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ICT in Business

Exploring information gathering behavior of niche players within IT ecosystems

Name   :Hüseyin Çolakoğlu
Student-no :s1099523
Date   :12/8/2016

1st supervisor :Dr. Hans Le Fever
2nd supervisor :Dr. Özgür Dedehayir

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Leiden Institute of Advanced Computer Science (LIACS)
Leiden University
Niels Bohrweg 1
2333 CA Leiden
The Netherlands

Abstract

In business ecosystems the end-user can use diverse products or services from different companies under one brand or platform. The diversity is an important health factor (performance indicator) for the business ecosystem. It concerns the number of new offerings being created for the end-user. So the higher the diversity becomes, the more new offerings for the end-user is presented. For this to be possible there are different roles within an ecosystem. The current literature on business ecosystems is mostly focusing on the keystone role perspective. The niche player role is mostly neglected in the literature in spite of having the biggest contribution to the diversity of an ecosystem. This thesis therefore explores more into the niche player's behavior in an ecosystem. Information gathering is an important part of innovation. For this reason this thesis focuses on information gathering behavior by niche players. The hypothesis that niche players gather information from multiple sources for diverse purposes is proposed. In order to test the hypothesis a research framework is developed from the boundary spanner theory. The framework will help to explore information gathering by niche players and determine whether the hypotheses is supported or not. First the concepts' *environment uncertainty*, *boundary knowledge types* and *knowledge exploration* within boundary spanning theory are used to explore the niche players information gathering conditions. Hereafter a set of boundary spanning activities are used in a survey directed to niche players. The empirical analysis shows that niche players have contact with organizations or individuals outside of their own project team. This is usually with other niche players, end-users or the keystone. They gather information from them for development and further evolve their of modules. They also gather information for trends of the platform software, next ideas and their development methods. The niche player also makes the information more understandable and manageable for their organization by selecting only relevant information and putting the information into their own words. The study shows that niche players vividly gather information from diverse members of the ecosystem and that the conditions for information gathering is demanding. So it is in the keystone's best interest to aid niche players with information gathering by creating an open environment where direct communication lines exits between the members.

Keywords: business ecosystem, IT ecosystems, niche player, boundary spanner theory, information gathering

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1   Introduction and background

Business ecosystems is an upcoming area of interest for both academia and managers [1] [2][3][4]. Simply because it brings considerable advantages in contrast to the traditional competitive marketplace. These advantages include:

- Stimulation of the economy by engaging organizations from across different industries.
- Stimulation of innovation by collaboration of different organizations

Ecosystems revolve around different actors who have vital roles and concerns [3]. These actors are keystone organizations, niche players and end-users [5]. The foremost participant is the keystone organization [2]. The keystone plays an important central role in providing an open environment for other companies to co-evolve, align their goals and activities, and further bond themselves to one another [1][3]. So most of the literature on ecosystems focus on the keystone role perspective [3][6][5][7][8]. In ecosystems the end-user can use diverse products or services from different companies under one brand or platform [9]. The diversity is an important factor for the health (performance) of an ecosystem [7]. Diversity concerns the number of new offerings being created for the end-user. So the higher the diversity becomes, the more new offerings for the end-user is presented. Niche players are the actors who have the biggest part in establishing the diversity [10]. However very little attention has been given to the niche players and their behavior. Despite being the highest counted member of the ecosystem. Niche players have little impact on their own but all of them together contribute the biggest part to the diversity. The studies that are about niche players that have been found include Inoue and Nagayama's study who distinguished four different strategies of niche players [11]. Ku and Cho [12] and Goldbach and Kemper [13] investigated the motives of ecosystem selection. Ceccagnoli et al. empirically prove that independent software developers preform better in ecosystem environments [14]. No study has come across that focuses on niche player behavior in ecosystems. This thesis therefore wants to complement to the niche player role perspective by giving insight into the behavior of niche players in IT ecosystems. IT ecosystem is chosen because it is a relative new study ground [15]. Because information gathering is a very important factor in innovation processes [16][17] this thesis focuses specifically on the niche player's information gathering behavior. For this thesis information gathering ground is derived from the boundary spanner literature.

Research gap

Niche player knowledge is minimum
As stated above the current literature has focused more on the keystone organization [7] and their strategy [18][19]. However little is known about the niche players and their actual actions. The niche player is important because they contribute to the diversity of an ecosystem. The literature on ecosystems will be confined if focus is mainly on the keystone role perceptive. With the minimum knowledge about niche players it is more difficult for keystone organization to manage them and thus keep product/service diversity within their ecosystem high. This could lead to competing motives and goals among the members of the ecosystem or not fully exploiting the end-users needs [20]. This thesis is therefore concerned with expanding the niche player role perspective in the literature.

No studies on niche player behavior
As mentioned above current studies that subject niche players are on their strategy [11], ecosystem selection [12][13] and performance [14]. However, no study was found that focused on actual behavior of niche players. This study complements to the niche player studies by giving insight in niche player's specific behavior concerning information gathering.

No boundary spanners point of view of business ecosystem
The boundary spanner theory has been around for quite some time, with one of the founding work by Tushman dating back to 1977 [17]. In his paper he shows that the boundary spanner role is important in the innovation process of an organization. The role fulfills a crucial part in the process by sharing information between the organizations internal network and external sources of information. However, no study is encountered that links business ecosystems with the boundary spanners theory.

Research objective

The objective of this thesis project is to expand the niche player perspective and aid keystone organizations with decision making by giving a better understanding of niche player behavior within IT ecosystems. This will be done by using the boundary spanner theory for giving insight into the information gathering behavior of niche players.

Research question

This thesis is based on descriptive research where behavior of niche players concerning information gathering is the subject. In order to guide the research to meet the research objectives the following research question is set:

What is the information gathering behavior of niche players within IT ecosystems?

After a literature study a hypothesis is proposed. The hypothesis is tested with help of a research framework. The framework is constructed with concepts from the boundary spanner theory. The framework consists of two parts, the first part is a theoretical discussion and the second part is empirical data analysis. The (1) theoretical part discusses the conditions of information gathering for the niche player with the concepts' *environment uncertainty*, *knowledge types*, *knowledge exploration* from the boundary spanner theory. The goal is to better understand the information gathering conditions of niche players from the literature. The literature that is used for this are scientific papers and books on (IT) ecosystems and niche players.

Secondly in the (2) empirical part, a survey is created from a set of boundary spanner activities. This survey is directed to niche players that are active in IT ecosystems. The goal is to gather empirical evidence about how and to what extend niche players gather information.

This thesis is organized as follows; In chapter 2,3 and 4 a literature review on business ecosystems, IT ecosystems and niche player is given. In chapter 5 a hypotheses is build and the research model is presented. Chapter 6 summarizes how the research is

conducted. In chapter 7 the first part of the research model is analyzed with the literature. In chapter 8 the empirical part is analyzed. And in chapter 9 the results are discussed and a conclusion is presented.

2 Business Ecosystems

2.1 Traditional value chain vs Business Ecosystems

In a traditional business setup a company focuses on value delivery to the customer [1]. This value could be either be in form of a product or a service. Other companies could see this same value need and start direct competing. This results in fierce competing to deliver the same value to the same customer. And these companies try to make their processes as cost efficient as possible, slimming their margin's. The products or services eventually become commodities, making innovations a diminishing factor. Moore [1] argues that there are two main differences between a traditional business and a business ecosystems. The first one is that an ecosystem setup also focuses on its environment, the context of the business. The second difference is that co-evolution with this environment is also done. It will be very hard to succeed as a good restaurant in a falling neighborhood. And a collapsing retail chain is not a good settling place for a first-rate supplier. Traditional businesses suffer from many similar business offering in the market so that profits stay limited. This is especially evident with airlines, steel companies, long-distance telephone companies and deregulated electric utilities. Although this will bring short term benefits like pricing advantages for consumers, these thin margins influence a company's next generation investments. This handicap causes a barrier to innovation. Business ecosystems also forester market creation. Market creation is a form of applied economic development. Where intense cooperation among main contributors is necessary to realize a workable economic future. These contributors need to generate a shared vision, negotiating deals and alliances and managing complex relationships. Where relationships of the traditional business is static, in a business ecosystem they are dynamic. Gossain and Kandiah [9] refer to the relationships of a business somewhat like an integrated value chain. With the exception of three differences. First is that the relationships go further than an efficient information flow and the sharing of data. Unlike traditional value chains where each relationship adds a part of value in each step, in business ecosystems all relationships work together to form the value. Secondly the relationships within ecosystems are intimately linked and constantly evolving. In contrast to the traditional business chain, the relationships of entities within an ecosystem are more fluid and has more impact on the economies supporting the ecosystem. And thirdly the entities in an ecosystem promote a single brand. Like for example the Android mobile operating system platform from Google Inc. where different hardware vendors and developers are supporting Google's platform.

2.2 Competition & cooperation

Mars et al. [20] state that in an ecosystem multiple actors interact that result in a flow of

resources. This interaction could involve multiple actors who act as pair or as a group. According to the researchers the ecosystem metaphor is used by scholars, business journalists and practitioners when referring to the interactions among organizations that share common or complementary features. These interactions facilitate some form of exchange of information and other resources. An example is the innovation ecosystem metaphor which is described as a complex network of actors that are linked together to pursue common technological goals and/or mutual economic gains. These actors could be private industries, financiers, universities, and governmental agencies. The different actors or organizations of an ecosystem could participate based on a wide range of intentions. Because ecosystems are not anchored in pre-determined goals individual actors or organization could develop their own goals and agendas. These goals or agendas could be diverse and sometimes even competing. Mars et al. give an example of the forest industry that includes market-offering and profit-seeking organizations. In this industry the different actors and organizations have confronting motives. For instance this ecosystem includes social moment groups that lobby against the profit-seeking organizations. And government organizations also tax these industries, regulate certain laws and sometimes incent state aid or subsidies. From this it is evident that ecosystems deal with tenuous balance between actors and/or organizations. In some ecosystems more than other like for example the forest industry.

The hierarchical emergence and structure of ecosystems vary due to the types and diversity of actors and functions. Mars et al. explain that due to this ecosystems could either develop from top down or bottom up. Top down organization usually occur within centralized, government-controlled economies or where market monopoly may exist. Bottom up is in most cases where ecosystem is in competitive market-orientated environment. Here individual actors reject or accept market offering and change movements that emerge within societies where actors have relatively freedom to socially or political organize. Due to this difference in emergence and development it makes it very hard in identifying, analyzing and ultimately working within ecosystems. Apart from organizational structure, actors and organizations form networks around common or complementary cultural features. The researchers claim that ecosystems emerge by logics and worldviews flow out of the complex formation ties between the organizations. These logic's and worldviews could be complimentary as well as competing. So the common believe that ecosystems are formed by organizations who have harmonious relationships is in great doubt. Mars et al. claim that the individual actors or organizations have own goals and agenda's that could vary greatly from the overall purpose that an ecosystem is come into existence. Different goals like realizing a return on investment, capturing a share of a market or electing a politician or advancing a social cause. It is important to mention that the goals and purposes are not to be seen as ridged and fully predetermined. That is why ecosystems should be seen as organic structures that develop over time. It is therefore important that the governing organization of the ecosystem should manage relationships between its members. And to make sure that the diverse interests of the members are as much as possible accommodated.

2.3   Structure

Most scholars and business analysts have compared business ecosystems with elements of biological ecosystems [1][5][7][21]. However, both cannot be identically compared

because they have different contexts [21]. Iansiti and Levien [21] state that business ecosystems are formed by large, loosely connected network of entities. The researchers identified different roles that taken by the entities. These entities have complex capabilities and interact in complex ways with each other. They state that like in biological ecosystems, each entity in the business ecosystem serves an important function in its overall existences. Unlike traditional industries, business ecosystems are defined by the strength and type of organizational interactions. For example the sharing of tools and technical components that is done in the Microsoft developers network ("MSDN"). Or in Walmart's suppliers network with buyer-supplier interactions. The entities within these ecosystems are influenced substantially by the collective dynamics of these networks. It is because of this that ecosystems may span several traditional industries. Another example is the computing ecosystem. This ecosystem comprise of the software and hardware industries but also many other industries that rely on computing and information technology. These include governments, logistical industry, aviation industry etc. Organizations in these industries put much effort in resources to adapt these technologies to their needs.

Now coming back to the roles of the entities. There are three main actors who have their own role in the ecosystem [21][9]. These are the keystone, niche player and the end-user. One of the most important role or function is the keystone role. These entities have specific characteristics that produce immense benefit to the ecosystem and its members. In such a degree that any change in its characteristics or absence drastically will change the ecosystem or even wipe it out from its existence. These so called hubs provide the foundation for many niches, regulate connections among the ecosystem's members and work to increase productivity and diversity. They provide a stable and predictable platform that other members can rely on. A good example is Microsoft who has provided operating systems like DOS and Windows. Other software and hardware vendors have made software and hardware suitable for Windows. Microsoft on its turn has made tools like Visual Basic, Visual Studio and programming component models like OLE, Visual Forms that the vendors can use for making their artifacts. To keep the ecosystem stimulant and healthy they consistently keep innovating and renewing their platforms. Also, they keep renewing their tools and component models according to the needs and preferences of the vendors. Next to technological development, Microsoft provides support and schooling for their products and services.

