership | Supporting the work of the OpenStreetMap project*. [online] Retrieved from: <https://join.osmfoundation.org/> [Accessed 30 August 2017]

Lardinois, F. (2013, September 3). *OpenStreetMap Founder Steve Coast Leaves Microsoft For Telenav*. [online] TechCrunch. Retrieved from: <https://techcrunch.com/2013/09/03/openstreetmap-founder-steve-coast-leaves-microsoft-for-telenav/> [Accessed 20 July 2017].

Lardinois, F. (2014, August 9). *For The Love Of Open Mapping Data*. [online] TechCrunch. Retrieved from: <https://techcrunch.com/2014/08/09/for-the-love-of-open-mapping-data/> [Accessed 19 Jul. 2017].

Letellier, F. (2008). *Open source software: the role of nonprofits in federating business and innovation ecosystems. (a submission for AFME 2008)*.

LeMay, Renai. (2005, July 28). *Google mapper: Take browsers to the limit*. [online] Retrieved from: <https://www.cnet.com/news/google-mapper-take-browsers-to-the-limit/> [Accessed 6 Aug. 2017].

Lyman, J. (2012, February 14). *Open APIs Are the New Open Source | Developers | LinuxInsider*. [online] Retrieved from: <http://www.linuxinsider.com/story/74419.html> [Accessed 27 August 2017].

Marshall, Catherine and Gretchen B. Rossman. (1999). *Designing Qualitative Research*. 3rd edition. Thousand Oaks, CA: Sage Publications. California.

McCormick, Rich. (2016, Juny 27). *Alphabet's Sidewalk Labs plans to take over public transport in Columbus, Ohio*. [online]. Retrieved from: <https://www.theverge.com/2016/6/27/12048482/alphabet-sidewalk-labs-public-transport-columbus-ohio>. [Accessed 5 August 2017]

Murphy, M. and Sloane, S. (2016, May 21). *The rise of APIs*. [online] Retrieved from: <https://techcrunch.com/2016/05/21/the-rise-of-apis/> [Accessed 27 August 2017].

Official Google blog. (2014, September 3). *Making of Maps: Reaching a milestone*. [online] Retrieved from: <https://maps.googleblog.com/2014/09/making-of-maps-reaching-milestone.html>. [Accessed 25 August 2017]

Onwuegbuzie, A.J. and Frels, R., (2016). *Seven steps to a comprehensive literature review: A multimodal and cultural approach*. Sage Publications. London.

OpenStreetMap Foundation, (2017). *Data and statistic*. [online] Retrieved from: <http://wiki.openstreetmap.org/wiki/Stats> [Accessed 31 August 2017].

Operations.osmfoundation.org. (2017). *API Usage policy*. [online] Retrieved from: <https://operations.osmfoundation.org/policies/api/>[Accessed 31 August 2017].

Perez, S. (2015, February 6). *Google Takes On Yelp Elites With Its New "Local Guides" Program*. [online] Retrieved from: <https://techcrunch.com/2015/02/06/google-takes-on-yelp-elites-with-its-new-local-guides-program/>. [Accessed 28 August 2017].

Popper, B. (2017, May 17). *Google announces over 2 billion monthly active devices on Android*. [online] Retrieved from: <https://www.theverge.com/2017/5/17/15654454/android-reaches-2-billion-monthly-active-users> [Accessed 17 July 2017].

Oreskovic, A. (2017, April 28). *Sundar Pichai just hinted at how Google will make money from maps, and it sounds like lots of ads*. [online] Retrieved from: <http://nordic.businessinsider.com/sundar-pichai-hints-at-ads-in-google-maps-2017-4?r=US&IR=T> [Accessed 17 July 2017].

Ramm, F., Topf, J., & Chilton, S. (2011). *OpenStreetMap: using and enhancing the free map of the world*. Cambridge: UIT Cambridge.

Rothwell, R. (2008). *Creating wealth with free software*. Free Software Magazine.

Raymond, E. (2007, Juny 16). *Goodbye, free software "; hello," open source"*. [online] Retrieved from: <http://www.catb.org/esr/open-source.html>. [Accessed 27 July 2017].

Schutt, R.K., (2011). *Investigating the social world: The process and practice of research*. Pine Forge Press.

Simon, M., (2011). *Assumptions, limitations and delimitations*. Dissertation and scholarly research: Recipes for success. LLC. Seattle, Washington.

St. Laurent, Andrew M. (2008). *Understanding Open Source and Free Software Licensing*. O'Reilly Media. p. 4.

Tapscott D, Williams AD. (2008). *Wikinomics: How Mass Collaboration Changes Everything*. Toronto: Penguin Group. Canada.

Tarantola, A. (2017, Juny 13). *Google gives its Local Guides more perks and higher levels*. [online] Retrieved from: <https://www.engadget.com/2017/06/13/google-gives-its-local-guides-more-perks-and-higher-levels/> [Accessed 17 July 2017].

Techvibes. (2016, July 21). *Google improves maps data with new crowdsourcing features*. [online] Retrieved from: <https://techvibes.com/2016/07/21/google-maps-crowdsourcing>. [Accessed 28 August 2017].

The Linux Foundation. (2017, February 28). *6 Reasons Why Open Source Software Lowers Development Costs - The Linux Foundation*. [online] Retrieved from: <https://www.linuxfoundation.org/blog/6-reasons-why-open-source-software-lowers-development-costs/>[Accessed 26 August 2017].

Vanhaverbeke, W. & Roijackers, N., (2013). *Enriching open innovation theory and practice by strengthening the relationship with strategic thinking*, in Pfeffermann, N., Minshall, T. and Mortara, L. (eds.) *Strategy and Communication for Innovation*. Berlin Heidelberg: Springer, pp. 15-25.

Vardhan, H. (2017, March 30). *Google Open Source – Location & Maps developers get ready*. [online] Retrieved from: <https://www.geospatialworld.net/blogs/google-open-source-location-maps/> [Accessed 23 August 2017].

Vaughan-Nichols, S. (2015, April 16). *It's an open-source world: 78 percent of companies run open-source software* / ZDNet. [online] ZDNet. Retrieved from: <http://www.zdnet.com/article/its-an-open-source-world-78-percent-of-companies-run-open-source-software/> [Accessed 27 August 2017].

Wang, Y. et al (2013). *Integration of Google Maps/Earth with microscale meteorology models and data visualization*. US Army Research Laboratory, Adelphi, MD 20783, USA

Wiki.openstreetmap.org. (2017, July 26). *Mapping projects - OpenStreetMap Wiki*. [online] Retrieved from: [http://wiki.openstreetmap.org/wiki/Mapping\\_projects](http://wiki.openstreetmap.org/wiki/Mapping_projects)

Wiki.openstreetmap.org. (2017, March 18). *Databases and data access APIs - OpenStreetMap Wiki*. [online] Retrieved from: [http://wiki.openstreetmap.org/wiki/Databases\\_and\\_data\\_access\\_APIs](http://wiki.openstreetmap.org/wiki/Databases_and_data_access_APIs) [Accessed 31 August 2017].

Yin, R.K. (2009). *Case Study Research: Design and Methods*. Sage Publications. London.

Zielstra, D., Hochmair, H. H., & Neis, P. (2013). *Assessing the effect of data imports on the completeness of OpenStreetMap—a United States case study*. *Transactions in GIS*, 17(3), 315-334.