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FACULTY OF BUSINESS ECONOMICS

Master of Management

Masterproef

Theoretical thesis - Open innovation

Promotor :
dr. Anna ROIJAKKERS

Yannick Adriaensen

Master Thesis nominated to obtain the degree of Master of Management

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KNOWLEDGE IN ACTION

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Foreword

I got the assignment in my master year to write a thesis. I chose the write a thesis about Open Innovation because it looked very interesting to me. It was my job to explore if Open Innovation is a new value adding innovation theory or that it just aggregates some already existing innovation theories. During this thesis I learned a lot of new things that were very remarkable.

I could never have written this thesis without the help of my two promoters. Therefore I would like to thank professor Wim Vanhaverbeke and Professor Nadine Roijakkers for the support and help that they gave me to write this thesis.

Besides them I would also would like to thank my friends and family for the encouragements that they gave me during the year. Without hem this task would have been a lot more difficult.

Summary

Chesbrough, the founder of the Open Innovation theory, says that the theory is a new value adding theory. Trott and Hartmann don't agree with him. They say that the theory just integrates different aspects of current innovation management theories. In order to investigate this, I will look at the evolution from Closed Innovation to Open Innovation and at some already existing innovation theories.

Closed Innovation is a form of innovation in which the search for new knowledge and the developing of applications based on that knowledge takes place in the own organization only. The goal is to protect the newly acquired knowledge and applications and to achieve the highest possible profit by creating a competitive advantage. It is a view that says that successful innovation requires control. This means that companies have to generate their own ideas.

The erosion of the Closed Innovation paradigm has created a pathway for the Open Innovation paradigm. Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology.

Open source is described as software that can be spread without restraints or royalties, that the source code must be accessible by everybody and that work that is derived from it should also be spread as open source software.

Then there is Absorptive capacity, that is described as a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends.

The resource-based view is a management device used to assess the available amount of a business' strategic assets. It is based on the idea that the effective

and efficient application of all useful resources that the company can muster helps its competitive advantage.

The stage-gate model is a very useful tool if you want to develop a new products. It splits the development process in different stages and therefore brings some structure to that process.

Organizational learning is a method for detecting and correcting mistakes, a process whereby an organization builds knowledge and reconstructs existing knowledge and it means improving actions with better understanding.

Open Innovation definitely builds further on existing innovation theories. Some of the building blocks of Open Innovation come from the open source theory, the stage-gate model, the resource-based view, the absorptive capacity and organizational learning. But Open Innovation goes further than that.

Chesbrough described 8 points where Open Innovation contributes value to the already existing innovation theories. These 8 points are the following:

1. Equal importance given to external knowledge, in comparison to internal knowledge
2. The centrality of the business model in converting R&D into commercial value
3. Type 1 and type 2 measurement errors in evaluating R&D projects
4. The purposive outbound flows of knowledge and technology
5. The abundant underlying knowledge landscape
6. The proactive and nuanced role of IP management
7. The rise of innovation intermediaries
8. New metrics for assessing innovation capability and performance

For Open Innovation, external knowledge gets the same importance than internal knowledge. The theory also tries to avoid type 1 and type 2 measurement errors. Ideas, technology and knowledge are not kept internal, but also leaves the company for the benefit of other companies as well for their own benefit. Besides that, Open Innovation has no limits to seek for new knowledge, ideas or

technologies. So as you can see, the possibilities of the Open Innovation theory are endless.

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1. Problem statement

Henry Chesbrough is the Executive Director of the Center for Open Innovation at the Haas School of Business at UC Berkeley. In 2003 he wrote the following book: "Open Innovation: The new imperative for creating and profiting from technology" (chesbrough, 2003). The term Open Innovation was then used for the first time. Chesbrough described Open Innovation in that book as follows:

> Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology.

In that book, Chesbrough describes how firms go from Closed Innovation to Open Innovation.

In 2006 he wrote another book about Open Innovation. That book is called: "Open Innovation: Researching a new paradigm" (Chesbrough, 2006). Here he gives another definition for Open Innovation:

> The use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology.

Chesbrough sees Open Innovation as a an extension of prior innovation management theories. He said that Open Innovation differs from the other theories at the following 8 points:

1. Equal importance given to external knowledge, in comparison to internal knowledge
2. The centrality of the business model in converting R&D into commercial value
3. Type 1 and type 2 measurement errors in evaluating R&D projects
4. The purposive outbound flows of knowledge and technology

5. The abundant underlying knowledge landscape
6. The proactive an d nuanced role of IP management
7. The rise of innovation intermediaries
8. New metrics for assessing innovation capability and performance

Chesbrough isn't the only person who thinks about Open Innovation like this. There are other researchers who are agreeing with him that it is a value adding theory, for example Wim Vanhaverbeke and Joel West. Those two, together with Chesbrough concluded in their book (Chesbrough, Vanhaverbeke, & West, 2006) that Open Innovation builds upon previous academic work. They also indicated the new contributions and emphases that Open Innovation can bring that to the previous academic work.

But not everyone agrees with Chesbrough that Open Innovation is something new. Paul Trott and Dap Hartmann are two of them. They wrote the following article together: "Why Open Innovation is old wine in new bottles" (Trott, & Hartmann, 2009). In this article Trott and Hartmann call attention to the fact that there were already people who emphasized the need for external linkages in the innovation process in the past. So this means that they already disagree about the first point which Chesbrough mentioned that Open Innovation differs in this way against the existing management theories.

Trott and Hartmann also give examples in their article about companies who already used Open Innovation principles before the theory Open Innovation existed.

There is clearly a disagreement about whether Open Innovation contributes value to the already existing management theories or that it is not. Some say that Open Innovation is a new value adding theory, but others say that Open Innovation simply integrates different aspect of current existing management theories.

In this thesis I will investigate the Open Innovation theory and also some other existing management theories like the resource-based view, open source theory,

etc. After studying these different theories I will be able to say whether Open Innovation brings or does not bring value to the current existing management theories.

2. Closed Innovation

2.1 Introduction

Closed Innovation is a form of innovation in which the search for new knowledge and the developing of applications based on that knowledge takes place in the own organization only. The goal is to protect the newly acquired knowledge and applications and to achieve the highest possible profit by creating a competitive advantage. It is a view that says that successful innovation requires control. This means that companies have to generate their own ideas. When that is done, they have to build, market, distribute, service, finance and support them on their own. This implies that companies should be very self-reliant, because you can never be sure of the availability, quality and capability of ideas of others. This was also the point when the term 'not invented here' (NIH) was first used. It meant that when a technology wasn't invented by the own R&D organization, the company couldn't be sure about the quality, availability and performance of that technology (Chesbrough 2003).

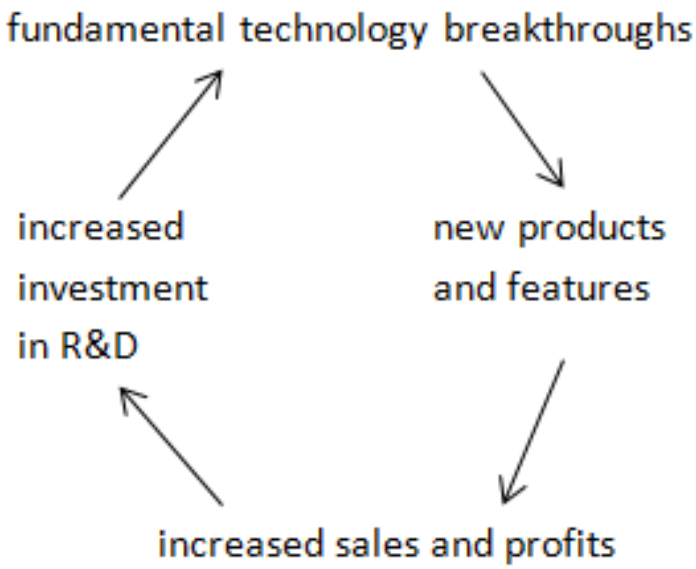
The Closed Innovation theory has implicit rules, some of them are mentioned below:

1. We should hire the best and the brightest people, so that the smartest people in our industry work for us.
2. In order to bring new products and services to the market, we must discover and develop them ourselves.
3. If we discover it ourselves, we will get it to market first.
4. The company that gets an innovation to market first will usually win.
5. If we lead the industry in making investments in R&D, we will discover the best and the most ideas and will come to lead the market as well.
6. We should control our intellectual property, so that our competitors don't profit from our ideas.

The Closed Innovation theory creates a virtuous circle. Companies that use the Closed Innovation theory will increase investments in their own research and

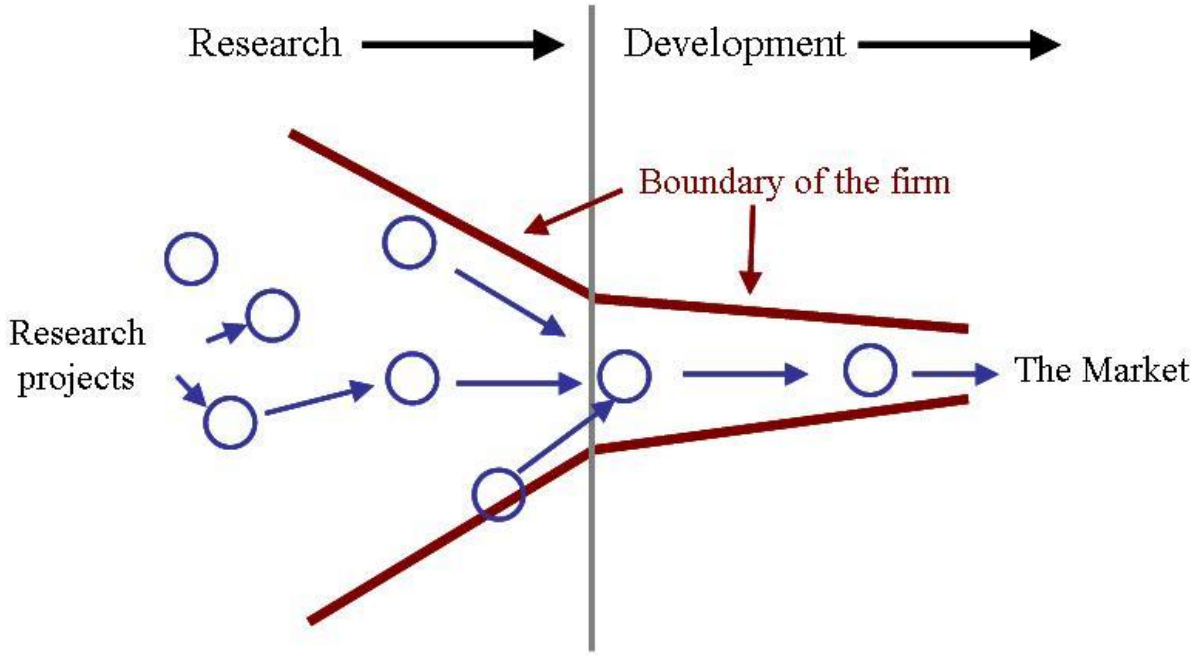
development (further mentioned in this thesis as R&D), this then should lead to breakthrough discoveries. These discoveries should enable the company to market new products and services. Because of new products and services, the company should realize more sales and higher margins. Eventually they can reinvest in more internal R&D and the circle starts all over again. The virtuous circle of the Closed Innovation theory is illustrated below (Chesbrough, 2003).