The second role is the niche player. The member that is performing this role has not so much influence in the ecosystem as the keystone, but fulfills a very important part. While the keystone is limited in an ecosystem, the niche player is the most counted member of the ecosystem. These actors are the most innovative player in the ecosystem. They are spread all over the ecosystem and are likely to reside in different industries. The niche player is best performing when they are near the outer borders of the ecosystem. It is here, according to Iansiti and Levien, that the most innovation opportunities lie. These *edge* firms, as the authors call them, are the ones that are mainly responsible for opening up new ecosystem niches. The advantage that the niche player has, is the ability to focus on concise capabilities. They only focus on leveraging the services provided by the keystone or other niche players. Thus, they can build and nurture capabilities that are unique to their niche. If their niche is big and rapidly expanding, the niche player can form an ecosystem around it. Nvidia Corporation is a good example of this. Nvidia participates in a ecosystem where the Taiwan Semiconductor Manufacturing, Co ltd (TSMC) is the keystone. TSMC is making chip designs that Nvidia is using to design high performance graphics processing units (GPU's). TSMC is active in the semiconductor industry. They

deliver a comprehensive manufacturing platform that is used extensively by other firms in the ecosystem. Next to that they offer a comprehensive component library of own design processes and semiconductor design tools that other firms can be used to optimize their own chip designs. Nvidia is one of those firms who have used TSMC's offerings for designing GPU's. Nvidia has made their own ecosystem around it where other firms use the GPU's in their products (like notebook manufacturers, Microsoft's xbox, smart phones manufacturers, etc.).

The third role is the end-user. They use the products and services of the ecosystem under a single brand or keystone company [9]. The ecosystem brings together the different companies and end-users. The products and services could be from different companies but are used by the end-users because they trust the core brand. In contrast to the traditional business setting the end-user in ecosystems is more actively involved in the value offering. When the ecosystem comes into existence the value offering is in a crude form [1]. By end-users interaction the products and services will fit to the needs of the end-user better. Therefore, the needs of the end-user should be exploited. As the value-offering becomes more refined the end-user will evolve their needs. This results in a constant matching of the value-offering of keystone and niche players with the needs of the end-users. This matching takes place over course of the lifetime of the ecosystem. In the next paragraph the development of ecosystems is discussed.

2.4 Development

Moore [3] takes biological ecosystems as analogy to describe his four stage model. He proposes that, like biological ecosystems, business ecosystems have stages of succession that are ignited by progressive change. In these stages the business leaders must come up with strategies to succeed in each stage. Moore names stage one as 'pioneering an ecosystem', during which potentially viable ecosystems are sought. The focus is on identifying specific seed innovations (technologies or concepts) that will likely generate an attractive value proposition. The work is mostly done by entrepreneurs who set up the ecosystem sufficiently so that the value proposition, embedded in a so-called "proof of concept", will satisfy initial customers. Importantly, the proof of concept must demonstrate a new value offering which exceeds the current status-quo offerings. During this period it is critical that resources are integrated, capabilities are established and the nature of the product/service value is defined for the end-user. The offering of value must be done in the most effective manner. Where traditional businesses have static value chains, the value chains of ecosystems are more active in the way that there is a constant mixing and matching of capabilities. Ecosystem value chains are designed and created with partners around new opportunities and paradigms of integration. Moore claims that the one who is better at defining and implementing desirable value for end-user is most likely to succeed in the birth phase. It is therefore crucial that integration with others is enabled in the ecosystem. Nevertheless, ecosystem members must find a way to balance collaborating with others and at the same time be protective of own ideas, as others can appropriate or thwart these if they are deemed to pose a threat.

In stage two, in what Moore refers to as the 'expansion of an ecosystem', the ecosystem must extent its territory and create certainty of survival. In this manner, the successful product or service should be applied more broadly and made more reliable and replicable.

The network of ecosystem members must be expanded with strong suppliers and partners, while concurrently attracting the support of a critical mass of membership. While doing this, clashes could occur with other ecosystems that pursue same markets or geographic space. An example is the "cola war" between two titans, Coca-Cola Company and Pepsi Co. They are in direct competition in the world's beverage market since the 60's [22]. The fiercest battles were fought in the United States, with a total industry worth of over 60-billion industry and the average person consumes per year a total of 200 liter of carbonated soft drinks. For example during the 1980's Coca Cola introduced 11 new products, like Cherry Coke and Caffeine-Free Coke. In response Pepsi Co launched its own 13 new line up, that included Cherry Pepsi and Caffeine-Free Pepsi.

During stage three authority is established in the ecosystem, which maintains stability in the relationships within the ecosystem. This period may also witness possible change in leadership as different members vie for this position. In stage three the important competition goes on inside the ecosystem. Hence, the keystone is focusing on balancing on the one hand the maintenance of authority and unique contribution, and encouraging innovation and co-evolution on the other. So the keystone must be a master in relationship management guarding other members and its own interests. As we can see from the personal computer ecosystem back in to the years 1983 to 1985. Where IBM entered the ecosystem with two moves that not only stabilized the ecosystem, but also stimulated internal competition. The first move was that the company invested in a single, slow changing architecture. And secondly components from third parties were brought in and allowed to be sold to companies within and outside the ecosystem. By doing so they established relationships that were crucial for the ecosystem to evolve. Making them the leader as they were managing these relationships and decided which members could participate in them.

And finally, stage four, referred to by Moore as 'renewal or death', the priority is on winning in the struggle against obsolesce. Continuous performance improvement along with anticipation and adaption to external changes, such as those sourced from regulations or market demand, is crucial during this stage. In his book he gives the example of the American auto ecosystem in the late 70's. The automobile ecosystem nearly collapsed due to the superiority of Japanese auto manufactures like Toyota and Honda. These Japanese auto manufactures did what their American rivals could not do, that is produce cars that American citizens wanted at a fairly cheap price. So as to survive the American manufacturers took counter measure. For example the GM invested a lot in their own production activities where they adapted to a lean manufacturing method. Ford took a more radical approach in to establishing a complex network web with a thousand suppliers. The move resulted in an improved performance and cost position.

From the stage model it is evident that the ecosystem is constantly moving. Changes occurs all the time. These changes have more impact than traditional business settings. Because all the actors of the ecosystem are interrelated and depend on each other. The keystone has a crucial role in managing relationships and diverse interests of the members. But a smaller member, like a niche player, could also fulfill an indispensable part. By for example having unique capabilities. In the beginning of this paragraph it was mentioned that progress to further stages happens after progressive change. In the next paragraph the performance factors of an ecosystem are closer inspected.

2.5   Health (performance)

2.5.1 Three health factors

The performance of ecosystem can be monitored with its "health" status [23]. Iansiti and Levien [23] have formulated three factors from natural ecosystems that could be used for monitoring business ecosystems. They use "health" as a synonym for the performance of an ecosystem. These three health factors (performance indicators) are *productivity, robustness* and *niche creation*.

Productivity
Ecosystems are constantly exposed to changing elements like new technologies, new processes and new demands. That is why the factor productivity concerns the efficiency that the ecosystem converts inputs into outputs. Iansiti and Levien have subdivided productivity into three metrics. The first one is *Total factor productivity* that compares the productivity of participants into converting factors of production into useful work. Next is the *Productivity improvement over time* that looks at cost reduction of production of products or complected tasks over time. The last one, *Delivery of innovations,* is about effectively deliverance of innovations within an ecosystem. This could be new technologies, processes or ideas between members.

Robustness
Iansiti and Levien see robustness also as an important factor for determining the health of ecosystems. Robustness in the sense that how vulnerable the ecosystem is against disturbances and disruptions. Put into other words, robustness is about the survival spirit of the ecosystem. The authors have summed up five metrics that form the robustness of an ecosystem. *Survival rates* looks at the survival rates of the ecosystem participants. This could be over a time period or relative to other, comparable ecosystems. The second metric is *Persistence of ecosystem structure* which looks at how structure of the ecosystem retains against external shocks/changes. These shocks changes could jeopardize relationships among ecosystem members or between products and services. *Predictability* ensures core stability of the ecosystem against different possible external changes or shocks. *Limited obsolescence* concentrates on the security of prior investments. *Continuity of use experience and use cases* is about the evolving experiences of ecosystem consumers due to introduction of new technologies and components.

Niche creation (diversity)
Next to the previous factors niche creation is also indispensable. This factor relates to the variation and diversity of functions of the ecosystem's value offerings. Off course should this variation and diversity to the value offering be meaningful and useful. This capacity to create new valuable niches is important for the ecosystem to evolve into further stages. The niche creation factor is subdivided into two sub categories. The first one is *diversity* and concerns the number of new options, technological building blocks, categories, products, and/or businesses being created. Second is *value creation* that looks at the overall value of new options created. The next paragraph discusses the diversity of the value offering further.

2.5.2 Diversity of the value offering

In a traditional value chain, value creation is sequential, where the value has a starting point and moves along the line towards its end destination [24]. This is usually the end-user. Along the line value is added until it reaches its complete form. With ecosystems this has changed. An ecosystem is based on complex forms of co-value creation [25]. Value creation is synchronous and interactive with increased involvement of members of the ecosystem [26]. This co-value creation increases the number and variety of products and services. This value-added diversity and associated service levels are determinant [9]. Moore refers to this as the total experience for the end-user [3]. The total experience means that the end-user can benefit from a core product or service that is accompanied by a diversity of complementary products or services. The umbrella of products or services will generate value that could not be achieved by a company alone. Under a single core brand, technology or platform the diverse set of products or services are provided by different companies. Solutions that complement other solutions and are well integrated [9]. When the end-user trusts the core brand or platform they will also trust its complement products or services. A good value added diversity is possible when niche players excel in different part of the value proposition. This could be a certain part-product of the larger product or an additional service that makes certain transaction possible. The members of the ecosystem produce services or products where a significant end-user demand for exists [8]. That is why the objective is the overall ecosystem performance instead of the interest of a single actor. It is important that all members share a somewhat same vision about the target marketplace. Most especially how to address the target audience. This makes collaboration between members easier. To forester co-value creation and value sharing within the ecosystems the keystone has to manage relationships and diverse interests among the niche players. For this to be possible the keystone usually creates an open environment where niche players have access to resources and knowledge. It is wise for niche players to take advantage of the available expertise and resources within the ecosystem. The open environment acts as vehicle for increasing productivity and innovation. If the part-products of services are very successful, the keystone may incorporate it into the core product or service [25].

From the discussion of this chapter it is evident that diversity is important for further development of the ecosystem. And that the keystone has to establish the foundation for the niche players to be able to provide the diversity to the ecosystem. However, the literature has been focusing more on keystone organizations [7] and their strategy [27][18] [19]. The niche player is almost neglected in literature in comparison to the keystone. That is why this thesis wants to further develop the understanding about the niche player. This will be done by exploring their behavior concerning information gathering. This thesis is narrowed to Information Technology (IT) ecosystems because of their increasing use for IT products and services [15]. And because IT ecosystem is a relative new study ground within the business ecosystem literature. The next chapter discusses IT ecosystems characteristics.

3   Information Technology (IT) ecosystems

When software companies make their software open for developers outside of their own organization boundaries, they are stepping over to an ecosystem model [15]. The

company that once was making new functions and features for their software in-house, has made the decision to let others outside the organization make them. These outsiders have creative visions and are keen at delivering novel solutions. The software of the company has become very successful in so that the focal company can not cope with the new needs and demands of the end-users. So opening up the software in the form of a platform to externals will ease the demand pressure for the focal company. In sort of a way the focal company becomes short on resources for the software to grow. Letting third-parties involved the software platform can grow. Making it a more lucrative business and attractive for (new and current) end-users. These third-parties developers are in the business ecosystem terminology profiled as niche players. The terminology of business ecosystems will be used in this thesis. The difference with outsourcing IT components is that the focal company does not own the software made by niche players, nor can they manage their development process. Bosch [15] states "that a software ecosystem consist of the set of software solutions that enable, support and automate activities and transactions by the actors in the associated social or business ecosystem". The products and services of an IT ecosystem are IT solutions or IT services. Coming back to the diversity in the previous chapter, the diversity for the end-user in IT ecosystems is the software platform complemented by additional functions and features of the niche players. These additional functions and features are in technical terms referred as additional modules. The boundaries of an IT ecosystem are difficult to define because IT is so diverse and broadly utilized [28]. Iansiti & Richards [28] argue that the reason for this is that IT ecosystems are dispersed in many traditional industries. The products and services of IT ecosystems can be categorized in hardware, software and services. However, for this thesis the hardware ecosystem is excluded. Prominent IT ecosystems are operating system (OS) platforms, standalone application platforms, mobile platforms and web platforms. These ecosystems are initiated by the keystone that is stimulating development of interesting additional modules compatible with their platform. In order for the additional modules to be compatible with the platform the keystone company supports the niche players. This support could be done by making the platform generic development environments friendly or with documentation about the platform. Established keystone organizations could support with education programs that are awarded with certificates e.g. Microsoft certificates. These programs not only develops the niche players skills but also gives recognition to peers or other organizations.

As mentioned above, the keystone organization is responsible for coordinating and maintaining the ecosystem. In doing so they set rules and regulations that members have to follow. The regulations contrast the keystone's strategy. When a keystone likes to have more control over the ecosystem they will set stricter regulations. If external creativity is more preferred then the regulations are not so much extensive. One of the most common regulations that are set concern submission of additional modules or services by niche players. The requirements for submission of modules or services could be strict. When this is the case then there are many rules about the usage of technology, tools or content [13]. In this way the keystone wants to ensure that the ecosystem will develop according to how they want it. The keystone then exercises a closed approach to manage the ecosystem. When the keystone wants a more open approach then they can loosen regulations. With the open approach the niche players can have more influence in the developments of the ecosystem. A good example is between the two most popular mobile ecosystems, Apple's iOS and Google's Android [29]. Apple is considered to have a closed approach where they have tight regulations concerning the submission of additional modules or services (in this case *apps*) by the niche players. They have guidelines about the visual appearance,

function and content of the apps. As they should match the iOS platform. They have a system for app approval. Where each submission is judged by an Apple internal team for acceptance. Google is quite the opposite where they use an open source platform. That allows outside organizations to change modules of the platform itself en create one own. For instance the Samsung company provides their mobile devices with Android based platforms that come with a lot of pre-installed Samsung apps. The niche players of the Android platform have also more freedom concerning appearance, function and content of their modules or services.

