

**MASTER**

**Roadmapping approach on business ecosystem environments**

Karam Marroquin, J.N.

*Award date:*  
2015

[Link to publication](#)

**Disclaimer**

This document contains a student thesis (bachelor's or master's), as authored by a student at Eindhoven University of Technology. Student theses are made available in the TU/e repository upon obtaining the required degree. The grade received is not published on the document as presented in the repository. The required complexity or quality of research of student theses may vary by program, and the required minimum study period may vary in duration.

**General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain

Department of Industrial Engineering & Innovation Sciences

# Roadmapping Approach on Business Ecosystem Environments

By

Jorge Nahib Karam Marroquín

In partial fulfilment of the requirements for the degree of  
*Master of Science in Innovation Management*

**Supervisors:**

Dr. S.A.M. Dolmans (TU/e)

Dr. ir. B. Walrave (TU/e)

Dr. ir. P.H. E. den Ouden (TU/e – Light House)

Eindhoven, August 2015

# Abstract

Living in an age of fast-paced technological developments and swiftly changing trends, it makes harder for companies to keep up developing products in isolation. Therefore, companies have decided to engage in collaborations projects by participating in joint ventures, strategic alliances and outsource processes, in order to tackle the market with shorter development cycle for products and reducing the time necessary to commercialize products.

By collaborating, companies have realized that new ideas might arise, while at the same time they can learn from their partners and/or use their resources to achieve better results that otherwise would be impossible if they were to try it alone. The setting where these interactions between multiple actors (i.e. companies) dwelled is better known as “**Business Ecosystems**”.

But not nothing comes without a price, the benefits that Business Ecosystems bring come with some new problems such as: by increasing the number of people involved on a product development also increases the number of actors (stakeholders) involved in the decision making process; thus, the interaction between the different parties working on a project can become chaotic without clear communication channels and a stable flow of information.

This predicament can be translated as how to manage and efficiently and support strategic communication, goal alignment and trust within departments, organizations or ecosystems while at the same providing a flexible method that can be customized according to the situation.

A tool that conveys those entire elements is “roadmapping”, it is a methodology that offers a flexible approach to strategic planning by building interactions where all the members of a project can share their ideas and develop a common language based on a shared vision generated by goal alignment.

# Management Summary

## ***Introduction***

Living in an age of fast-paced technological developments and swiftly changing trends, it makes harder for companies develop products in isolation (Borgh, M., 2012). Therefore, companies have decided to engage in collaboration projects, this setting which involves the interaction of multiple actors is better known as: “Business Ecosystems” (Adner, R., 2006).

Business Ecosystems require a flexible planning tool, this study presents “Roadmapping” because they offer an open environment, where all the stakeholders can grasp the information dealt in the project (Daim, T., 2014).

According to García, M., et al. (1997), “roadmapping” is an emergent methodology that can deliver a flexible approach to strategic planning; this is achieved by providing graphical representations of the stages of the projects, the steps to be taken in each stage of the project and the procedures.

The approach of “roadmapping” has been improved by lessons learned on the projects and has evolved to comply with the ever moving technological era, to focus on a technological environment; this tool evolves to “technology roadmap”.

## ***Literature Review***

After gathering and examining the literature available about the topics at hand: roadmapping, as it is the main research topic of the study, technology roadmap, given that this is a variant that is commonly used for technology research projects, open innovation, because it relationship with collaborations, since that is the type of projects used on this research, business networks and business ecosystems, these concepts are born from the interactions on a multi-actor setting, which is the setting for this research.

With the knowledge acquired from the literature analysis, it was understood that even though the concept is easy to fathom there is also complexity that rises from its implementation; its origins, evolution, applications and limitations; it was discovered that its literature is mostly directed towards a specialized approach, “Technology roadmapping”, as its name stated it, this approach focus on the technological path and development of an invention.

## ***Methodology***

Armed with the knowledge provided from the literature review, it was possible to attain a better comprehension of the topic, which led to formulate new propositions for the topic at hand, situating the concept in a multiple actor environment known as

“Business Ecosystem” and integrating a discussion regarding the different approaches for its implementation.

To complement the new integrated vision of the topic, a semi structured interview protocol was devised; the purpose of it was to recollect field data about the functionality of roadmapping in “Business Ecosystem” contexts.

The topics of the interview were chosen given its relevance to study; ***Collaborations in Business Ecosystem, Flow of information on business ecosystems – Roadmapping approach, Appropriation and Interaction Mechanisms.***

An email invitation for the study was sent to several companies fulfilling the requirements to fit in the research proposal, from the respondents that agreed to cooperate with the study an interview schedule was devised, there companies used for the interview consisted on firm inside small (suppliers network) and big (multiple firms) “Business Ecosystems”, the interviews were recorded and transcript, following with the help of an analysis software the transcript interviews were coded and analyzed.

The research study uses a multiple-case study approach and collected data by applying semi-structured interviews to a roadmapping expert – LightHouse and case study companies O and L.

### ***Results***

The results of the analysis provided more insight of the implementation of roadmaps in business ecosystems, the interesting findings were translated on propositions from this study.

For a successful implementation of roadmapping on a business ecosystem is necessary to consider.

- A) Projects in Business Ecosystem settings require planning tools that foster creativity.
- B) The communication among partners is essential key for successful projects.
- C) Projects were partners can and are able to trust each other are more likely to produce better results.
- D) Companies fail to size the importance of people on the projects.

### ***Discussion and Managerial Implications***

Roadmapping provides an integrated solution as a strategic planning tool for Business Ecosystems, the main reason is because they made by consensus; hence, a common language is developed (LightHouse).

By discussing everybody proposals, commitments can be established; goals can differ among parties but they should lead to the same conclusion: a shared vision.

People have to take a more central role in these projects based on initially on mutual trust; cross training of representatives from each party is highly recommended and frequent update meetings.

### ***Conclusion***

This research highly recommends the use of the roadmapping methodology on projects with multiple actors, because of the benefit that it brings to collaboration projects.



# Contents

<b>Abstract</b> .....	<b>I</b>
<b>Management Summary</b> .....	<b>II</b>
<b>Contents</b> .....	<b>V</b>
<b>List of figures</b> .....	<b>VIII</b>
<b>List of tables</b> .....	<b>IX</b>
<b>1 Introduction</b> .....	<b>1</b>
1.1 Research background.....	1
1.2 Problem Context .....	3
1.3 Purpose of study .....	4
1.4 Research scope.....	5
1.5 Research model.....	6
1.6 Thesis structure.....	7
<b>2 Literature Review</b> .....	<b>8</b>
2.1 Definition of Roadmapping .....	8
2.2 Main variant of Roadmapping, Technology Roadmapping.....	9
2.3 Foundations of Roadmapping.....	9
2.4 General Template of Roadmap .....	10
2.5 Types of Roadmaps .....	11
2.6 Uses and Benefits of Roadmapping .....	12
2.7 Roadmapping Process .....	13
Phase I. Preliminary activity.....	13
Phase II: Development of the Roadmap.....	13
Phase III: Follow-up Activity.....	14
2.8 Relevant Findings about Roadmapping .....	14
2.9 Business Ecosystems - Multiple Actors Setting.....	15
2.9.1 Definition of Business Ecosystem .....	16
2.9.2 Business Ecosystem Features and Advantages.....	16
2.9.3 Key Elements for Success on Business Ecosystems .....	17
2.9.3 Business Ecosystem Controversy.....	19
2.10 Roadmapping in Ecosystem context .....	20
2.11 Research Question .....	21

<b>3 Methodology.....</b>	<b>22</b>
3.1 Research design .....	22
3.2 Guidelines for data collection .....	23
3.3 Interview design .....	24
3.4 Interviewees profile .....	27
3.5 Interviewees selection and Data collection .....	27
3.6 Coding .....	31
3.7 Validity and reliability.....	33
3.7.1 Validity.....	33
3.7.2 Reliability.....	34
<b>4 Results.....</b>	<b>35</b>
4.1 Introduction of Case Studies .....	35
4.1.1 LightHouse – Expert on roadmapping process .....	35
4.1.2 Company L – Head of the business ecosystem .....	36
4.1.3 Company O – Part of a business ecosystem .....	37
4.1.4 Company SEMATECH – Case study example from literature (Kostoff, 2001).....	37
4.2 Data analysis.....	38
4.3 Answer to research question and sub research question.....	46
<b>5 Discussion &amp; Managerial Implications.....</b>	<b>49</b>
5.1 Discussion.....	49
5.2 Managerial Implications.....	50
5.3 Propositions .....	50
<b>6 Conclusions .....</b>	<b>51</b>
6.1 Limitations of the research .....	52
6.2 Future research.....	53
<b>Bibliography .....</b>	<b>8</b>
<b>Appendix A .....</b>	<b>13</b>
<b>Appendix B .....</b>	<b>14</b>
Phase I. Preliminary activity.....	14
Phase II: Development of the Roadmap.....	15
Phase III: Follow-up Activity.....	16
<b>Appendix C.....</b>	<b>18</b>
<b>Appendix D .....</b>	<b>21</b>
Roadmap Case Example – Kostoff et al. (2001) .....	21



**Appendix E..... 23**

# List of figures

Figure 1-1: Research Model .....	6
Figure 2-1: Schematic technology roadmap (Garcia, 1997).....	12
Figure 2-2: Roadmapping Flow (Albright, 2003).....	14
Figure 2-3: Advantages of a Business Ecosystem.....	17
Figure 3 -1: Reflective cycle and Regulative cycle (Van Aken, 2007) .....	23
Figure 4-1: Roadmapping Contributions .....	48

# List of tables

Table 1: Sections of the interview protocol .....25

Table 2: Interview Matrix.....31

Table 3: Validity and Reliability Methods (Yin, 1994) .....33

Table 4: Results from the LightHouse interviews .....39

Table 5: Results from the interviews 1 .....40

Table 6: Results from the interviews 2 .....41

# 1 Introduction

This chapter will introduce the background and the problem context for this research. After that the main purpose of this study is explained, the following step is to formulate the main research question, which in turn will be supported by the sub research questions. The next segment will present a discussion regarding the research approach and the scope of the paper. Finally this chapter will conclude with the outline on how this report is structured.

## 1.1 Research background

Nowadays with the ever changing business environment, firms look for the best practices to analyze the key components that assemble a successful project, so they can emulate those components and continue launching products that will keep evolving alongside the market (Griffin, 1996).

Several methods have been proposed and tested on site and the ones that have been proven to be successful are benchmarked globally (Browne, 1999). One of these successful methods is technology roadmapping – a planning tool with a flexible approach that links technology development to foreseen developments in the market (Phaal R. S., 2008).

However living in an age of fast-paced technological developments and swiftly changing trends (Aguiar, 2004), it makes harder for companies develop products in isolation (Adner R. , 2006).

To increase the success rate of developing and launching new products, companies have decided to engage in collaborations by participating in joint ventures, strategic alliances and/or to outsource processes, in order to tackle the market with shorter development cycle for products and reducing the time necessary to commercialize products (Cankurtaran, 2013).

By collaborating with others, for example by means of joint ventures and strategic alliances, companies have realized that such collaborative projects can bring new ideas to the table while at the same time they can learn from their partners and/or use their resources to achieve better results that would be impossible if they were to try these feats alone (Kogut, 1988).

Scholars such as Ernst, H., et al. (2010) have been studying these interactions between multiple actors (i.e. companies) in projects and have labeled these environments as “business ecosystems”; the interest in these “business ecosystems” has grown lately given that nowadays companies are aware of the benefits that such environments can provide (Adner R. , 2006).

But not nothing comes without a price, the benefits that business ecosystems bring come with some new problems (Adner R. K., 2010), such as: by increasing the number of people involve on a product development also increases the number of actors (stakeholders) involved in the decision making process (Sivasubramaniam, 2012); thus, the interaction between the different parties working on a project can become chaotic without clear communication channels and a stable flow of information (Barfurth, 2002).

Projects developed in a business ecosystem environment need to convey relevant information of the project to stakeholders with different mindsets and backgrounds (Adner R. , 2006), the information can vary from goals, milestones, status of stages, steps to be performed, tasks, allocation of resources, etc.

In order to achieve this feat a communication tool that can be adapted to different conditions and context is required (Smith, 1998), the question is: which planning tool can offer the flexibility to be adapted to actors with a wide range of mindsets and backgrounds?

Scholars such as Cosner, R., et al. (2007), Daim, T., et al. (2014), Moehrle, M., et al. (2013), Pretick, I., et al. (2005) and Phaal, R., et al. (2001) have agreed that the roadmapping approach is the a suitable tool to address the strategic planning needs for projects developed inside business ecosystem environments.

According to García, M., et al. (1997), “roadmapping” is an emergent methodology that can deliver a flexible approach to strategic planning; this is achieved by providing graphical representations of the stages of the projects, the steps to be taken in each stage of the project and the procedures.

The approach of “roadmapping” has been improved by lessons learned on the projects and has evolved to comply with the ever moving technological era, to focus on a technological environment; this tool evolves to “technology roadmap”.

A technology roadmap is defined as a plan that matches short-term and long-term goals with specific technology solutions to achieve the stablsh goals. Motorola is recognized with the initial development of the “technology roadmapping” approach in the 1970s, although scholars have traced the origins of roadmapping back to the 1950s (Phaal R. S., 2008).

Several companies across different industries have followed Motorola’s example, each of them tailoring the approach of “roadmapping” to their needs; the flexibility of this methodology not only caught the attention of companies but also the academia, scholars have chosen to study this methodology to understand its roots and to try to create a template that can be utilized for most situations in different environments, since this tool is not restricted to the development of new products, but can be applied in any situation that requires strategically planning, for example construction work, the management of healthcare institutes, amongst others (Garcia, 1997).

In academia, scholars such as (Phaal R. S., 2008), (Gerdsri, 2007) and (Saritas, 2004) have focused their research on the evolution of “roadmapping” and “technology roadmapping” approaches, the possible key elements that form part of them and the fields of application;

Literature illustrates that some barriers stand in the way to find the best mix of components that a “roadmap” should have, e.g. the flexibility of this approach can provide too much liberty which in turn could make it hard to be studied due to the wide variation of results from different companies and because of the multitude of actors involved on the project, another prominent barrier can be hampering attitudes of employees may show while performing interdepartmental or intercompany activities.

## 1.2 Problem Context

Top-performing companies recognize the increasing dynamism of the market today; hence, in order to deliver successful projects in such environments; companies have to learn how to adequately use their ability to create and apply knowledge in ways that better fit the context on their capabilities (Strauss, 2004).

Based on learned lessons and marketing research, companies acquire diverse management tools to forecast possible scenarios and plan accordingly to their expectations, this strategy provides an enhanced vision, flexibility and environmental monitoring that will be reflected on the clarity of goals for the firms, but there are many questions that arise in this setting, such as: how can firms integrate and transfer all the gathered knowledge?, how do companies plan adequately while dealing with several stakeholders at the same time?, which strategic plan tool is the best to apply in this context? To answer these questions this research choose to focus on roadmapping because this planning tool can fulfill the roles mentioned above and given that it works well on multiple actors scenario, to enrich the study we have to take in consideration that albeit roadmapping covers that role, this tool does not come without its limitations (Strauss, 2004).

To begin with, roadmaps are used because they can generate an open environment, where all the stakeholders involved can understand the contents of the information dealt in the project (Daim, 2014); the reason that makes this possible is because roadmaps are created on workshops, on these environments, decisions are made by consensus; hence, a common language.

This common language arises from those meetings (Argote, 2012), which in turn makes this planning tool easy to work with, since its contents can be understood by every member of the project, also it can be modified accordingly to any situation that could be presented along the way and it can integrate new information as soon as it is introduced on the workshops.

Despite the fact that roadmaps have the characteristic to be easily interpreted, this is accomplished by everybody working together to enable the creation of a common setting with a shared language.

The project management team has to take in consideration that new team members can be added to the project roster (Cosner, 2007), either by switching members or integrating new stakeholders, therefore, the project staff have to periodically check the list of people involved in the project and opportunely let the others know about changes of personnel.

Also, roadmaps are created from shared knowledge; hence, if people withdraw information, the main purpose of the collaboration cannot be attained; thus, roadmap require a setting where companies develop a certain degree of trust among each other's, which can be detrimental to the project if it is not achieved.

### 1.3 Purpose of study

The main purpose of this study is to find out the different approaches and implications of the **“Roadmapping”** process in a multi-actor setting; by a multi-actor setting, we refer to an environment with actors from different backgrounds and companies working together to co-develop a project, better known as **“Business Ecosystems”**.