Figure 1: Closed Innovation, the virtuous circle



There is also a figure that explains the Closed Innovation paradigm for managing R&D, this figure is depicted below. The bold red lines represent the boundary of a company. On the left side, ideas flow into the firm and they flow out to the market on the right side. The ideas are analyzed and filtered in the course of the research process. The ideas that survive this process will be developed and then taken to market (Chesbrough, 2003).

Figure 2: The Closed Innovation paradigm for managing industrial R&D



Closed Innovation has led to a lot of important achievements and to many commercial successes. It is an approach that is essentially inwardly focused. This inward focus fitted especially well with the knowledge environment of the early twentieth century.

The science that was embodied in university classrooms had a large gap with the beneficial use of those insights in commercial practices. That knowledge that was created in the universities appeared very promising, but your enterprise could not rely on this knowledge to be put in use in your industry. Universities also lacked the financial resources to properly execute enough significant experiments to test their theories.

The government also was not much of a help in the R&D sector. The size of the government in the economic environment was a lot smaller in this period than it is nowadays. They only created a patent system and supplied a small funding for special studies in weights and measures and in military materials. So the industry was the most important driver of research funding for the use of science

in a commercial way. The R&D laboratories of the companies were the main locations of industrial research.

2.2 Research and development

Within the Closed Innovation paradigm there was a problem with the different incentives of research and of development. It was up to the research organization to discover and explore ideas and then hand them over to the development organization for the further development of these ideas.

The research organization wants to move on as quickly as possible to a new idea, while the development organization wants a deeper discovery and exploration of the current research ideas before taking over its further funding.

Eventually this problem was solved by creating a buffer between the two organizations. When the research of a certain idea was done, the idea was put on 'the shelf' until the development organization wanted to further develop that idea. The research center often said: "we're done with this," whereas the development center said: "We don't think it's ready yet." In this way many ideas stopped getting funding. These ideas all came on 'the shelf'. The companies did not feared the fact that there would be any leakages of ideas out of the company into a start-up or a rival.

ultimately the basic logic behind the Closed Innovation paradigm had become fundamentally outdated. There were several factors that eroded this paradigm, these factors will be explained in the following chapter.

2.3 Erosion of the Closed Innovation paradigm

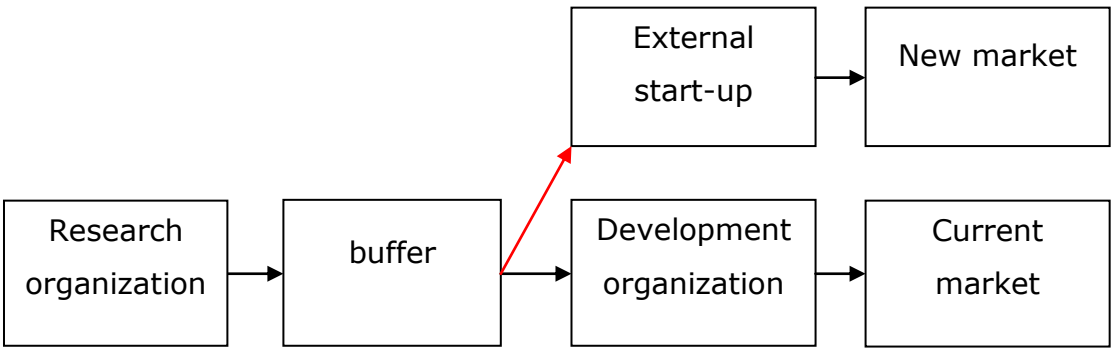
The first erosion factor is the increasing availability and mobility of skilled workers. A factor that played a great role in this, was the sudden increase of highly educated people. There were also other trends in the market that increased the mobility of these highly educated workers, what lead to a diffusion of the knowledge that they had from internal R&D to other companies, suppliers, consumers,…. So other companies could profit from the training and experience of a company by hiring an employee of that latter company. They did not even

have to pay the other company a compensation in return. Also immigration was an important facet in the availability of trained professionals. This phenomenon was seen as a brain drain by the home country, but it was a brain gain for the country where these people were going.

the arise of the venture capital market was a second erosion factor. In the past companies had problems finding enough capital to finance their enterprises. At the end of the twentieth century, there was a huge expansion of venture capital. Venture capital is money lent to someone so that they can start a new company (Longman dictionary of contemporary English, 2009). The person that lends his money to someone else is called the venture capitalist.

The third erosion factor was the fact that there were external options for ideas that were sitting on the shelf. As you already know, their existed tension between the research organization and the development organization. This tension created ideas that were put on the shelf, because researchers didn't want to explore it further and developers didn't want to develop it yet. But know with the combination of the two previous erosion factors, mobility and availability of workers and venture capital, these ideas could be developed by another company. You can see the two ways of how an idea on the shelf can be developed to ultimately reach a market in the figure below.

Figure 3: The outside option for ideas on the shelf



The red line shows the case when an idea that was placed on the shelf is further

developed by another company and then brought to the market. So companies had two choices:

1. When the research organization developed an idea that wasn't useful for the company, they put that idea on the shelve until someone else came up with that idea and it became no longer useful.
2. Try to license that idea, in order to sell it to companies that could use that idea.

The first choice is one that falls under the Closed Innovation paradigm. then it was seen as a cost, because you invested in the research but did not make a profit out of it. The second choice falls under the Open Innovation paradigm. Here you do profit from your idea, because you sell it to another company that can use it.

The fourth and last erosion factor is the increasing capability of external suppliers. In the past, companies did not rely on external suppliers for the supply of components of sufficient technical capability and quality and in sufficient quantities. Companies realized that not everyone had the knowledge, production experience and financial capital to become a partner of them in making new products, components and processed needed to serve the market. But because of the above mentioned factors (availability of a highly educated workforce for companies of all sizes and the existence of venture capital) the external supply basis is a lot more broadly developed in most of the industries nowadays than it was in the past.

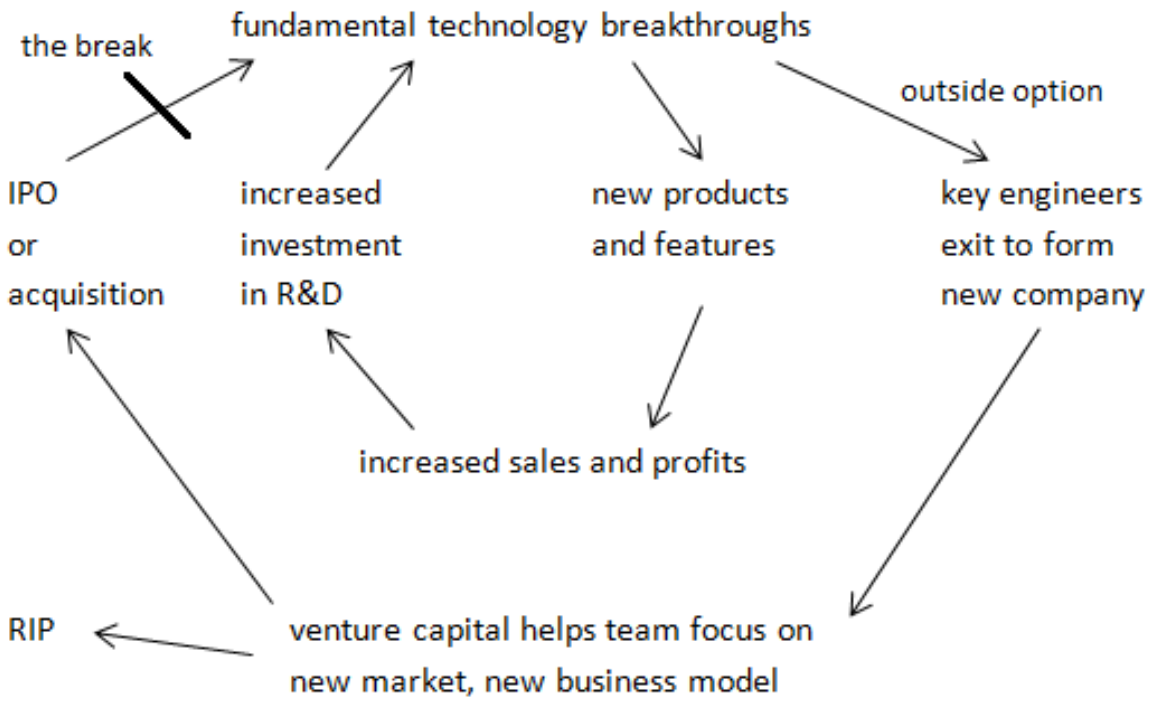
Because of these erosion factors, the link between the research organization and the development organization have loosened a bit. Ideas can't be put on the shelf anymore, because they will be revealed eventually to the external environment. So the ideas of the research organization of a certain company could be exploited by another company. But the result of these ideas could sooner or later turn into new valuable inputs for the company that putted that idea on the shelf. So there are both disadvantages and advantages about the erosion of the Closed Innovation paradigm.

3. Open Innovation

3.1 Introduction

The erosion of the Closed Innovation paradigm has opened the pathway for a new theory, namely Open Innovation. So in the situations where the erosion factors have taken place, Closed Innovation isn't sustainable anymore. In the figure below you can see how the virtuous circle of the Closed Innovation paradigm has broken down.