As becomes evident IT ecosystem form a market around different actors. In the literature IT ecosystems are compared with two-sided markets [30]. Within two-sided markets there are two main actors participating within a market. A mediator is also present whose function is to connect the two actors. The markets are divided in two parts. On one side of the market there is one type of actor and on the other side there is another type of actor. Events or changes on one side of the market effect the other side. In case of IT ecosystems the market is supported with a technical infrastructure. The keystone is responsible for the infrastructure. And the two types of actors are the niche players and the end-users. The niche players develop modules that are intended for the end-user. Within two-sided markets there are direct and indirect network relationships. A direct relationship is a relationship between the actors of the same type. And indirect relationships are the linkages between actors from different types. Example of a direct relationship is when end-users discusses aspects of the software platform or additional modules with each other. Or when two niche players work together to make a module. An example of indirect relationship is when users give feedback to external developers about a module. The technical infrastructure is very important in establishing these relationships. In the next two sections the infrastructure of IT ecosystems is further explored.

3.1   Software platform categories

Iansiti and Levien state that platforms form the technical foundation for the ecosystem [7]. The platform serves as the main resource where other members make use of. On the one side there are the niche players who use the technical interfaces and develop additional modules. And on the other side the end-user who use it for their own intent. As stated earlier the diversity of useful additional modules and services for end-users determine for a great deal the performance of an ecosystem. That will attract more users to the ecosystem making it a more fertile ground for new and current niche players. Of course the keystone has also a lot of influence in the success of the ecosystem. There job is to promote the ecosystem and its products. The focus of the thesis is on the niche players side, hence not so much attention is given to keystone and end-users of an ecosystem. One of the ways to promote the ecosystem is to make the platform better accessible for niche players. E.g. by using general development environments and tools, low entry barriers, large end-users base and constantly developing the platform. IT ecosystems are quite complex in comparison to regular business ecosystems. Bosch [15] has made a subdivision of software platforms into three categories. These are *Operating systems*, *Application* and *End-user programming* platforms. Within these platforms he distinguishes between desktop, online and mobile environments.

Operating system platforms

Operating systems (OS) have been around since the early 90's. Back than it was companies like Microsoft, Apple and IBM who had their own operating system. Niche players have the opportunity to create applications compatible for the operating systems. (Potential) Value for end-users is created by the niche players by building diverse useful applications. Sales of hardware devices determine for a great deal the use of the platform by end-users. Keystone organizations providing the platform usually provide platform specific development tools for niche players, e.g. *Visual Studio* from Microsoft is a development tool for Microsoft based platforms. For the desktop environment there are well known platforms like Windows by Microsoft, Mac OS by Apple and various Linux distros. In the case of Linux distros, the platforms are open source meaning that the license is free. Linux development is done by developers who are not on a direct payroll for their contribution. In the online arena it is services like Platform as a Service (PaaS) and Software as a Service (SaaS) that are considered as platforms. These services are hosted by an online keystone player that runs the platform on their servers, also known as cloud services. These platforms can be used with internet browsers. Popular service are Google's AppEngine, Yahoo's developer, and Bungee labs's Bungee connect. Gaining much popularity due to the success of smartphones, mobile operating systems are also within the operating systems category. These platforms include Apple's iOS, Google's Android and Microsoft's Window 8.

Application platforms

For applications based ecosystems the ecosystem involves an application that ones was a standalone software but has evolved due to its success to a platform architecture. Many users where using the application for diverse purposes. After using the applications the user evolved their needs for the application. With so many and diverse requests the keystone does not have the resources to deal with all these requests. In order to cope with this problem they open up their platform to niche players. These niche players specialize in a particular function within the platform. This function is used by a subset of end-users. This function is consistently developed by the niche player. Example of applications platforms are Microsoft's Office, Mozilla's Firefox, Google's Chrome or VLC media player. There are also online examples which include SalesForce.com, Amazon.com, eBay.com and Facebook.com. The online platforms are based on Software as a Service (SaaS) approach. The success of an application based platform dependence for a great deal on the size of the users base. The end-users will develop needs that could be satisfied with specific functions. This increases opportunities for niche players making the platform attractive to increase their commitment.

End-user programming platforms

The last type of platforms according to Bosch are end-user platforms. These platform appoint the end-users also as niche player. The end-users are giving the opportunity to make or change functions of the platform. This could be done via simple users interface settings or via more complex coding languages. Users could install additional modules made by other users. Example of simple users interfaces is Microsoft's Excel. In Excel the user can insert different formulas that he has made. These formulas can be saved in a

template and could be transferred to other systems. Another example that recently has become popular are within a gaming environment. Here the user could for example make own levels and let other users play it via an online platform. A sample of these games are *Minecraft* (multi gaming platform) and *Little big planet* (PlayStation platforms).

3.2   Software development kit (SDK)

Along with the software platform the keystone is usually also providing an important resource that niche players could use for developing their modules. This is called the software development kit (SDK). An SDK contains diverse resources complied by the keystone. These resource usually are Application Programming Interfaces (API's), licenses, tools, and documentation. An API is a pre-written programming code that preforms a certain function on the platform software. Some API's are made public meaning that niche players could also use those function within their modules. For example if there is a function that uses the camera of hardware device where the platform is installed on, the niche player could also use the function in their module. Because the keystone has already programmed how the platform should use the camera of the IT device, the niche player does not have to. By making the API public the keystone makes sure that niche players could also use the function. API's could also be web-based, meaning that they preform functions on an external server. This is also called a web-service. An example is Facebook. Facebook gives public API's that niche players could use in their modules. These API's could for example give information about Facebook users. By providing API's the keystone eases much effort for the niche players. The niche player does not have to put much effort in what already is done. Other resources included in the SDK could be tools and documentation. The tools that could be included are development tools for developing the modules, feedback tools for error reporting of the module. Documentation could also be included in SDK's. This documentation could be about the platform software, the API's and how to use the tools.

3.3   Distribution of additional modules

Via the interfaces of the platform software niche players can create their own value [31]. This value is expressed as an additional function to the platform. In technical terms the additional function comprises a module that connects with the modules of the platform software. These modules can be plugged in the platform. This will make the platform work like a complete software package. The end-user then selects additional modules that he wants to use and installs them on top of the platform. The additional module could either be a standalone module or one with a back-end. The standalone module uses solely components of the hardware device on which the platform is installed. When the module is installed additional files are copied into the platform directory. When a module has a back-end the module uses services outside the hardware device. This could be a connection with an online server. When the end-user uses these functions the hardware device makes a connection with a server in order to retrieve information or web-services from it. In case of online platforms the additional modules are installed on the server where the platform is also installed. If the module uses an external web-service than the module is linked to an

outside server.

The additional modules for the software application can be retrieved via online distribution platforms or via specific locations on the internet. Distribution via specific locations could be websites maintained by the niche player. Next to physical distribution (e.g. installation CD) download via websites are a more traditional manner of distribution. Other online distribution locations are software repositories maintained by certain organizations or individuals. Repositories include diverse software from different niche players. A subscription is usually needed for being able to download modules. This could be free or payed. Repositories are popular for open source distributions [32]. Examples of repositories are *RPM Fusion [33], EPEL [34]* and *zero install [35].* Another manner of online distribution is via distributions platforms also known as *application stores*. The application store makes diverse modules available for their associated software platform. Usually the application platform provider (keystone) also maintains the application store. The application store is the most commonly used use of distribution of modules. Application stores became popular when Apple started using it for their iPhone 4 in 2008. However they were not the one who used them for the first time. That was in 1993 with *AppsWrapper* by the then NeXT, Inc company [36]. At present there are more than a dozen of application stores. Popular examples are App store, Google play, Microsoft store, Ubuntu software and Firefox ad-on manager. The application store makes it easier for the user to find additional modules and install it. Most of the modules can be found via the application store. Hereby the user does not have to go to different locations to find modules. Apple's apps store for example has more than 60,000 additional modules (apps) for their iOS platform [29]. Installation of the module is also simple for the user. This is because the application stores are integrated with their application platform. So after downloading the modules the module is automatically installed on the application. On the application store is next to the description of a module, additional information available. This information is usually developers information, download charts and users impressions. The user's impression section is a very interesting part of the application store. Because it makes relationship with the developer or other users possible. This relationship is as already mentioned called indirect network effect. The user could comment on the modules. The niche players could use this information and apply this into adjusting the module. Making the modules serve the user needs better. In case of online platforms the distribution of modules is usually integrated into the platform. The end-user then simply selects modules that he wants to use via an option menu.

4 Niche player

As mentioned in earlier chapters the diversity of an ecosystem is one of the important indicators of its health [5][37]. Diversity is important because it serves an important success factor for the performance of the ecosystem [19][10]. Good performance leads to further development of the ecosystem. The keystone has an important part into coordinate and manage the diversity of an ecosystem [8][27][21]. The literature has been mainly about the keystone organization perspective. However, the niche players are the ones who have the biggest role in fulfilling the diversity [38][19]. They fulfill the diversity by expanding the platform product with additional features or options [39]. In doing so the niche players contribute to deliver added value (diversity) for the end-user. The niche player is the most

counted member of the ecosystem. They have small impact on their own but together they determine for a great deal the performance by providing diversity to the ecosystem. Focusing on a specialization they have minimum overhead to handle with. The resources they do not have in-house they can leverage from other members of the ecosystem. A good example of a niche player is again the Nvidia corporation [40]. Nvidia is specialized in designing video accelerating units. They do not have the knowledge and ability to design them from the ground up. So they use platforms that are made by the keystone organization TSMC. Nvidia leverages the tools, blue prints of chips and manufacturing plants from TSMC. This makes them free from concerns like manufacturing the chips and raw material R&D. In this way they can only focus on their core business, which is designing video accelerating units. They optimize the blue prints of TSMC and hand them in for production. Companies like Nvidia keep the chip industry innovative and constantly developing.

Niche players within IT ecosystems act as third-party developers. They are concerned with expanding the software platform [8]. The software platform within IT ecosystems is usually a software program that can be expanded with additional functions or features. The niche players provide these functions or features, as mentioned in the previous chapter. A classic example is the Windows ecosystem owned by the Microsoft company. Obviously in this scenario Microsoft is the keystone organization who has developed the software platform Windows. The niche players are the application providers like Adobe (with e.g. *Photoshop)*, Norton (with security software), etc. Within this ecosystem there is one prominent keystone, Microsoft, and a large number of niche players, the application providers. So when each of these niche players have high specialization, the diversity is also kept high [5]. The number of niche players is also important for diversity, but if their specialization is somewhat the same the diversity will keep limited. It is important for the niche player to keep innovating and specializing in specific abilities [25]. Their existence within the ecosystem lies on it. With their specialization niche players can focus on a clearly defined user segment or a function within the ecosystem. In this way they make themselves a vital part of the ecosystem. The higher their unique specialization, the more valuable they are for the ecosystem [5]. For example within mobile OS ecosystems, one niche player could develop apps on navigation and another niche player could be responsible for an app on payment transactions. The niche players are familiar within their own specialized domain and utilize the resources needed for deployment of their products or services. If niche players keep being general there is the risk that other niche players will develop similar modules that are better. When the end-users notice that there is a better alternative then they will likely switch to the better one. Thus, the use of the less interesting module will decline. This will make the abilities of the niche player, that has developed the module, redundant. Another risk is that the keystone could incorporate a similar module to the software platform. Then the developed module by the niche player would also become redundant.

Therefore, the niche player should identify opportunities and exploit user needs. It is upon the niche player to be creative and create value by effectively utilizing the available resources within the ecosystem [38]. They could do this by combing resources from the ecosystem with their own internal knowledge and abilities [19]. Resources that are available in the ecosystem are technical artifacts, services or knowledge from the other members. An example of a technical artifact by the keystone organization is obviously the software platform. The online distribution platform is also an artifact from the keystone. But also knowledge from the keystone is important. This knowledge usually includes

knowledge about the technical infrastructure of the platform and development tools. The keystone informs niche players about technical infrastructure and changes to it. In this way they can better utilize the platform or other resources from the keystone. This informing is done via meetings organized by the keystone. Recently keystone organizations use social media to inform niche players about how to use their resources. Prominent keystone organizations like Amazon, Google and Facebook have channels on *youtube.com* where they have large amounts of videos directed to niche players. Resources could also be utilized from another niche player. A good example is from the ecosystem of the Amazon.com company. In 2008 a niche player made additional web-services available for *Amazon Web Services (AWS)*, Amazon's online platform [25]. These additional services where linking the Amazon database with other databases (Netflix's movies and Apple's iTunes). In doing so additional information for products on the Amazon website could be offered. These services where at the time not accessible via the AWS itself. Other niche players integrated the services into their own modules and provided them to the end-users. From the end-user the niche players could get feedback concerning the additional module. This feedback could be direct (e.g. integrated in the module itself or via the niche players website) or indirect (via the application store or build-in feedback mechanism in the platform software).

4.1 Ecosystem participation

Because niche players are not bound to a keystone organization they could choose whether to participate in an ecosystem or not. When participating in an ecosystem they have the freedom to leave the ecosystem whenever they want. Niche players could participate in ecosystem in two extremes. On one extreme there is participation in solely one ecosystem. And the other is being active in multiple ecosystems. Being active in multiple ecosystems is also referred as *multi-homing* [40]. With multi-honing the niche player wants to reach more end-users. They leverage the end-users base of the ecosystems they are participating in [38]. With multi-homing the niche player engages with a loosely coupled relationship with the ecosystem and the keystone. Here is where the niche players has confined knowledge about the technical infrastructure. Only knowledge that is relevant to deploy their developed module is necessary. This strategy makes the niche player flexible and productive [11]. By participating in multiple ecosystems they want to disperse risk. If one ecosystem is not lucrative enough they could simply withdraw from it. Their effort in participating in an ecosystem is kept minimum.