To achieve that goal, this research will start by investigating the available literature about the “roadmapping”, first as a concept and its implementation on a multi-actor setting; to better understand how roadmapping works on these environments, this research will also contemplate literature about “Business Ecosystems”.

Equipped with this knowledge, the research will make propositions to lay out a common ground to work with the roadmapping approach for these types of collaborations. As such, this thesis will demonstrate the elemental conditions that a “roadmap” needs and the steps for its implementation in a multi-actor settings.

The propositions that this study offers are based on the knowledge gained by the literature review and complemented by the feedback provided by the company expert on the roadmapping process, LightHouse as well as the tutors for this project, the following as the proposition presented:

- A) **Projects developed on open innovation environments, require planning tools that foster creativity** (De Dreu, 2010).

The roadmapping methodology offers flexibility in its processes by been able to be adapted and modified at any stage of the project, by continuously been updated, it keeps the document alive and evolving.

This flexibility means that roadmapping is a planning tool that foster and nourish creativity by been able to adapt to any changes that the project requires along the way.

**B) The communication among partners is an essential key to successful projects (Albright, 2003).**

Roadmapping works better on workshops, because workshops create an open environment where ideas are shared and mutual agreements are draft by improving the communication among the members of the project; thus, a common vision is tailored.

With a shared vision, a set of goals are aligned among the partners and the foundations of the project are set; therefore, workshops can provide an adequate environment for the roadmapping process to be implemented.

**C) Projects were partners can and are able to trust each other are more likely to produce better results (Moore, 2006).**

In Business Ecosystems a key element is trust, the reason behind it is that in some collaboration projects it is difficult to draft contractual agreements at the start of the project, negotiations have to be made; hence, a certain level of trust is required to embark on collaborations.

With partners that trust each other, hindering conditions are minimized and all the parties are able to work more freely while contributing their optimal work.

**D) Companies fail to seize the importance of the human factor on the projects (Griffeth, 2000).**

In some cases the staff that initiated a project is not the same that finish it; therefore, integrating the variable of people involved on a project in the equation of a project will allow foreseeing the possibility of changes on the staff.

Roadmapping is a tool that actively involves the staff of the project, first by requiring a consensus among the parties to optimize the goal alignment process and later to continuously improving and adapting the roadmap with the feedback from the members of the project. As an alternative, cross training of the staff of each company is recommended.

## 1.4 Research scope

The tasks performed in this research study are planned accordingly to fit with the time set for the thesis project on the research proposal.

The main objective of this research is to build knowledge, based on findings that rose from the literature study of the topics at hand and the exploration of the



experiences of using roadmaps and implementing them as a strategic tool that helps in project planning activities in a multi-actor setting, also known as business ecosystems (collaborations).

Taking in consideration that most of the literature is focused on a variation of the roadmapping approach that specializes on technology development, “*technology roadmap*”; this research study attempt to improve the knowledge that literature has about general roadmapping, instead of many focusing on the technology aspect.

### 1.5 Research model

To serve as a guide for this paper, a research model was created, which will provide a global view concerning the steps that must be executed to achieve this research’s goals.

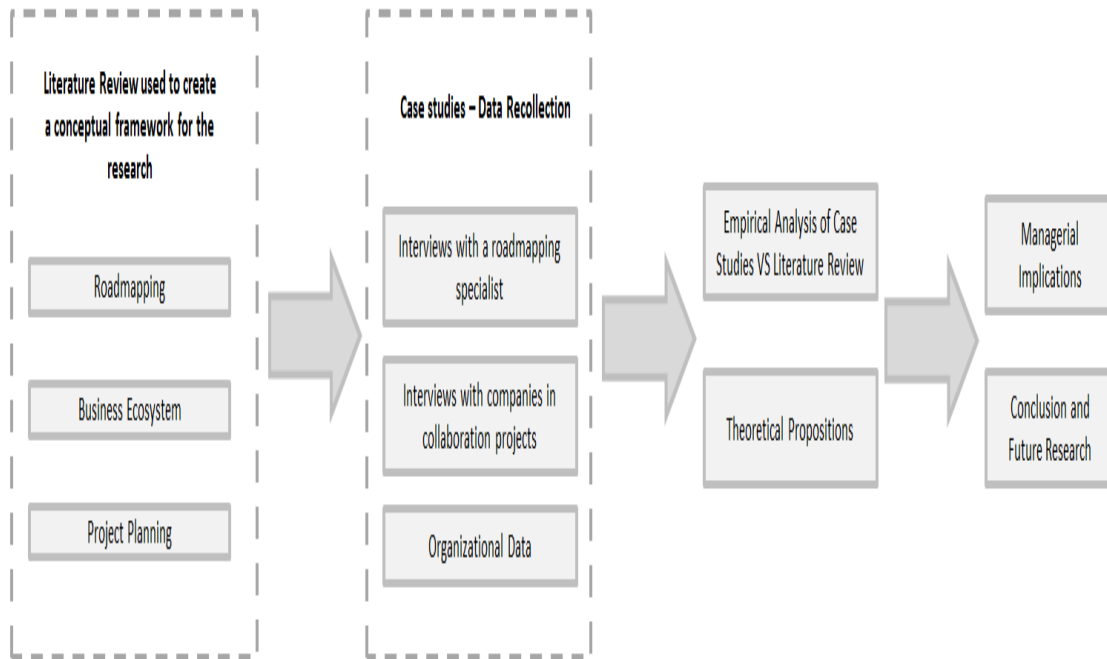


Figure 1-1: Research Model

On the left hand side of Figure 1-1, we can see the initial sources of information gathered for the research, this segment represents the literature review process; more than sixty scientific publications, reports, articles and books were reviewed to select relevant information for the body of the paper, from the literature review, we obtained the preliminary insights to formulate the research proposal.

Next, an interview protocol was designed based on the findings from the literature review. This protocol acted as the guidelines for the research, delimitating the boundaries of the study as well as the step that were followed in order to apply the interviews.

The information acquired from these interviews delivered the main source of data for the empirical analysis of this research, each company acted as a case study; case study analysis recollects qualitative data, an exploratory approach was used to work with the collected data.

As the next step, the results of the empirical analysis were cross-analyzed and compared against the knowledge obtained through the literature review. A comprehensive analysis of the information served as a basis to develop the theoretical propositions as well as the managerial implications; these results are summarized on the conclusion notes of the research and suggestions for future research to improve the knowledge drafted on this research.

## 1.6 Thesis structure

The structure of the document is as follows: First, an extensive literature review on the roadmapping methodology is provided. Next, a formulation of the problem statement and the research question will be presented along with a set of propositions underpinned in literature and reasonable assumptions. An in-depth explication of the research methodology will be provided. Next, the document presents the results of the research followed by a discussion. The document closes with the conclusions, limitations and further research.

## 2 Literature Review

This chapter will address the literature available about the topics debated on this paper, such themes include: roadmapping, as it is the main research topic of the study, technology roadmap, given that this is a variant that is commonly used for technology research projects, open innovation, because its relationship with collaborations, since that is the type of projects used on this research, business networks and business ecosystems, these concepts are born from the interactions on a multi-actor setting, which is the setting for this research.

The goal of this section is to build the foundations for the theoretical propositions that will be presented on the study; this will work as background material for references and to compare the knowledge proven on the literature against the findings exposed from the study.

As an initial point, this paper will begin with generic definitions of the roadmapping approach as well as its main variant, technology roadmapping, from there it will progress to explain the layout of a general roadmap, it will also present a taxonomy of roadmaps that will attempt to better classify the spectrum of uses for roadmapping and its objectives, from there the chapter will transition to introduce the definition and principles of the multiple actors setting and how roadmaps are useful in these business ecosystems environments, to conclude this section will address the gap found in the literature, which is failing to incorporate the interaction of multiple actors while planning activities on the roadmapping process, finally it will close with the main research question as well as the sub questions.

### 2.1 Definition of Roadmapping

Roadmap is a document that is produced by the project planning process. It identifies the critical requirements for a set of product needs, the product and processes performance objectives, the technology alternatives and milestones for attaining those targets.

A roadmap recognizes the alternate “roads” to reach certain performance objectives. First an initial path is selected; following a plan to accomplish the selected path is designed. If there is high uncertainty or risk, then several paths may be selected and pursued simultaneously (Phaal R. F., 2005).

The roadmap identifies clear and concise goals and focus resources on the critical technologies that are needed to attain those goals, providing more effectively investments for the limited budget of a project.

## 2.2 Main variant of Roadmapping, Technology Roadmapping

Technology roadmapping is a needs driven planning process that helps to identify, select, and develop technology alternatives to satisfy a set of product needs. This process gathers a team of experts to develop a methodology for organizing and presenting the critical technology-planning information to make the appropriate investment decisions and to leverage those investments (Phaal R. F., 2005).

It also provides a way to develop, organize, and present information about the critical requirements and performance objectives that must be satisfied by certain periods, while identifying the technologies needed to be developed to meet those objectives. Finally, it provides the information needed to do trade-offs between different technology alternatives (Garcia, 1997).

Technology planning is important for many reasons. Globally, companies are facing many problems. Products are becoming more complicated and customizable (Williams, 2004). The product time to market is shrinking. Product life is shortening. A short-term focus is reducing investment funding. There is increased competition. Cut-backs are occurring because of increased competition (Griffeth, 2000). These problems require companies to be more focused and better understand both their industry and markets. Better technology planning can help deal with this increasingly competitive environment. A few U.S. companies and industries are beginning to use technology roadmapping as a technology planning tool to better position themselves and their products (Garcia, 1997).

For this study we will only focus on two segments where roadmapping can be applied: industry or corporation, these segments involve different level of commitments in terms of time, cost, level of effort, and complexity (Garcia, 1997). Nevertheless, for both case the roadmaps have the same structure: needs, critical system requirements, targets, technology areas, technology drivers and targets, technology alternatives, alternatives paths, and a report; although with different levels of detail (Garcia, 1997).

## 2.3 Foundations of Roadmapping

Roadmapping is a relevant tool for collaborative planning and coordination for firms. It is a detailed technique used for project planning, which provides flexibility to fit within a more general set of planning activities (Garcia, 1997). As a result of using the roadmapping approach; a company, an industry or governmental entity can accomplish better investment decisions given the better information received from applying this technique, such as:

- Identify critical product needs that will drive technology selection and development decisions.

- Determine the technology alternatives that can satisfy product needs.
- Select the appropriate alternatives.
- Generate and implement a plan to develop and deploy the appropriate alternatives.

A roadmap is determined by a need. The roadmapping approach offers a way to identify, evaluate, and select alternatives that can be used to satiate the need. However, roadmapping is only a strategy for developing these technologies. A more detailed plan is needed to define the actual projects and its activities (Phaal R. F., 2005). This approach is simply traditional project management, not something unique to roadmapping or technology roadmapping. Regrettably, some of these activities are sometimes label as roadmapping, which causes confusion about what the unique characteristics and real benefits of roadmapping (Garcia, 1997).

Scholars use the term roadmapping or technology roadmapping to express different things (Phaal R. F., 2004). To eliminate this confusion, this research will unify terminologies and clarify what is meant by a technology roadmapping and a technology roadmap, first both terms will be defined, then their uses and benefits of technology roadmapping will be identified, and finally the technology roadmapping process will be explained.

## 2.4 General Template of Roadmap

A roadmap delivers a graphic representation of the strategic plans, it articulates and shares them, both within and between organizations (Kerr, 2010); but for it to effective, a roadmap needs to be developed taking into consideration the graphical design principles in order to provide a clear communication.

As subdomain, the information design is relevant to roadmapping because it focuses on visually structuring and organizing information to develop effective communication. One of the great assets of graphical techniques is that they can convey large amounts of information in a small space (Wainer, 1984); therefore, the graphical design intent for a roadmap should be able to condense a large amount of information into an innate format (Ma, 2006).

The most fundamental graphical representation in roadmapping is the single-page, high-level strategic view. According to Phaal R., et al. (2009), this summarized visual format of a roadmap establishes “strategic lenses” on the problem at hand. Phaal R., et al. (2008) recommends the single-page representations, because while using them it is easier to ensure that “the key issues are focused on”.

Additionally, “one-page views can also be updated more easily, enabling the process to be more agile, enabling the roadmaps to keep pace with the rapidly changing business situations” (Phaal R. S., 2008). These “single-pagers” have an equivalent

degree of graphical information to KPI dashboards (Kerr, 2010); according to Kerr (2010), they share two key aspects:

- Dashboards have to be customized – The design “must be tailored specifically to the requirements of a given person, group, or function; otherwise it won’t serve its purpose” (Few, 2006).
- Single-page represents a graphical challenge – “The first and toughest goal of a dashboard designer is to squeeze the information onto a single screen. All relevant information should be instantaneously viewable” (Eckerson, 2006). It encompasses “squeezing a great deal of useful information and often disparate information into a small amount of space, all the while preserving clarity” (Few, 2006).

According to Daim T., et al. (2014), roadmaps provide a powerful canvas that help to communicate the strategic decisions and their implementation plans, this is achieved by creating an appropriate balance between two factors – (a) the structure that is embedded on the canvas and (b) the appropriate set of visual objects that are then overlaid to represent informational content (Phaal R. M., 2009).

Roadmapping provides a “framework within which all the time-based business strategies of an enterprise can be aligned on a continuous basis in support of the business goals” (Whalen, 2007).

In management science, modelling involves framing the problem (Pidd, 2003). The term “framing” in a roadmap refers to how the information is organized on the canvas (Petrick, 2005). Goffman E., et al. (1974) introduced the term ‘framing’ to refer to a scheme of interpretation, i.e. a framework, as a means to making sense of situations.

Phaal, R., et al. (2004) labels the action of structuring a roadmap as “architecture”. This architecture of roadmaps consists of two dimensions: (i) the horizontal axis (which is most commonly a timeline), and (ii) the vertical axis, which consists of a number of layers that relates to how the business is physically viewed (Phaal R. F., 2004) with each layer providing input into the next level (Cosner, 2007). For a more detailed description of the roadmap template refer to Appendix A.

## 2.5 Types of Roadmaps

In literature we can find different types of roadmaps, but the most common approach is encapsulated in the generic form proposed by EIRMA (1997) (see Figure 2-1). The generic roadmap is a time-based chart, comprising a number of layers that include both commercial and technological perspectives. The roadmap enables the evolution of markets, products and technologies to be explored, together with the linkages between the various perspectives (Phaal R. F., 2001).

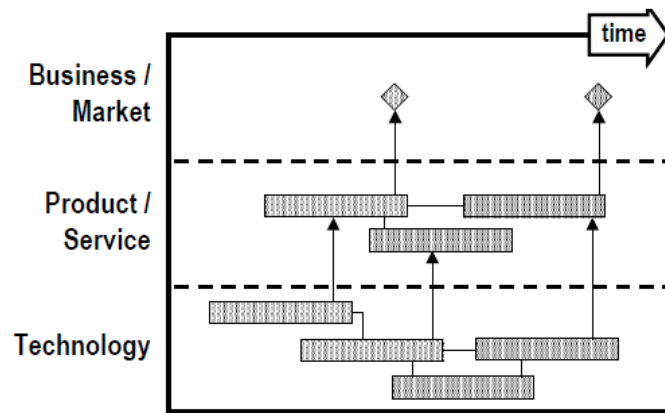


Figure 2-1: Schematic technology roadmap (Garcia, 1997)

Roadmaps can have different applications. According to Phaal R. (2001), these can be classified into 8 areas:

1. Planning of products: The most common technology roadmap. This roadmap shows that the different generations of manufactured products are tied to the necessary technologies for their development.
2. Planning of services and capabilities: This roadmap emphasis is on how the technologies foster the firm's development of capabilities.
3. Strategic planning: This kind of Roadmap evaluates the different opportunities that markets and business tendencies can offer, at strategic level.
4. Long run planning: Roadmaps are often used at regional and national levels, where planning is projected long-term.
5. Capabilities and knowledge planning: Roadmaps let the firm align its knowledge capabilities and business goals.
6. Project planning: This roadmap aligns different project activities (e.g. R&D projects with technologies development).
7. Process planning: Roadmapping permits managing knowledge, focusing on a particular area of the firm.
8. Integration planning: Offers a vision about integration and evolution of the technology, and how they combine with products and systems in order to create new technologies.

## 2.6 Uses and Benefits of Roadmapping

At both the corporation and industry levels, technology roadmapping has several potential uses and resulting benefits. The most relevant of those uses are the following (Phaal R. F., 2001):

- Technology roadmapping can develop a consensus about a set of needs and the technologies required to satisfy those needs.