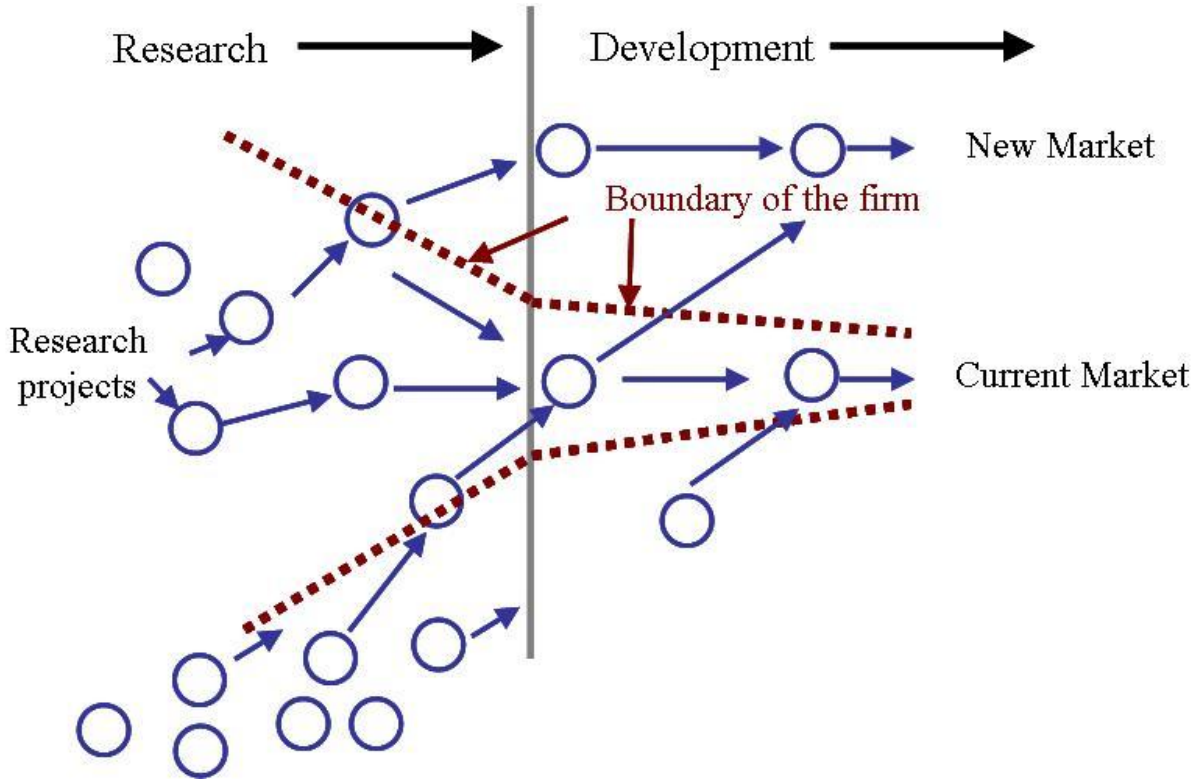
Figure 4: The breakdown of the virtuous circle of the Closed Innovation paradigm



In these circumstances they should follow the Open Innovation theory. That theory combines the external and internal ideas of businesses in such a way that it creates value. The Open Innovation paradigm is quite different then the Closed Innovation paradigm as you can see in the figure below. With the Open Innovation theory, ideas can still arise from the firm his own research organization. But some of those ideas will not be developed in that same

company, those ideas can leak out the firm in the research phase as well as in the development phase. These ideas usually seep out to a start-up company that employs personnel that used to work for the former company. Such companies are also known as spin-off venture companies. Also ideas can leave a company by means of out licensing (Chesbrough, Vanhaverbeke & West, 2006). But it also could be the other way around. Ideas can originate in the research department of another firm and then enter your own company.

Figure 5: The Open Innovation paradigm for managing industrial R&D



The Open Innovation process still filters out the false positives (ideas that seem to be valuable but actually are not), these are also known as type 1 error measurements. But now these type 1 errors are also from external ideas and not only from the internal ones. But it also gives the opportunity to recover false negatives, these are known as type 2 error measurements. These are the ideas that seem useless in the beginning, but eventually are quite valuable.

The ideas that arise in a company can't be constrained to the internal pathways of that company to market those ideas. In the same way, a company's internal pathway to market can't be constrained to the ideas that come up in the company. This point of view delivers other organizing principles for the Open Innovation process than it does for the Closed Innovation process. In the table below you can see the contrasting principles of these two different theories.

Table 1: The contrasting principles of the Closed and Open Innovation theory

Closed Innovation principles	**Open Innovation principles**
The smart people in our field work for us.	Not all the smart people work for us. We need to work with smart people inside and outside our company.
To profit from R&D, we must discover it, develop it and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to market first will win.	Building a better business model is better than getting to market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our IP, so that our competitors don't profit from our ideas.	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business model.

As you have read above, the knowledge landscape has changed in the twentieth century. And this brings another logic about the supplies and utilization of ideas.

> Open Innovation means that valuable ideas can come from inside or outside the company and can go to market from inside or outside the

company as well. This approach places external ideas and external paths to market on the same level of importance as that reserved for internal ideas and paths to market during the Closed Innovation era (Chesbrough, 2003).

The end of the knowledge monopolies was a great factor in the Open Innovation paradigm. There were a few factors that lied at the basis of the end of knowledge monopolies. One of them was the rise of the quality in scientific research that was done by universities and the diffusion of that knowledge. A second factor was the change in the share-out of patents. There were a lot of companies who were in the possession of quite some patents.

Also the expression 'not invented here' got a whole new meaning. In the twentieth century not invented here (NIH) means that companies do not need to reinvent the wheel. If some technology already was developed by another company, they can just use that technology for their benefit. So every company can focus on their core activity and use external sources for the other processes.

The way that R&D was managed in the nineteenth century has become outdated. But that does not mean that the R&D sector has become obsolete. It just has to be organized in another way.

3.2 Important changes from Closed to Open Innovation

3.2.1 A new way of managing R&D

The Open Innovation paradigm changes the tasks of the research and development functions. In the past, researchers only had to generate knowledge, but nowadays they also have to do knowledge brokering. This means that they have to move knowledge in and out of the company. So R&D is now organized to execute the following functions:

1. To identify, understand, select from and connect to the wealth of available external knowledge.
2. To fill in the missing pieces of knowledge that are not being externally developed.

3. To integrate internal and external knowledge to form more complex combinations of knowledge, to create new systems and architectures.
4. To generate additional revenues and profits from selling research outputs to other firms for use in their own system.

A company can't wait anymore for the internal R&D to arrive with certain technologies. They will need technologies that will not be created by their internal research organization. This means that they will access the needed technologies as soon as they have to, whether it comes from inside or outside the company.

Organizations also changes their view about spillovers. In the past they were seen as a cost of doing business. But today firms perceive it as a much more positive effect. They see it as an opportunity to enlarge their business model, or as the possibility to spin off a certain technology that is not useful in their current company.

Companies still are investing in their own research departments. This is very crucial because the internal research improves the companies capacity to use external knowledge. And if you fail to make use of external knowledge, you may have a big disadvantage in comparison with your components.

3.2.2 Looking in a whole other way at venture capital

Venture capitalist weren't popular in the closed innovation paradigm. Companies viewed them as pirates and parasites. People then wanted that they got punished and when that wasn't possible they tried to avoid them.

Now, in the Open Innovation paradigm, venture capitalist are accepted. Everybody has seen that there are a lot of benefits about having a lot of venture capitalist in the world. Often there are small firms that try to develop something for a certain market that is being ignored by the larger companies. The technologies that are created by the small start-up companies could eventually be used by the larger companies or lead them to a certain market direction. So

as you can see, these start-up companies provide a range of market research and technologies that could be very profitable.

Some firms even go further. They sometimes choose to foster the fact that someone wants to set up a start-up company. That firm then invests in that start-up company. Occasionally there are some firms who want to ally with a certain start-up company or even acquire such a company.

Also customers are involved in the Open Innovation paradigm. When a firm markets a product, there are some costumers who try to create new combinations with your product or try to improve your product. So companies have to respond to these needs of the costumers and to the required changes that they want in order to produce the new improved product their selves.

3.2.3 Dealing with intellectual property

Firms did not want to share their intellectual property in the past. But that vision has totally changed. Now firms are willing to sell their intellectual property (further mentioned as IP) and they also want to buy IP.

Firms acknowledged the fact that it was impossible to have an exclusive control over an important technology for a long period. So they rather sell it then keep it on the shelf. Because after a while, another company will have developed a technology that is quite similar to that of yours. So when you sell your IP, at least you earned some money with it. Knowledge and technology also changes all the time. So if you keep it with you, it could be useless after a while. So the faster technology leaves the R&D organization, the faster researchers will develop new things.

Researchers also want to get recognition for the job that they did. When you keep your ideas inside of the firm and don’t use them, researchers won’t be motivated to start thinking about the next great technology. They even want to quite their job and go to the competition if they do want to use the ideas that were developed by their R&D organization. Researchers are eager to learn, so they are very excited when they see that an idea of them is used. Even when it

is used by another company. They also want to learn from the use of their ideas by others.

3.2.4 Inbound and outbound Open Innovation

We can summarize the part above a bit by dividing Open Innovation in two parts. The first one is the inbound Open Innovation. This refers to how companies can use external sources of innovation for their own benefit (Dahlander, & Gann 2010). This is divided in a pecuniary and a non-pecuniary part. The former means that they have to buy the knowledge that they want, so it is for commercial purposes. The latter means that is available without paying for it. Inbound Open Innovation is the acquiring or sourcing of knowledge. Acquiring knowledge is known as licensing-in.

Outbound Open Innovation is the external exploitation of internal knowledge (Huizingh, 2010) or revealing internal resources to the external environment. This is also divided in a pecuniary and a non-pecuniary part. The latter one means that firms reveal their knowledge to the outside without being financially rewarded for it. They are more looking for indirect benefits from it. The former one is the selling of their internal knowledge, also known as licensing-out. In the table below you can see these 4 possibilities.