The opposite extreme is when the niche player is active in just one ecosystem. He is than fully acquainted with the technological infrastructure of the ecosystem. He can then fully utilize the infrastructure's potential. With so much commitment to the ecosystem the niche player knows the capabilities of the infrastructure very good. And also the users base of the ecosystem. The niche player that follows this extreme is very focused on innovations [11]. In contrast to multi-homing this niche player type is more taking risk because of their loyalty to one ecosystem. However, being so engaged with the ecosystem this niche player type has becomes more depended on other members. Changes in strategy or technology by the keystone will have great impact for the niche player. Some keystones organize partnering programs where this type of niche player has the opportunity to become the keystone's partner.

A combination of both extremes is also possible. This combination strategy fosters multiple ecosystem participation but one dominate. This niche player type has most of its resources used in the dominate ecosystem. Participation in the other ecosystems is rather shallow. Meaning that efforts are minimized to just deployment of an additional module. The innovations come from the dominate ecosystem. It could be that the niche player has a similar module deployed in multiple software platforms. But the dominant platform module is where most developed occurs. If developments are a success in the dominant platform then they could delegate it to the modules in other platforms.

4.2   Ecosystem selection

The keystone as mentioned before has huge impact on ecosystem selection by niche players [12]. Their strategy and management of the ecosystem is very important for attracting both users and niche players. The niche player is likely to participate in ecosystems that align with their own goals and agendas [20]. Their financial goals concern good return on investment (ROI) or grow potentials. For ROI the niche player could look at the technological aspects e.g. familiarity and difficulty of the programming language or tools, platform software possibilities or module deployment efforts. Next to this other indirect financial subjects are relevant like users base or available resources. The end-users base of an ecosystem could be large or be a specif segment. When the users base is large, economy of scale could play a role. When there is a specif users base its users could pay extra to have working modules or additional functions for their specif needs. Also, the availability of usable resources for the niche player eases much effort so that they could focus only on the development of the modules.

Also, a cooperative keystone that mitigates conflicts within the ecosystem is also an important selection factor. Here the keystone's ability could make things easier for the niche players. The keystone could for example provide useful tools and libraries (pre-written program codes that preform certain tasks) that the niche players could use for developing their modules. Also, adjustments to the technical infrastructure that eases workloads for niche players. For example when niche players find it difficult to integrate the modules to the platform, the keystone could adjust the interface of the platform to make it more accessible. Some keystones even offer partnering programs for niche players as mentioned earlier. They then get support and training for development of modules for the software platform [38]. The niche player eventually could grow and become partner of the keystone. Some eventually could form their own ecosystem. Niche players could also look at the complement possibilities of the platform with their modules [12]. For example when a platform has four similar modules a niche player that wants to enter the ecosystem with a similar module is not very promising. It is also possible that niche players join ecosystems for intrinsic reasons. For instance when a niche player wants acknowledgment and recognition by its peers. This is usually the case with open source ecosystem where money plays a minimum role. The more and difficult modules the niche player has developed, the more respected he will be among the other niche players. Other niche players might be technology enthusiast that are after ecosystems that are all about the latest technology. As mentioned earlier ecosystems could be a more open or a closed one. Niche players could make a selection between an open or closed ecosystem. With open ecosystem the niche player could be more creative in creating modules whereas with closed ecosystems they are more contained by the guidelines of the keystone.

4.3 Business model

Niche players develop additional modules that are intended for the end-users. Developing and maintaining the modules requires effort and resources from the niche player. In order to get rewarded for their contribution they apply their own business model. Since there are difference in ecosystems and users bases various business models could be applied by the niche players. The most obvious form is a paid model where the end-user makes a payment to use the additional module and the underlying service. This could be a one time payment or be periodic in form of a subscription. A one time payment is applicable where the most effort is spent on development of the module. Then a niche player could ask for a payment before installation of the module. It could also be that a payment is needed after using the module for a period. For a subscription model the end-user needs to make periodic payments to use the module. With this model the niche player usually puts many resources into maintaining the underlying infrastructure of the modules or regularly generate new content for its module. The underlying infrastructure could be maintaining servers.

Niche players could also implement an advertisement system where advertisements are shown while the user uses the module. The niche player then has a contract with the companies who submit their advertisements or could do this via an intermediary who has contracts with multiple companies who want to submit their advertisements. This intermediary could also be the keystone. A niche player could also introduce a semi payment model where basic functions are free but advanced functions are only available when a payment is done. This model involves micro transactions for additional functions [29]. An example of an additional function could be to remove advertisements for less distraction while use of the module. Certain niche players develop specif modules for companies who want to use the modules for their operations. In this case the company is using the platform software but has needs that are not fully satisfied. The niche player then is on the contract of the company and makes modules for the companies specific needs.

4.4 Marketing

In order to promote their module(s) niche players could use the resources of the keystone. They could for instance make interesting descriptions in the application store. And provide videos or other visual techniques that shows (potential) end-user the usefulness and how they could use it for their own liking. Next to that niche players could maintain a website that contains this sort of information. Social media, like twitter and Facebook, is also a very practical medium to reach end-users. Niche players could let end-users know their organization and current and future projects. In case of niche players that build specif modules for companies they could directly contact the companies. Convince them with their abilities, idea's for modules and project portfolio. Of course the main source that could attract end-users is developing outstanding modules. Modules that are very practical and efficiently at preforming a needed task. Then word of mouth could mean very much [41]. When other end-user notice that the module is very practical and helps users that

uses the module very good, then they will be likely to also try the module. This could be someone they know personally or via a rating or review system on the application store.

5   Hypothesis development and research framework

Decision makers in organizations constantly have to make choices between different business options [42]. These options bring consequences, usually unexpected ones. Thus, the choices between the options bring a lot of uncertainty [43] for the decision makers and the organization. This uncertainty usually coincides with environmental factors like, changing market demands, new technologies, competition, changing suppliers conditions and etc. Thus information about the environment is needed. This information should be accurate, correct and relevant in order to minimize the uncertainty. This is also the case for new product development or innovation processes. An important aspect of the innovation process is information exchange between the involved parties [16]. This information needs to be gathered and dispatched among the external environment of the innovation system. Tushman [42] mentions that information communication within innovation processes coincides with many difficulties, inefficiencies and hazards. This is due to the fact that the involved parties develop their own norms, values, time frame and coding schemes. This causes a lot of misunderstanding when communicating and results in bigger gaps between the parties. These communication boundaries not only separate external sources but also internal units [42]. Communicating across the boundaries involves learning the local coding schemes and language and local conceptual frameworks. Here is where the boundary spanner becomes useful. Boundary spanners are individuals or roles within a focal organization that perform these functions [44]. These individuals link the internal networks and the different sources in the environment with each other. The boundary spanner understands the coding scheme that belongs to the contextual information on both sides of the boundary. This ability enables the boundary spanner to gather relevant information on each side of the boundary. These boundary spanners also function as an information buffer. The boundary spanner gets information from individuals outside the organization and then passes it through in their own organization. These individuals have strong external linkages and strong internal linkages.

Much of the boundary spanning literature has been about the involvement of boundary spanners in innovations settings [17][45][46][47][48][49]. Fleming and Waguespack [45] investigated what boundary spanning characteristics are relevant for leadership in open innovation systems. Andersen et al. [46] and Bengtsson and Soderholm [47] researched what boundary spanning abilities are needed when managing a innovation process. Björk [48] looked at how boundary spanning influences idea generation within innovations. Carlile [49] developed a framework for managing knowledge across innovation development projects. Friedman and Podolny [44] looked into labor negotiations and conflicts from a boundary spanner perspective. Levina and Vaast [50] researched how boundary spanners emerge within the implementation of information systems. Marrone [51] used the boundary spanner theory to better understand teamwork within organizations. O'Mahony and Bechky [52] investigated the role of boundary spanning within open source project collaborations. Ramarajan et al. [53] looked at the negative effects of boundary spanning between different organizations. Rosenkopf and Nerkar [54] researched how boundary spanning can be used in four different types of technological

exploration. Sturdy and Wright [55] looked at consulting projects and identify three different boundary spanner roles within these types of projects. Williams [56] explored the main factors that influence effective collaborative among organizations.

The literature review on the boundary spanner theory made evident that the literature is quite extensive and also focusing on different business contexts. However, no study was found that explored an IT ecosystem environment. When the niche player's setting within IT ecosystem is looked at from a boundary spanner perspective, the niche player becomes the focal organization and the other members of the ecosystem form the outside of the boundary. As mention earlier these members could be the end-users, other niche players and the keystone. These many members have their own important function within the ecosystem [21]. The members are loosely connected to each other. They co-create value and share resources between each other [20]. The niche player is heavy dependent on the other members. For example if end-users do not use the platform, provided by the keystone, they will also not use the part product (also called module) made by the niche players. And if other niche players do not make interesting part products the platform again will become less attractive for end-users [10]. This is why cooperation between members of ecosystems is important as mentioned earlier [20]. For this reason the proposed hypotheses is:

H: Niche players gather information from multiple sources for diverse purposes

The remainder of this thesis will try to test if the hypothesis is supported or not. For this a research model is developed. The model is depicted below. This research model helps to better understand the niche players information gathering conditions from the literature point of view and gathers empirical evidence of the extend and manner of information gathering by niche players. The model thus consists of two parts. In the first part important concepts from the boundary spanner theory are used to expose the information gathering conditions of niche players within IT ecosystems. The niche player's conditions is argued from the literature in the previous chapters about (IT) ecosystems and niche players. The goal is to better understand the niche player's information gathering conditions using the boundary spanners perceptive. The last part discusses a set of boundary spanner activities from the boundary spanner literature. Relevant activities, that help to test the hypothesis, are selected and used in a survey directed to niche players within IT ecosystems. When the conditions of information gathering are clear and empirical evidence about information gathering activity is at hand then it can be judged whether the hypotheses is supported or not. This is discussed in the discussion and conclusion chapter of this thesis.
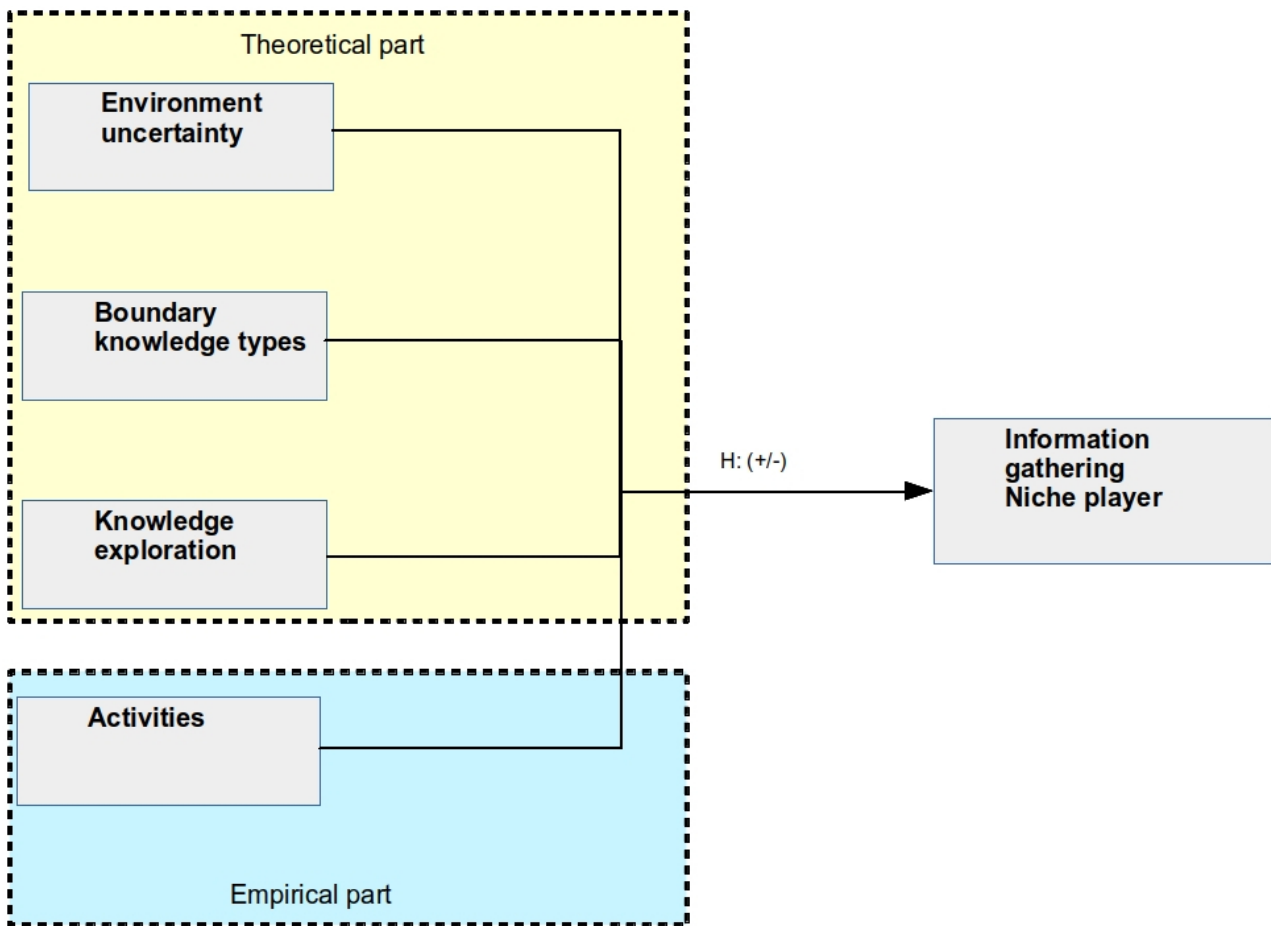
Research framework

6   Research method

With this thesis the goal is to understand more about niche players behavior. As mentioned in the introduction information gathering is important for innovation processes that is why this thesis wants to focusing on how it is done by niche players. This study follows a descriptive research that is drawing out characteristics of information gathering behavior by the niche players. So first a literature study is preformed with the goal of learning more about IT ecosystems and niche players. The literature is found via *Google scholar* on diverse scientific databases (e.g. Science Direct *sciencedirect.com*, JSTOR *jstor.org*, IEEE *ieee.org*, Springer *springer.com,* ACM *dl.acm.org,* citeseerx *citeseerx.ist.psu.edu* and etc). Literature is selected according to the relevance of the subject, author and the number of scientific papers that have cited it. Also if a paper or a book is very interesting for the thesis the literature that is used is also looked at. In retrospect if a paper is most useful other papers that have cited the paper are also examined. By doing these diverse literature finding techniques relevant literature is gathered that helped this thesis come into place. A research model is formed out of important concepts from the boundary spanner literature. These concepts are used to learn more about the conditions and activities of niche player concerning information gathering. A set of activities from the boundary spanning literature is selected to construct a survey. The survey is intended for niche players that are active in

IT ecosystems.