- It provides a mechanism to help experts forecast technology developments in targeted areas.
- It can provide a framework to help plan and coordinate technology developments both within a company or an entire industry.

The main benefit of technology roadmapping is that it provides information to help make better technology investment decisions (Garcia, 1997). It does this by:

- a. Identifying critical technologies or technology gaps that must be filled to meet product performance targets.
- b. Identifying ways to leverage R&D investments through coordinating research activities either within a single company or among alliance members.

An additional benefit is that a technology roadmap can indicate that a company understands the customer needs and has access to or is developing technologies to meet their needs.

## 2.7 Roadmapping Process

This section provides an overview of the three phases of the developing process of the roadmapping methodology. The first phase involves preliminary activity without which the roadmapping probably should not be done. The second phase is the development of the roadmap. The third phase is the follow-up and use of the roadmap. For further detail on each step of the phases refer to Appendix B.

### Phase I. Preliminary activity

In the initial phase, the stakeholders define the scope and boundaries for the roadmap (Garcia, 1997). A complication that this phase can present is goal alignment, given that the people involved on the project can expect different outcomes; it is recommended to strive for a general consensus, a tool that can be used on this step is workshops, in these environments people share ideas and have open discussion with the purpose of establishing a common language for the project which would lead to alignment of ideas and goals (Stephen, 2007).

### Phase II: Development of the Roadmap

The second phase involves the tasks required to develop the project, working groups or teams are essential to develop the content of the roadmap (Whalen, 2007). The focus of the roadmap is to strategically plan the tasks necessary to complete the project, first the critical system requirements and their targets have to be distinct, the next step is to specify the technology required for the project, the technical and implementation recommendations, also it is indispensable to discourse the technology alternatives that could be pursued in case they are needed. Finally it is fundamental to analyze the areas not addressed in the roadmap (Garcia, 1997).



### Phase III: Follow-up Activity

Since the representatives of each company were involved in developing and drafting the roadmap, it must now be critiqued, validated, and accepted by a much larger group that will be involved in any implementation. An implementation plan needs to be developed using the information generated by the roadmapping process to make and implement the appropriate investment decisions. Finally, since both the needs and the technologies are evolving, the roadmap needs to be periodically reviewed and updated (Garcia, 1997).

To provide a better understanding of the process of roadmapping, Figure 2-2 shows how Albright R., et al. (2003) describes the flow of roadmapping, starting from the need (Market), continuing to the concept of the product, the ideas to satisfy the need, following the actions and resources (Technology) necessary to produce it and last the plan of actions achieve it.

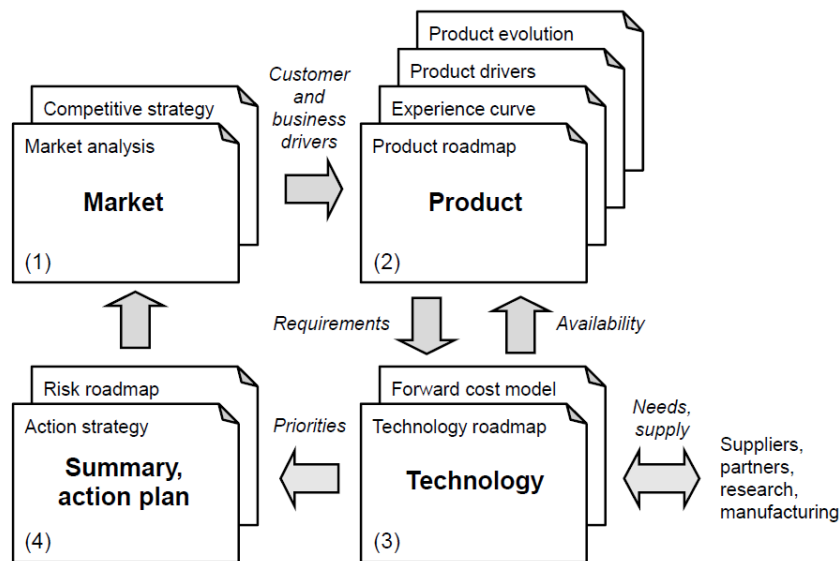


Figure 2-2: Roadmapping Flow (Albright, 2003)

## 2.8 Relevant Findings about Roadmapping

Roadmaps are employed as decision assistance tools; their emphasis lies in improving the planning, coordination and administration activities of diverse resources in a progressively complex and uncertain environments (Petrick, 2005).

This versatile tool is preferred amongst others due to its flexible approach, since its adaptability allows it to be applied in industry, governmental and academic areas, roadmaps can achieve this synergy given that it can depict the structural relationships among administration, science/technology and applications (Moehrle, 2013).

To mention some of the most relevant specific uses for roadmaps we can mention: strategic planning, executing and reviewing tasks, enhancing communications among researchers, product leaders and managers, suppliers, users and other stakeholders involved on the projects, identifying areas with high potential in the projects by analysis the gaps in the processes and providing options to narrow or close them and recognizing obstacles that prevents a rapid and low-cost product development (Lee, 2005).

The process of creating roadmaps is complex, nonetheless that is the easy part, the actual challenge arrives after that, in the form of maintaining the roadmap updated and implementing it, in this stage is where complications might arise and people could start to be discouraged, but also this stage is when real value can be created.

According to Kostoff, R., et al. (2001) there is no one size fits all formula for crafting a roadmap properly, to craft a successful roadmap, all the stakeholders have to be integrated, but as the number of actors increase in a project unique challenges appear, such as conflicting interests, competition, different proposals about risk management, varying degrees of technical expertise and the struggle to be in charge of the decision making process.

In order to deal with these challenges first it is necessary to understand the environment where they are born, this multiple actor setting known as “Business Ecosystems” (Adner R. K., 2010).

The following section will present the terminology of Business Ecosystems, its characteristics, advantages, success factors, roles and controversy.

## 2.9 Business Ecosystems - Multiple Actors Setting

These days, economic activities have changed structure from a dominantly stand-alone to a network system; henceforth, new approaches are needed to analyze the relationships created between companies in a business network (ecosystem) setting (Anggraeni, 2007).

The significance of relationships, partnerships, networks, alliances and collaborations is obviously not a novel concept but indeed it is a growing research field (Adner R. S., 2010) (Aguiar, 2004) (Argote, 2012) (Barfurth, 2002) (Eamonn, 2015); the reason behind this increasingly interest on business networks comes from the proposition that in such environments it becomes easier for companies to use and deploy assets that they do not own nor control, in order to create joint efforts to develop new proposals that would snatch better market share, while at the same time expanding their possibilities, applying their expertise and learning at the same time (Eamonn, 2015).

## 2.9.1 Definition of Business Ecosystem

After reviewing a several articles related to Business Ecosystems, we observed that many authors share similar visions regarding the topic, for this research we decided to use Peltoniemi, M., et al. (2004) definition and Adner, R., et al. (2010) because those integrate many aspects already discussed on this research; henceforth, Peltoniemi, M., et al. (2004) defines a business ecosystem as a dynamic structure which is born from an interconnected population of organizations, these organizations varies in size (small firms to large corporations) and focus from profit driven and nonprofit driven (i.e. universities, research centers, public sector organizations), each party is able to influence the system.

Adner, R., et al. (2010) talks about the ecosystem construct, which makes the interdependencies between partners more explicit, it focuses on stablishing an understanding coordination and communication among partners which differentiates them from networks, because networks aside from cooperation also promote competition.

In numerous texts, business ecosystem is defined as a partnership consisting of several organizations (Clarysse, 2014), business ecosystems develop through self-organization and coevolution of partnerships, but it requires a sense of adaptability. This business setting presents both competition and cooperation present simultaneously (Peltoniemi, 2004).

## 2.9.2 Business Ecosystem Features and Advantages

According to Anggraeni, E., et al. (2007) a business ecosystem perspective is embodied by the following features:

- Individual unit or organizational success requires a healthy ecosystem.
- The importance of unpredictable, nonlinear, and natural consequences is underscored.
- Influence is achieved by managing initial conditions and the underlying forces or attractors, which organize the system.
- Systemic change is a continuous, it is a relentless process.
- Self-organization triggers transformation.
- Cultural integrity is the basis for establishing relevant boundaries. Given the emphasis on community and the recognition of actors, complexity-based strategies rely on shared values and common purposes, rather than procedures to guide behavior.

Figure 2-3 shows the advantages that a Business Ecosystem can provide to the actors that inhabit it.



Figure 2-3: Advantages of a Business Ecosystem

### 2.9.3 Key Elements for Success on Business Ecosystems

When companies decide to work on collaborations projects, they should understand that those environments have elements that differ on scale and magnitude from that they are used to, in Business Ecosystems as the number of partners increase, also the amount of conflicts may arise (Adner R. K., 2010).

In order to avoid or lessen the impact of conflicts and to increase the success of collaboration projects it is necessary to take in consideration the following key elements:

### ***Goal alignment***

As stated on the initial phase of the roadmapping process, it is fundamental to define the vision that the collaboration project will have, even though each member/company of the alliance have their own agendas, a mutual horizon has to be set in order to focus the resources towards it (Garcia, 1997), with a common vision at hand, the following step is to outline goals that would lead to fulfil that vision, goals can vary per company, some will be shared while other will be company focused (Stephen, 2007).

It is not easy to attain a balance of ideals, resources and expertise among the companies, each company conveys different proposals to the table; therefore, tools such as workshops can create environments for open discussions and forums to shared ideas and knowledge, which in turn would draft a common language for the project leading to alignment of ideas and goals (Stephen, 2007).

### ***Flow of information***

The second and third phases of the roadmapping process require optimal communication among the members of the collaboration project, the stakeholders need to be regularly informed about the status of the project, and accordingly they can keep track of the process and opportunely detect hurdles that may appear along the way (Anggraeni, 2007).

Despite the fact that the way that companies convey information may vary, a general consensus has to be achieved by all the members of the collaboration project, some formats can be shared or new ones can be designed specifically for the project.

### ***Monitoring tools for projects***

This topic it is link with the flow of information, how companies perceive and relay information to the member of the collaboration project as well as the people of their companies; several methods can be used to track the status of a project, a milestones approach can be used, dashboard for visual aid, balance scorecard, etc., but for this study we will manly focus on the strategic planning tool known as "roadmapping".

### ***Appropriation Mechanisms***

In the collaboration projects companies expect similar results but at the same time each company has their own agendas, as was mentioned earlier, goal alignment it is one of the pinnacles that business ecosystems should have, workshops were mentioned as a helpful tool to achieve this feat, the purpose of those event it is to build trust amongst the members of the project, creating guidelines to work efficiently while providing the flexibility that the project requires.

Adner, R. et al., (2010) teaches us that the base of the business ecosystems start by building trust, in order for the negotiations to be more fruitful, so companies can perform a better role capturing value from these collaborations.

### ***Interaction Mechanisms***

Business ecosystem environments portray a myriad of new variables that companies have not anticipated before agreeing upon working on collaboration projects; there is a small amount of literature available regarding the use of roadmapping on multi-actor settings; therefore, some variables escaped the scope of this research on the initial literature review, such it is the case of the relevance human factor of the collaboration projects, meaning how relationships are built and the effect that they have (Argote, 2012).

Companies strive to acquire or use resources that are not at their hand reach, these collaborations are established to fill this void, but the balance of the resources that each company has at their disposal can tilt the scales of negotiations, in order to prevent opportunistic behaviors, contractual agreements have to draft, but in an open innovation setting this can hinder the liberty of creation in the project (Amabile, 1998), linking this argument with fact that human relation are not a pivotal factor considered while drafting the lay out for collaboration projects, this research will consider this factor as relevant for the study.

### **2.9.3 Business Ecosystem Controversy**

Ecosystems normally bring together multiple actors of different types and sizes in order to create, scale and serve markets in ways that are beyond the capacity of any single organization (Eamonn, 2015). The diversity of actors involved is distinguished by their collective ability to learn, adapt and innovate together; these characteristics become key determinants of longer term success of the projects. (Eamonn, 2015).

These environments require anchor organizations that facilitate connections between the different actors (Clarysse, 2014), but by doing so, one could argue that the value created on these collaborations is only captured by a few central players in the business ecosystem, to prevent this a balance has to be established, in open innovations environments it is recommended to build trust at the start and along the way of the project (Borgh, 2012), policy makers on the other hand suggest to support the creation of value in the ecosystems with contractual agreements to avoid opportunistic behaviors (Dawson, 1998).

Anggraeni, E., et al. (2007) points out three critical characteristics that business networks possesses and that have to be taken in consideration in the negotiations of collaborations projects, namely innovation, competition among the members and

degree of expertise of the actors involved; all these issues concerning business ecosystems will be further discussed and analyzed on this paper.

## 2.10 Roadmapping in Ecosystem context

Scholars such as Phaal, R., et al. (2001), Daim, T., et al. (2014) and García, M., et al. (1997) have focused their research on a variant of the roadmapping methodology used to track technology developments, this variant it is known as “technology roadmapping”; although it is true that roadmaps can perform the job of a planning tool, where step by step the evolution of the technology used on a project can be tracked, this approach does not take in consideration that several of these technology innovation projects are development inside collaborations (Adner R. K., 2010).

Collaborations projects are developed inside business ecosystems, these business ecosystems are generated in order to create combined efforts from companies to co-develop innovation products or services that alone they will be unable to perform (Borgh, 2012).

The business landscape of collaborations is created from the interaction of multiple actors and the actions that they perform using the resources available for the project (Håkansson, 2009). These ecosystems have to cope with the constant motion of activities, resources and actors, these factors also change over time.

Here, the available literature also misses its mark, because while planning the creation of a roadmap they failed to integrate these changes on the strategic planning process, which in time would be detrimental for the success of the project, the actors of a project continue to evolve or move to a different project, the resources of the project move on a particular paths and the tasks will become successively more specialized in one or more directions (Borgh, 2012).

In the environment that houses these collaborations not all the companies have the same technological expertise, even though companies have knowledgeable actors within their ranks, they mainly focus on their small worlds and tend to fail at grasping the whole structure of the network (Håkansson, 2009).

At the same time while new IPs are created, this knowledge is not shared; therefore, it would make more sense that the roadmaps used on the collaboration environments should be more general than the technology based from each company, this in turn would provide a more casual language for companies with less technological expertise but at the same time everybody can contribute on the decision making process, working by consensus (Moore, 2006).

## 2.11 Research Question

The efforts performed from literature review to gather information regarding the different elements of roadmapping and general roadmapping. With the aid of those analyses; based on the problem context described in Section 1.2, the main research question is formulated to provide a deep analyze of the best mix of components that a “roadmap” should have,

**What are the different approaches and implications of the roadmapping process for a multiple actors setting?**

In order to answer this question, the following sub research question has to be answered:

- Which key elements (conditions) make more likely for a “roadmap” to be successfully applied in environments with multiple actors involved? (Saritas, 2004).



## 3 Methodology

Within this section it will be explained the approach used to collect data in order to answer the main as well as the sub research questions. First, it will be provided the research layout. Following it will be presented the methodology selected for the research together with the particularities.

### 3.1 Research design

To insure that this research has a balance between rigor (Kuhn, 2012) and relevance (Lakatos, 1976); the two cycles of research proposed by Van Aken et al. (2007) will be used.

First, this research initiates on the reflective cycle of Van Aken et al. (2007), which is used to identify and select the relevant theoretical contributions for the research, in chapter 2 an extensive literature review was performed with the use of different information retrieval systems, amongst others: ABI/Inform, Google Scholar, Science Direct and books, the key works for the research were: roadmap, technology roadmap, open innovation, business networks, business ecosystems, collaborations; based from this preliminary research.

The following step was to use the snowball-method to find other relevant papers that could complement the knowledge acquired from the initial information research, in this step new findings appeared, after a careful analysis of them and with the aid of the tutors of this research project, the topics “**value appropriation mechanisms, human interaction and trust**” were added to provide a more robust and complete study.

After analyzing the information collected, interesting and relevant papers were carefully chosen and summarized; and when necessary, more literature was searched with the same procedure, here the topics that added were “**Business Networks and Business Ecosystems**”.

The information gathered is used on the first step of the regulative cycle, “Problem definition”, and the literature review functions as the basis for the theoretical framework, which in turn leads to the research gap that provides the research question as well as the sub research questions.

Since this research purpose is to build theories about the roadmapping approach on business ecosystems, the Van Aken (2007) regulative cycle will end around the third step (Figure 3-1), because this study is not going to implement the propositions made and neither will evaluate their results.