Table 2: different forms of openness

	Inbound Open Innovation	Outbound Open Innovation
Pecuniary	Acquiring	Selling
Non-pecuniary	Sourcing	revealing

3.3 Contributions of Open Innovation in comparison with other existing innovation theories

Despite the fact that Open Innovation is an extension of prior existing management theories, there are also some points where Open Innovation differs from those already existing management theories. Chesbrough distinguished 8 points of differentiation. I will now continue with explaining these 8 points of differentiation.

The first one is the fact that external knowledge plays an equally important role in the Open Innovation theory than internal knowledge does. In the past, the firm only concentrated on the internal activities of the firm. This also meant that only internal knowledge was used.

The second point of difference is the business model that was the center piece in the Open Innovation paradigm. Companies were actively seeking brilliant people inside as well as outside the company in order to provide extra knowledge for the business model. They also did not mind that when an idea was developed in the current business model, it went to the market through a variety of channels. In the Closed Innovation paradigm, there was very little attention for the business model in organizing for innovation. There the focus was on having the most genius man and hoping that he will come up with new ideas when he was sufficiently funded.

A third area of differentiation is that former innovation theories assumed that there were no measurement errors of type 1 or type 2 in the evaluation of R&D projects. When a project was terminated, then that was the end of it. There was nothing that could be done about it, because they never suspected any systematic error that had led to the cancellation of that project. The processes were even managed in a way to reduce type 1 errors. These false positives would arise when a R&D project would be developed entirely, went to market and then failed completely. Type 2 errors weren't even considered as important. These false negatives are for example projects that do not fit within the business model of a company and, as a result of that, do not have any value to the company.

However, efforts to lower the number of type 1 errors will unintentionally increase the number of type 2 errors. The business model is the tool that evaluates the R&D projects within the Open Innovation theory. This means that the business model lets projects enter the company when they fit with it and refuses projects that do not fit with the business model of the company. When a firm is trying to minimize the false positives, they should also integrate a way of managing the false negatives.

A fourth distinction is that the existing theories accorded almost no acknowledgment to purposive outbound flows of knowledge and technology. When companies looked beyond the boundaries of their firm in order to take in external knowledge, it was only for the objective of internal development, manufacture and sales. But in the Open Innovation paradigm, outward flows of technologies are a way of letting technologies, that lack a clear path to market internally, seek such a path externally. So there is a growing competition between internal businesses of companies because of these external channels to market (for example: spin-offs, joint ventures and licensing). This gives projects that were false negatives a second chance to be fully developed and brought to market.

A fifth point of differentiation is the assumption of the underlying knowledge landscape. In the former innovation model, useful knowledge was scarce, difficult to find and dangerous to trust. Open Innovation considers knowledge as generally believable, widely spread and of good quality. The external sources of knowledge go far beyond that of universities, national laboratories, to startup companies, specialized companies, individual inventors and even graduate students or retired technical staff.

A sixth difference is the new proactive role IP management has in the Open Innovation theory. Although the appliance of proactive IP management is not new to some companies, for former innovation theories IP was seen as a byproduct of innovation. They used it primarily for defensive reasons. In this way companies could practice their technologies without the restriction by external

IP. Should this problem arise, IP could be cross-licensed. This last transaction is just one of the many possible things where IP could be used for in the Open Innovation theory. In this case, IP is a very important element of innovation that could flow constantly in and out of a firm.

A seventh distinction is the rise of intermediaries in innovation markets. The process of innovation becomes more open and therefore there was an arise of intermediate markets in which companies can make transactions, which previously were conducted entirely inside the company. There are even specialist that provide information, access and financing in order to enable the transactions.

The eighth and last point of difference is the development of new metrics for evaluating the performance of a company's innovation process. The earlier used metrics consisted of the percentage of sales spent on R&D, the percentage of sales from new products, the number of new products developed in the past year,…. New metrics could substitute some of the former measures. These new metrics are how much R&D is being conducted within the company's supply chain, what percentage of innovation activities originated outside of the firm, the time it takes for ideas to get from the lab to the market,….

So as you can see, the Open innovation theory builds on the work of former innovation theories. But it does also offers certain points of differentiation in comparison with those prior theories. These differences are shortly summed up below.

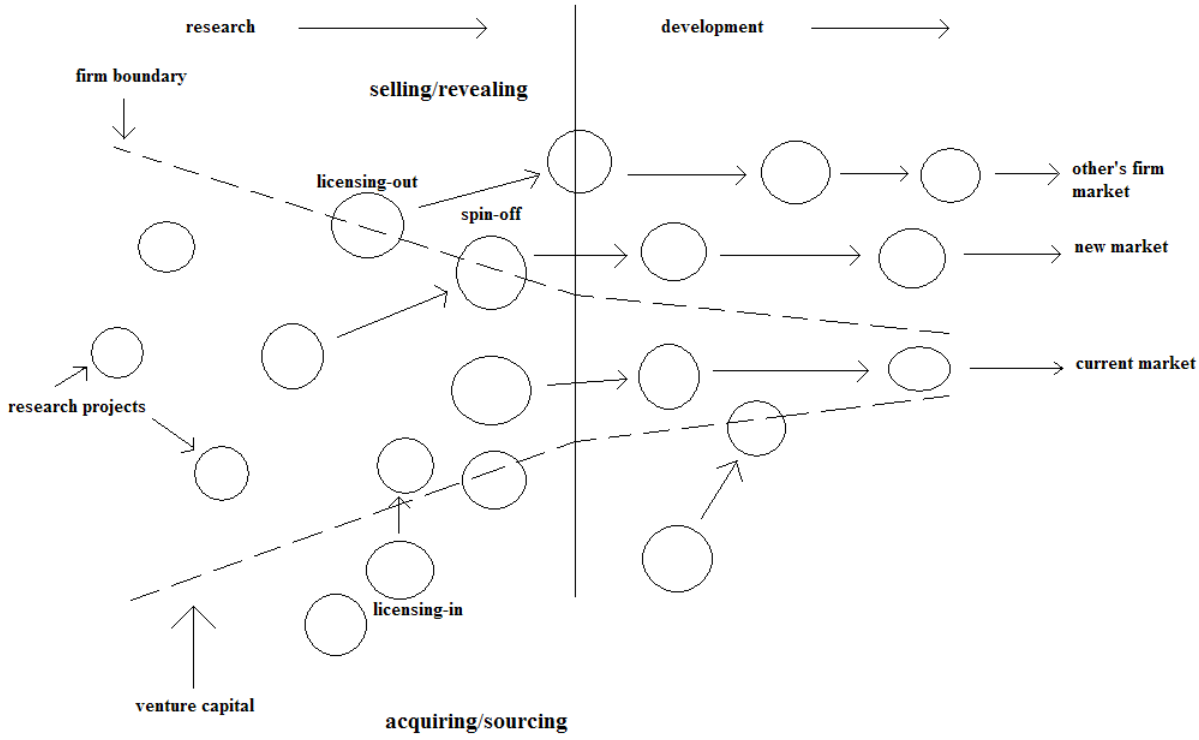
1. Equal importance given to external knowledge, in comparison to internal knowledge
2. The centrality of the business model in converting R&D into commercial value
3. Type 1 and type 2 measurement errors in evaluating R&D projects
4. The purposive outbound flows of knowledge and technology
5. The abundant underlying knowledge landscape
6. The proactive and nuanced role of IP management

7. The rise of innovation intermediaries
8. New metrics for assessing innovation capability and performance

3.4 The core of the Open Innovation theory

The best summary of the Open Innovation theory would be the well-known funnel. In the introduction part of Open Innovation you already got to learn this funnel. But here I will give you a little more expanded version of the Open innovation funnel.

Figure 6: The Open Innovation funnel



This is a very important figure for the further development of this thesis. Because based on this, I will investigate other existing innovation management theories that are related with the Open Innovation theory. After that I will mention what parts of those theories were the building blocks of Open Innovation. Eventually I will point out the new value adding features of the Open Innovation theory.

4. Other innovation management theories

4.1 Introduction

There are a lot of different innovation management theories nowadays. You have open source, absorptive capacity, stage-gate model, resource-based view, transaction cost economics, complementary assets, lead user, and so forth. Describing them all would take quite some time. Therefore I'm not going to explain them all, but only take a few of them to describe.

4.2 Open source

The term open source was introduced by Bruce Perens in 1997. He was a Linux developer and wrote the Debian free software guidelines. This became known later as the open source definition. That definition describes open source as software that can be spread without restraints or royalties, that the source code must be accessible by everybody and that work that is derived from it should also be spread as open source software. This is only a short version of the definition. The Open Source Initiative has ten points which open source should cope with.

1. Free Redistribution

   The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license shall not require a royalty or other fee for such sale.

2. Source Code

   The program must include source code, and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well-publicized means of obtaining the source code for no more than a reasonable reproduction cost preferably, downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the

program. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.

3. Derived Works

The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

4. Integrity of The Author's Source Code

The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.

5. No Discrimination Against Persons or Groups

The license must not discriminate against any person or group of persons.

6. No Discrimination Against Fields of Endeavor

The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.

7. Distribution of License

The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.

8. License Must Not Be Specific to a Product

The rights attached to the program must not depend on the program's being part of a particular software distribution. If the program is extracted

from that distribution and used or distributed within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.

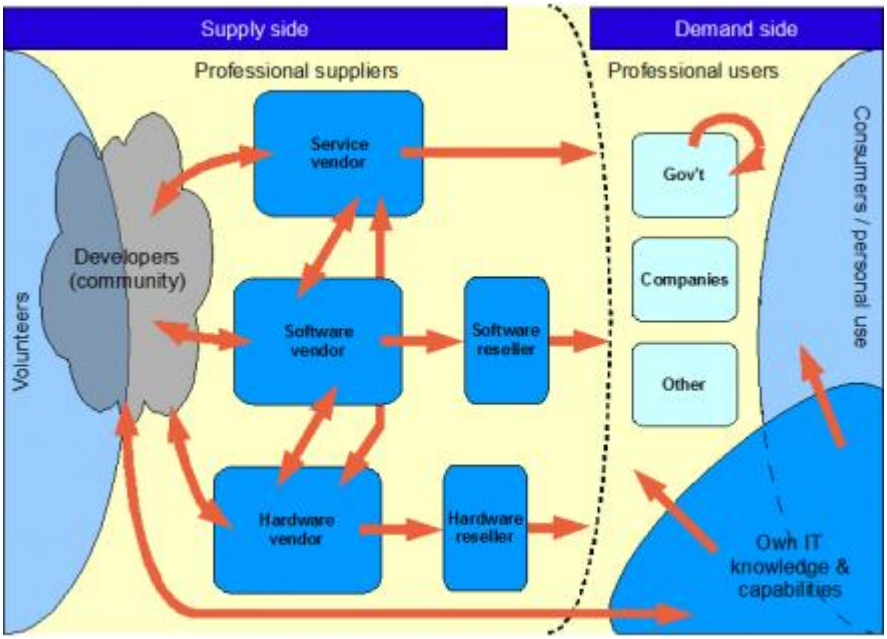
9. License Must Not Restrict Other Software

The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.