The survey is made on *Google Forms* (google.com/forms) which is a free online survey tool. Google Forms is choosing because of the familiarity with other Google services and allows to make forms with unlimited questions and respondents. Google forms is however rather basic in comparison to other semi free online survey services, but for the intended survey there is no need for advanced options. The survey itself is formed from a set of boundary spanner activities mentioned in the paper of Ancona and Caldwell [57]. The activities that are relevant for this thesis are selected and made questions about. The questions are made up of simple language and it is tried to use jargon of the niche players. The jargon is learned from the papers about niche players. For example software platform is referred as just software and the keystone is referred as software owner. The survey is included in the appendix.

Respondents are searched for via GitHub.com and approached via mail. GitHub.com is a website that allows developers to publish their IT projects. There are over 10 million users on GitHub.com [58]. Projects that are additional modules for platform software (Android OS, Google chrome, iOS and Firefox) is searched for. From these results the project publishers are contacted via mail. The mail is asking the project publisher to reply if they want to participate in the survey. When no reply came within two days, a reminder mail was send. A total of 90 project publishers were approached. 32 of them had send a reply wanting to participating in the survey. That makes a response rate of 0.35. An invitation mail example is included in the appendix.

Analysis of the results is done with Google Forms own analyzing tools. Although these tools are basic they are enough to help verify the hypothesis. The analyzing tools include pie charts and bar graphs. In the next two chapters the theoretical part and the empirical part of the research model is analyzed.

7 Theoretical analysis

7.1 Environment uncertainty and information need

Leifer and Delbecq [43] have linked boundary spanning activities with perceived environmental uncertainty. The authors state that there is positive relationship between perceived environmental uncertainty and boundary activity. According to them the perceived uncertainty influences the initiation of boundary spanning (dimension one) and how boundary spanning is performed (dimension two).

In the first dimension the authors differentiate between regulated versus unregulated boundary spanner activity. If initiation of boundary spanning is regulated by the organization there will be a formal function. The organization then states by whom, when and where it should be performed. If boundary spanning is unregulated then the organization's decision making relies on varied and unpredictable information. Decision are usually made for unforeseen issues. Anyone within the organization could preform some sort of boundary spanning tasks. Unregulated boundary activity is also performed

when organizations are searching for new opportunities. The second dimension is how boundary spanning is preformed. In this dimension boundary spanning is either done routine or non-routine. This dimension is formed by availability and complexity of the information. Here the concern for the decision making is the number of exceptions encountered and search requirements to get information. This dimension is heavy influenced by the nature of the environment. The more the environment becomes complex and heterogeneous (uncertain), the more exceptions and difficulties in finding information it becomes. A higher perceived uncertain environment results in non-routine boundary activities. With a lower perceived uncertain environment the boundary spanner function becomes more routine.

Out of the two dimensions the authors have formulated four types of boundary spanner organizations. The first type of organization is where the most common boundary activity takes place (type 1). This type of organization perceive the environment as certain and boundary activity is routine. The boundary activities within this type of organizations are considered non-complex and low costing. These activities could be interactions between supplier-customer, state regulating agencies and industrial manufacturing facilities, contractually agreements between entities. In the second type of organization the environment is uncertain and the need for information is regular and anticipated (type 2). Because information is needed very often boundary spanning is regulated by the organization. However, because the organization perceives it's environment uncertain information sources are not known. The organization is considered closed with boundary spanning activities monitoring the environment. Because the environment is changing rapidly, information sources are also changing so boundary spanning will be non-routinized. The third type of organization boundary spanning is non-regular and routine (type 3). In this situation the environment is certain and information need is irregular and anticipated. When information is needed the boundary spanner uses standardized methods to gather it from known sources in the environment. The last type of organization is where boundary spanning is non-regulated and non-routinized (type 4). Here the need of information for decision making is irregular and unanticipated. The environment is seen as uncertain. These organizations are generally very open, where many personnel perform some type of boundary spanning activity. Being open these organizations want to create more certainty.

Information Need	Perceived Environmental Uncertainty	
	Low	High
Anticipated, regular	I Initiation: Regulated Process: Routine	II Initiation: Regulated Process: Nonroutine
Unanticipated, irregular	III Initiation: Nonregulated Process: Routine	IV Initiation: Nonregulated Process: Nonroutine

Boundary spanner organization types by Leifer & Delbecq (1976)

When the types of organizations are compared with the niche player's situation it is clear

that they profile a type 4 organization. The first dimension, the initiation of boundary spanning, is done unregulated. Iansiti and Levien [40] state that niche players should constantly be aware of technological threats coming from inside and also outside the ecosystem. These threats could be a rival features that are better by other niche players. Or outside threats like innovative developments in other ecosystems that could attract users. However, these changes are not planned far ahead and could happen instantly. Since these changes could come from multiple sources the information is varied and usually unpredictable. Niche players do not only have to look out for threats but also for opportunities. These opportunities could be via resources from the keystone or other niche players [38]. Each niche player has its own specialization [25]. Each specialized domain is linked with a unique set of terminologies or tools [49]. Hence, information from another niche player could be different and be difficult to interpret. The information could also be unexpected like users' feedback or keystone strategies. The modules are intended to be used by the users, so uncovering their needs and their experiences is important information for the niche players. Users feedback is however hardly to foreseen. Keystone strategies are also important because a change in strategies could influence the ecosystem in a great deal. For example entry requirements, users segment, but also practical decisions like used programming language, supporting tools or platform specific knowledge etc.

The second dimension, how boundary spanning is preformed, is done in a non-routinized manner. The niche player sees its environment as uncertain. As stated in chapter 3 the ecosystem goes through different stages [3]. In each stage the goal is different. For example in the birth phase the ecosystem needs to provide an interesting end-product. This is to be done with a small to non-existing users-base. It is the keystone's responsibility to coordinated and manage this. The niche players have the task to provide interesting part-products or in the case of IT additional modules. The niche players have high uncertainty when making decisions concerning this. For example, does the developed product meet the end-users expectations, does it have the potential to evolve, does the ecosystem as a whole have the potential to make success, does the keystone provide room for creativity. The influence of change is felt deep within the ecosystem. Whether the change is internal (e.g. rival module deployment) or external (e.g. technology developments). The environment of a niche player constantly moves and evolves. Relationships within ecosystems are not static but dynamic [5]. So roles could change resulting in the changing of information sources. This makes the requirements for searching information non-standard. The highly specialization of individual niche players also makes the number of exception encountered high.

7.2   Boundary knowledge types

In Carlile's [49] framework for managing boundary knowledge, Carlile distinguishes between three types boundary knowledge properties. These are differences, dependence and novelty.

The first one, difference, refers to diversity of knowledge accumulated. Where each unit has it's own knowledge specialization that will contribute to the overall product or service. Carlile gives an example of an automobile manufacturer, where different units contribute their specialized knowledge to solve problems within their part of the car production. For

example the motor unit develops the motor that is powerful and efficient, the styling unit handles the outer en interior design and the safety unit is responsible for the safety attributes of the car. From a niche player's perspective the diversity of knowledge applies to the specialization of their produced modules. So the different niche player contribute to the overall end-users experience with their produced modules [25]. As an example the web browser ecosystem is given. One niche player might specialize itself into an *advertisement-block* module while another niche player specializes itself into a *web integrated video content download* module. The end-user could install both modules. In this way the end-user is customizing the web-browser to his own liking.

The second property is dependence, where each entity is dependent on each other in order to complete their goals. The entities must take each other in to account. Again in the example of the automobile manufacturer, each unit needs to communicate their design specifications to each other in order to match all design parts accordingly. For example the motor development unit must share their measurements of the motor artifact to the outer and interior design unit. So any change in one part of the car design will influence other design parts. The bigger the dependence, the more effort and resources is needed to match and adapt the different knowledge streams. In the niche player's situation this is not so much relevant. Because dependence is more a task for the keystone organization. It is their task to set regulations concerning the platform and or business model and communicate them to the other members of the ecosystem. For example the keystone should make decisions what programming language is to be used, if certain modules are appropriate or not and etc.

The third property is novelty of the circumstances around the knowledge. For a new product-development the involved entities or units need to use their specialized knowledge to design part of the product conform new requirements of the customer's need. It could also be the case that the units need to adapt or renew their current knowledge. As again with the car production reusing previous designs will likely have common knowledge accumulated between the units from the previous productions, however a completely new car design will cause the units to adapt or renew their own knowledge and learn relevant knowledge of the other units. Put into other words the level of novelty dictates level of difference and dependence of knowledge. The higher the novelty of knowledge at boundaries, the higher the differences and dependence. Which results that more effort and resources are needed to match and adapt the different knowledge streams. In the niche player's case this could resemble two scenarios. The first one is when a niche player enters a new ecosystem. They have to learn and adapt to the ecosystem. For example what are the end-users preferences, does implementing modules to the platform require new knowledge or technology, what are the entry requirements of the modules, etc. The second scenario is when a change occurs within the ecosystem. The most obvious change is a change in strategy of the keystone. This could lead to renewing the niche player's own knowledge for example learning a different technology or programming language. Change could also be external like a change in government regulations or the investment of a new technology. A change in government regulations for example could be stricter privacy control of user. This means that there will be a need to implement new security aspects within modules.

7.3   Knowledge exploration

Rosenkopf and Nerkar [54] have developed a model for exploration search for knowledge by organizations. The model concerns combining own knowledge with knowledge that is acquired due to exploration. This combined knowledge is then used to make new products or services. The model is formed out of two dimensions. The dimensions are divided into two extremes. So exploration search could be categorized according to the two extremes within both dimensions. The researchers state that exploration search is not always black and white. It could be that more exploration categories are used but one is predominant.

The first dimension is organizational boundary spanning. The extremes within this dimension are internal or external. Internal search for knowledge is done within own organization. This could be in a different technological sub-unit. For example when Canon developed the precision mechanism and fiber optics and developed mechanical cameras. They used knowledge within own firm by different sub-units and created the cameras. And the extreme external involves spanning to other organizations. Here different knowledge from external organizations is used to develop a product or a service. For example the transition from CD format to DVD format. The companies that made the CD format involved into making the optic disk storage capacity higher. This format was called the DVD and allowed full motion pictures to stored on the same 12 cm size disc of the CD.

The second dimension is technical boundary spanning. This dimension differentiates the extremes similar technology and distant technology. Similar technology span is when exploration is done within the same technology. This usually involves incremental innovations. For instance in the CD format era, when Sony and Philips where involved in incremental innovations based on the CD standard knowledge. They used the optic and data storage technology to develop similar products. These where for example CD-ROM, Mini Disc and CD-V. A distant technological knowledge search is when different technology knowledge is used to create products or services. For example the company Kao used surfactant (soap) technological knowledge to develop a better coating for their floppy disks.

<table>
<tr><td>Local</td><td>External Boundary-Spanning</td><td>Similar</td></tr>
<tr><td>Internal Boundary-Spanning</td><td>Radical</td><td>Distant</td></tr>
</table>

Technological Boundary Spanning
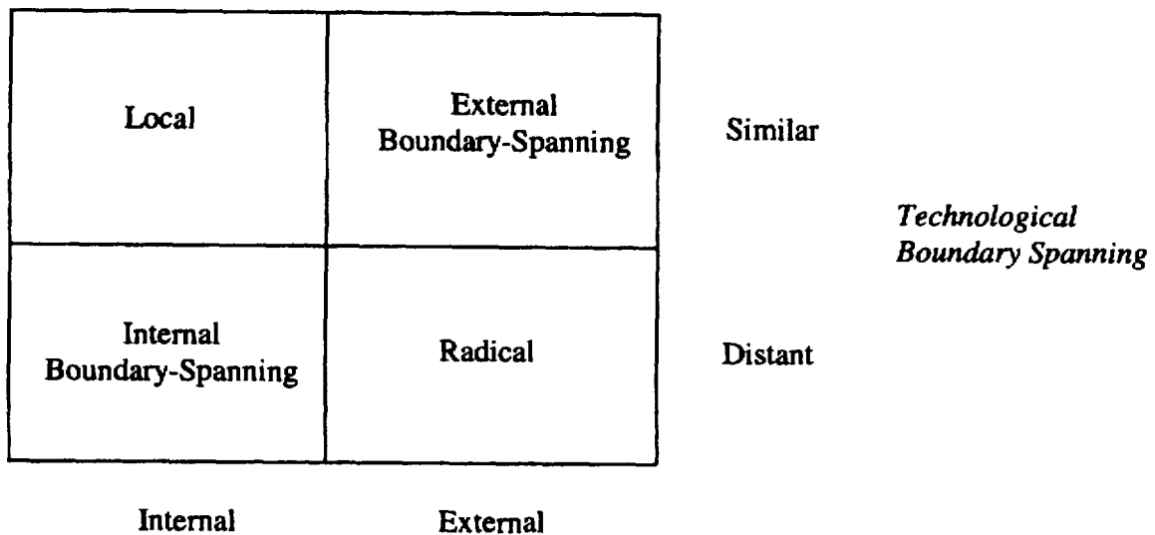
Internal   External

Organizational Boundary Spanning
Knowledge exploration types by Rosenkopf & Nerkar (2001)

If the model is compared with the niche player's situation the first dimension leans towards an external organization knowledge search. Because niche players leverage resources from other members of the ecosystem [38]. These members could be the keystone or other niche players. It is in the niche player's best interest to be light-weighted focusing on their own specialization [40]. They therefore leverage tools, technologies, services and products available within the ecosystem. So external organizational boundary spanning is a must. The second dimension about similar or distant technology search could resemble two scenarios. In the first scenario the niche player is already participating within an ecosystem. Here the niche player has already established the needed technology knowledge within ecosystem. This could be the platform or the needed tool to develop modules. The niche player can use this knowledge to develop modules. The second scenario is when a niche players is a new entrant in an ecosystem. The niche player then has to search for technological knowledge that is other than the technological knowledge in-house. For example when a iOS developer for apple devices decides to also develop for Android based devices. The developer then has to learn for example the framework of Android that is radically different from iOS one. As iOS meanly works with the programming language *Objective-C* and Android apps are usually written in the *Java* language.