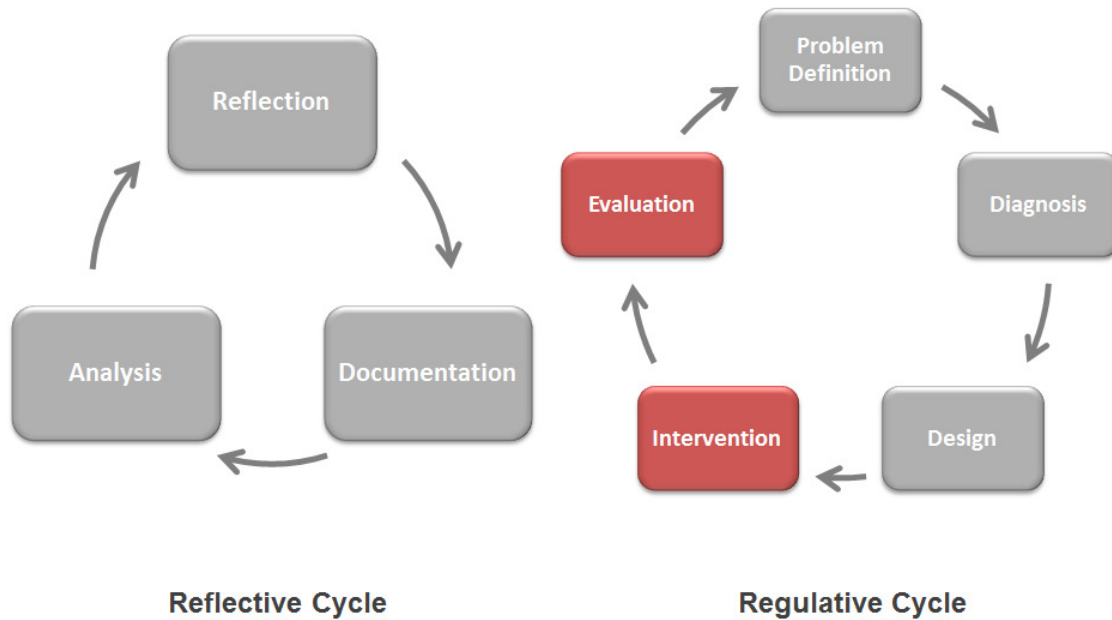


Figure 3 -1: Reflective cycle and Regulative cycle (Van Aken, 2007)

The knowledge attained from the literature review is used to structure the bases for the study and to formulate the research question as well as the sub research questions, in order to find answers for the questions presented, first it is necessary to define which type of research is going to be performed, this is based on the goal of the research, for this study we will use Yin's (2013) definitions of research types, he distinguishes three types of research:

- A) Exploratory research, the goal is to define questions and hypotheses.
- B) Descriptive research tries to create a description of the phenomenon within its context.
- C) Explanatory or causal research presents the data bearing on cause-effect relationships, explaining how the events appeared.

Based on Yin's (2013) definitions, this research study can be categorized as an exploratory research, for the reason that it aims to grasp a better understanding about the use roadmaps in an open innovation environment with multi-actor interactions (Business Ecosystems).

### 3.2 Guidelines for data collection

Following the guidelines proposed by Yin (1981) when facing is a very complex subject that is highly depended or embedded within its context, we learn that this type of research is heavily represented by qualitative data, since this type of data offers better insights on complex social processes. The best approach is to use a multiple-case studies analysis, because the cases can replicate each other, either

predicting similar results (literal replication) or contrasting results (theoretical replication).

The case study approach studies experiences from the interviewee's point of view, the information is obtained from practical context and translated into generic statements (Yin, 2013).

Nevertheless, Yin (1981) also warns us about three critical issues while dealing with case studies and he proposes a set of solutions for them. The first one is the lack of systematic handling of data; this can be corrected by systematically reporting all evidence.

In this research we cover that argument by applying semi-structured interviews that were recorded. The next issue that we have to be careful about is the lack of basis for scientific generalization, which this research counters it by stating that the purpose of using case studies is not to generalize a population as in statistical research, but instead to generalize theoretical propositions.

Finally, research papers that use case studies are often critiqued for taking long time to be completed, meaning the interviews can take a considerable amount of time from the interviewee, and the results are unreadable in the main document, this research tackled that issue by establishing time limits for each interview and by addressing these guidelines beforehand with the interviewees, the interview protocol and the questions asked were structured according to the theoretical framework performed on chapter 2, a thoroughly analysis of the interview protocol and the questions was executed by TU/e tutors of this thesis project and by several colleagues of the faculty.

### 3.3 Interview design

The design of the interview was built with the purpose of grasping a better insight from the interviewees that will represent each case study, the interviews provide data for each case study analysis and eventually this data will help to understand the current situation, which will lead to identify the key elements used to develop roadmaps on collaborations in business ecosystems, as well as to recognize the factors that influence the roadmapping success on those projects and the different approaches that companies on business ecosystems have on roadmapping.

The questions that shape the interview are based on the findings from literature examined (refer to chapter 2) and they are drafted on a semi-structured interview (open-ended interview) design; the reason behind selecting a semi-structured interview approach is due to the fact that this method of research enables the interviewer to go beyond the set of questions scripted, this flexibility allows the opportunity to ask follow-up questions and let interviewees elaborate on these questions; depending on the feedback received, the interviewer can add more

questions or skip some, allowing new ideas to be brought up during the interview as a result of what the interviewee answers (Van Aken, 2007).

The interview protocol (refer to Appendix C) is composed of five sections as shown in Table 1, this table illustrates the purpose of each section and the information expected to be obtained from it.

Section of the interview	Information to be expected from the section
Interviewee Background	<ul style="list-style-type: none"> <li>• Work trajectory of the interviewee</li> <li>• Organization where the interviewee currently works</li> <li>• Job position in such organization</li> </ul>
Collaborations - Business Ecosystem	<ul style="list-style-type: none"> <li>• General idea of the collaboration projects or partnerships that the organization has</li> <li>• Goal(s) of such collaborations (Sivasubramaniam, 2012)</li> <li>• The role that the organization perform in these collaborations (Adner R. , 2006)</li> <li>• The resources or expertise that the organization bring into the collaborations (Adner R. K., 2010)</li> </ul>
Flow of information on business ecosystems – Roadmapping approach	<ul style="list-style-type: none"> <li>• Information about the use of roadmaps or similar project planning approach (Saritas, 2004) &amp; (Eckerson, 2006)</li> <li>• Key elements for a successful planning on a project (Barták R. S., 2010)</li> <li>• How to monitor the status of each project and its KPI's (Ernst, 2010)</li> <li>• Information sharing between the business ecosystem (stakeholders and shareholders) (Phaal R. M., 2009)</li> </ul>
Appropriation Mechanisms	<ul style="list-style-type: none"> <li>• Value in collaborations (Barfurth, 2002)</li> <li>• Goal alignment in collaborations (Albright, 2003)</li> <li>• Contractual agreements (Moore, 2006)</li> <li>• Relationship with the partners of the business ecosystem (Peltoniemi, 2004)</li> </ul>
Interaction Mechanisms	<ul style="list-style-type: none"> <li>• Trust and/or relational norms in collaborations</li> <li>• Contractual agreements (Moore, 2006)</li> <li>• Rules or guidelines in collaborations (Kogut, 1988)</li> </ul>

Table 1: Sections of the interview protocol

The first section of the interview, “*Interviewee Background*”, looks to understand how the interviewee by learning about his/her priorities, the work trajectory that he/she has follow up to date, some relevant anecdotes that could help enrich his/her profile

and with this information we will be able to grasp a better understanding on how the interviewee thinks and acts.

After the ice has been broken with the introductions, the following topic to be addressed is "*Collaborations - Business Ecosystem*", in this segment, the interview has the purpose of recollection experiences of the interviewee regarding collaboration projects in which he/she was involved, the information that will be acquired from these questions is the goals of such collaborations in order to understand why those collaborations are created, the roles that companies perform inside the collaborations, the balance of power and finally the resources or expertise that the companies bring into the collaborations.

After learning on how companies work on a business ecosystem environment, the next step is to gather information about the "*Flow of information on business ecosystems – Roadmapping approach*", this research is proposing the roadmapping methodology to effectively cope the project planning activities with a flexible approach; thus, learning how companies share information amongst each other and how do they illustrate such information in a way that everybody can understand without taking in consideration their backgrounds and how do they propagate the information to all the stakeholders of the project, this is a pivotal point for this research; hence, most of the questions of the interview are going to be focus on these topics.

The main topics of this section ask questions about the information used to create roadmaps and if the companies do not use this approach which similar project planning approach do they apply, the key elements that each company thinks conform a successful planning on a project, the monitoring tools that companies use to screen the status of each project and the most used KPI's per project, which of those are the most wide used and accepted, lastly the information sharing procedures applied on these business ecosystem, meaning, how do companies share information between the stakeholders and shareholders of the projects.

To expand the knowledge regarding why collaborations are created, the section of "*Appropriation Mechanisms*" was added to the interview, this topic was not added on the draft of the interview protocol, but as the research started to include more information about the interaction of companies that work on business ecosystems, this topic was found relevant for the research, thus, this section was added.

This set questions focus on the value generated on collaborations, how this value is shared among the companies involved, the main goal of collaborations and how the different goals of each company are aligned to create a shared goal, how relationships are built on these collaborations, this topic is link to contractual agreements and trust.

After examining the first set of interviews we realized that some questions arise about how trust is built in business ecosystems; therefore, another set of questions

was added to the interview, the new section was labeled, “Interaction Mechanisms”, the final segment of the interview covers the new questions that appeared, such as, how trust is achieved on business ecosystems, the relational norms used in collaborations, the prospect establishing of contractual agreements and if that case the rules and guidelines that have to be followed in collaborations.

### 3.4 Interviewees profile

In order for the interviews to be relevant to the research, some guidelines and qualifications have to be defined, the literature review has provided us with the insight required to define the interviewee profile.

After a careful analysis of the literature, some requirements for the interviewee candidate were defined, first it was decided that the interview candidate has to be personnel in charge or part of the staff involved on a collaboration project, joint venture and/or strategic alliance, because the setting for this study is an environment where multi-actors dwell.

The selected company has to be part of a business ecosystem with a current collaboration project on their portfolio roster; also the representative of the company has to be an active member of said project.

Based on those parameters, the selection process for the case study companies was implemented, since the study was performed on the region of Eindhoven, the Netherlands, the main search engines for the companies were: the website of Brainport Development<sup>1</sup>, High Tech Campus<sup>2</sup>, among others.

The representative of the company needs to have the authorization from its company to be part of this research study; since sensible information from the companies is going to be left out of this paper, the name of the interviewee as well as the name of the company that his/her is representing and specific project details will be removed from the context of this report, the reason behind this regulation is that this study is meant to build the theoretical knowledge about the different approaches and implications of the roadmapping process for a multiple actors setting; therefore, this kind of information only serves as reference material for the research.

### 3.5 Interviewees selection and Data collection

With the parameters for the interviewee candidates defined, the selection process for companies started, aided by websites containing information about industry in the region, several companies that fulfil the requirement for the study were selected.

---

<sup>1</sup> <http://businesscompassbrainport.nl/en/Home>

<sup>2</sup> <http://www.hightechcampus.com/companies>

An introduction email was sent to those companies with the highlights of the research and from the result of that search, the layout of the emails sent started by introducing the interviewer (myself) and the research proposal at hand, following by a request to support this research by enriching it with their participation and explaining the purpose of the study, also the interview protocol and questions to be asked on the interview were presented.

From the positive respondents the following companies were interviewed:

### **LightHouse – Expert on roadmapping process**

The company specializes on supporting its clients to design scenarios for solutions, their proposals are created with a mix of academic research and practical experience from working for renowned companies; they provide advice to companies on goal alignment strategies, building trust exercises, strategic planning activities and generating a shared vision, these tasks are achieved by designing realistic roadmaps and flexible business models, they also procure to involve the stakeholders in these processes. LightHouse is a partner of the Intelligent Lighting Institute (ILI); their offices reside at the Innovation Lab of the Eindhoven University of Technology<sup>3</sup> (TU/e).

### **Reason why the company was chosen:**

LightHouse offers to its clients a support service created from the amalgam of academic research and work experience of its employees, they help their clients to achieve a common language grounded on shared goals among all the parties involved on a project; in order to achieve that, LightHouse promotes workshops, because this open environment stimulates team building exercises and bonding experiences, that leads to build trust among the participants.

As part of the workshop methodology, LightHouse opts to apply the roadmapping approach as the planning tool, the reason behind this choice is that roadmaps offer a flexibility that mix well with the focus of the workshops, they offer a general approach which helps to foment the creation of a common language so everybody can stay tuned with the topics dealt and with the updates on the project.

This study chose LightHouse given their expertise on roadmapping processes, they supported this research study as guides and mentors; they helped to shape the interview protocol and assisted to draft the questions proposed in the interview layout.

Due to confidential agreement, sensitive information from the following companies, such as its names and specific project details were removed from the context of this report.

---

<sup>3</sup> <http://www.ili-lighthouse.nl/About.html>

### **Company L – Head of business ecosystem (small scale / internal)**

The main focus of this company is the development of innovative and high-quality personal peripherals that provide an enhanced digital experience for the computer users (PC and laptop users). This company has the role of the main hub of their ecosystem (Peltoniemi, 2004); their vast connections within the network provide them with the ability to attract and move resources, which in turn gives them a significant power in the ecosystem. As a big player of their ecosystem Company L has many benefits but those do not come with challenges.

#### **Reason why the company was chosen:**

Company L is part of an ecosystem with a small number of members; most of them are suppliers with whom they have development projects of components for their products. Inside this small ecosystem, Company L prioritizes having strong ties with the members of the network.

They possess great influence in its ecosystem; they attained that condition thanks to the vast and strong connections that they established in their network, these connections allow them to attract and move resources with ease inside their ecosystem. This company has situated itself on a strategic position where they are able to lead and shape their surroundings to their utmost convenience.

This study contemplates Company L as a pivotal case study, because we can learn from them the practices that they use to manage their ecosystem as a lead actor, such as, how they promote goal alignment amongst all the actors across the network, in the same way which strategic planning tools do they use and how they convey information to all the stakeholders,

Company case study can also be useful as a comparison between Company O which is in a reverse condition; they recently became a new member of a big ecosystem composed of several actors, in this case they are not leading but learning how to interact with their neighbors in the ecosystem.

### **Company O – Part of a business ecosystem (big scale / external)**

This company designs, manufactures and sells printing and copying hardware with their related software. Company O has research, development and production facilities all around the world. In order to provide a better offer for their clients, they have opted to establish a strategic alliance with Group C; this Group has more experience on the market, also they have a bigger infrastructure on the Asian market, this provides a launching platform for Company O to expand their targeted market, Company O is perceiving many benefits from this union but at the same time now they form part of a big scale ecosystem which has shown to arrive with challenges that they have not faced on the past, Company O has to make changes and reevaluate their project planning process to be able to manage a wider number of stakeholders that they are used to.



**Reason why the company was chosen:**

Company O decided to enter a business ecosystem with multiple actors because of the benefits that will receive from it, such as, support on new projects, learning form more experienced partners and connections with actor outside their locality, just to mention some of the most relevant reasons.

As a new and inexperienced player on a business ecosystem with numerous actors, Company O provides an antonym case study to one of Company L, this comparison of case studies will enriches this research study given that it will show the similarities and differences of how the roadmapping approach is applied in a small and enclose business ecosystem against a big ecosystem with multiple actors scatter across the ecosystem.

**Company SEMATECH – Case study example from literature (Kostoff, 2001)**

From the literature reviewed an example about roadmapping implementation (Kostoff, 2001) was extracted; the company from the study chosen is a manufacturer of semiconductors (for further details refer to Appendix D). This example is used as comparison point to refer the findings about the cases studies obtained from the interviewing process.

**Reason why the company was chosen:**

This case study serves as an example of how literature has registered the implementation of the roadmapping process; it will serve as comparison of the knowledge acquired on the literature study against the data recollected from the case studies from the interviewing process.

Further detailed information on the companies selected as case studies will be provided on the following chapter, such as, an extended description of the company and its activates, the reason to choose that company and the role of the representative of the company.

A summary of the company profile and number of interviews per case study can be seen on Table 2.

