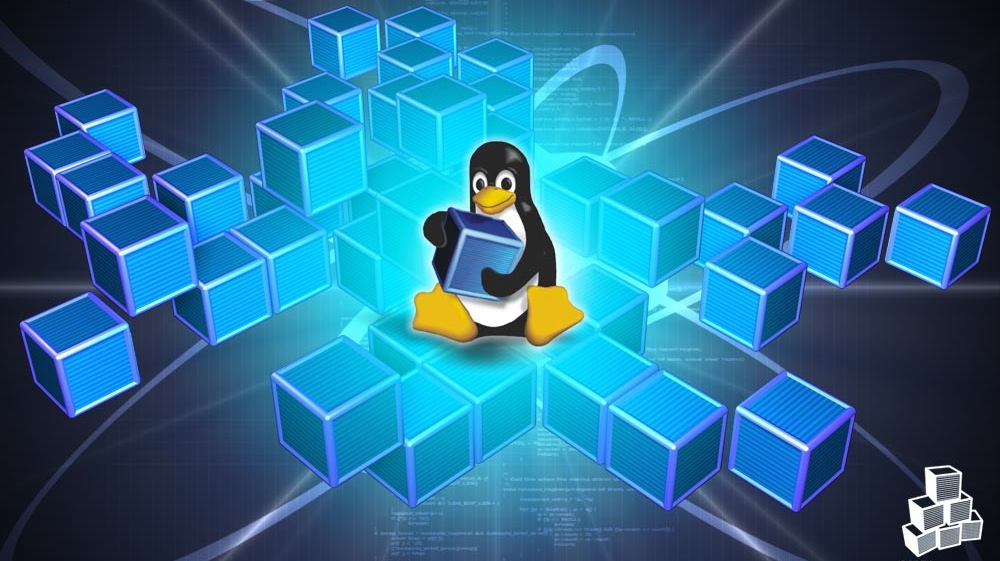
NETWORK ANALYSIS OF CEPHIS



**MASTER THESIS**

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**TABLE OF CONTENTS**

[1.- INTRODUCTION 5](#_Toc239837850)

[2.- PROBLEM FORMULATION 7](#_Toc239837851)

[2.1.- Bloom’s taxonomy 8](#_Toc239837852)

[2.2.- Definitions 9](#_Toc239837853)

[3.- METHODOLOGY 11](#_Toc239837854)

[3.1.- The overall methodology approach 11](#_Toc239837855)

[3.1.1.- Ultimate presumptions 12](#_Toc239837856)

[3.1.2.- Paradigm 12](#_Toc239837857)

[3.1.3.- Methodological approach 13](#_Toc239837858)

[3.1.4.- Operative paradigm 16](#_Toc239837859)

[3.2.- Theories 19](#_Toc239837860)

[3.2.1.- Theory selection 19](#_Toc239837861)

[3.2.2.- Limitations 20](#_Toc239837862)

[3.3.- The project design 22](#_Toc239837863)

[4.- NETWORK PERSPECTIVE 27](#_Toc239837864)

[4.1.- Definition 27](#_Toc239837865)

[4.2.- Sociological view of networks 28](#_Toc239837866)

[4.2.1.- Connections 28](#_Toc239837867)

[4.2.2.- Homophily 28](#_Toc239837868)

[4.2.3.- Distance between two nodes 29](#_Toc239837869)

[4.2.4.- Dyads and Mutuality 29](#_Toc239837870)

[4.2.5.- Balance and Triads 30](#_Toc239837871)

[4.3.- Social attributes of Nodes and Networks 30](#_Toc239837872)

[4.3.1.- Position 30](#_Toc239837873)

[4.3.2.- Centrality 31](#_Toc239837874)

[4.3.3.- Multiplexity 31](#_Toc239837875)

[4.4.- Aspects of complete networks 32](#_Toc239837876)

[4.4.1.- Position and social capital 32](#_Toc239837877)

[5.- CIRCUMSTANCE OF CEPHIS 33](#_Toc239837878)

[5.1.- Introduction 33](#_Toc239837879)

[5.2.- Tasks 35](#_Toc239837880)

[5.3.- Network Relationships 39](#_Toc239837881)

[6.- MARKET ORIENTATION 45](#_Toc239837882)