8   Empirical analysis

8.1 Boundary spanner activities

Ancona and Caldwell [57] have formulated boundary spanning activities. They have grouped the activities into; *scout, ambassador, sentry* and *guard*.

Scout activities concern bringing in information and resources into the organization or team. These activities are subdivided into *modeling, gathering information and resources, scanning* and *feedback seeking*. *Modeling* concerns mapping the environment, making a picture of the external surrounding of the organization or team. So that the focal entity could expect where to get support, what is expected of the entity itself, where and how to acquire information or resources. *Gathering information and resources* entails bringing information or resources into the focal entity. The information or resources are needed to complete current tasks of the focal team. *Scanning* is about gathering information not relevant about the current task but important for anticipating on changes or trends within the environment. *Feedback seeking* concerns with the perceptions of the environment towards the progress, deliverables and functioning of the focal organization or team itself. The scout activities are interesting for this thesis. They will provide a good picture of niche player's behavior concerning information gathering within IT ecosystems. Questions concerning these activities are to be used in the survey.

Ambassador activities are the opposite of the scout activities, as to bring information from the focal organization or team to the environment. These activities involve a lot of promoting the focal organization or team to get support from entities in the environment. Within ambassador activities Ancona and Caldwell [57] distinguished *Opening up communication channels, informing, coordinating, negotiating* and *molding*. *Opening up communication channels* is preformed for making relationships with parties who at a point in time may be beneficial to the organization or team. With *informing* the focal team or organization informs entities in the environment about its status and progress. *Coordinating* needs to be done in order to align the schedules of the different entities. The goal is to integrate the work from various parties. *Negotiating* is done to align the goals of the different entities. *Molding* concerns influencing the environment to steer the direction towards the focal organization's or team's own goals. The focal organization or team advertises their own work and capabilities in order to get support from other entities. These activities resemble actions that a keystone organization would take. For attracting other niche players, promoting the ecosystem and the platform. For this reason these activities are not included in the survey.

Sentry activities are focusing on governing the information that comes into the focal organization or team. Issues like when, in what form and how much information enters the focal organization or team. Activities that are mentioned are *allowing entry, translating* and *filtering*. *Allowing entry* is about accepting outside information into the focal entity. *Translating* focuses on interpreting the information from outside of the focal entity and making it understandable to the members of the focal organization or team. *Filtering* is used to trim down the information to only what is relevant to its members. These activities are also very interesting and will also make the behavior of niche players more clear. Sentry activities are also intended to be used in the survey.

The last group of activities are guard activities. These activities regulate the outbound information flow to the environment. The activities include *classifying, delivering* and *protecting*. *Classifying* involves segmenting information requests from the environment. This is done according to legitimacy and impact of the focal team or organization. Once the information is classified as legitimate and acceptable the *delivering* activity makes sure that the information is delivered. On the other hand the *protecting* activity will prevent information to be delivered when the request is viewed as non-legitimate or unacceptable. These activities are also very interesting however they are not so much relevant to this

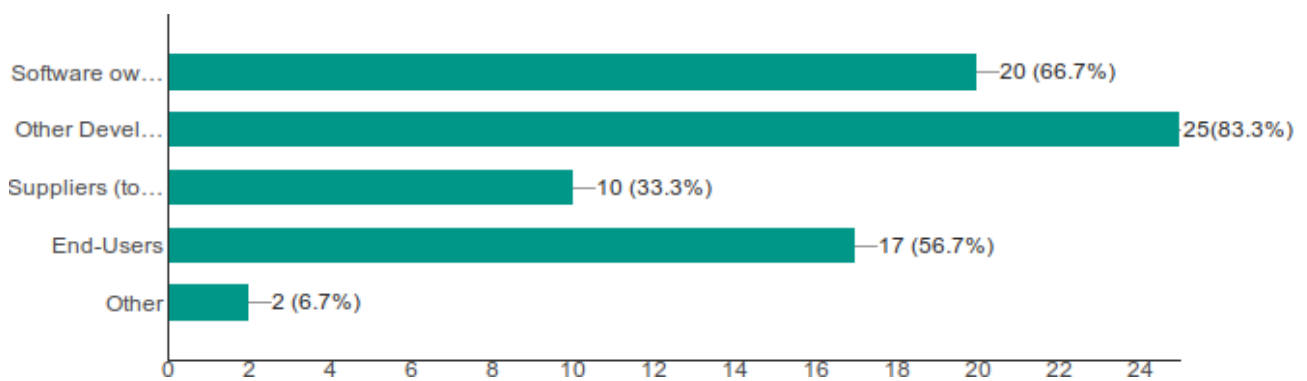thesis. That is why these activities are excluded from the survey.

8.2 Survey results

8.2.1 Scout activities

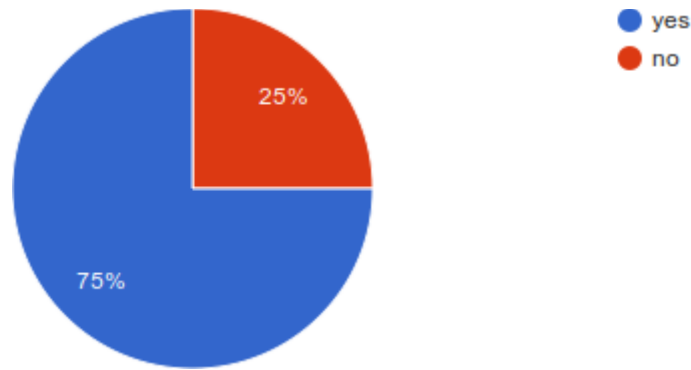**Mapping the environment of the organization or team**
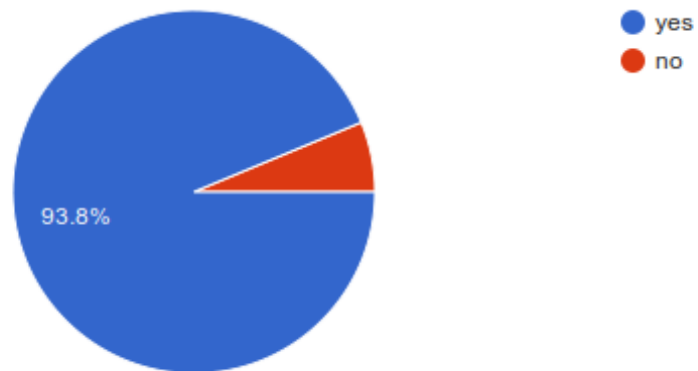
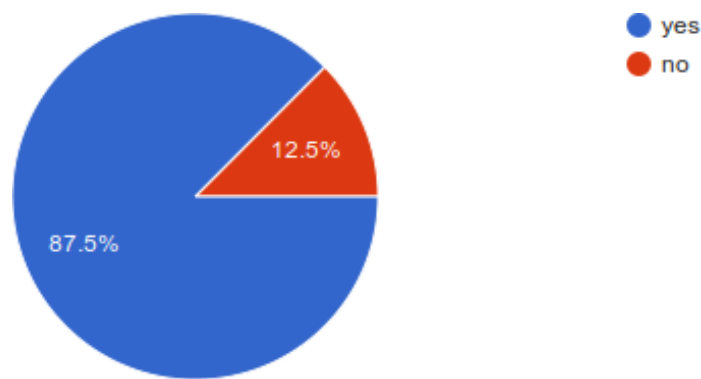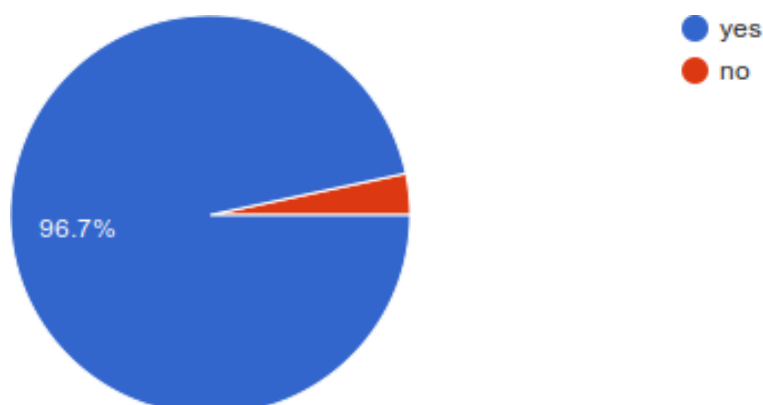*Contact with outside organizations or individuals*
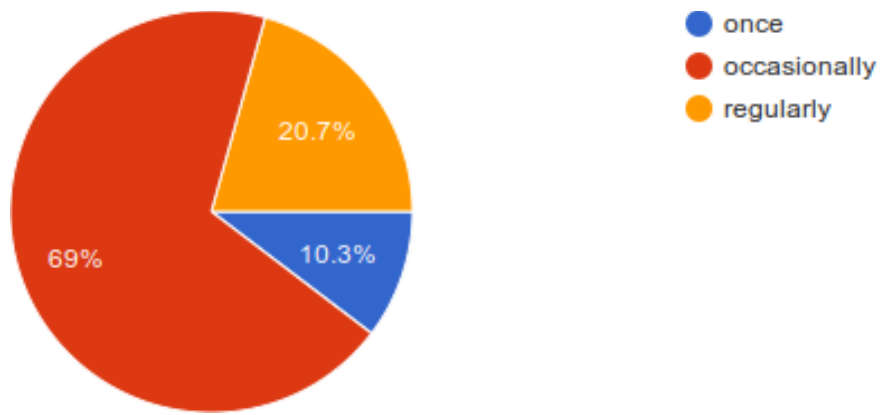

Outside contacts

Support from contacts

Additional information from contacts

From these results it is clear that niche players do map their environment. As almost 94% of the respondents say that they have contact with organizations or individuals outside their own project team. Most of these contacts are other developers (83%), the keystone (66%) and the end-users (56%). To a low extend (33%) the niche players have also contact with suppliers (tools, technology and etc). 75% of the respondents who have outside contacts say that they expect support from them if needed. And 87% of these same respondents say that they also expect additional information from their contacts if needed. This section of the survey shows that niche players are aware of their environment and have outside contacts that are expected to provide information and support.

Gathering information and resources

Frequency

Almost 97% of the respondents who gather information from outside contacts use this information for development of modules. 69% does this occasionally and 20% regularly. This part shows that information gathering is done by nearly all niche players on an occasionally to regular basis.