	Industry	Reason for choosing the company	Number of Interviews
LightHouse	Consulting	Experts on roadmapping process, source of valuable knowledge because of their mix of academic research and work experience	2
Company L	Computing peripherals	Head of their business ecosystem, small scale	1
Company O	Printing and copying (hardware and software)	Part of a big scale business ecosystem	1
Company SEMATECH	Semiconductors	Case study extracted as an example from literature	-

Table 2: Interview Matrix

### 3.6 Coding

To analyze the information contained on the recorded interviews, those records were transcript in order to thoroughly study its contents; software that provides a platform that helps the user to easily organize and analyze unstructured information was used to work with the transcript interviews.

Scholars such as Borgh, M. (2012) and Ying (1981) recommend following an open approach to analyze the gathered data from the interviews, this approach provides a flexible coding procedure, which allows making changes on the coding categories, either by modifying stablished definitions or the deletion of categories.

The interviews transcripts are divided on fragments, after analyzing the info from each fragment; they are rated based on the meaningfulness and relevance for the research, with 1 as the highest value and 3 as the lowest, this procedure was based on the knowledge acquired on chapter 2.

When a fragment is considered relevant, a label is placed on it (i.e. code), the codes used are the main topics defined for the research: ***“Collaborations in Business Ecosystem, Flow of information on business ecosystems – Roadmapping approach, Appropriation and Interaction Mechanisms”***.

Each fragment that provides information of one of the main topics of the study is labeled with the following codification:

A - Interviewee Background

B - Collaborations in Business Ecosystem

C - Flow of information on business ecosystems / Roadmapping approach

D - Appropriation Mechanisms

## E - Interaction Mechanisms

After completing this task, the codes are reviewed to verify if they cover all the findings from the literature review or whether new codes needed to added.

Additionally, the codes are classified on subcategories; a set of similar codes can be combined to create a subcategory that covers the data in a more optimal way or codes can be separated due to its low compatibility with the context of the research.

The codes subcategories are the following:

### **A - Interviewee Background**

1. Work trajectory of the interviewee
2. Organization where the interviewee currently works
3. Job position in such organization

### **B - Collaborations in Business Ecosystem**

1. General idea of the collaboration projects or partnerships of the company
2. Goal(s) of such collaborations
3. The role that the organization perform in these collaborations
4. The resources or expertise that the organization bring into the collaborations

### **C - Flow of information on business ecosystems / Roadmapping approach**

1. Information about the use of roadmaps or similar project planning approach
2. Key elements of a successful planning on a project
3. How to monitor the status of each project and its KPI's
4. Information sharing between the business ecosystem (stakeholders and shareholders)

### **D - Appropriation Mechanisms**

1. Value in collaborations
2. Goal alignment in collaborations
3. Contractual agreements
4. Relationship with the partners of the business ecosystem

### **E - Interaction Mechanisms**

1. Trust and/or relational norms in collaborations
2. Contractual agreements
3. Rules or guidelines in collaborations

The next step is to perform an axial coding approach, this approach focus on analyzing each category by cross referencing it to the literature review, analyzing the elements that conforms a category and subcategories, and how they relate to each other.

### 3.7 Validity and reliability

After collecting and analyzing the data gathered, Ying (1994) recommends that when the information used on a research is based on qualitative data, it is advisable to ensure the quality of the research by several measures in order to improve the validity and reliability of the data presented.

Ying (1994) segmented the concept of validity into 3 categories (Table 3): Construct, Internal and External, following these methods of quality assurance for the research, each will be addressed according to the recommendations of Yin (1994).

<b>Assurance method</b>	<b>Method of approach</b>
Construct Validity	• Multiple sources of evidence
	• Maintain chain of evidence
	• Use of informants
Internal Validity	• Pattern matching
	• Explanation building
	• Time-series analysis
External Validity	• Replication logic in multiple case studies
Reliability	• Case study protocol
	• Case study database

Table 3: Validity and Reliability Methods (Yin, 1994)

#### 3.7.1 Validity

To improve the validity of the analyses, this task was accomplished by assessing to what extent the relationships found in the data concurred with the findings from literature. Following, each of Yin (1994) assurance methods to improve the validity of the study will be addressed.

##### **A) Construct Validity**

This methodology strives to find the correct operational measures for the phenomenon that is studied; according to Yin (1994) this can be achieved by increasing the triangulation, which refers to include in the research multiple sources of data for an event (i.e. multiple respondents within a case).

The primary source of data collection for this research is the interviews, aside from that; this research complemented the analysis of the interviews by cross referencing the findings against the knowledge acquired from the literature review.

Aside from LightHouse that provided two interviews, each case study correspond to one interview per company.

### **B) Internal Validity**

To improve the internal validity of the research, TU/e tutors of this study reviewed the paper, their analysis and suggestions based on their expertise and experience, guided this research towards a more relevant and meaningful material.

To complement these annotations, fellow colleges from the faculty helped with the coding procedure, which proved to avoid overlooking data that could have meaningful information.

### **C) External Validity**

The concept of external validity refers to the ability to generalize the study beyond the presented case. As stated before referring to Yin's (1994) guidelines for working with case study analysis, while case studies tend to be often criticized for their supposed lack of external validity, it should be kept in mind that this research deals with qualitative data in the form of the case studies (i.e. interviews); therefore; this research does not rely on statistical but on analytical generalization of data, this means that the results obtained from the analysis of case studies can be generalized not to other cases but to a broader theory (Yin, 1981).

## **3.7.2 Reliability**

Reliability can be defined as the quality or state of being *reliable*, the extent to which an experiment, test or measuring procedure yields the same results on repeated trials<sup>4</sup>. Interviews sometimes are regarded as a less reliable option for building causalities; this statement is based on possible interviewer bias and changing social beliefs and opinions (Van Aken, 2007), but as Yin (1994) stated, high reliability can be assured by supporting and improving the results with multiple sources of information.

Additionally, the results of the case study analysis were presented on a structured way and the chain of evidence was maintained by the transcription of the recorded interviews, using a specialized software to code the interviews and by asking fellow colleges to help in the coding process so the work can be compared and proved that the results match with more than one operator.

---

<sup>4</sup> [www.merriam-webster.com/dictionary/reliability](http://www.merriam-webster.com/dictionary/reliability)

## 4 Results

This chapter will provide a thorough analysis of the information collected from the interviews; in the same way, the research question as well as the sub research question will be addressed and answered with the data input obtained from the coding procedure and the categorization of findings; first the companies involved on the study will be presented on detail, following the results from each interview will be explained and cross referenced against the findings from the literature review, propositions will be drawn on the similarities of the results between companies and the differences will be examined.

### 4.1 Introduction of Case Studies

Let's recapitulate, Yin (1981) recommends to implement a multiple-case studies analysis approach when dealing with the afore mentioned scenario, given that case studies can replicate between each other, either predicting similar results (literal replication) or contrasting results (theoretical replication).

With the aids of search engines, emails were sent to companies that fitted the profile established for an interviewee candidate, from the positive respondents the following companies were carefully chosen for the interviewing process:

#### 4.1.1 LightHouse – Expert on roadmapping process

##### **Description of the company:**

This consulting firm is a solution partner of the Intelligent Lighting Institute (ILI) at the Eindhoven University of Technology. It aims to disclose the knowledge of the ILI research programs for society. LightHouse makes concrete project proposals for specific requests of clients which integrate the knowledge of ILI, the competences of students and the practical experience of the project producers.

In this way, the research, design and advice requests can be answered promptly, by adapting to the required speed for clients.

LightHouse mission is search for make meaningful innovations in a city context that add value to the citizens, with this mind set we are looking how to go away from technology push to a needs driven innovation.

The value producers of the firm oversee the whole process of understanding the issues at hand, reframing the questions asked, generating a shared vision among the parties, designing scenarios for solutions, building realistic roadmaps and business models, involving stakeholders and facilitating dialogues, preserving the integrity of the solution during the realization phase, and communicating the results.

By integrating their experience working for top companies with the knowledge produced from their research studies at technical universities, LightHouse offers robust and well-structured solutions to its clients.

One of their esteemed offerings is the roadmapping approach, which they use on every project that they work, as a pinnacle strategic planning tool; roadmapping fits optimally with the workshops that they launch at the start of a project, given its flexibility and adaptability.

Roadmapping provides the necessary support for every client, by addressing all the suggestions and propositions, creating a consensus that is reflected on a common language that will develop on a shared vision and goal alignment.

By working with this methodology for several years at industry level and later by improving it with the findings from their research studies, LightHouse provides a solid proposal with the roadmapping approach; since, this tool can tackle the strategic planning role for their client's projects by providing structure and guidelines, while at the same time fostering creativity and communication.

**Role of the representative:**

The personnel interviewed from LightHouse were the heads of the company; they provided insight of the work performed on the workshops as mediators for their clients on the workshops, support to designing scenarios for solutions, advisers for goal alignment and promoters of the roadmapping planning tool.

As the company expert on implementation of the roadmapping process, the interviews for LightHouse will be used as reference material for this study.

## 4.1.2 Company L – Head of the business ecosystem

**Description of the company:**

Due to confidential agreement, sensible information from this company, such as its name and specific project details were removed from the context of this report. Company L primarily focuses on the development of innovative and high-quality personal peripherals that provide an enhanced digital experience.

The company vision is to be the world leader in computer products design with a wide range of interface equipment (i.e. computer mouse, speakers, etc.), this will be achieved by renewing the design time and time to meet the evolving needs of PC and laptop users. Their products are sold in almost every country in the world. Their leadership in innovation is reflected on the wide variety of personal peripherals (both cordless and corded), with special emphasis on products for PC navigation, gaming, Internet communications, digital music, home-entertainment control.

They digitally monitor the feedback from their customers, armed with this information, they strive to generate a richer experience with their devices, more comfortable, more productive and more convenient, and they define this philosophy as: *“devices that are a pleasure to work with”*.

**Role of the representative:**

The representative of Company L is an active member of the project management team that coordinates several collaboration projects with the actors of their ecosystem, his presence in this study shed light on how an experienced company interacts with their partners on the business ecosystem.

### 4.1.3 Company O – Part of a business ecosystem

**Description of the company:**

Due to confidential agreement, sensible information from this company, such as its name and specific project details were removed from the context of this report. Company O develops manufactures and sells printing, copying hardware and related software. Their offering includes office printing and copying systems; production printers and wide format printing systems for both technical documentation and color display graphics. Company O has research, development and production facilities all around the world.

Recently, Company has become part of a larger group that also has similar product offerings as them, this Group C has more experience on the market and they have a bigger infrastructure on the Asian market, hence, this alliance benefits Company O by opening the doors to new market opportunities, these changes made Company O reevaluate their project planning process to be able to manage a wider number of stakeholders that they are used to.

**Role of the representative:**

The personnel interviewed from company O is member of the team that works and interacts with multiple actors of the ecosystem, he performs analytical and planning activities, he has direct contact and constantly with the representatives of the members of the ecosystem.

### 4.1.4 Company SEMATECH – Case study example from literature (Kostoff, 2001)

**Description of the company:**

From the literature reviewed, we obtained an example about roadmapping implementation (Kostoff, 2001), the context of the example is a manufacturer company and the project studied is the development of semiconductors (for further



details refer to Appendix D). The example follows the steps described on section **2.3 Roadmapping Process** of this research. The purpose of using this example is to cross reference the data gathered from the interviews against the knowledge received from the literature review, this procedure will enrich the analysis of the interviews because we can compare the results and formulate propositions considering literature material as well as field data.

**Role of the representative:**

This case study is an example extracted from literature (Kostoff, 2001).

## 4.2 Data analysis

Following the methodology described on chapter 3, the interviews were transcript and examined with specialized analytical software, each case study was examined individually, the relevant information found through the analysis was coded and segregated; a summary of the information gathered can be found on Table 4 for LightHouse, as this case study was considered pivotal for the reason that the information acquired on the interviews was provided from experts on the roadmapping process, also the answers provided are used as reference material for the proposition of the study, Tables 5 and 6 provide the summaries for the case studies.

The categories used to classify the findings are based on the outcome from the literature review; these topics were selected due to the great influence found on the implementation of the roadmapping methodology in a business ecosystem setting.

The first category, **Collaborations - Business Ecosystem**, looks to understand the reason(s) behind establishing collaboration projects and the resource that the interviewed company offers, the next topic, **Flow of information on business ecosystems**, focus on the communication among partners, how this is achieved and which elements are considered relevant to share with the stakeholders, the final segment is about the appropriation and interaction mechanisms, the **appropriation mechanisms** on the value captured on the collaborations, goal alignment among all the parties involved and their relationships. The **interaction mechanisms** discuss how companies build trust on the collaborations, guidelines and contractual agreements.

		Collaborations - Business Ecosystem				Appropriation Mechanisms			
Industry		Reason for establishing collaboration projects or partnerships	Goal(s) for collaborations	Role that the organization has in these collaborations	Resources or expertise that the organization bring into the collaborations	Value in collaborations	Goal alignment in collaborations	Relationship with the partners of the business ecosystem	
LightHouse	Consulting	Provide designs of solutions to their clients based on the academic research	Apply their methodology of designing solutions based on a mix of academic research and work experience	Consulting role, mediator	Academic knowledge and work experience	Knowledge sharing to develop new products and services	Creation of common language and shared vision through workshops	Relationship based on trust and mutual understanding	
		<b>Flow of information on business ecosystems – Roadmapping approach</b>				<b>Interaction Mechanisms</b>			
		Information about the use of roadmaps or similar project planning approach	Key elements for successful planning on a project	Monitor the status of projects	Information sharing between the business ecosystem	Trust and/or relational norms in collaborations	Contractual agreements	Rules or guidelines in collaborations	
		Experts on roadmapping methodology	Communication, goal alignment, shared language, people	Communication with clients, workshops	Workshops	Open innovation environments require trust	No	Initial agreements	

Table 4: Results from the LightHouse interviews

		Collaborations - Business Ecosystem				Flow of information on business ecosystems – Roadmapping approach			
	Industry	Reason for establishing collaboration projects or partnerships	Goal(s) for collaborations	Role that the organization has in these collaborations	Resources or expertise that the organization bring into the collaborations	Information about the use of roadmaps or similar project planning approach	Key elements for successful planning on a project	Monitor the status of projects	Information sharing between the business ecosystem
<b>Company L</b>	Computing peripherals	Improve their current line of products and generate new ones	Development of new technology for their products, improve the quality of work of their suppliers	Lead role, management, support	Expertise in their field, monetary resources and research facilities	Technology layouts - similar to technology Roadmaps	Detailed plan of activities, follow up status, communication	Weekly project meetings, status on dashboards	Emails and meetings
<b>Company O</b>	Printing and copying (hardware and software)	Develop of new software, increase their market reach	Use resources that they do not have	Team player, new actor in learning process	Experience on the local market, expertise on their field	Risk based planning tool	Risk analysis, planned schedule, lessons learned	Weekly meetings, Company format (Planned activities vs Real time)	Meetings
<b>Company SEMATECH</b>	Semiconductors	Develop new technology for their products	Development of new technology	Planning and support	Example of experience in their field	Example of roadmapping from literature	Definition of the project, detailed planning	Status meetings	-

Table 5: Results from the interviews 1

		Collaborations - Business Ecosystem				Flow of information on business ecosystems – Roadmapping approach			
	Industry	Reason for establishing collaboration projects or partnerships	Goal(s) for collaborations	Role that the organization has in these collaborations	Resources or expertise that the organization bring into the collaborations	Information about the use of roadmaps or similar project planning approach	Key elements for successful planning on a project	Monitor the status of projects	Information sharing between the business ecosystem
<b>Company L</b>	Computing peripherals	Improve their current line of products and generate new ones	Development of new technology for their products, improve the quality of work of their suppliers	Lead role, management, support	Expertise in their field, monetary resources and research facilities	Technology layouts - similar to technology Roadmaps	Detailed plan of activities, follow up status, communication	Weekly project meetings, status on dashboards	Emails and meetings
<b>Company O</b>	Printing and copying (hardware and software)	Develop of new software, increase their market reach	Use resources that they do not have	Team player, new actor in learning process	Experience on the local market, expertise on their field	Risk based planning tool	Risk analysis, planned schedule, lessons learned	Weekly meetings, Company format (Planned activities vs Real time)	Meetings
<b>Company SEMATECH</b>	Semiconductors	Develop new technology for their products	Development of new technology	Planning and support	Example of experience in their field	Example of roadmapping from literature	Definition of the project, detailed planning	Status meetings	-

Table 6: Results from the interviews 2

After the results were classified, a cross reference analysis of the data was done to examine the similarities and differences among the cases studies.