10. License Must Be Technology-Neutral

No provision of the license may be predicated on any individual technology or style of interface.

Figure 7: Open source system



In the figure on the previous page, you can see the open source system. The software that people use can be developed by the community. They develop the software on the internet via network collaborations. All sorts of technics, like users participation, social networks, mail,… are used to cooperate. The biggest strength of this system is that everyone can participate in this system. Because there are more masterminds outside a company than there are in a single company. So it's better to make use of those people. These days, software isn't only developed inside the company anymore but more and more outside the company.

4.2.1 Vendor lock-in

Some companies still work with the closed source system. But they don't always do that voluntarily. There are companies that use a sort of application that isn't compatible with other applications. So these companies are stuck with their supplier. Because that supplier does make applications that are compatible with the former ones. Sometimes there are more suppliers with the compatible applications, but the company is still limited by the software that those suppliers make.

A company that is in the situation that I described above has two choices if they want to replace their old software. They can replace it by an upgrade of the old application that is produced by their own supplier. Or they can invest in a totally new system that is compatible with a lot of applications. But this brings an extra cost on top of the cost for the purchase of the new application. The first option is the one with the lowest cost on the short term. Unfortunately this isn't the best possibility if you look at it on the long term.

There is a shift towards more open source nowadays. Most of the last innovations are already using open source. So companies are going to have to use it more and more if they want to or not. It will lower their control costs, so companies will benefit from the use of it.

4.3 Absorptive capacity

Cohen and Levinthal (1990) define absorptive capacity as follows: a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends (p128).

A critical component of innovative capabilities is the ability to exploit external knowledge. The ability to evaluate and use outside knowledge is for the most part a function of the firm's level of prior related knowledge.

Absorptive capacity can be divided in an individual's absorptive capacity and in absorptive capacity at the organization level. The absorptive capacity of an organization will depend largely of the absorptive capacity of the individual members of the organization. However the absorptive capacity of the organization isn't just the sum of the individual's absorptive capacity. First I will start with describing the absorptive capacity of an individual and after that I will continue with the absorptive capacity of an organization.

4.3.1 Individual's absorptive capacity

The ability to put new knowledge into your memory and the ability to recall and use that knowledge is higher when a person has more accumulated prior knowledge.

It's insufficient just exposing a person shortly to the relevant prior knowledge in order to develop an absorptive capacity. It is crucial to have an intensity of effort. Lindsay and Norman (1977) said that the more deeply the material is processed, the more effort used, the more processing makes use of associations between the items to be learned and knowledge already in the memory, the better will be the later retrieval of the item.

Learning is cumulative and when the object of what you want to learn is related to something what you already know, then the learning performance is the highest. This means that learning is the most difficult in new domains. The diversity of knowledge also plays an important role in this matter. When there is uncertainty about the knowledge domains from which information that is

potentially useful may come out , a diverse background offers a better basis for learning. This will increase the prospect that the information that is coming in will be better related to the things that you already know. Besides the fact that this strengthens the assimilative powers, knowledge diversity also smoothens the innovative process by allowing the individual to make new associations and linkages.

4.3.2 Absorptive capacity at the organizational level

The absorptive capacity of an organization depends on the individuals absorptive capacity, but it's not the only thing it depends upon. But just like the individual's absorptive capacity, also absorptive capacity of an organization will have the tendency to develop cumulatively.

Absorptive capacity does not only refer to the assimilation or acquisition of information by an organization. It also refers to the ability of the organization to exploit that information. For this reason, the absorptive capacity of an organization does not only depend on the organization's direct boundary with the external environment. In addition to that it also depends on the transmission of the knowledge across the company. So in order to know the absorptive capacity of an organization, we have to look at the structure of the communication between the external environment and the organization as well as to the communication between the subunits of the organization and also at the character and distribution of expertise within the organization.

The absorptive capacity of an organization depends largely on the individual who is located between the organization and the external environment or between the different subunits of the organization.

The person standing between the boundary of the firm and the external environment (gatekeeper) sometimes has to translate the technical information into a form that the people inside the organization can understand. But sometimes the external information is closely related to the activities that are going on in the organization. In this case it's not so necessary to have a gatekeeper.

Sometimes it is difficult for the gatekeeper to know which person in the organization needs the knowledge that he has gathered from the outside. In this case it is better to have a broad range of receptors of that external information.

The absorptive capacity of the organization does not only depend on the gatekeeper's absorptive capacity. Also the people inside the organization to whom the gatekeeper is transferring his knowledge have to have some expertise. So it is important that all the people in the organization have relevant background knowledge.

if you look at the absorptive capacity of an organization as a whole, there could be a trade-off between the efficiency of internal communication of a subunit or the entire organization against the ability of the subunit or organization to assimilate and exploit information that is coming from outside. If there is a dominance by one of those two, this will lower the absorptive capacity of the organization.

If individuals have a better understanding of who knows what in the organization, their individual absorptive capacity will be leveraged. This will also lead to the strengthening of the organizational absorptive capacity.

The people inside an organization should have partially overlapping knowledge, complemented by non-overlapping diverse knowledge. This will make sure that they can communicate with other people inside the organization, as well as that they can absorb information that is coming from outside the organization.

It is also better for the organization to work with cross-functional teams. This will improve the communication between the different subunits of the organization.

4.3.3 The two features of absorptive capacity

The first feature of absorptive capacity is that it is cumulative. If an organization already has build op some absorptive capacity in a specific area, then the possibility is higher that it accumulates supplementary knowledge that it could need in the following periods in order to make use of external knowledge that becomes available in the future.

The second feature of absorptive capacity is its effect on expectation formulation. If an organization possesses related expertise about a certain subject, it will allow the organization to better evaluate and comprehend the import of intermediate technological advances that offer signs about the eventual value of new technological development.

This latter feature gives an advantage when an organization has to deal with an uncertain environment. The organization is than better capable to predict the nature and commercial potential of technological advances.

These two features suggest an extreme case of path dependency. This means that once an organization decides to stop investing in its absorptive capacity in an environment that is changing fast, the probability is high that it will never be able to assimilate and exploit novel information in that environment.

4.3.4 Absorptive capacity and R&D

Investing in R&D does not only increases the chance of inventing the next best thing. It also creates the capacity to assimilate and exploit new knowledge. Organizations conduct basic research in order to be able to give themselves the general background knowledge that would allow them to react quickly to exploit external knowledge. So R&D generates innovation as well as it facilitates learning.

For many organizations absorptive capacity is a part of their decision calculus in allocating resources for innovative activities. Sometimes it is seen as a byproduct, for example when an organization wants to exploit a certain knowledge domain that is very close related with the current knowledge that they have. In the other case, when an organization wants to acquire and exploit knowledge that is not related to their ongoing activities, then the organization has to give their effort exclusively to creating the absorptive capacity. In the latter case, absorptive capacity is not seen as a byproduct.

4.3.5 Complementation for absorptive capacity

Absorptive capacity is only one of the six knowledge capacities that exist (Lichtenthaler & Lichtenthaler, 2009). Absorptive capacity only focuses on using external knowledge inside the organization. In the table below, you can see the 5 other knowledge capacities.

Table 3: six knowledge capacities

	Knowledge exploration	Knowledge retention	Knowledge exploitation
Internal	Inventive capacity	Transformative capacity	Innovative capacity
external	Absorptive capacity	Connective capacity	Desorptive capacity

External knowledge exploration illustrates the acquirement of knowledge from sources external of the organization. External knowledge retention is the knowledge that is maintained by a firm's interorganizational relationships (e.g. alliances). External knowledge exploitation is the transferring of knowledge outwards the firm (e.g. licensing-out). As a complementation of absorptive capacity I will further explain the 2 other external knowledge capacities, namely connective capacity and desorptive capacity.

4.3.5.1 Connective capacity

Connective capacity is the ability of a firm to retain knowledge in interfirm relationships. It has its focus on maintaining knowledge externally. This is a capacity that has often been ignored. Here there is no assumption of inward knowledge transfer like in absorptive capacity. An organization's connective capacity increases when the organization has higher levels of prior knowledge. For an organization that has a lot of knowledge in a certain domain, it is easier control interfirm relationships and to benefit from external knowledge retention.

4.3.5.2 Desorptive capacity

Desorptive capacity is the opposite of absorptive capacity. This external knowledge exploitation refers to transferring knowledge out of the company. It is defined as a firm's ability to externally exploit knowledge. Desorbing knowledge does not preclude its internal use because of non-rivalry of knowledge.

Desorptive capacity consist of 2 processes. The first one is the identification of external knowledge exploitation opportunities. The second one exist of transferring that knowledge to the recipient. Opportunity identification is a major challenge for most organizations. This exist because of imperfections in the markets for knowledge. This task requires adequate prior knowledge.

4.4 Resource-based view

4.4.1 Introduction

The resource-based view is a management device used to assess the available amount of a business' strategic assets. In essence, the resource-based view is based on the idea that the effective and efficient application of all useful resources that the company can muster helps its competitive advantage.

This resource-based view is a new way of looking towards companies. In the past the dominant view was the market-based view. In the market-based view, companies were seen as homogeneous and competition between the companies existed of the market position that they took. In this case the main purpose was finding attractive markets to compete in. But an even important question to ask is whether a company, with their current resources and capabilities, is able to compete in that certain market.