Scanning
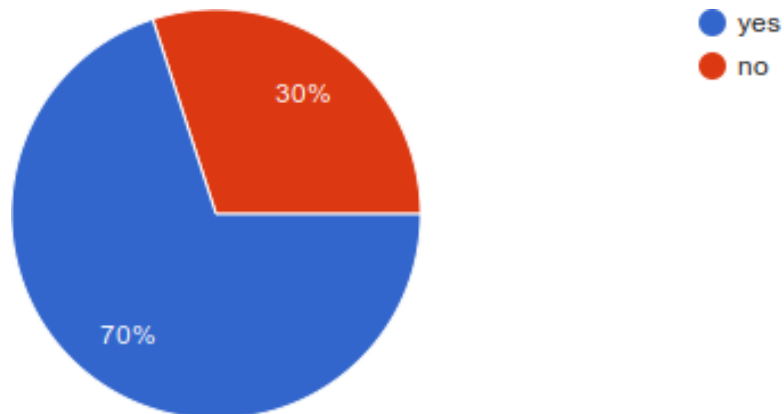
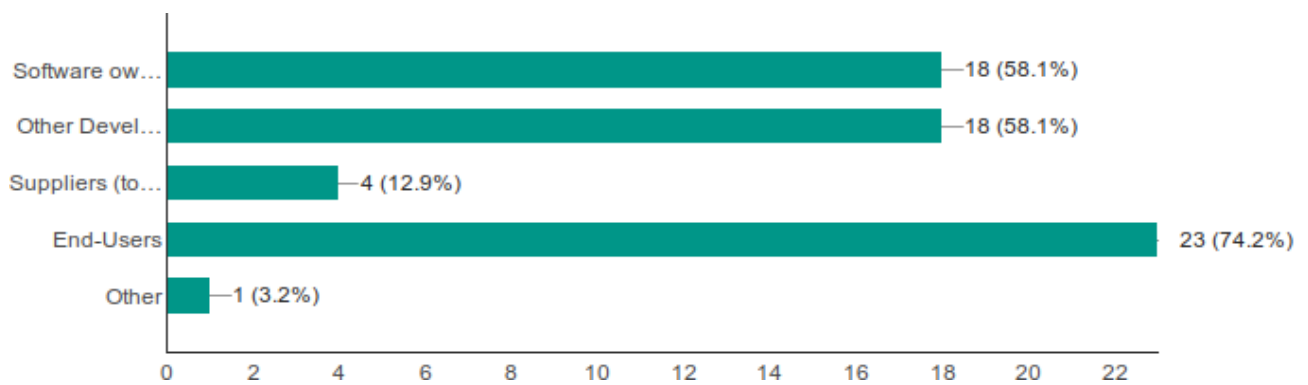*Information from contacts used for other than development of modules*
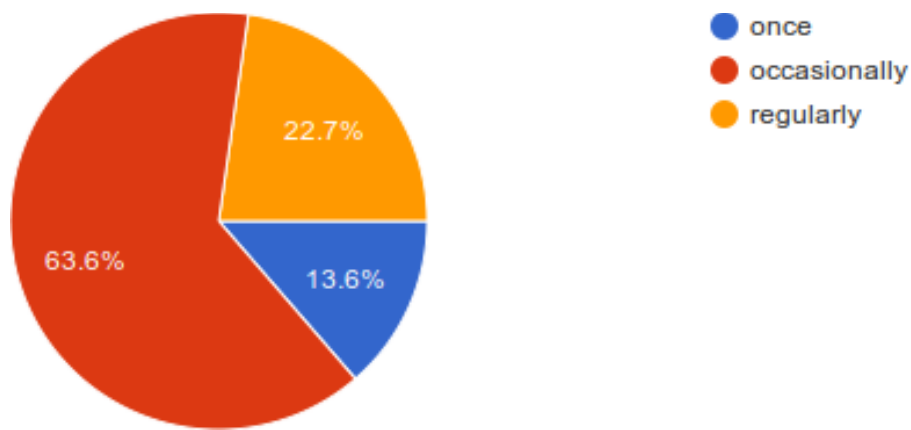
Frequency
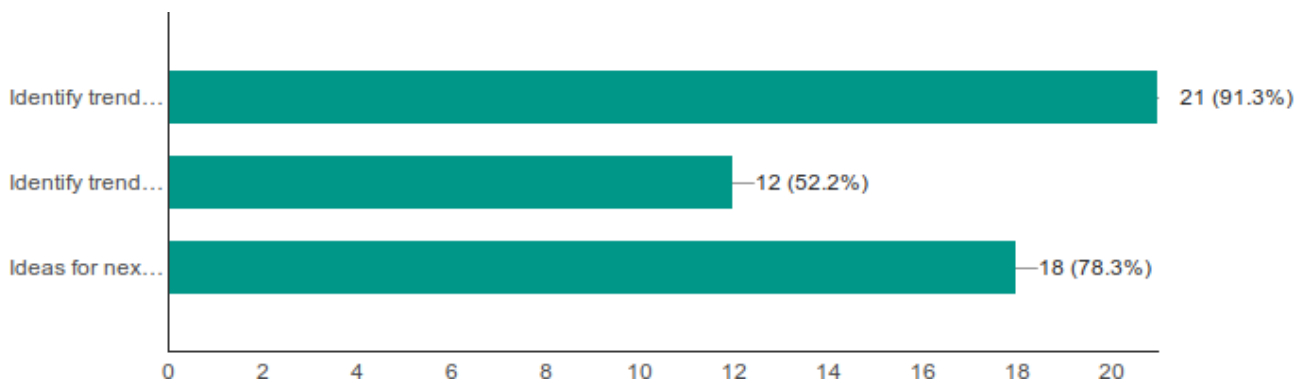
Information was used for

70% of the respondents that have outside contacts gather information other than for development of modules. This was done 63% occasionally and 22% regularly. This information was used mostly to identify trends of the platform (91%) and ideas for next projects (78%). From this it is evident that most niche players also gather information for identifying trends of the platform software and ideas for next projects.
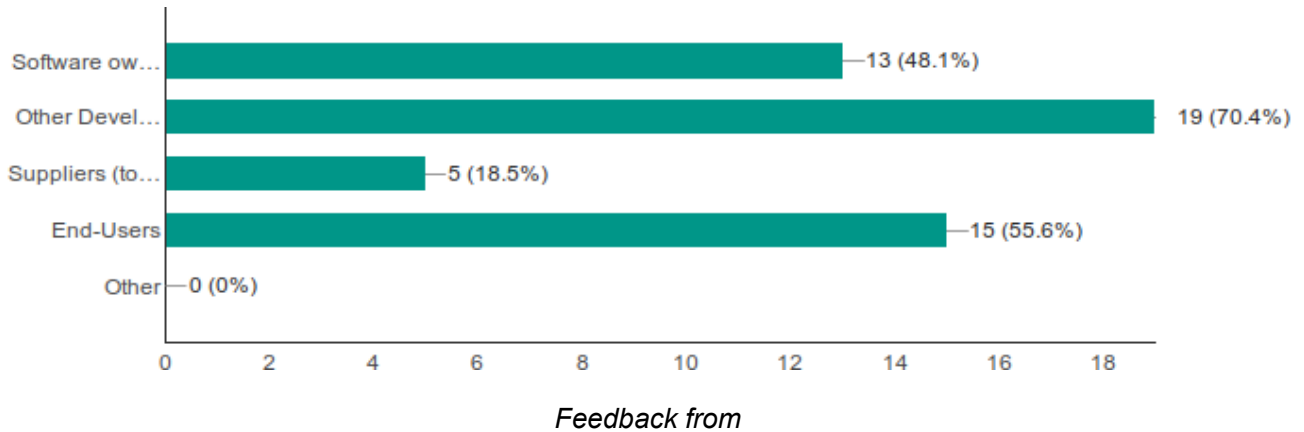
Feedback seeking
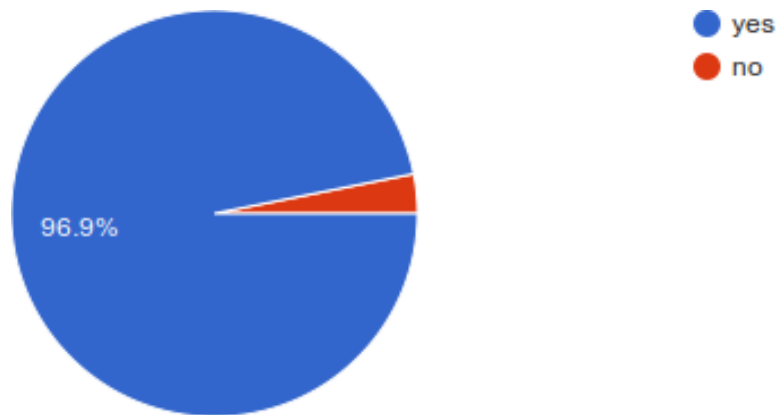
Feedback for projects


Feedback from

Feedback from

Almost all (97%) niche players seek feedback for their modules. Most (74%) of them turn for feedback to the end users. Also, they turn to the keystone and other developers (both 58%). Next to feedback on modules most niche players also seek feedback for development methods and development progress. For niche players turn most likely to other developers (70%). Next to the end users (55%) and some also contact the keystone (48%) for this. From this part it is evident that niche players really care for the quality of their modules and development methods and gather information concerning it.
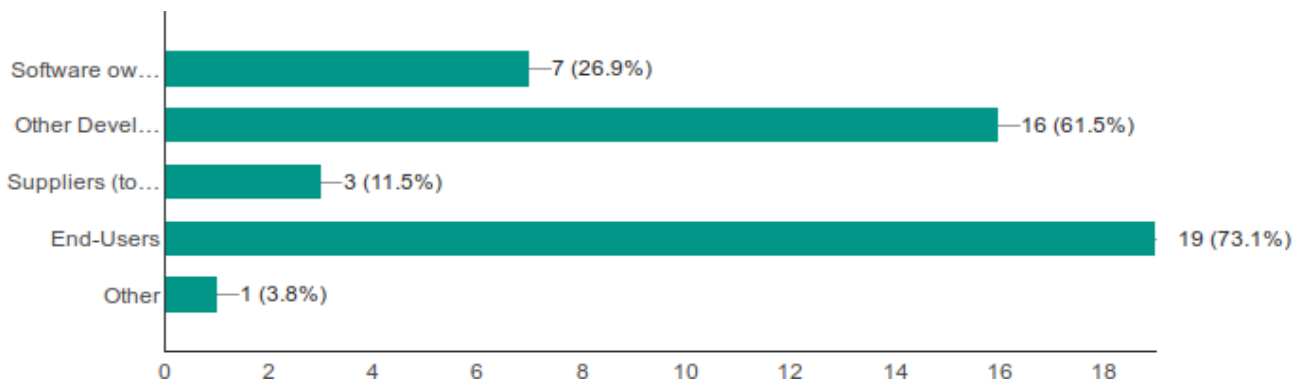
8.2.2 Sentry activities

**Allowing entry**
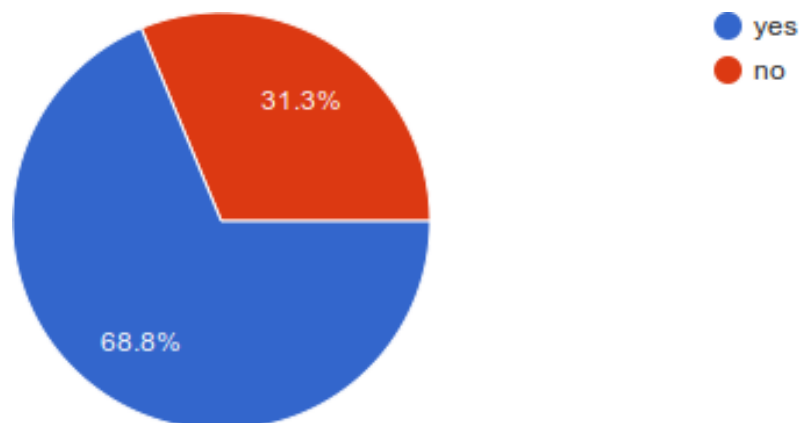
Rejection of information
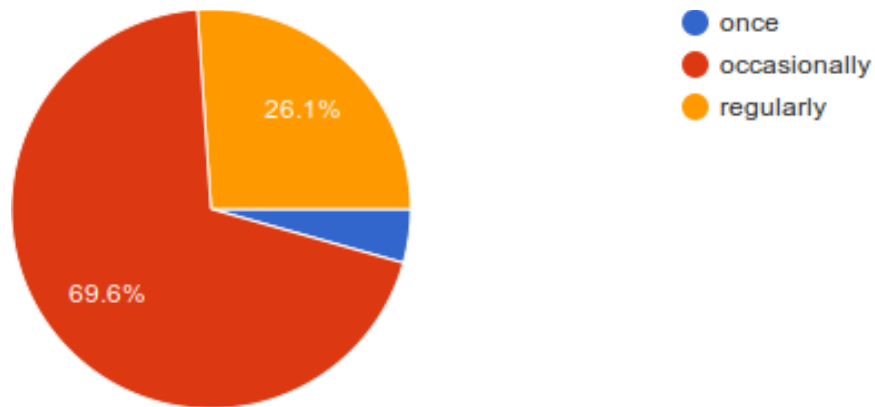
Frequency

Source

A great amount of 68% also rejects information that will not use for their development of modules or other purposes. 69% says that they do this occasionally and 26% say that this happens regularly. Most of the rejected information is from end-users (73%) and information from other developers is also rejected quite often (61%). This part shows that rejection of information does occur by niche players and that this is occasionally to regularly done.
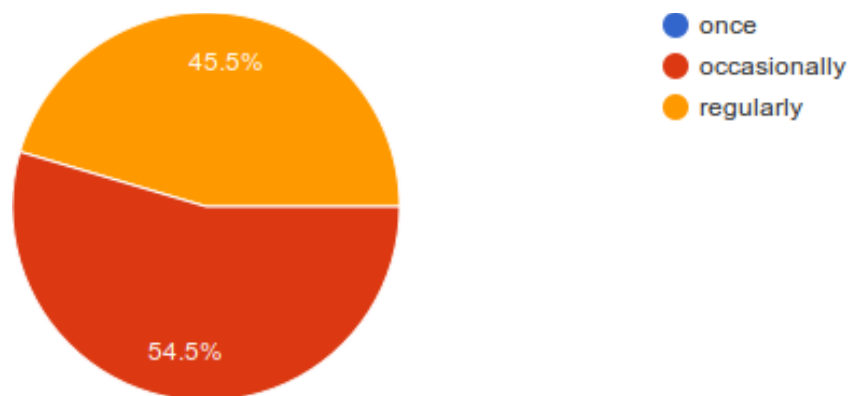
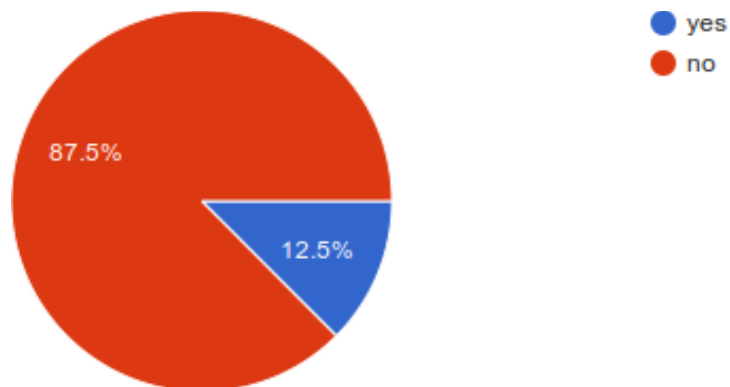**Translating**