### **Goal alignment**

A difference appeared on the topic of setting goals for the collaborations, while the companies usually defines such goals on the initial negotiations and contractual agreements (Moore, 2006) and (Stephen, 2007), LightHouse recommends to work towards a common language with workshops, with this the companies will interact and shared ideas until a shared vision and commons goals are defined.

The way that LightHouse works right now is with workshops, by creating these open settings everybody can convey their opinions and express their thoughts/concerns, the main purpose is not for everybody to agree on some topics but instead to understand why some people prefers something or why they like an idea, so that we along the way gain a deeper understanding of the motivations and the drivers that people have (refer to Table 4).

“I believe very much on the discussions that arise. In these workshops we go step by step asking questions to make sure that everybody has the opportunity to express their thoughts, this structure help us avoid chaos, we discuss the structure and what do we need to know first. We work with posters, lots of posters to eventually design the roadmaps”. - dr. ir. Elke den Ouden, LightHouse, 2015.

All the interviewees agree that sometimes not all the people involved on the project are open which reflects on resistance to adapt to the changes on the project (refer to Tables 4, 5 and 6).

Griffin, a., et al. (1996) talks about the measures that defines the success or failure of projects, a key element in any project it is goal alignment, nevertheless, it is worth mention that strict negotiation and formality (De Dreu, 2010) tend to suffocate the creativity on an open innovation project (Amabile, 1998).

“Most of the time people are stuck in the now; hence they are not always aware of what may come, LightHouse takes those visions to the future so they can translate those future or evolved needs into roadmaps to understand the steps that they need to take to get there. *Trigger them to dream, dare them to dream!*” - dr. ir. Rianne Valkenburg, LightHouse, 2015.

### **Flow of information**

The following topic is information that companies consider relevant to convey to the stakeholders, while the most traditional approach is to compare the planned activities against the real time (Barták R. S., 2010), Company O stresses that the information that they convey are the risk that each stage signifies and the resources to be invested, “We classify the tasks to be performed on each project by risk categories,

that way we only review on weekly basis the hot topic ” – Company O representative, 2015 (refer to Tables 5 and 6).

While Company L prefers short daily meetings just for the review the status of the projects and weekly meetings to follow on the programmed tasks, “Fast daily meetings keep the flow of information smooth, that way we only focus time on the most critical items” - Company L representative, 2015.

In both cases the communication among partners tend to be limited but concise, each company has found their optimal time and frequency for each meeting, LightHouse also concurs that excess of communication will lead to demotivation, long and periodical meetings tend to provide small quantities of new information, however, those meetings still consume time (refer to Table 4).

“We know that we did not be there all the time, we do not have regular meetings but we regularly monitor the progress and if we feel that the energy is dropping out of it, we organize other events to regain the momentum and make sure that they keep on going and do not stop for the lack of discussion or inspiration”. - dr. ir. Elke den Ouden, LightHouse, 2015.

In this case Lighthouse acclaims that workshops renew the interest on the projects and keep the communication flowing through the interactions and debates, the workshops are only done when they are needed, even though that the workshops are not periodical, LightHouse procures to monitor each company frequently (refer to Table 4).

### ***Monitoring tools for projects***

Both companies apply similar strategic planning tool, although none uses the term roadmapping to refer to them, nonetheless the design of the formats are closely related.

Company O tracks the status of each task and compare them with the programing, real time vs planned time, each activity has a sequence but in every stage a risk management study is performed, this way the critical activities will received more attention (refer to Tables 5 and 6).

In the case of Company L, they use dashboards on the meeting areas, these items are updated with daily basis and everybody can access them (refer to Tables 5 and 6).

LightHouse recommends the use of roadmaps, they are flexible tools that can be adapted in every stage of the project, it is part of the project and it is the start for the implementation of the project, for LightHouse a roadmap is the aim because it gives the Stakeholders’ network or ecosystem a common goal for the years to come, “We do not only include technology roadmaps, we try to make them more broad so we can include the other challenges that we need to overcome, not only the

technological one; when we think about a project, we do not only think about technologies but also we talk about transitions, collaborations, evolution, human behavior, because every aspect needs to change along”. - dr. ir. Rianne Valkenburg, LightHouse, 2015.

All the interviewees agree that graphical representations are easier to visualize, formats may vary but the essence is the same, it is useful if everybody is using the same system because all the members will be using the same language and everybody can learn from each other's strong points.

Roadmaps bring a flexible approach that allows us to easily modify or update information along the way of the project without big communication problems.

### ***Appropriation Mechanisms***

All the companies find value on the collaboration projects, that value can either be the development of new technology or the use of resources that they do not possess, every party looks to gain something from the other, knowledge, experience, resources, etc. (refer to Tables 4, 5 and 6).

This finding is supported by the studies of scholars such as (Adner, R., et al., 2010), Anggraeni, E., et al., 2007, Borgh, M., 2012, Iansiti, M., et al., 200) and Kogut, B., 1988); in these researches they provide us with insight regarding the reason and benefits of forming collaboration projects.

Both companies labor in similar way, formal relationships based on prior negotiations and contractual agreements (Moore, 2006), although LightHouse does not deny this, they recommend to start the collaborations with workshops, in this kind of gatherings, all the parties can interact, share experiences and work towards establishing common goals and a shared vision, and finally when everybody uses the same language, the negotiations and contractual agreements can take place (refer to Table 4).

“In this kind of process as soon as you bring lawyers to the table, innovation is dead. The only thing that we invest on these projects is our mind, so everybody is free to withdraw something, only what we say is on the table; consequently, we try to avoid contracts and confidentiality agreements, and since we are on the fuzzy end of innovation, we can do that, because the roadmap that we develop are more general and do not show IP been developed specifically.” - dr. ir. Rianne Valkenburg, LightHouse, 2015.

### ***Interaction Mechanisms***

Continuing with the same line of thought, LightHouse suggests a relationship based on mutual trust, which reinforces the findings of Moore, J. (2006), while the other companies are more rigid and prefer to set all the agreements with contract.

LightHouse expresses that in open innovation environments, contracts tend to limit the relationships, which in turn hinders the communication, creativity and possible outcomes (refer to Table 4), this finding will be further explored on the next chapter.

Albeit, the items that the companies consider are closely similar, none of them takes the human factor as a relevant point to be observed on the projects (Peltoniemi, 2004), in the experience of LightHouse, people leaves projects for several number of reasons, even though companies understand this statement they do not usually plan for this foreseen event, in the following chapter this topic will be dealt with more detail.

The critical factor of all projects is people, since these open innovation environments require building trust between all the party members; sometimes there are people that do not click with each other, people can change along the project, so each company need to create backups to avoid losing information because of these changes.

“In LightHouse we recommend to have open systems that allows participation of different parties not only the initial ones because we do not want to close the door to possible new ideas, this is due to our experience, we have seen companies that do not want to step out of their comfort zone and if a similar company come along and they are willing to be more cooperative, we can still adapt the project to these changes. In this sense we think that contracts have to evolve, to be more flexible and open to these changes.” - dr. ir. Elke den Ouden, LightHouse, 2015.

### ***Other Relevant Findings***

Insights found on the interviews that are worth to mention and are not draft on Tables 4 - 6; we found out that some people see the roadmapping process as a standalone deliverable that arises from an apparent crisis or need, instead of a strategic planning tool that can be applied to any project, since the conception of the project until the end.

Interviewees concurred that a major cause of frustration that detracts the initiative to design and/or implement roadmaps is the perception of sudden and arbitrary changes on policies and assignments.

In the same manner, interviewees agreed that if only these type of changes were alerted in advance, the team could prepare the ground to receive the changes with the least impact possible.

Another interesting finding from the interviews is that even when a mutual understanding is achieved by all the parties involved on the developing process of roadmaps, follow up actions need to be established, in order to continually maintain that equilibrium and to be prepared for possible changes on the future.



### 4.3 Answer to research question and sub research question

Based on the knowledge acquired from the literature review and the findings obtained by the interviews, this research will provide the support to properly answer the research question that started this paper, but before that, this research will address the following sub research question in order to provide background for the answer of the main research question:

- ***Which key elements (conditions) make more likely for a “roadmap” to be successfully applied in environments with multiple actors involved?***

From the findings obtained in the analysis of the interviews, this study presents the conditions to successfully implement a roadmapping process on a business ecosystem are:

- A) Projects developed on open innovation environments, require planning tools that foster creativity, the flexibility of the roadmapping approach can provide that setting.**

LightHouse has proved by experience that in collaboration projects created on business ecosystems, rigid strategies tend to locked the potential of improvement and creativity, the flexibility and adaptability that roadmapping provides, ensures that all the procedures are updated as they see fit.

Roadmapping is a methodology that encourages continuously evolving, but at the same time it is based on a common language that all the members of the projects understands, following the principles of the shared vision and common goals,

“In LightHouse we recommend to have open systems that allows participation of different parties not only the initial ones because we do not want to close the door to possible new ideas, this is due to our experience, we have seen companies that do not want to step out of their comfort zone and if a similar company come along and they are willing to be more cooperative, we can still adapt the project to these changes. In this sense we think that contracts have to evolve, to be more flexible and open to these changes” - dr. ir. Elke den Ouden, LightHouse, 2015.

- B) The communication among partners is an essential key to successful projects,**

As LightHouse states, the roadmapping approach works better on workshops, because they are based on improving the communication among the members.

LightHouse promotes workshops as a tool to integrate the stakeholders involved on the projects, they use lots of notes to collect the information and structure it on the roadmaps. Since the start of the project they integrate as many stakeholders as possible, so when they participate on the workshops, they can feel that they

ideas are giving birth to the vision and roadmaps, therefore they become co-owners of the ideas and they will work more willingly towards those shared goals.

Workshops serve as a medium for the parties involved knowing each other ideas and propositions, to generate a better understanding and to develop a shared vision and a common language along the way.

**C) Projects were partners can and are able to trust each other are more likely to produce better results, because hindering conditions are minimized and all the parties are able to work more freely while contributing their optimal work.**

Companies are used to work based on a supply chain model, but every day more companies are adapting to open business ecosystems, ecosystems create a bond between the parties involved, these bonds enhance trust and improve the work environment.

By motivating all the parties involved in collaboration projects to generate a share vision, they also create a bond between them.

**D) Companies fail to seize the importance of people on the projects, the people that started on a project sometimes is not the same that finish it; therefore, integrating the factor of people involved on a project can foresee changes on the staff.**

People change jobs or responsibilities which will hinder the progress of the project; in LightHouse experience, they have learn to adapt to these situations, take measures like giving more time in between those roles are filled, so the new people can learn and be on the same page like everybody.

It is hard to predict those changes; that is why roadmaps are made from a general point of view, so it is easier for new people to understand them.

With the bases established by the responding the sub research question, this paper will focus on answer the main research question: ***What are the different approaches and implications of the roadmapping process for a multiple actors setting?***

According to literature, the roadmapping approach can be applied depending of its context (Phaal R. F., 2001), the planning can be based on the products or services, on a strategic level that focus on the markets and business tendencies, in the knowledge capabilities and business goals of the company, in a specific process or in the evolution of the technology.

Considering these approaches that the roadmapping methodology can have and extrapolating the insights from the interviews, as LightHouse proposes, a more

general approach to roadmapping can provide better results, given that the roadmap will conserve its flexibility, it will work with the shared goals developed with all the parties involved and can be easy to interpret thanks that it is based on a common language.

Business Ecosystems consist of a setting where multiple actors converge, as the number of actors increase, more complications will rise, there will be breaches, such as, different technical expertise and experience, different languages, and these conditions can create constraints to the project.

The proposal of a general roadmapping approach pretend to cover these hindering conditions by offering a strategic planning tool that begins for sowing the seeds of communication, by discussing and analyzing all the points of view from each party, it will be easier to amalgam a shared vision of the project (refer to Figure 4 -1).



Figure 4-1: Roadmapping Contributions

With a solid base such as a shared vision, the goals for the collaboration can be set, to achieve this feat, the roadmapping approach offers flexibility, which is reflected on the easiness to update information on the roadmap, the changes can be tracked swiftly because all the members are aware of the status of the project, the task that encompass it and it is written on a common language developed through everybody consensus.

## 5 Discussion & Managerial Implications

With this section, the final arguments for this study will be provided; the chapter will start with a discussion about the findings of this research, highlighting the similarities with the information contained in the literature and debating the differences, it will proceed to expose the managerial implications that could arrive from the findings of the research and it will close with some proportions.

### 5.1 Discussion

The purpose of this research was to investigate the implementation of the roadmapping approach on a business ecosystem (multiple actors) setting, through a literature study and case studies analysis some insight about the topic was obtained.

While dealing with multiple actors several considerations have to be taken into account, as the number of members increases so the number of conflicts will rise, it will be more difficult to settle commitments (Anggraeni, 2007), to agree on topics and to manage the system (Stephen, 2007), roadmapping offers a flexible approach that can be modified according to the situation (Cosner, 2007), the roadmaps can be created on workshops, this environment fosters creativity and sponsor openness, by discussing ideas in workshops a shared vision can be created.

LightHouse mentioned that companies do not have contingent plans for the people involved on the projects, in the interviews this topic was addressed, even though all the companies recognized the importance of the people working on a project, none have that factor included on their plans.

Therefore, some contingency has to be set, cross training people involved on a project can be beneficial, since the company will have a substitute in case that they need it, also the representative of the company has to keep the steering committee of the company informed and updated of the status of the collaboration project.

Every company wants to capture value from collaborating in a business ecosystem (Adner R. K., 2010), roadmapping offers a balance where all the companies add the resources that they have in order to benefit the project agreements are made in order to equilibrate the benefits that collaborations bring.

Collaboration projects are increasing in popularity given the number of benefits that they provide, small players can use the obtained resources that by themselves they will be unable to acquire (Peltoniemi, 2004).

Companies are still reluctant to be part of a business ecosystem since some projects are based on mutual trust instead of contractual agreements, roadmapping is a planning tool that can be fitted on relationships based on trust, the common language

necessary to create a roadmap it is also based on interaction among the parties involved and are based on mutual trust (Adner R. K., 2010).

## 5.2 Managerial Implications

Roadmapping is an iterative process that fits within strategic planning, technology planning and business development contexts (Albright, R., 2003, Daim, T., 2014, Moehrle, M., 2013 and Phaal, R., 2001). However, since there are many successful variations of strategic planning, technology planning, and business development processes, which contributions can make the roadmapping approach the default choice (Aguilar, 2004)?

To begin, roadmapping is a strategic planning tool that offers flexibility to integrate or modify information; it is written on a common language that is easy to understand and it is established on a mutual trust relationship.

Companies benefits from been part of a business ecosystem given that they can share their resources and in return acquire experience, resources that they do not have, connections and new business opportunities, the reasons afore mentioned can be fulfilled with the implementation of the roadmapping approach on collaboration projects.

## 5.3 Propositions

This research highly recommends the use of the roadmapping methodology on projects with multiple actors interact, the process will star with a workshop as recommend by LightHouse, in that forum the participants will have their voice heard and their ideas will be communicated.

By discussing the proposals of everybody, commitments can be established by creating a shared vision, goal of the parties can differ but they should lead the project to the same conclusion following the shared vision.

With a common language generated from the interaction of the parties, the creation of the roadmap can start; this tool is easy to design and continues with that trend.

People have to take a more central role in these projects based on initially on mutual trust; cross training of representatives from each party is highly recommended and frequent status meetings.

## 6 Conclusions

This thesis project started just with a word, “roadmapping”, from there the literature review process began, and by applying the snowball technique, relevant and complementary subjects appeared, such as: technology roadmap, open innovation, business networks and business ecosystems, goal alignment, trust and value creation.

The analysis of the selected literature gave us the knowledge to develop propositions that served as the structure for the research; the proposal statements were the following:

- A) Projects developed on open innovation environments, require planning tools that foster creativity (De Dreu, 2010).
- B) The communication among partners is an essential key to successful projects (Albright, 2003).
- C) Projects where partners can and are able to trust each other are more likely to produce better results (Moore, 2006).
- D) Companies fail to seize the importance of the human factor on the projects (Griffeth, 2000).

The propositions were converted on to the layout of the interview protocol, the companies that contribute on the study were: LightHouse (firm expert on roadmapping), Company L (Head of the business ecosystem) and Company O (Part of a business ecosystem), also a case study example from the literature – Company SEMATECH.

From the examination of the interviews we corroborated the validity of the initial propositions, while doing the inspection of the transcripts from the interviews, we discovered the conditions that the roadmapping approach requires for its implementation on a multi-actor setting (Business Ecosystem).

The conditions are: Goal alignment created from a shared vision, effectively flow of information among the partners, proper monitoring tools for projects, trust building and value creation mechanisms.