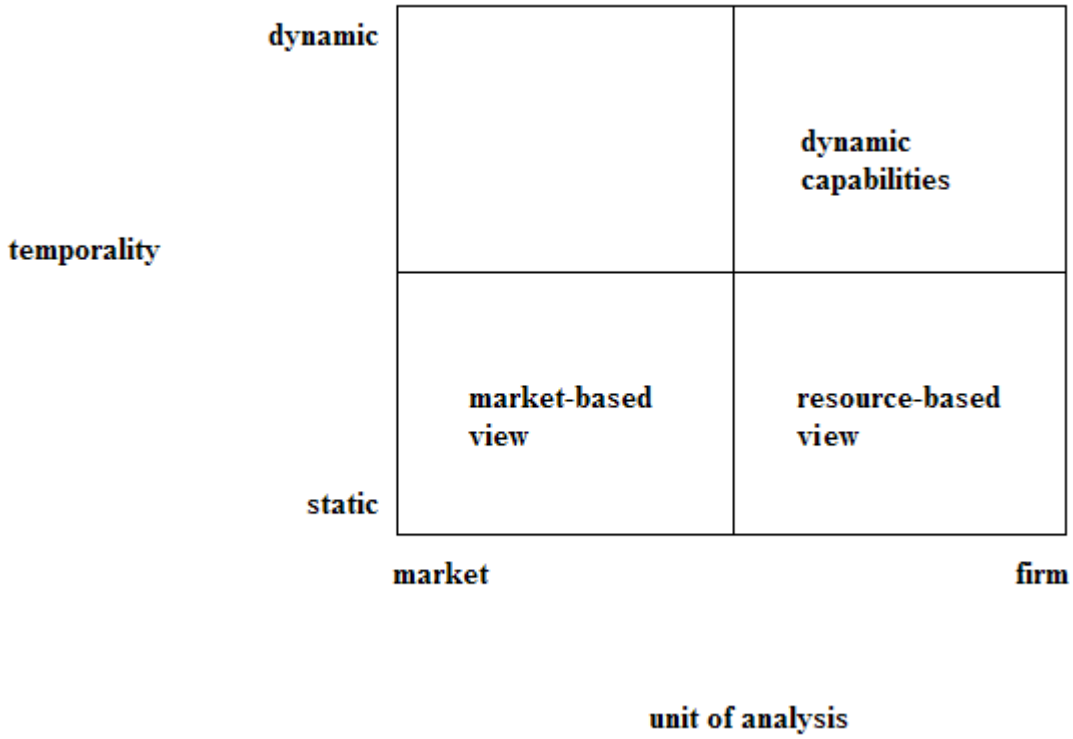
Nowadays markets change faster than ever. So companies should always look for new resources to be able to keep up with the changing environment. This third view, the dynamic capabilities perspective, is related to the two views above. The resource-based view looks at what resources are strategically important for a

company. The dynamic capabilities perspective looks at how these resources need to change over time to remain their relevancy in a certain market.

The resource-based view, market-based view and the dynamic capabilities perspective all have a different focus towards dimensions of strategy and competitive advantage. None of those three different views is the dominant one. Each of those three views offers another important insight that can lead to a better strategy and a better competitive advantage.

The relation of these three views can be seen in the figure on the next page. I will only further discuss the resource-based view.

Figure 8: The resource-based view, market-based view and the dynamic capabilities perspective



4.4.2 Resource-based view

The starting point of the resource-based view is the company's internal environment, so it takes an inside-out approach. The resource-based view emphasizes the internal capabilities of the organization in formulating strategy to achieve a sustainable competitive advantage in its markets and industries. This means that the internal capabilities and resources determine the choice of strategy of the company in order to compete in its external environment.

Resources are inputs that allow an organization to fulfill their activities. The resource-based view draws upon the resources and capabilities that are located inside an organization or that an organization wants to develop further in order to achieve a sustainable competitive advantage.

Resources on their own have no value, they will only bring value when they are put to use. So it is possible that two organizations have the same resources but have a different performance. There are two sorts of resources that I will discuss below, the first ones are tangible resources and the second ones are the intangible resources. I will start by explaining the tangible resources.

4.4.2.1 Tangible resources

Tangible resources are the physical goods that an organization possesses. These resources can be categorized as physical resources, financial resources and human resources. Machinery, the buildings, materials and productive capacity are examples of physical resources. These resources must be very flexible in order to respond to changes in the environment. The organizations that have the best up to date physical resources will have an advantage against the other organizations.

The financial resources are the cash balances of the organization, debtors, creditors and debt to equity ratio. If an organization can attain an acceptable return on their physical resources, they will be able to attract more outside capital or financial resources.

Finally you have the human resources. These are the workforce of the organization and their productivity measured by certain criteria like sales per employee or profit per employee.

The tacit knowledge and the special skills of the workforce are an intangible resource that is very difficult to imitate by their competitors. So this brings us to the second sort of resources, the intangible resources.

4.4.2.2 Intangible resources

Intangible resources are the ones that contain intellectual resources, technological resources and reputation. The ability of the firm to innovate and the speed at which it does that is a technical resource. Patents and copyrights are intellectual resources and they could derive from the technical resources of the organization. As I said before, the tacit knowledge that an organization has build up is also a valuable intangible resource. The reputation or goodwill of the company is another important intangible asset of an organization. This asset can be damaged very easily by not good thought out strategies and bad marketing campaigns.

4.5 The stage-gate model

4.5.1 introduction

Everybody wants to invent the next best thing in order to bring it to market and to profit from it. But without a good process, it is most likely that you will fail to invent something innovative. Therefore it is very important that you bring structure to your procedure.

Robert cooper is the person who invented the stage-gate model. That model is a very useful tool if you want to develop new products. The stage-gate model splits the processes in stages and gates in order to bring some structure to the project that you are doing.

Using the stage-gate model will bring more success to an organization. The organization will be capable to deliver more innovative products than when you don’t use the stage-gate model. Also when a certain project or technology

doesn’t seem exploitable, the stage-gate model will discover this in the early stages of the process. So you can just stop the process at that point and you won’t have extra losses for developing a product that isn’t profitable.

4.5.2 Stages and gates

The stage-gate model of R. Cooper consists of 5 stages. Stages are activities within the process of development. So this means that the innovation process is sub-devised, preferably by multidisciplinary product development teams.

The gates are decision points. They consist of a certain set of characteristics and criteria that are used for quality checkpoints between the different stages.

At each gate, there is a certain decision that has to be made. The possible decisions are: continue with the project, don’t continue with the project, temporarily stop the project or do the last stage again. They also discuss the path that the project has to follow during the next stage. The date for the next gate meeting should be agreed upon and they also have to discuss the criteria used for the next quality checkpoint.

During this process, the project will need more and more resources from the organization when it comes closer to the point where the product is brought to market. So this brings a bigger risk for the organization because they would have to invest more in the project every stage. But at every stage, they learn more about the project and about the risk of the project. So at every stage the risk for the organization as a whole becomes smaller.

An organization has the possibility to run more projects at the same time. Then it would be useful to apply a portfolio planning. Than it is important that the risk of the portfolio of the organization isn’t too high. This does not mean that the organization can’t do a project with a slightly higher risk. But it is dangerous if all the projects of the portfolio have a high risk.

4.5.2.1 The stages

1. Scoping: at this stage you do a quick scan of the project’s technical merits and market prospects. This scan happens in the initial market research

stage. With the scan you can see what products are already in the market or in development that could form a threat. You can also determine with this scan if it is possible to develop a product that could be commercially feasible.

2. Build business case: This stage could make or break the project. It is sort of an extension of the scoping stage, but it delves a little bit deeper in the commercial prospects and technical, marketing and business feasibility of the product. This usually results in a business case document with three main components: the proposed product and project definition, a project justification and a project plan.
3. Development: At this stage, the business case document is transformed into a real business plan. This business plan contains the product development activities, the manufacturing or operation plan is drawn up, the market launch and operating plans are developed and the test plans for the next stage are defined. This plan also details the sails and cost forecasts, legal considerations and the quality standards.
4. Testing and validation: This stage has to provide validation for the whole project. They evaluate the product, the production process, customer acceptance, and the financial merit of the project. At this stage they also check that the entire project has run smoothly and that there are no surprises when they want to launch the product.
5. Launch: This is the final stage of the project that takes the product to full commercialization. Here they begin with the full production of the product and the commercial market introduction.

The stage-gate model offers useful tools for coordinating and optimizing the product development activities of large product-based organizations. Mostly, these organizations don’t lack the existence of new ideas but the means to reach their goals. In this way they can strengthen their innovation power by providing attention to their product innovation processes.

4.6 Organizational learning

4.6.1 Introduction

The environment of organizations changes rapidly so the ability to learn is seen as a very important characteristic of an organization to stay competitive. When an organization doesn't learn new things, they just keep repeating their old practices. So the growing need for learning has increased the interest for organizational learning theories. That's why I will discuss them further in this paper.

At the moment there are a lot of definitions given to the word "learning". I will give you a few of these definitions, to give you an idea of the broad meaning of the term "learning.

- Learning is the human process by which knowledge, skills, attitudes and habits are acquired and changed in such a way that also the behavior is modified.
- Learning is a social experience, built upon interaction and dialogue with significant others in a context where people are willing to share their ideas with others.

So learning can be treated as a technical processing of information as well as a social act of sense making.

Some people say that there are different kinds of learning. Schein divides learning in three different aspects:

- Knowledge acquisition and insight.
- Habit and skill learning.
- Emotional conditioning and learned anxiety.

Kim differentiates two meanings of learning:

- The acquisition of skill or know-how.
- The acquisition of know-why.

Nonaka makes the difference between tacit and explicit knowledge. Tacit knowledge is highly personal and hard to formalize. It is not easy expressible and visible and therefore difficult to share with others. Explicit knowledge is expressible in words and figures and can be passed on between individuals.

4.6.2 Different levels of learning

Researchers make a distinction between three different levels of learning. These three are individual, group and organizational learning. I will discuss all three of them because individual and group learning has an impact on organizational learning, because an organization is composed of individuals and groups.

4.6.2.1 Individual learning

Individual learning is the change of skills, insights, knowledge, values and attitudes acquired by a person through observation, technology-based instruction and self-study.

Although organizational learning takes place through individuals, we cannot take organizational learning as the total amount of each of their elements individual learning. Individuals and organizations differ from each other in a certain way. Organizations develop and sustain learning methods that influences their immediate members and they also pass that on to others by such means as the history of their organizations and their norms.