yes
no
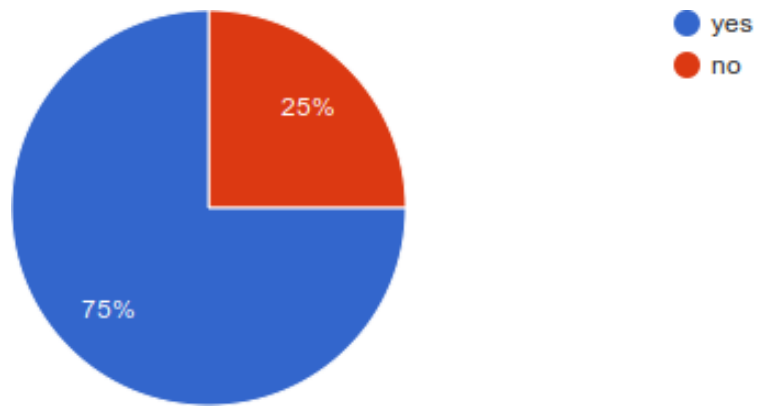
Understanding of information

yes
no
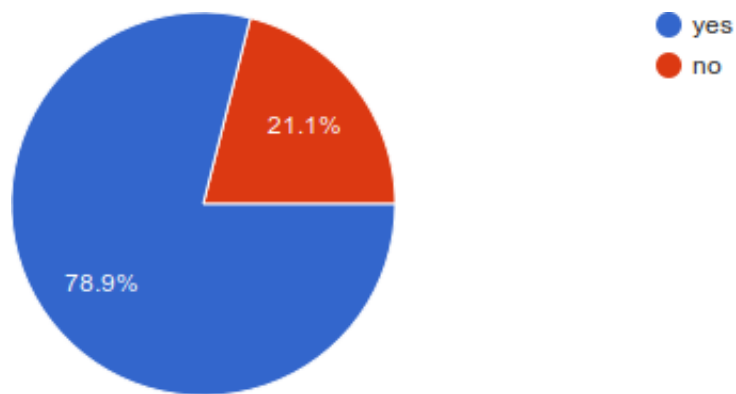
Put information in own words

once
occasionally
regularly
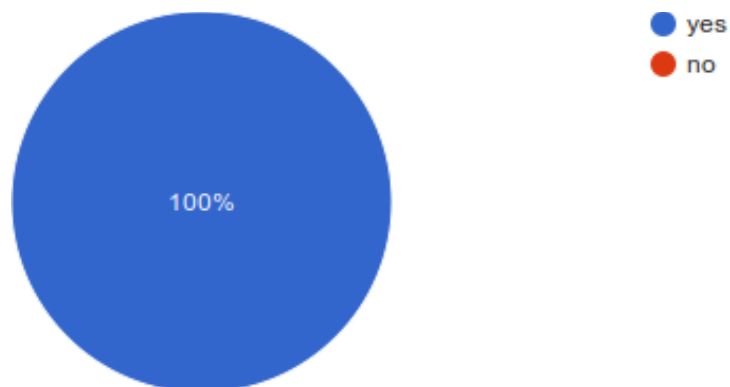
Most of the niche players understand (75%) the information from their contacts. A remarkably amount (79%) puts the information in their own words or terms. Putting the information in own words or terms happens occasionally (45%) to regularly (54%).
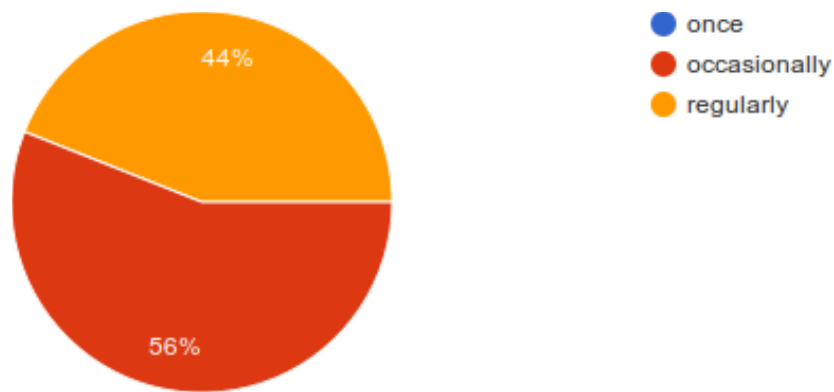
Filtering

Usage of all information gathered

Select relevant information

Frequency

87% of the respondents say that do not use all the information that they gather. All of them select information that is relevant to them. This happens occasionally (56%) to regularly (44%).

9   Discussion and conclusion

Hypothesis supported

For this thesis the proposed hypothesis was, *niche players within IT ecosystems gather information from different sources for different purposes*. The research framework that was developed to test this hypothesis has two parts. One theoretical and one empirical. In the theoretical part the concepts' e*nvironment uncertainty*, *knowledge types*, *knowledge exploration* from the boundary spanner theory where used to learn more about the information gathering conditions of the niche players. These concepts where chosen because they show the conditions of information gathering by niche players. The concepts are discussed from the perceptive of the niche player. This perspective is formed by the (IT) ecosystem and niche player literature. The *uncertain environment* concept shows that information gathering of niche players is unregulated and non-routinized. This is because the environment of the niche player is dynamic and roles within ecosystems change a lot. For the concept *Boundary knowledge types* the analysis showed that the knowledge within the ecosystem is quite diverse due to the many different specializations. Also, it became evident that the circumstances of the knowledge for niche players is highly novel. This is especially the case when a niche player enters a new ecosystem and when the keystone makes changes in his strategy. With the concept *knowledge exploration* the discussion made clear that niche players do external organizational exploration because they leverage resources from other members. And use external technological exploration when entering a new ecosystem and internal technological exploration when all ready participating in an ecosystem. The theoretical part shows that information gathering conditions is hard and the need for information is high. Active information gathering behavior must be taken in order to get useful and valid information.

The second part of the research framework is the empirical evidence of the information

gathering activity. The empirical evidence showed that niche players have contact with organizations or individuals outside of their own project team. This is usually with other niche players, end-users or the keystone. They gather information from them for development and further evolve their of modules. They also gather information for trends of the platform software, next ideas and their development methods. The niche player also makes the information more understandable and manageable for their organization by selecting only relevant information and putting the information into their own words. The empirical analysis shows that the information gathering behavior is quite diverse and active.

Both analysis support the hypotheses, namely that niche players gather information from different sources for different purposes. This implicates that information gathering among members of the ecosystem should be supported and made easy. This could be possible with an open environment that stimulates information sharing and collaboration. The keystone could very much help with this. Some of them have already made it possible for communication between the end-user and the niche player. But as the empirical analysis makes clear niche player also gather information from other niche players and the keystone. So an integrated system that makes information exchange easy would be a great win for the niche player and the ecosystem as a whole. Direct communication lines between the niche players themselves and with the keystone would contribute to a better cooperation among the ecosystem members. With better cooperation less effort will be needed to develop the additional modules. And the niche player could focus more on their users needs. By doing so they can deliver a better contribution to the diversity of the ecosystem.

This thesis also contributes to the literature of ecosystems by giving a better understanding of niche player behavior. This study empirically acknowledges that collaboration occurs within ecosystems [3][20]. Where Mars et al. mentions that information exchange occurs this thesis indicates that this (in the case of IT ecosystems) information is mostly about development of additional modules, trends of the platform software and self audit of modules and development methods.

Limitations

This study has taken a quantitative approach for the empirical data collection. So the data is quite limited and general. If a combination of qualitative methods (like interviews or case study) were to be used, more specific empirical results would be possible. That would have made the thesis more specific and detailed. Also in the empirical data no distinction was made about the type of software platform (application, mobile, online, etc.). It would be interesting to know if there are any differences in different software platforms ecosystems.

Future research

This thesis is an important progress in understanding the niche player behavior within IT ecosystems. However, there is a lot more to discover about niche players. For instance further deepen into information gathering by doing qualitative empirical data collection in form of interviews or case studies. This can give more detail about the outside contacts of

the niche players. For instance how did the contact come into existence. How strong are the relationships. What are the mutual benefits of the relationships. Are the other niche players active in the same ecosystem or others. Does a strong control strategy by keystone influence the information gathering behavior. So there is a lot to find out about information gathering alone but other subjects about the niche players behavior is also interesting. For instance how do they protect information which is crucial to their success from other niche players or the keystone.

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Appendix A *Example invitation email*

Subject: Re: Assistance with thesis
From: S⬛⬛⬛⬛⬛⬛⬛ <s⬛⬛⬛⬛@gmail.com>
Date: 04-07-16 11:16
To: Hüseyin Çolakoğlu <huseyin@colakoglu.nl>

Hello,

yes, I can fill your survey

-- ⬛⬛⬛⬛⬛⬛⬛⬛⬛⬛⬛⬛⬛⬛⬛⬛

On 24 Jun 2016, at 12:17, Hüseyin Çolakoğlu <huseyin@colakoglu.nl> wrote:

Dear Mr ⬛⬛⬛⬛⬛,

I have send you an mail earlier about filling out a survey for my thesis. Maybe you missed it, therefore I would like to ask again if you would like to fill out a survey for my thesis. Your input is very valuable for my thesis. I have tried to keep the survey short and aimed for it to take approximately 7 minutes to fill it out.

If you would like to fill out the survey please reply to this mail so that I can send you the link to the survey.

Kind Regards,
Huseyin

On 22-06-16 13:58, Hüseyin Çolakoğlu wrote:
Dear Mr ⬛⬛⬛⬛⬛

I am a student at the Leiden University in the Netherlands. I am doing my thesis research on third-party developers that develop apps/plugins/additional modules for software. Therefore I want to ask if you would like to fill out a survey. Your input is very valuable for my thesis. I have tried to keep the survey short and aimed for it to take approximately 7 minutes to fill it out.

If you would like to fill out the survey please reply to this mail so that I can send you the link to the survey.

Kind Regards,
Huseyin

Appendix B *Survey*

Information gathering by third-party developers

Third-party developers that develop apps/plugins/additional modules mean a lot for the software that they develop for. They not only expand its functionalities but they also serve the needs of the end-users better. By doing so third-party developers help to evolve the software and bring it to next levels. My thesis is about how third-party developers go to work for their projects. I want to explore how they gather information for their projects. With this survey I would like to know more about your experience with that. I have tried to keep the survey short and aimed for it to take approximately 7 minutes to fill it out.

General

These two question are general questions interested in your situation.

What is your function within the organization or project team? (more answers possible)
1. CEO
2. project leader
3. developer
4. other

How big is your organization or project team?
1. one person
2. less then 10 persons
3. more than 10 persons

Scouting activities
The next set of questions will be on bringing in information and resources into your organization or team for current or future projects.

Mapping the environment of the organization or team
These questions concern mapping the environment, making a picture of the external surrounding of your organization or team. So that you could know where to expect support, what is expected of your team, where and how to acquire information or resources.

Do you have contact with other organizations or individuals outside your own project team or organization?
1. *yes*
2. *no*

If so, who do you have contact with? (more answers possible)
1. *Software owner/provider/maintainer*
2. *Other Developers*

    3. *Suppliers (tools, technology, etc)*
    4. *End-Users*
    5. *Other ….*

Do you expect support, if needed, from your contacts?
    1. *yes*
    2. *no*

Could you acquire additional information or resources from your contacts?
    1. *yes*
    2. *no*

Gathering information and resources
These questions are about bringing information or resources into your organization or project team. This information or resources are needed to complete your projects.

Have you ever acquired information from your contacts that you used for projects?
    1. *yes*
    2. *no*

If you did, how many times roughly was this the case?
    1. *once*
    2. *occasionally*
    3. *regularly*

Scanning
The next questions are about gathering information not relevant for your projects but important for anticipating on changes or trends within your environment.

Have you ever acquired information from your contacts that you used other then for your projects?
    1. *yes*
    2. *no*

If you did, how many times roughly was this the case?
    1. *once*
    2. *occasionally*
    3. *regularly*

What was this information used for? (more answers possible)
    1. Identify trends or changes of the software
    2. Identify trends or changes of other developers or the software provider
    3. Ideas for next projects

Feedback seeking

These questions concern with the perceptions of the environment towards the progress, deliverables and functioning of your organization or team itself.

Do you gather information concerning your project's reception?
1. yes
2. no

Who do you generally approach for this? (more answers possible)
1. *Software owner/provider or maintainer*
2. *Other Developers*
3. *Suppliers (tools)*
4. *End-Users*
5. *Other …*

Do you gather information concerning your project's progress or approach?
1. yes
2. no

Who do you generally approach for this? (more answers possible)
1. *Software owner/provider or maintainer*
2. *Other Developers*
3. *Suppliers (tools)*
4. *End-Users*
5. *Other …*

Sentry activities
This set of questions focus on how the information that comes into your organization or team is governed. Issues like when, in what form and how much information enters your organization or team are addressed.

Allowing entry
These questions are about accepting outside information into your organization or team.

Do you ever reject information to be used for project?
1. Yes
2. no

If you did, how many times roughly was this the case?
1. once
2. occasionally
3. regularly

Who is this information generally from? (more answers possible)
1. *Software owner/provider or maintainer*
2. *Other Developers*
3. *Suppliers (tools)*
4. *End-Users*
5. *Other …*

Translating

These questions concern interpreting the information from outside of your organization or team making it understandable to be used.

Do you or your team understand the information from your contacts directly?
1. Yes
2. no

If not, do you put the information in your own words or terms?
1. Yes
2. no

If yes, how many times does this generally occurred?
1. once
2. occasionally
3. regularly

Filtering

These questions are about trimming down the information to only what is relevant to your projects.

Do you use all the information from your contacts?
1. Yes
2. no

If not, do you select information that is relevant?
1. Yes
2. no

If yes, how many times does this generally occure?
1. once
2. occasionally
3. regularly