[7.- INNOVATION PROCESS 49](#_Toc239837883)

[7.1.- Sustaining vs. Disruptive 49](#_Toc239837884)

[7.2.- Scope of a business 50](#_Toc239837885)

[7.3.- Commoditization vs. De-commoditization 52](#_Toc239837886)

[7.4.- Appropriability 53](#_Toc239837887)

[7.5.- CEPHIS innovation process 54](#_Toc239837888)

[8.- TRANSACTION COST ECONOMICS 59](#_Toc239837889)

[8.1.- Theory 59](#_Toc239837890)

[8.1.1.- Assumptions 60](#_Toc239837891)

[8.1.2.- Variables 61](#_Toc239837892)

[8.2.- Discussion 62](#_Toc239837893)

[8.3.- Trust for an effective interfirm collaboration 63](#_Toc239837894)

[8.4.- Application of Transaction Cost Economics 64](#_Toc239837895)

[9.- KNOWLEDGE TRANSFER 71](#_Toc239837896)

[9.1.- Theory 71](#_Toc239837897)

[9.1.1.- Network position 72](#_Toc239837898)

[9.1.2.- Absorptive capacity 72](#_Toc239837899)

[9.1.3.- Interaction between network position and absorptive capacity 73](#_Toc239837900)

[9.2.- Importance for the research 75](#_Toc239837901)

[10.- NETWORK CONFIGURATION AND INNOVATION SUCCESS 77](#_Toc239837902)

[10.1.- Introduction 77](#_Toc239837903)

[10.2.- Technology-oriented relationship 77](#_Toc239837904)

[10.3.- Types of network configuration 79](#_Toc239837905)

[10.4.- Network configuration of CEPHIS 80](#_Toc239837906)

[10.5.- Relation between network configuration, innovation process and transaction cost economics 84](#_Toc239837907)

[11.- CONCLUSIONS 87](#_Toc239837908)

[12.- REFERENCES 89](#_Toc239837909)

[13.- ANNEX 92](#_Toc239837910)

**TABLE OF FIGURES**

Figure 1: Bloom’s taxonomy 8

Figure 2: Methodological approach 11

Figure 3: The three methodological approaches 14

Figure 4: Framework 24

Figure 5: Market Orientation 45

Figure 6: Independent effects model of relationships between market orientation, business-specific factors, market-level factors, and performance 46

Figure 7: Overshooting the functionality that customers can utilize triggers change in the way companies must compete 51

Figure 8: Commoditization & De-commoditization process 53

Figure 9: Market Hierarchy Model 59

Figure 10: A model of interfirm collaboration 63

Figure 11: Business position in relation to degree of centrality 74

Figure 12: Innovation partners and their contributions 77

Figure 13: Network patterns 83

# INTRODUCTION

Innovation is an important aspect in computer science since new improvements appear in the market almost every day. Any enterprise that wants to survive in this market has to be capable to generate innovative ideas and apply them to build more developed systems.

The most valuable resource in this field is the knowledge possessed by engineers to come up with revolutionary designs which will be an advance of the devices operating in the market. Since knowledge is so valuated, its transmission becomes significant to success. It is important to possess specialized knowledge but it also needs to be transferred to the rest of the engineers’ team to make the most of it. The more knowledge is gained, the higher is the possibility of getting better methods than the ones used until now. For most of the companies this is a big reason to work in association with other firms in the resolution of research projects. The structure of network relationships includes a number of interesting aspects to be analyzed. Depending on the position that the focal firm would take, it will vary its possibilities to operate. A central position among the members of the network always implies easier access to knowledge starting from the fact that the firm would have contact with more partners than if they are positioned closer to a small group but far from the rest of the network partners.

A company has been chosen to analyze the aspects forming network relationships and how they influence the process of knowledge transfer and consequently the innovation process. The name of this company is CEPHIS, which works in the field of microelectronics. The aim of their business is the development of research projects, which almost all of them are run in connection to other firms and institutional bodies. CEPHIS enables the study of the processes named below making clear the understanding of them through a real case.

# PROBLEM FORMULATION

When a company is working in association with other firms for the development of a final product there are several aspects of notable importance. The position occupied by the focal firm has an effect on its performance, what subsequently provokes an impact on its success. Relationships among members of the value-added chain are relevant in order to understand how each position in the work of the analyzed company influences.