4.6.2.2 Group learning

There are a few researchers (Senge, Pawlowsky) who have revealed the importance of group learning in order to reach learning at the organizational level. Senge even sees group learning as the foundation for a learning organization. He says that groups are the most important learning unit in an organization and not the individual.

Argyris and Senge say that group learning needs creative tension and productive conflicts, but they warn about underlying structures in group work that prevents them from reaching their objectives and testing new structures and behaviors.

4.6.2.3 Organizational learning

First of all we can say that all organizations learn, whether they intentionally choose for it or not. Organizational learning is greater than the sum of the individual learning of all the parts of the organization.

Organizational learning differs from individual learning, because organizational learning takes place trough knowledge, mental models and shared insights. Learning in an organization also builds on experience and past knowledge (memory).

There also exist a lot of definitions about organizational learning. I will shortly mention a few of them.

- Organizational learning is a procedure for detecting and correcting mistakes.
- Organizational learning means improving actions with better understanding and knowledge.
- Organizational learning is a process whereby an organization builds knowledge or reconstructs existing knowledge.

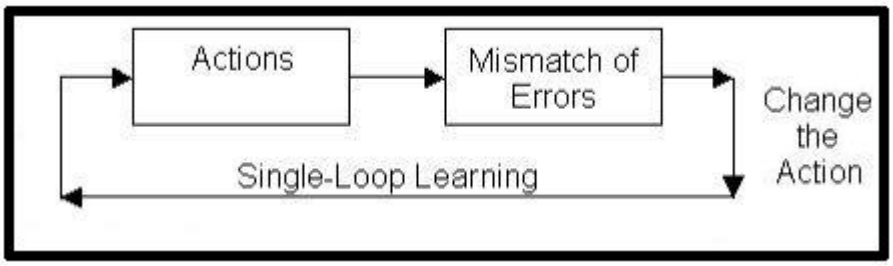
As conclusion we can say that all the definitions describe organization learning as a process resulting an enhanced knowledge foundation and better performance.

There are different levels of organizational learning. The one that is the most frequently used is that of Argyris and Schön. They devide organization learning in single-loop learning, double loop learning and deutero-learning.

4.6.3 Single-loop learning

Single-loop learning solves the problems that are presented at that moment. This sort of learning occurs when people want to correct the mismatches between actions and planned results simply by changing their actions when the governing values or assumptions that lie beneath those actions are not open to alternation.

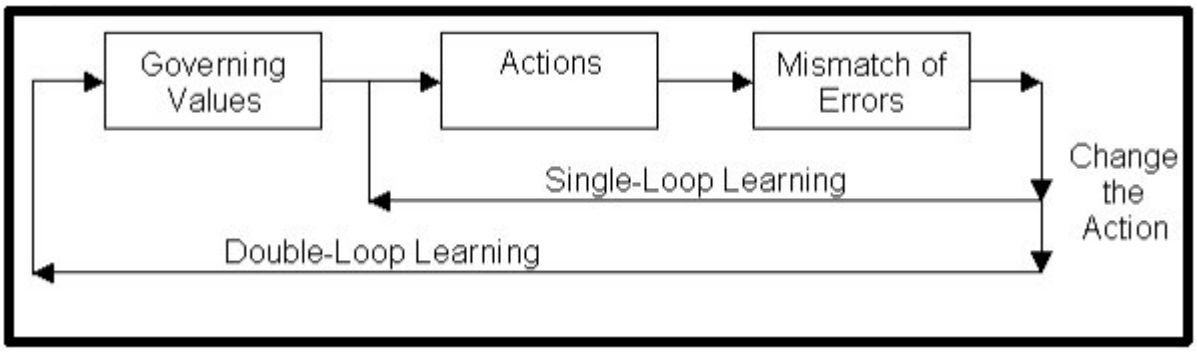
Figure 9: Single-loop learning



4.6.4 Double-loop learning

Double-loop learning goes one step or a few further than the previous. This happens when in addition with detection and adjustment of errors, the organization is mixed up in the questioning and adjustment of existing procedures, norms, objectives and policies. So double-loop learning also asks questions about reasons and motives behind the objective facts.

Figure 10: Double-loop learning

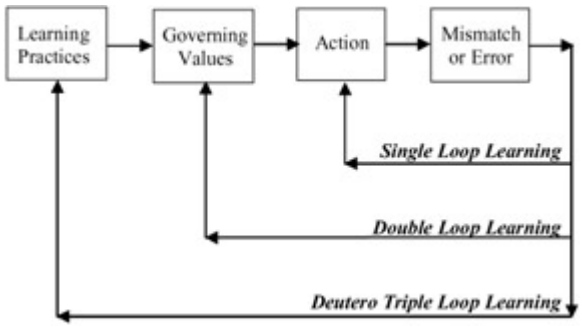


4.6.5 Deutero-learning

The highest level of organization learning is deuteron-learning. This can be viewed as learning how to learn. The persons in an organization ask more essential questions about their own organization. They reflect on and inquire preceding context for learning. This learning refers to the organization capacity to find solutions for problems and to design and redesign policies, techniques and structures in a world of constantly changing assumptions about the environment and about themselves.

All the three levels of learning can occur in an organization. But the latter two (double-loop learning and deutero-learning) are crucial for the existence of the organization and the success of it.

Figure 11: Deutero-learning



5. The building blocks of Open Innovation

5.1 Introduction

Now that I have discussed The Open Innovation theory and some other existing innovation theories I can continue with describing the building blocks of Open Innovation. The building blocks of Open Innovation are parts of existing innovation theories that are used in the Open Innovation theory. Some of these parts could be used exactly the same as in the existing theory, others can be adjusted a bit. I consider both of them as building blocks of the Open Innovation Theory.

5.2 The basis of the Open Innovation theory

The Open Innovation funnel is a very good summary of the whole theory. It's not a very extended theory, but it gives you an excellent view on the core of Open Innovation. The Open Innovation theory starts with research projects, this is also the case in the stage-gate model. This research project has several different ways to go within the Open Innovation theory. A first one is that they just stop working on it or put it on the shelve, another possibility is that it becomes something for another firm's market. The last two possibilities are that it gets developed for a new market or for the firm's current market. Whatever way the research project eventually goes, it has to be evaluated at certain moments. This is also the case in the stage-gate model. During the stages, certain activities take place for or with the research project. Then when they reach a gate, they have to make the decision to stop or proceed with the research project or to re-do the previous stage.

So as you can see, there are a lot of similarities between the Open Innovation theory and the stage-gate model. So I can conclude that the Open Innovation funnel is derived from the stage-gate model of Cooper. The stage-gate model is not totally integrated in the Open Innovation theory. But the stage gate model is adjusted a bit to fit into the Open Innovation funnel.

5.3 Other building blocks of Open Innovation

5.3.1 Open Source and Open Innovation

You can already see the resemblance between Open Source and Open Innovation just by reading those two theories. They both have the word "open" in it. In the Open Source Theory, everybody shares their software with each other. This software could be the existing software of a company, a new software that was recently developed or a software that has been modified. But the most important fact is that there are no restraints on the sharing of the software. So this means that the software is available for everybody who wants to use it. Some people just want to use the software, others that have tried the software want to adjust the software (improve it) or want to use the software in one of their own software productions. After this, they in turn share this modified or new software again with the rest of the world. The people that first revealed their software can then learn of the improved version or the new software that has been developed based on their own. In this way, everybody can learn from each other and this can go on and on.

With Open Innovation, this is also the fact, but in a different kind a way. It does not have to be software, it could be all sort of things that a firm can develop. It's also not obligated to reveal it without constraints. But the rest is quiet similar. Everybody can reveal for instance a new technology. Everybody can learn from it, improve it, make a new technology based on it. Eventually that new technology could be revealed and this also could go on and on.

There is a second similarity between these two theories. The revealing does not has to start with a company, also a person can reveal his new invention and then a company can learn from it. So it is an open circle where everybody can participate in. It's not only business to business but also business to consumer, consumer to business and even consumer to consumer. In this way companies know better what their customers want and can use that in the development of the next best thing. The customer can also give a sign when he is not happy with a certain product that he wants an adjusted product with other features.

So some ideas of the openness of Open Innovation come from the Open source theory as you could see above.

5.3.2 Absorptive capacity and Open Innovation

Absorptive capacity is defined as the ability to in-source knowledge, technology or ideas that were externally developed. It's not because there are certain ideas, knowledge or technologies available outside the boundaries of organizations, that a certain organization can use it as well as another organization. This depends on their absorptive capacity. If a firm does not have that, they can't make use of all the valuable things outside their organization.

Open Innovation has an inside-out option (outbound Open Innovation) and an outside-in option (inbound Open Innovation). The inside-out option are ideas, technology and knowledge that leave the company. The outside-in option is the other way around, it is technology, knowledge and ideas that a company uses that come from outside their boundaries.

It is obvious that in this case it is the outside-in option of Open Innovation that is connected with the absorptive capacity theory. This outside-in option, inbound Open Innovation, has two parts. The first on is pecuniary inbound and the second is non- pecuniary inbound. They are both related with absorptive capacity, because it does not matter how you get the external knowledge. Pecuniary inbound means that you have to pay for it and non-pecuniary means that you can get it for free. Absorptive capacity does not look at how you get the external information, but it looks at how well you can absorb and use that knowledge.

Open Innovation is also about using external knowledge, ideas and technologies for your own benefit. Not all the external ideas or technologies are useful for every company. They should look at which of them fits best in their own organization and look at how it would be the best to implement them in their activities. So every company should have the right people to internalize external ideas, technologies and knowledge in order to use them in the proper way to achieve the highest benefit from it.

So as you can see, absorptive capacity is also a building block for a part of the Open Innovation theory.

5.3.3 Resource-based view and Open Innovation

The resource-based view looks at the strategic assets that a company owns. These resources are divided in tangible and intangible ones. The tangible resources are separated in physical, financial and human resources. The intangible resources are divided in intellectual and technological resources and reputation.

This view only looks at the resources that the company has at a certain moment and at the resources that the company wants to develop further. With these resources, they want to build a sustainable competitive advantage.

The better your own resources are, the better the company will be able to be competitive. The activities of the company will be restricted by their resources and their strategy will also depend on that.