We also found out that some people see the roadmapping process as a standalone deliverable instead of a strategic planning tool; likewise, sudden and arbitrary changes on policies and assignments are detrimental for the implementation of roadmaps.

## 6.1 Limitations of the research

This research study was subject to some limitations that were confronted by the best efforts of the author, some of the most relevant hurdles were rooted on the methodology and the conceptual method used.

To start with, the initial framework of this study was grounded on the knowledge acquired by the literature review; this shed some light for the topic at hand. However, due to the limited material available regarding roadmapping process on a general setting not all factors/variables were covered on the initial conceptual framework, the reason behind this was that the majority of the material tend to focus on a specific type of roadmap, "*technology roadmap*", but this research wanted to address the topic from a general perspective not only focusing on technological paths; in spite of that, the structure of the interview protocol was devised to include open questions which allowed the interviewees to talk freely and provided information outside the pre-defined model, that way this limitation was partially overcome.

This approach proved to be the right choice when the interviews provided new insights for the research, which in turn improved the conceptual framework of the study, to cope with the new findings, the interview protocol was updated and the research questions were reformulated.

The second limitation was encountered at the stage of data recollection from the interviews, the number of respondents was limited and the whole population used on the study is from the same locality (Eindhoven), the environment surrounding the companies was technology driven; based on all these factors some questions arise such as: Can the same proposition be valid on an environment not technological focus? Do different localities on the same business branch behave on the same way? What will be the results obtained by performing the same study on different countries? Just to mention some.

Regarding the limited number of respondents not much can be done due to the fact this is tied to the initial planning of the research, more time would equal to more opportunities to gather more respondents; to deal with the questions concerning the locality, the interview protocol (shown in Appendix C) is designed to be able to be applied on the different contexts and research settings.

Third, as mentioned before on the methodology used on the research (refer to chapter 3), the environment that encompassed the study was complex; following the teaching of Yin (1994) to face these environments an exploratory research approach is needed, this method requires the use of multiple case studies approach, the data obtained from this method has a qualitative nature, which is useful since the aim of the study is to achieve a deeper understanding and to generate new insights concerning the roadmapping technique.

A problem that may arise from performing a qualitative study is subjectivity and researcher's bias, due to the fact that the findings are not based on the exact facts, but mainly on the researcher's interpretation of the literature and interviews.

To prevent this allegation, the study used triangulation to better analyze all the information contained on the research, which increases the validity of the findings to some extent; although, the bias cannot be completely removed.

## 6.2 Future research

Despite the measures taken to decrease the impact of the limitations that the study faced, there is room for improvement; in this section some suggestions some suggestion will be provided to guide future research and improvement of the topic of roadmapping on business ecosystems.

To begin, the study had to be concluded on a short span of time, with more time in our hands, more resources could be allocated on reaching a larger population sample for the study, thus, increasing the number of applications sent, which in turn will make the number of respondents grow, and when the number of test subjects reaches a fair amount, the population size will permit to use statistical tools to test the propositions made on the study, by achieving this, the study can consider to include a quantitative approach to complement the knowledge acquired on the qualitative phase of the study, therefore, increasing the validity of the study.

Another point to be considered it is that the study was performed on one locality, future research can be performed on different localities to compare results and the same can be said about applying the study on different type of industries.

A cross analysis of the results obtained from different localities and industries can provide a wider look to the topic of roadmaps in a business ecosystem environment, this will lead to execute the same procedure on different countries and continents, which will result in a great collaboration study.

The information gathered by the interviewing process shows some interesting remarks that are worth to investigate further, such is the case of:

- A) The companies that were part of the study recognize the importance of the human factor on projects but even knowing this fact they tend to take this resource take by granted; people can change during a project, diverse circumstances can such as changing job positions, replacing personnel, people switching jobs, amongst others; therefore, companies need to plan for this type of changes as well.
- B) The roadmapping expert company LightHouse talked about this issue which they have observed on companies on several occasions, that why we recommend to use the general approach of roadmapping, thanks to the



simplicity of the approach, most users can understand all the items discussed of the project without much training, we recommend to expand on this knowledge, for example adding cross training on the roadmapping workshops, this way more people on a company would be aware of the status and the agreements dealt on the meetings.

- C) When an external company helps to mediate the initial talks between the companies working on a collaboration project, it is easier for them to create a common goal and focus towards it; all the interviewees commented that in some projects they have required the help of a consultancy agency.

# Bibliography

- Adner, R. (2006). Match your innovation strategy to your innovation ecosystem. *Harvard Business Review*, 84, 98–107.
- Adner, R. K. (2010). Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*, 31, 306–333.
- Adner, R. S. (2010). Old technology responses to new technology threats: demand heterogeneity and technology retreats. *Industrial and Corporate Change*, 19, 1655–1675.
- Aguiar, M. &. (2004). Emerging market business cycles: The cycle is the trend . Aguiar, M., & Gopinath, G. (2004). *Emerging market business cycles: The cycle is the trend* (No. w10734). National Bureau of Economic Research., (No. w10734).
- Albright, R. E. (2003). Roadmapping in the Corporation: Product-Technology Roadmaps Define and Communicate Product and Technology Strategy along with a Longer, Smarter View of the Future. *Research-Technology Management*, 46(2), Albright, R. E., & Kappel, T. A. (2003). Roadmapping in the Corporation: Product-Technology Roadmaps Define and Communicate Product and Tech31.
- Amabile, T. M. (1998). How to kill creativity. *Harvard Business School Press*.
- Angraeni, E. D. (2007). Business ecosystem as a perspective for studying the relations between firms and their business networks. *European Network on Chaos and Complexity Research and Management*. Bergen aan Zee: Institute for Business Engineering and Technology Application, Eindhoven University of Technology.
- Argote, L. (2012). *Organizational learning: Creating, retaining and transferring knowledge*. Springer : Springer Science & Business Media.
- Barfurth, M. A. (2002). Evaluation factors for multi-stakeholder broadband visual communication projects. *IEEE*, 18.
- Barták, R. S. (2010). Constraint satisfaction techniques in planning and scheduling. *Journal of Intelligent Manufacturing*, 21(1), 21(1), 5-15.
- Barták, R., Salido, M. A., & Rossi, F. (n.d.). Constraint satisfaction techniques in planning and scheduling. *Journal of Intelligent Manufacturing* , 21(1), 5-15.
- Borgh, M. C. (2012). Value creation by knowledge-based ecosystems: evidence from a field study. *R&D Management*, 150-169.

- Browne, S. (1999). Beating a moving target: Optimal portfolio strategies for outperforming a stochastic benchmark. *Finance and Stochastics*, 3(3), 275-294.
- Cankurtaran, P. L. (2013). Consequences of New Product Development Speed: A Meta-Analysis. *Journal of Product Innovation Management*, 30(3), 465-486.
- Clarysse, B. W. (2014). Creating value in ecosystems: Crossing the chasm between knowledge and business ecosystems. *Research Policy*, 43(7), 1164-1176.
- Cosner, R. H. (2007). Integrating roadmapping into technical planning. *Research-Technology Management* 50(6), 31-48.
- Daim, T. U. (2014). *Planning and Roadmapping Technological Innovations*. Portland, OR, USA: Springer.
- Dawson, R. J. (1998). Practical proposals for managing uncertainty and risk in project planning. *International Journal of Project Management*, 16(5), 299-310.
- De Dreu, C. K. (2010). Creativity in individuals and groups: Basic principles with practical implications. *Social psychology and organizations*, 297-324.
- Eamonn, K. (2015). *Business ecosystems come of age*. Westlake, Texas: Deloitte University Press.
- Eckerson, W. (2006). *Performance dashboards: Measuring, monitoring and managing your business*. Hoboken: John Wiley and Sons.
- EIRMA. (1997). 'Technology roadmapping - delivering business vision', Working group report. Paris: European Industrial Research Management Association, No. 52.
- Ernst, H. H. (2010). Sales, marketing, and research-and-development cooperation across new product development stages: implications for success. *Journal of Marketing*, 74(5), 80-92.
- Few, S. (2006). *Information dashboard design: The effective visual communication of data*. Sebastopol : O'Reilly Media.
- Garcia, M. L. (1997). *Fundamentals of technology roadmapping*. Albuquerque, NM: Sandia National Laboratories.
- Gerdri, N. &. (2007). Applying the Analytic Hierarchy Process (AHP) to build a strategic framework for technology roadmapping. *Mathematical and Computer Modelling*, 46(7), 1071-1080.
- Goffman, E. (1974). *Frame analysis: An essay on the organization of experience*. New York: Harper and Row.

- Griffeth, R. W. (2000). A meta-analysis of antecedents and correlates of employee turnover: Update, moderator tests, and research implications for the next millennium. *Journal of management*, 26(3), 463-488.
- Griffin, A. &. (1996). PDMA success measurement project: recommended measures for product development success and failure. *Journal of product innovation management*, 13(6), 478-496.
- Håkansson, H. F. (2009). *Business in networks*. John Wiley & Sons.
- Iansiti, M. &. (2004). *The keystone advantage: what the new dynamics of business ecosystems mean for strategy, innovation, and sustainability*. Cambridge: Harvard Business Press.
- Kaplan, R. S. (1996). Using the balanced scorecard as a strategic management system. *Harvard business review*, 74(1), 75-85.
- Kearney, E. &. (2009). Managing diversity and enhancing team outcomes: the promise of transformational leadership. *Journal of applied psychology*, 94(1), 77.
- Kerr, C. P. (2010). Depicting options and investment appraisal information in roadmaps. In: *The 19th International Conference on Management of Technology (IAMOT 2010) – Technology as the Foundation for Economic Growth, Cairo, Egypt,, March 8-11*.
- Kogut, B. (1988). Joint ventures: Theoretical and empirical perspectives. *Strategic management journal*, 9(4), 319-332.
- Kostoff, R. N. (2001). Science and technology roadmaps. *Engineering Management, IEEE Transactions on*, 48(2), 132-143.
- Kuhn, T. S. (2012). *The structure of scientific revolutions*. Chicago: University of Chicago press.
- Lakatos, I. (1976). *Falsification and the methodology of scientific research programmes*. Netherlands: Springer Netherlands.
- Lee, S. &. (2005). Customization of technology roadmaps according to roadmapping purposes: Overall process and detailed modules. *Technological Forecasting and Social Change*, 72(5), 567-583.
- Ma, T. L. (2006). Roadmapping as a way of knowledge management for supporting scientific research in academia. *Systems Research and Behavioral Science* 23(6), 743–755.
- McFarland, T. D., & Parke, R. (1990). *Expert Systems in Education and Training*. New Jersey: Educational Technology.
- Moehrle, M. G. (2013). *Technology Roadmapping for Strategy and Innovation. Charting the Route to Success*. Berlin: Springer.

- Moore, J. F. (2006). Business ecosystems and the view from the firm. *Antitrust Bulletin*, 51, 31.
- Peltoniemi, M. &. (2004). Business ecosystem as the new approach to complex adaptive business environments. In *Proceedings of eBusiness research forum* (pp. 267-281). Tampere, Finland: Tampere University of Technology,.
- Petrick, I. P. (2005). Roadmapping as a mitigator of uncertainty in strategic technology choice. *International Journal of Technology Intelligence and Planning* 1(2), 171–184.
- Phaal, R. F. (2001). Technology Roadmapping: linking technology resources to business objectives. *Centre for Technology Management, University of Cambridge*, 1-18.
- Phaal, R. F. (2004). Technology roadmapping – A planning framework for evolution and revolution. *Technological Forecasting and Social Change* 71(1-2), 5–26.
- Phaal, R. F. (2005). Developing a technology roadmapping system. *Technology Management: A Unifying Discipline for Melting the Boundaries*, 31, 99-111.
- Phaal, R. M. (2009). An architectural framework for roadmapping: Towards visual strategy. *Technological Forecasting and Social Change* 76(1), 39–49.
- Phaal, R. S. (2008). Next generation roadmapping for innovation planning. *International Journal of Technology Intelligence and Planning*, 4(2), 135-152.
- Pidd, M. (2003). *Tools for thinking: Modelling in management science*. Chichester: John Wiley and Sons.
- Saritas, O. &. (2004). Systemic analysis of UK foresight results: joint application of integrated management model and roadmapping. *Technological Forecasting and Social Change*, 71(1), 27-65.
- Sivasubramaniam, N. L. (2012). Determinants of New Product Development Team Performance: A Meta-analytic Review. *Journal of Product Innovation Management*, 29(5), 803-820.
- Smith, P. G. (1998). *Developing products in half the time: new rules, new tools* (Vol. 298). New York: John Wiley & Sons.
- Stephen, A. T. (2007). Interfirm behavior and goal alignment in relational exchanges. *Journal of Business Research*, 60(4), 285-295.
- Strauss, J. D. (2004). Roadmapping for dynamic and uncertain environments. *Research technology management*, 47(2), 51-58.
- Van Aken, J. B. (2007). *Problem solving in organizations: A methodological handbook for business students*. Cambridge: Cambridge University Press.

- Wainer, H. (1984). How to display data badly. *The American Statistician* 38(2), 137–147.
- Whalen, P. (2007). Strategic and technology planning on a roadmapping foundation. *Research Technology Management* 50(3), 40–51.
- Williams, C. B. (2004). Designing platforms for customizable products in markets with non-uniform demand. In *ASME 2004 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference* (pp. pp. 337-349). American Society of Mechanical Engineers.
- Yin, R. K. (1981). The case study crisis: Some answers. *Administrative science quarterly*, 58-65.
- Yin, R. K. (1994). Applied social research methods series. *Case study research: Design and methods*, 3.
- Yin, R. K. (2013). *Case study research: Design and methods*. Osaka: Sage publications.
- Yoon, B. P. (2008). Morphology analysis for technology roadmapping: application of text mining. *R&d Management*, 38(1), 51-68.

## Appendix A

According to Phaal and Muller (2009), a roadmap at its most fundamental form should be encompassed of three layers over a horizontal axis (refer to Figure below).

This generic roadmap architecture consisting of three layers across the two-dimensional space of the canvas (Phaal R. F., 2004):

- Horizontal axis – Time, the 'know-when' dimension
- Top layer – Purpose, the 'know-why' dimension
- Middle layer – Delivery, the 'know-what' dimension
- Bottom layer – Resources, the 'know-how' dimension

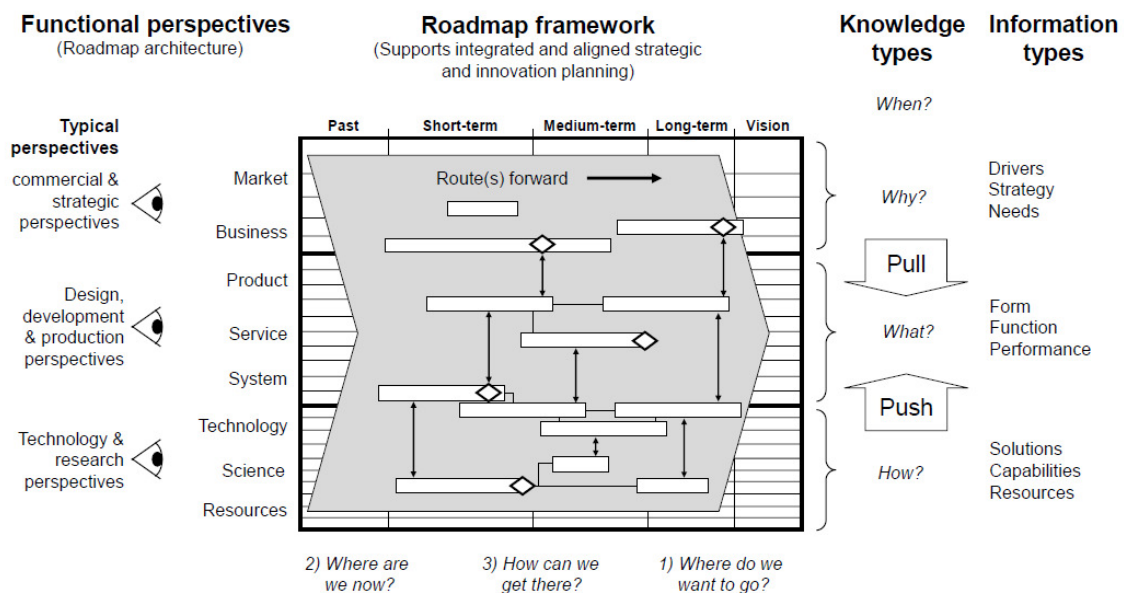


Figure: Generalized roadmap structure (Phaal R. S., 2008)

This generic form was further elaborated upon by Phaal and Muller (2009), who state that the:

- Top layer – “Relates to the trends and drivers that govern the overall goals or purpose associated with the roadmapping activity”.
- Middle layer – “Relates to the tangible systems that need to be developed to respond to the trends and drivers (top) layer. Frequently this relates directly to the evolution of products (functions, features and performance)”.
- Bottom layer – “Relates to the resources that need to be marshalled to develop the required products, services and systems, including knowledge-based resources, such as technology, skills and competences and other resources such as finance, partnerships and facilities”.