The problem formulation of this project is defined as:

*Network Analysis: Underlining the position CEPHIS finds itself in.*

Network analysis is based on the network perspective but taking in account more aspects than the ones described in this theory. Since CEPHIS is an enterprise which core business is the innovation, concepts of relevance for this issue should be related to the network perspective. Furthermore, the project will have a consistent basis thanks to the use of transaction cost economics. Theories related to network configuration, knowledge transfer and innovation process are more subjective perspectives. That is why those theories will be supported by transaction cost economics in order to develop a sound research.

A process described later in the project design will be followed to answer the problem formulation. Previously to achieve the resolution, making clear essential questions is necessary to position the firm. Theories and articles chosen for the development of the project have been taken as the most adequate even though the extent of papers related to the subject is so large that it would be possible to use some other of the ideas proposed.

The decision of choosing CEPHIS as the object of this study lies on the fact that it is a familiar company for the writer and an ideal organization to investigate about network relationships in a perspective of continuously innovation process.

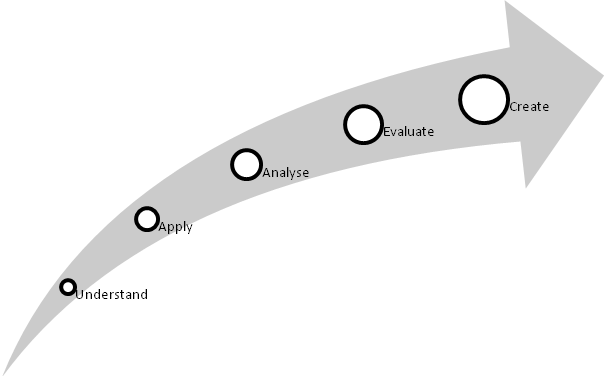
## Bloom’s taxonomy

Bloom’s taxonomy was used in developing the problem formulation. Its goal is to describe and systematize knowledge in a taxonomy, which is composed of six steps.[[1]](#footnote-2) The purpose here is to build a scientific pattern of classification for learning.

Figure 1: Bloom’s taxonomy

**Bloom’s Taxonomy**

Remember



**Source: own design**

The problem formulation of the project is on the fourth level in the taxonomy, and it concentrates on “how”. Thus, the problem formulation can be described as explanatory and interpretative, since the problem formulation will be solved by the means of theoretical tools, which will helps to understand the phenomenon that the problem formulation refers to. This will be done through firstly an analysis of the theories of internationalization, and secondly the analysis of CEPHIS on the basis of theories.

The fourth step in which an analysis is performed, divides the subject into components. This action allows drawing a new picture of the problem formulation.

In the following chapters, a description and presentation of the network perspective will be made. This is performed to make an overview of different terms referring to this phenomenon and state the importance of companies’ relationships in the fast developing technological world.

Then, CEPHIS will be presented and their network relationships will constitute the case during the analysis of the importance of the theories. Moreover, the description of the innovation process, transaction cost economics, knowledge transfer and network configuration and their analysis will also be performed. These chapters will be crucial, as they will help to take a decision related to the problem formulation.

The problem formulation will be answered in the conclusion to close the project. The methodological arrangement of the problem formulation will be shown in the next chapter.

## Definitions

In order to introduce the reader in the subject of the knowledge transfer in business a brief definition of basic terms which should be known for a better understanding of the following sections is going to be described. It is crucial to present a definition of the meaning of knowledge in business, how to proceed the process of codification, and the two kinds of knowledge manifestation.

**Knowledge**: Information that is relevant, actionable, and based at least partially on experience.[[2]](#footnote-3)

**Codification of knowledge**: Process of reduction and conversion which renders especially easy the transmission, verification, storage and reproduction of knowledge. It implies that knowledge is transformed into “information” that can be easily transmitted through information infrastructures. [[3]](#footnote-4)

**Explicit knowledge**: Knowledge typically expressed in a format that is compact and standardized in order to facilitate and reduce the cost of such operations.

**Tacit knowledge**:Knowledge that cannot be easily transferred because it has not been started in an explicit form.[[4]](#footnote-5) Some examples of tacit knowledge are: skills, beliefs and modes of interpretation.