The Open Innovation theory also looks at the resources that a company has at a certain moment. Those will be the most important working assets of the company. Because it's not easy to change your workforce, machinery, buildings or cash balances. So their activities will also be partly restricted by their current resources. The more valuable resources that a company has, the better their position will be.

Resources that aren't up to date anymore or resources that could be improved will be developed further by the company in order to stay competitive or becoming even more competitive than before.

When a company wants to improve their resources, they can only make use of the resources that they possess at that moment according to the resource-based view. Using the Open Innovation theory, the company can also update their resources with only using what they have at that moment. But they still also have a second option for when their current resources aren't sufficient enough to do the job.

The internal part of dealing with resources within the Open Innovation theory has resemblances with the resource-based view.

5.3.4 Organizational learning and Open Innovation

Learning can be seen as a technical processing of information as well as a social act of sense making. There are a lot of people who say that there are different kinds of learning. Besides that there are also three different levels of learning: individual learning, group learning and organizational learning.

Organizational learning on its part is divided in single-loop, double-loop and deutero learning. The latter two are crucial for a company the sustainability of the company and the accomplishments of it.

Learning in a company starts with individual learning. Persons who don't learn don't progress and therefore fall behind. After that they have to share their knowledge in groups and learn from each other. The last step is that the organization as a whole learns from all the people that are part of it. In this way the organization can reach a higher level than it had before.

An individual can learn from his own actions, books, external knowledge, other people…. The Open Innovation theory suggests that everyone should learn whenever they have the possibility for it. People should learn from each other and everything else from which they can learn something.

The learning process should not be restricted to the internal environment of the organization. People can and should also learn something from others who are working for another company. Groups can learn by looking at other groups of their own as well as of other organizations. Last but not least should the organization try to learn. They could do that by looking at their own activities and their history, but they could also look at the external environment and at other companies. They can learn by taking in knowledge, doing all kinds of activities or buying certain knowledge or technology. Learning is a very important activity, it definitely plays a crucial role in the development of an organization.

The learning process of Open Innovation is definitely based on the different levels or learning that exist.

6. New contributions of Open Innovation

Chesbrough, the founder of Open Innovation, said that there were 8 points where Open Innovation differentiated from already existing innovation theories. These 8 points are the following:

1. Equal importance given to external knowledge, in comparison to internal knowledge
2. The centrality of the business model in converting R&D into commercial value
3. Type 1 and type 2 measurement errors in evaluating R&D projects
4. The purposive outbound flows of knowledge and technology
5. The abundant underlying knowledge landscape
6. The proactive and nuanced role of IP management
7. The rise of innovation intermediaries
8. New metrics for assessing innovation capability and performance

Now I can analyze some of these 8 points and see whether it are all new contribution of the Open Innovation theory.

6.1 Equal importance given to external knowledge, in comparison to internal knowledge

The resource-based view is a theory that only looks at the resources that a company owns at that certain moment. Then they see what the company can do with those resources. Knowledge is also a part of the resources that a company has. So with the resource-based view, the focus is only on the internal knowledge that the company has. They don’t look at the external environment of the company.

Organizational learning looks at the different ways of how an organization can learn. This can occur on three levels. You have individual learning, group learning and organizational learning. They never really mention were the knowledge comes from when the learning takes place. So we do not really know whether they learn from external or from internal knowledge.

Absorptive capacity is the opposite of the resource-based view. This is the ability to exploit and use external knowledge for the benefit of the company. This only looks at the external knowledge that the company can use. They don't look at the knowledge that the company already possesses.

Open Innovation looks at knowledge in both ways. The internal knowledge of the company is important for it, but also the external knowledge that they can use. They do not focus on one of them, so they are both equally important. This is the first theory where the attention is not given to just one of them, but where this is divided between the two.

6.2 Type 1 and type 2 measurement errors in evaluating R&D projects

The stage-gate model is a very useful tool if you want to develop a new products. It splits the development process in different stages. After every stage they reach a gate. At the gate they have to decide whether they want to continue with the project, don't continue with the project, temporarily stop the project or do the last stage again.

A type 1 measurement error arises when you totally develop a certain product that not seems profitable at all. The type 2 measurement error is the opposite, this happens when they stop working on the development of a certain product that does not seem profitably in the beginning but could become really beneficial after a while.

The stage-gate model helps you in trying to avoid type 1 measurement errors. Because after every stage, they look at the product and evaluate it. The further the product is developed, the better they know whether it could become profitable or not. So when that is not the case they can stop the process and don't waste to much money on the project.

The type 2 measurement error can still occur with this stage-gate model. Because sometimes a certain product does not seem to have any benefit for a certain company at the moment, but it could become important after a while.

Another option is that the product does not have any value for the company that is developing it, but that it has a high value for other companies. In both cases they stop proceeding with the project and the product won't be developed at that moment.

The Open Innovation theory has a solution for both the type of measurement errors. The R&D department evaluates every project so that they won't develop a useless product. When they develop or are developing something that isn't useful for themselves, they won't just stop the project. They will look outside the company and try to sell their product to a company for which it is very useful. Sometimes a spin-off company will arise that focuses around the newly developed product. They will always try to use the product in a way that it can benefit themselves. Either they use it or they will sell it and use the money that they get for it. But they will never develop a product that they will never use or that will never be revealed to the world.

6.3 The purposive outbound flows of knowledge and technology

This lies very close with the previous one. None of the theories that I discussed above have an external pathway to market for the products that have been developed internally by a company. Open Innovation does have that. I already gave the example of the spin-off above, but besides that they also have the opportunity to form a joint venture with another company or to license-out their products to any other company that wants to pay for it.

This helps to avoid type 2 measurement errors, because these external pathways give the false negatives a second chance to be fully developed if that wasn't the case already and to find their way to the market. So products that aren't useful for the company that developed them can still be brought to market by others. The company that made the product still benefits from it through the money that they get by selling the product to the company or companies that find the product very valuable.

6.4 The abundant underlying knowledge landscape

The open source theory is one of the theories that uses knowledge from outside the company. A company looks at the software that is made available by others. This software can come from other companies or from private individuals. Besides that also the absorptive capacity looks at how a company uses external knowledge for their own benefit, but they don't say where they get that knowledge exactly. So as you can see, the places for companies to get external knowledge is quiet limited with the existing innovation theories.

Open Innovation describes a lot more possibilities to get external knowledge. These sources for external knowledge are: other companies from their own sector or from other sectors, start-up or specialized companies, private individuals, universities, laboratories,…. So as you can see, the possibilities to get external knowledge are endless.

6.5 Other contributions

I have now discussed 4 of the 8 contributions of Open Innovation in comparison with the existing innovation theories. The 4 that I didn't discuss are the following ones:

1. The centrality of the business model in converting R&D into commercial value
2. The proactive and nuanced role of IP management
3. The rise of innovation intermediaries
4. New metrics for assessing innovation capability and performance

The reason that I did not discuss these is because they don't really come up in the other innovation theories. It could be that some of them come partially from other innovation theories that I did not discuss in my paper, but it could also be that they are brand-new ideas and never have been discussed in former innovation theories.

7. Conclusion

The stage-gate model was an important building block for the Open Innovation Theory. It is practically the basis of the whole theory. Because in Open Innovation, as well as in the stage-gate model, the whole process starts with a research project. And this projects has to go through a funnel. While it goes through the funnel it undergoes a series of stages and gates. At the gate there will be a decision to stop the process, do the last stage again, put it on hold for a moment or to continue with the process.

But besides that, their where other theories where Open Innovation build upon. The open source theory was the foundation for the openness of Open Innovation. A company revealed their software to the rest of the world and they all could make us of that software. Eventually everybody was better off because the revealers of the software could make use of the improved versions of it that sometimes arose. Besides that they could also make use of software that other companies exposed. So it is a win-win situation for the revealer of the software and for the one that uses it.

Absorptive capacity is all about taking in external knowledge, ideas and technologies. A firm that can't absorb those things, is stuck with using their own internal knowledge and technology. This limits the possibilities of an organization. The Open Innovation theory also knew this, so they also used it to see where they could get their knowledge from. Because it is always better to have as much possible sources to get your knowledge from. And it does not matter if these are internal sources or external sources.

The resource-based view is an excellent theory to see what the internal assets of an organization are. Because with them you can decide what you are going to develop. For Open Innovation, it is important to see what resources you already have (internally), but also after what resources you can get in the future (externally). So for the internal part of this, they looked at the resource-based view.

Last but not least is the fact that an organization has to learn. This is also the case for Open Innovation, because when you don't learn, it is difficult to innovate. For this part, the Open Innovation theory used the idea from the organizational learning theory.

Besides the fact that Open Innovation uses existing innovation theories and builds further on them, it also has new insights that weren't described before in other innovation theories.

The fact that external knowledge an internal knowledge are getting the same importance is new about this theory. The former innovation theories always gave the most attention to just one of them. But they are equally important so they both should get their deserved attention. You just cannot support on only internal or only external knowledge. You have to have both of them to find the best solution.

Also type 1 and type 2 measurement errors are getting a lot of attention with the Open Innovation theory. This theory tries to eliminate this kind of errors. Research projects are evaluated and they only continue when they think that it's going to be a useful thing. When they think that it isn't useful for themselves but for others, they will let the research project be developed somewhere outside the company in order to avoid a type 2 measurement error.

Together with the previous one is the outbound flow of knowledge and technology. The Open Innovation theory gives the opportunity for cancelled research projects to be developed externally. This by another company, or by for example a start-up. Or it also could be that it is just an idea that they don't want to develop internally. But as you see this also helps avoiding type 2 measurement errors.

And eventually there is also the assumption of the underlying knowledge landscape. In previous theories they thought that knowledge wasn't widely spread around the world. But The Open Innovation theories acknowledges that

you can get knowledge all over the world. You can get it at universities, national laboratories, to startup companies, specialized companies, individual inventors….

I can now conclude that Chesbrough was right about his Open Innovation theory. The building blocks from the theory come from existing innovation theories, but Open Innovation goes a little bit further than that. So it’s not just a combination of those theories. It does combine some of them, but in a way that it still contributes to organizations that use the theory. Besides the combining part, there are also elements that are completely new to the world. Open Innovation is clearly a new value adding innovation theory.

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