## Appendix B

This section provides a detailed overview of the three phases of the developing process of the roadmapping methodology. The first phase involves preliminary activity without which the roadmapping probably should not be done. The second phase is the development of the roadmap. The third phase is the follow-up and use of the roadmap.

### Phase I. Preliminary activity

In this phase, the stakeholders must realize that they have a problem that a roadmap can help them solve. The acceptance and buy-in of these decision makers is critical to get the resources needed to create the roadmap and the willingness to use it. A complication for this phase is that different people expect different results and all of them must be at least partly satisfied. The steps in this phase provide some assurance that this essential buy-in will be obtained (Garcia, 1997).

#### 1. Satisfy essential conditions

For a roadmapping effort to succeed, a number of conditions must be satisfied, the roadmapping effort needs input and participation from several different groups, which bring different perspectives and planning horizons to the process. The roadmapping process should be needs-driven rather than solution driven. There must be a clear specification of the boundaries of the effort, what is and is not within the scope of the roadmap and how will the roadmap be used.

#### 2. Provide leadership/sponsorship

Because of the time and effort involved in roadmapping, there must be committed leadership. Furthermore, this leadership must come from the group that is going to do the actual implementation and benefit from it. For a corporation, this means that the line organization must drive the roadmapping process and use the roadmap to make resource allocation decisions. For an industry roadmap, this means that industry must lead the effort, although its customers and suppliers, along with government and universities, should also be participants in developing, validating, and implementing the roadmap.

#### 3. Define the scope and boundaries for the roadmap

This step ensures that the context for the roadmap has been specified. It develops or ensures that a vision exists and that a roadmap can support that vision. It identifies why the roadmap is needed and how it will be used. Finally, it clearly specifies the scope and boundaries of the roadmap. A roadmap starts with a set of needs. The intended use of the roadmap determines the planning horizon and the level of detail.



## Phase II: Development of the Roadmap

This phase involves seven steps. These steps to create the actual roadmap are similar for both corporation and industry roadmaps, but the resource and time requirements are much greater for an industry roadmap. In both cases, working groups or teams are essential to develop the content of the roadmap (Garcia, 1997).

1. Identify the “product” that will be the focus of the roadmap

The critical step in roadmapping is to get the participants to identify and agree on common product needs (e.g., for an energy efficient vehicle) that must be satisfied. If there is major uncertainty about the product needs, the use of scenario-based planning can help. The scenarios are used to better identify the needs, services, or products. Over time, as the degree of uncertainty about needs changes, the emphasis on technologies addressing this need could be increased or decreased. This is one of the reasons for periodic reviews and updates of the roadmap and its implementation plan.

2. Identify the critical system requirements and their targets

The critical system requirements provide the overall framework for the roadmap and are the high-level dimensions to which the technologies relate. Once the participants have decided what needs to be roadmapped, they must identify the critical system requirements.

3. Specify the major technology areas

These are the major technology areas that can help achieve the critical system requirements for the product.

4. Specify the technology drivers and their targets

At this point, the critical system requirements are transformed into technology oriented drivers for the specific technology areas. These technology drivers are the critical variables that will determine which technology alternatives are selected. The technology driver targets specify how well a viable technology alternative must be able to perform by a certain date.

5. Identify technology alternatives and their time lines

Once the technology drivers and their targets are specified, the technology alternatives that can satisfy those targets must be identified. For each of the identified technology alternatives, the roadmap must also estimate a time line for how it will mature with respect to the technology driver targets.

## 6. Recommend the technology alternatives that should be pursued

This step selects the subset of technology alternatives to be pursued. These technology alternatives vary in terms of cost, schedule, and/or performance. One path may get you there faster; another path may be cheaper, while still another path may result in a performance improvement over the target this emphasizes the difference between simply improving performance with respect to a technology metric versus the actual change in the product metrics, which a technology change causes.

## 7. Create the roadmap report

The report should include:

- The identification and description of each technology area and its status.
- Critical factors which if not met will cause the roadmap to fail.
- Areas not addressed in the roadmap.
- Technical and implementation recommendations.

## Phase III: Follow-up Activity

Since relatively few people were involved in developing and drafting the roadmap, it must now be critiqued, validated, and accepted by a much larger group that will be involved in any implementation. An implementation plan needs to be developed using the information generated by the roadmapping process to make and implement the appropriate investment decisions. Finally, since both the needs and the technologies are evolving, the roadmap needs to be periodically reviewed and updated (Garcia, 1997).

### 1. Critique and validate the roadmap

In Phase II, a relatively small group or groups of experts and technologists developed a draft roadmap or roadmaps if multiple technology areas are involved. This work must be exposed to a much larger group for validation and buy-in for two reasons:

- a) The draft needs to be reviewed, critiqued, and validated.
- b) There must be buy-in from the broader corporation or industry group that will be involved in implementing the plan.

### 2. Develop an implementation plan

At this point, there is enough information to make better technology selection and investment decisions. Based on the recommended technology alternatives, a plan is then developed. The implementation plan may be one or more project plans, which would be developed based on the selected technology alternatives.

### 3. Review and update

Roadmaps and plans should be routinely reviewed and updated. A formal iterative process occurs during this review and update. With the initial roadmap, uncertainty increases with the time frame. Over time, as certain technologies are explored and better understood, some of this uncertainty is reduced, although other areas of uncertainty may develop. Also if scenarios were used up front to address uncertainty about the needs, there may be refinement, or even elimination, of some of the scenarios, which could affect the roadmap or its implementation plan. The review and update cycle allows both the roadmap and the implementation plan to be adjusted for these changes.

# Appendix C

## Interview Protocol (Roadmapping approach on Business Ecosystems)

(Estimated duration: 30 - 40 minutes)

### Introduction

First of all, I would like to thank you for making time on your agenda to talk with me; your contribution will support my research in “**Roadmapping approach on business ecosystem**”. My name is Jorge Karam, I am a master student at Technical University of Eindhoven (TU/e) and currently I am working on my thesis project. The objectives of this research are the following: understand how private and governmental organizations interact while working on a project, how the information is conveyed between all the parties and the stakeholders, how the management supports these interactions and which tools are applied to achieve the best communication performance?

I want to start this interview by asking you about your working experience, and then I will proceed to ask you about your experience in regard work environment and collaborations between private and public organizations, particularly, the interactions with the stakeholders. Do you mind if I record the interview so I can type it and analyze your answers in detail? If you prefer, this interview can be reported as anonymous, also if you think certain answers contain sensible information and you prefer to avoid having them published in my thesis report please let me know it. Furthermore, I will send you the transcription of this interview afterwards so you can check everything and decide whether to agree with the content or not.

### 1. Interviewee Background

1. Can you briefly talk about yourself (name, age, etc.), work trajectory, the organization you are currently working for and your position in such organization?

### 2. Collaboration, open questions about business ecosystem

1. Does your organization have collaboration projects or partnerships (with private and/or public organizations)?
2. Can you describe the background the goal(s) of such collaborations?
3. What role does your organization perform in these collaborations? And what kind of resources or expertise does your organization bring into the table?

### 3. Flow of information on business ecosystems – Roadmapping approach

1. In general, does your organization is well informed about the business/profit potential from been part of this collaborations?
2. How does your organization convey the information with the stakeholders of the project?
3. Do you think a graphical representation of data/information could simplify and ease the process of understanding information?
4. Are you familiar with the term roadmap? (if the answer is negative, explain the concept)
5. Does your organization apply the roadmapping methodology? If the answer is affirmative, how many years does your company take in consideration?
6. On your opinion, which are the key elements of a successful planning on a project?
7. How does your organization monitor the status of each project and its KPI's?
8. Does your company uses their own graphical representation of data (e.g. roadmaps) while working on partnerships or create a unified version used for all parties involved?
9. Does your company share this graphical representation of data (e.g. roadmaps) with the partners and how often does the company share this information with them?
10. How often do the partners use your company graphical representation of data (e.g. roadmaps) templates?
11. How often does your company use the graphical representation of data (e.g. roadmaps) templates from the partners?
12. Do you think graphical representation of data (e.g. roadmaps) influence decisions in your company and/or in the partnerships?
13. In which way do you think graphical representation of data (e.g. roadmaps) influence decisions?
14. Do you think these graphical representations of data (e.g. roadmaps) provide a flexible approach and how do you think they provide flexibility?

### 4. Appropriation Mechanisms

1. How does your company create value in these collaborations?
2. How does your company ensure to capture a fair proportion of the created value from the collaborations?
3. How does your company align goals in these collaborations?
4. Does your company use graphical representations of data (e.g. roadmaps) for goal alignment, if not which methodology/process do they use
5. Does your company employ any type of contractual agreement concerning the result/output of the collaborations? If so, why do you think these contracts are used?
6. Can you explain the general contents of these contracts (e.g. the rules, and agreement)?
7. Does your company procure a healthy relationship with the partners of the business ecosystem and how does your company achieve it?

## 5. Interaction Mechanisms

1. What are the roles of trust and/or relational norms in these collaborations from your perspective?
2. In your opinion, during these collaborations do the common vision, goals and strategic decisions of each party are well communicated?
3. How does your company align its goals with the partners in these collaborations?
4. Does your company create rules or guidelines concerning these collaborations?
5. After the start of the project, does your company review the goals alignment between parties or just continue with the same agreement from before the start of the project?
6. How does trust was built between the parties involved and what were the critical factors in developing trust?
7. How does your organization manage trust and good relations with the partner(s)?

With this we conclude the interview session. Do you have any remarks or suggestions for my research project? Again I will like to kindly thank you for your participation in my study. I will send you my final thesis report as soon as I have finished it, in case you are interested.

## Appendix D

### **Roadmap Case Example – Kostoff et al. (2001)**

This section provides an example of a needs-driven technology roadmap. The purpose of this example is to show the process flow from product need to actual roadmap, not to completely describe the roadmap but to understand how this approach is applied. For this case example we will use a company named SEMATECH

First, the product focus of the roadmap, in this case was semiconductors, which could be used in various types of products (such as memories, consumer products, portable computers, and high-performance computers), each of which had different requirements. However, semiconductor manufacturing technology was the common area on which the industry could cooperate. They competed on semiconductor designs and the products that used them, not the underlying manufacturing technology.

Second, the critical system requirements included smaller size (i.e., feature size), lower cost, and power dissipation for portable equipment. As an example of targets, they projected feature size between 1992 and 2007 as declining in three year increments from .5 to .1 microns.

Third, the roadmap identified 11 technical areas (e.g., chip design and test, lithography, and manufacturing systems). Using the critical system requirements as an overall framework, teams were set up for each technical area and technology roadmaps were developed for each area.

Fourth, each team developed a set of technology drivers specific to their area, which were derived from and related to one or more of the critical system requirements. For example, technology drivers in the lithography area that related to feature size included overlay, resolution, and device size. The lithography area was further decomposed into exposure technology; mask writing, inspection, repair, processing, and metrology; and resist, track, and metrology.

Fifth, for each technology area (e.g., lithography) and/or subarea (e.g., exposure technology), the roadmap identified technology alternatives such as x-ray, e-beam, and ion projection. Technology driver performance was projected for each technology alternative for various time points.

Sixth, based on these projections and their impact on the critical system requirement targets, certain alternatives were recommended. Seventh, the completed technology roadmap report was created in preparation for the follow-up activity. A major workshop was held to critique and validate the roadmap.

The roadmap is being used by Industry Canada to evaluate and prioritize potential projects. Does the project fit within the roadmap and if so, where? Other participants can also use the roadmap to focus their research and development activities. In this example, the roadmap has already undergone two reviews and revision cycles (refer to Figure below).

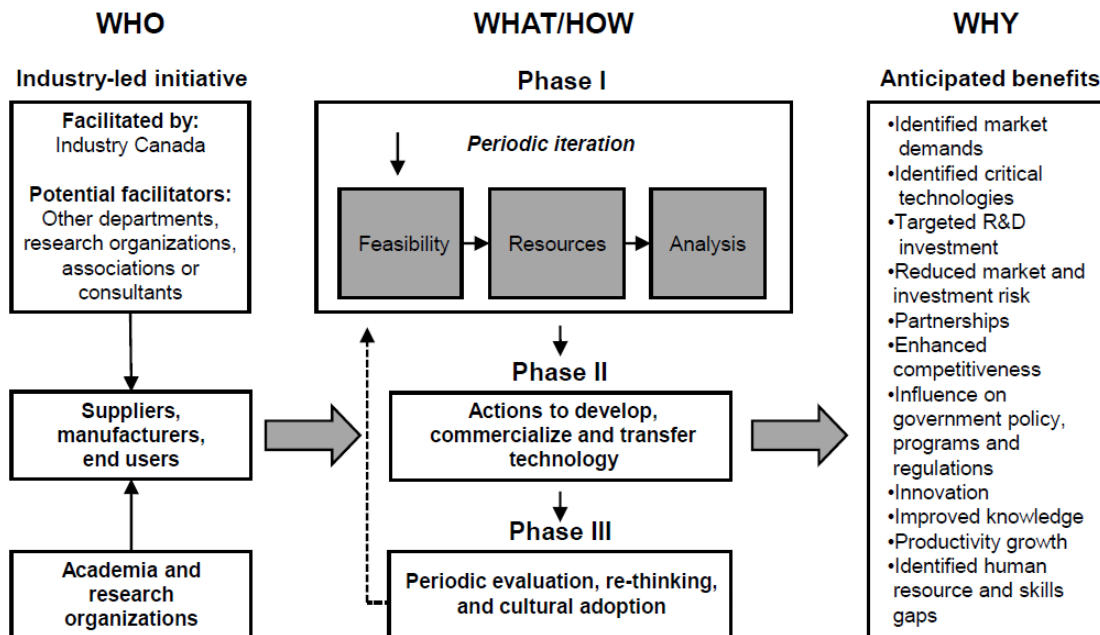


Figure: Example of a technology roadmap



## Appendix E

### The codebook

Category	Code	Information to be expected	Sub code
Interviewee Background	A	<ul style="list-style-type: none"> <li>• Work trajectory of the interviewee</li> </ul>	1
		<ul style="list-style-type: none"> <li>• Organization where the interviewee currently works</li> </ul>	2
		<ul style="list-style-type: none"> <li>• Job position in such organization</li> </ul>	3
Collaborations - Business Ecosystem	B	<ul style="list-style-type: none"> <li>• General idea of the collaboration projects or partnerships that the company has</li> </ul>	1
		<ul style="list-style-type: none"> <li>• Goal(s) of such collaborations</li> </ul>	2
		<ul style="list-style-type: none"> <li>• The role that the organization perform in these collaborations</li> </ul>	3
		<ul style="list-style-type: none"> <li>• The resources or expertise that the organization bring into the collaborations</li> </ul>	4
Flow of information on business ecosystems – Roadmapping approach	C	<ul style="list-style-type: none"> <li>• Information about the use of roadmaps or similar project planning approach</li> </ul>	1
		<ul style="list-style-type: none"> <li>• Key elements of a successful planning on a project</li> </ul>	2
		<ul style="list-style-type: none"> <li>• How to monitor the status of each project and its KPI's</li> </ul>	3
		<ul style="list-style-type: none"> <li>• Information sharing between the business ecosystem (stakeholders and shareholders)</li> </ul>	4
Appropriation Mechanisms	D	<ul style="list-style-type: none"> <li>• Value in collaborations</li> </ul>	1
		<ul style="list-style-type: none"> <li>• Goal alignment in collaborations</li> </ul>	2
		<ul style="list-style-type: none"> <li>• Contractual agreements</li> </ul>	3
		<ul style="list-style-type: none"> <li>• Relationship with the partners of the business ecosystem</li> </ul>	4
Interaction Mechanisms	E	<ul style="list-style-type: none"> <li>• Trust and/or relational norms in collaborations</li> </ul>	1
		<ul style="list-style-type: none"> <li>• Contractual agreements</li> </ul>	2
		<ul style="list-style-type: none"> <li>• Rules or guidelines in collaborations</li> </ul>	3