Other remarkable aspect for the understanding of the project is the governance structure of business. It can be categorized two kinds of modes of organization: vertical integration and disintegration.

**Vertical integration**: Degree to which a firm owns its upstream suppliers and its downstream buyers. Vertical integration is typified by one firm engaged in different parts of production (e.g. growing raw materials, manufacturing, transporting, marketing, and/or retailing). This kind of management control is also hierarchy mode.

**Disintegration**: Refers to a specific organizational form of industrial production. As opposed to integration, in which production occurs within a singular organization, vertical disintegration means that various [diseconomies of scale](http://en.wikipedia.org/wiki/Diseconomy_of_scale) or scope have broken a production process into separate companies, each performing a limited subset of activities required to create a finished product.

# METHODOLOGY

This section will concerns the methodology reflections aligned with the whole purpose of the project. Here will be discussed subjects related to knowledge creation and the way of doing research efficiently and effectively in different situations stressing the conditions in which is formed this paper. According to Arbnor & Bjerke there exist three different methodological approaches for gaining business knowledge. Those are the analytical-, systems- and the actors approach. The analytical approach is the positivist approach; the systems approach favours the development of explanatory models and the actors approach is more commonly known as “structural theory” which derives from the work of Anthony Giddens.

These three approaches will be briefly described for giving to the reader a complete view of the methodology and the understanding of what it has been chosen the approach that has been and not any other.

## The overall methodology approach

Here is presented the theoretical research, namely the ultimate presumptions, paradigms, the methodological approaches and the choice of one of them for the development of the project. The second point will be the description of the chosen methods through the methodological approaches, the operative paradigm and the study area.

Figure 2: Methodological approach

Theory of science

Methodology

Paradigm

Methodological approach

Operative paradigm

Study area

Ultimate presuptions

**Source: Arbnor, I. & Bjerke, B. (1996) p. 17**

Figure 2 shows linkages between the elements forming the overall methodological approach. It is seen that theory of science contents ultimate presumptions, the paradigm, and the methodology approach. This last component is built with the conception of reality, conception of science, scientific ideals and ethical aesthetical aspects. On the other side there is the methodology which relates to the operative paradigm including methodological procedures and methods; and the study area. The last constituent of the methodology is the methodological approach which is connected to both the theory of science and the methodology.

### Ultimate presumptions

Ultimate presumptions are unconscious and basic presumptions that an individual makes about his or her environment and how he or she views his or her role in the particular surroundings. As these presumptions are very fundamental, they are difficult to observe and change.[[5]](#footnote-6)

Process of knowledge development is controlled by the ultimate presumptions. Formulating a problem or collecting data are examples of procedures arranged under a set of philosophical assumptions and concepts like ontology and epistemology are in relation to the theory of science being seen as the nature of reality.

### Paradigm

First association of this term is direct to Thomas Kuhn through an analysis of the development of knowledge. He argues that scientific theories developed revolutionary and new research patterns replaced old ones, Kuhn named the patterns paradigms. From the study realized by Arbnor & Bjerke, definition chosen is the one built up bt Törnenbohm. In Törnenbohm’s model the three methodological approaches are related to paradigmatic categories.

It contents the ultimate philosophical presumptions and the practical way in which the different methodological approaches are used. Paradigms are viewed as a bridge between the ultimate presumptions and the methodological approaches.[[6]](#footnote-7)

The two main paradigms are the interpretative- and functionalistic paradigm.

*Interpretative paradigm* explains the reality from a subjective point of view – actors’ point of view. The reality is created from actions made by an actor. Players act in accordance to how they see the reality and that is why this interpretative paradigm is concerned to the interpretation of an actor’s view of reality.

*Functionalistic paradigm* views the social world as the combination of empirical facts and the connection between them. This paradigm consists on finding solutions t problems by connections. The reality is viewed as a blend of systems that together crate it. Since reality exists in the light of given laws and structures, individual’s actions are independents from reality. In this way this paradigm is not concerned on the single actor and his interpretation of reality.[[7]](#footnote-8)

### Methodological approach

In the area of business economics there are catalogued three methodological approaches

1. The analytical approach
2. The systems approach
3. The actors approach

The analytical- and systems approach are reflected in the functionalistic paradigm, whereas the actors approach and part of the systems approach are connected to the interpretative paradigm. It means that there is the possibility of having more than one methodological approach.[[8]](#footnote-9) The three approaches can be used alone or in combination if it is useful for the problem formulation. There is not an ultimate approach that can be used over and over. The approach should be adjusted according to the problem formulation.[[9]](#footnote-10)

Figure 3: The three methodological approaches

Analytical approach

Systems approach

Actors approach

The functionalistic paradigm

The interpretative paradigm

Understanding Knowledge

Explanatory knowledge

1

2

3

4

5

6

Reality as concrete and confirmable to law from a structure independent of the observer

Reality as a concrete determining process

Reality as mutually dependent fields of information

Reality as a world of symbolic discourse

Reality as a social construc-tion

Reality as a manifestation of human intentionality

**Source: Abnor & Bjerke (1996) p. 44-46**

Figure 3 shows the three methodological approaches and how they are connected to paradigmatic categories. Paradigmatic categories are divided into six different business’ perspectives and represent diverse ways of how the reality is perceived. In this way the business perspective will vary in relation to the methodological approach used and it will unleash the flow of the reality.[[10]](#footnote-11)

The three methodological approaches previously mentioned will be described in a wide view, being deeper explained the approach chosen for the development of the project.

1. **Analytical approach**

This approach is based on the assumption that elements of the object being studied are relatively independent of each other. Assuming that makes possible for results that are developed from various inquiries to be formulated “ceteris paribus”, as if all other things remain equal. Among other activities, all sampling, hypothesis testing, and theory construction in the analytical approach are based on this assumption. In consequence, casual relations that have developed are considered to be valid provided “nothing else has changed”.

Analytical approach began with what is called positivism. To be “positive” in this context means to be “affirmative”. “Positive knowledge” is knowledge provided by experience.[[11]](#footnote-12)

1. **Systems approach**

The purpose of systems is to explain and/or understand reality, which consists of objective and subjective facts. However, the high level of formalism demanded in the analytical approach is not asked for here. Using the various techniques “correctly” does not guarantee success in the system approach: success is associated with imagination, flexibility and awareness when facing the complex reality postulated by this approach.

Systems approach is a matter of trial and error, which means that, to some extent, techniques have to be chosen and developed into methods only when the creator of knowledge has gained enough knowledge of the real system to make a correct and progressive choice.[[12]](#footnote-13)

1. **Actors approach**

It can be said that a person (an actor) is simultaneously psychological, social, historical, and political (in the sense of power-political). Various actors exert power and are subject to it. In association with each of these basic aspects of human life, different meta-areas become part of the conception of science in the actors approach. This fact leads to see human being as subjective interpreters of the reality. People cannot be described and explained in terms of their environment alone. Interpretations and actions take place in a social reality with several other actors. The researcher must therefore, try to understand the subjective constitution of knowledge, interpretation, and action.[[13]](#footnote-14)

### Operative paradigm

An operative paradigm combines the methodological approach with a specific study area. It includes two parts, which are methodological procedures and methods. A methodological procedure is concerned if the investigator includes, develops and/or modifies earlier made techniques and results in a methodological approach. Thereby a technique only becomes a method through conscious and explicit methodological procedures. The technique will be incorporated, developed and/or modified in accordance to the methodological approach and also in relation to the study area.

From this adaptation of technique a methodological approach is the same as a methodological procedure, whereas the use of this adaptation is a method. It is important that the method used is in line with the approach and study area that were chosen. If there are any disruptions, the methodological procedures may be partial and the results obtained may be weak. Consequently every theory and technique must be in line with the ranges of the operative paradigm – and the methodological procedures and methods.[[14]](#footnote-15)

**Methodology approach and scientific tradition**

Concerning the methodology the choice of the most adequate approach to deal with the development of this project has been the systems approach. Reasons for the choice of this approach era exposed below.

The rationale behind the systems approach is that it develops understanding of linkages between different parts of a system and their effects on each other and the whole system alike. For the entire system it is essential that the single components cooperate and they create a positive synergy effect. In this way it is not possible to make changes in one part of an organization without this having an effect on the rest. By a positive synergy effect it is meant that the single parts together come out with more than just the sum of the parts (2 + 2 = 5). On the other hand it will have a negative synergy effect if the parts do not cooperate with each other.

Since the way that the company focus of the study is studied is based on its network relationships, regarding the impact factors provide a better understanding. Constituents of the network where the firm is acting, such as customers, suppliers, administration, competitors, etc; are the factors which built the system. Participation in a business network affects all the departments of the company, as the flow of information allows acquisition of new knowledge. From this point it becomes a reciprocal cycle providing positive synergy effects. Knowledge moving through the network is used by each member in their own benefit which leads to come up with new ideas. Here starts the cycle when new results are shared again by the rest of the partners. This process can provide a high level of innovation findings.

Regarding the theory of science it has been chosen to work from a pragmatic approach. It signifies that it makes no difference whether reality is actually constituted in this way or the creator of knowledge studies it as if this were the case.[[15]](#footnote-16)

Finally, it should be pointed out the view of CEPHIS as the local system and more considered to be an open system. Therefore the local system is studied in the context of their environment. The environment is considered to be a key factor that affects the local system, but is beyond its control.

According to the previous definition of the paradigm it will be clarified how the system approach is related to its paradigm.

*Conception of reality (ontology):* The world is seen as objective accessible and it is constituted by components and relations. As mentioned, the whole is not the sum of its parts and from here stems the synergy effect. The relations between the different part/subsystems are important to investigate. Moreover human is seen as a social component and he is adaptive, socialized and dependent on the system.

*Conception of science (epistemology):* Knowledge is unique and qualitative. Quantitative data can also be used. Knowledge is generated about the unique system and its type of connections.

Scientific ideals lie on the belief that it is impossible to be totally impartial; however it is the aiming goal to be as neutral as possible. It will be described and explained the existing system and herby guide and predict a possible system change according to adapt the system to another market.

*Study area:* It is used to evaluate the chosen material of the project. It is relevant to evaluate the main sources in accordance with a number of quality criteria; validity; reliability and representativity.[[16]](#footnote-17) **Validity** shows the relationship between the subject that is actually being investigated, and what you want to investigate.[[17]](#footnote-18) **Representativity** is concerned whether a spot thesis is covering the entire population and if it can be generated to make up for the entire population. **Reliability** is whether you can produce the data, and if other researchers can determine the investigation to be truthful. Truthful is understood as finding the same results in other research using the same methods.

*Primary and secondary data*: The data used in this project can be groups into two categories; primary and secondary. The definition of primary data is information that has been gathered specifically for the research project. Secondary data are information that has been collected by someone else for another purpose than the specific research area. The internet, especially CEPHIS website, has played a major role in the availability of secondary data. This data can be very useful for the researcher, but it also has to be learned how to handle this information. The secondary data are furthermore grouped in internal and external. The internal secondary data are information that is collected within the company. The external secondary data are information that is attained outside the company. These are moreover divided into three categories: published, syndicated services and databases.[[18]](#footnote-19)

Primary data collected for the project is gained from an interview with the director of the company and support information from employees of CEPHIS. These data are formulated specifically for the purpose of the research area.

Secondary data used in the project are both internal and external. The internal data come from the web site posted by the firm concerning projects in which they have been or are evolved and general information about the employees’ team. The external data are articles from different publications and databases.

## Theories

In order to obtain a better understanding of the innovation process and the importance of the firm’s position into a network, there are different theories presented in the project. The choice of these theories is affected by the methodological approach used for the purpose of this project, which is the systems approach.

### Theory selection

The background of this project is the network relationships around CEPHIS. That is why the network perspective is the basic point to understand the whole project. Some relevant aspects of this theory related to kinds of connections between nodes and positions into the network are present in this work. Network theory maps relationships between individuals in a social angle. This will be the starting point for a deeper research in this issue. Together with the market orientation theory, they form the foundation of this writing. Market orientation is defined as a business approach or philosophy that focuses on identifying and meeting the stated or hidden needs or wants of the customer, through its own or acquired products.

Another relevant aspect developed along this document is the innovation. An insight view into the innovation process is given using an article written by Clayton M. Christensen & Michael E. Raynor. The article named *“The Innovator’s Solution”* is about concepts coming up when a new business or product is launched. Ideas discussed in the paper are sustaining- vs. disruptive technologies; interdependent- vs. modular architectures; commoditization- vs. de-commoditization processes; and appropriability.

Transaction cost economics is a theoretical framework for predicting when certain economic tasks would be performed by firms, and when they would be performed in the market. According to Williamson, the determinants of transaction costs are frequency, uncertainty, asset specificity, limited rationality and opportunistic behavior. There are more recent authors who disagree with some of these aspects including the issue of reputation in their statements. Inclusion of reputation makes sense for some enterprises to choose disintegration as a model for running the business even if that asset specificity is high enough to implant vertical integration from Williamson’s point of view.

Another thought taken in account is a network perspective on organizational learning. For this issue an article named *“Knowledge transfer in interaorganizational networks: effects of network position and absorptive capacity on business unit innovation and performance”* is used, written by Wenpin Tsai. It highlights the reciprocity relationship between network position and absorptive capacity. It explains how they need each other in order to gain important knowledge from the constituents of the network.

The last authors studied in order to achieve the aim of the problem formulation are Hans Georg Gemünden, Thomas Ritter, and Peter Heydebreck; in their article *“Network configuration and innovation success: An empirical analysis in German high-tech industries”*. The article talks about the possible components of a network describing each interaction into the system and categorizes seven different types of network configurations. Network configurations are built depending on the relation that the focal company maintains among customers, suppliers, consultants and universities.

### Limitations

Selection of theories presented in the project is limited due to the large extent of authors that discussed about the network issues. A wide range of theories and articles related to knowledge transfer, network configuration and transaction costs can be found. That is why only some of them had to be chosen for the proposal of the study. If too many theories or viewpoints are taken in consideration the project would not be consistent. Talking about so many issues makes the study unclear and does not enable making a deep study in any of the items.

One of the aspects related to the network theory which is not discussed in the project is “the strength of weak ties”, proposed by Mark Granovetter. Weak ties describe the nature of a relationship between nodes in terms of consequences for an entire network. Granovetter’s argument shows how relations with individuals only weakly linked to a focal person put that person in touch with others who are not members of one's immediate circle. This aspect is included in one of the data read to understand the network perspective, *“Introduction to Social Network Theory”* by Charles Kadushin (2004). Weak ties were seen as a deeper insight view into the theory but for this study only the basic concepts are important.

Innovation process is a subject which involves different variants. It is a complex process formed by series of stages that a company pass through in order to achieve its objectives. The purpose of this study is not focusing on the process of innovation understanding how it is developed from the first idea to its implementation. However, for further information, a theory that could help make clear this issue is the *Stages of innovation decision process* suggested by Everett Roger (1995). Roger describes four stages – knowledge stage, persuasion stage, decision stage, and implementation. Though, as said before, it has been avoided because of its low importance to the resolution of the problem formulation. It is a relevant issue for developing innovative processes, although this project focuses on how innovations come to the customer but not on how ideas work. That is why the article called *“The Innovator’s Solution”* written by Clayton M. Christensen & Michael E. Raynor was chosen for the study.

Before the decision of working with the transaction cost economics theory, some other possibilities were considered. Resource dependency is an open-system theory that states that all organizations exchange resources with the environment as a condition for survival. The need to acquire resources creates dependencies between organizations and external units, which ultimately can cause political problems that require political solutions. In this perspective, organizations have choice over their own fate. Managers try to acquire resources without creating difficult dependencies. The most definitive reference is Pfeffer and Salancik (1978).

The article of “*Knowledge transfer in intraorganizational networks: effects of network position and absorptive capacity on business unit innovation and performance”*, written by Wenpin Tsai, was preferred to work with because of the clear understanding about network position and absorptive capacity that it provides.

Finally, attention turned to Hans Georg Gemünden, Thomas Ritter, and Peter Heydebreck; in their article *“Network configuration and innovation success: An empirical analysis in German high-tech industries”*. This article is crucial determining the configuration that CEPHIS finds itself, which is the goal of the problem formulation.

## The project design

In this part a graphic design of the project is placed. Underneath the graph there is also a description of all the chapters, to give the reader a fast overview of the project.

The project focuses on two main issues.

The first one concerns the model of organization that CEPHIS is following to operate. Company operations take place into a network formed by more enterprises and other bodies. In order to understand the behaviour of a firm into a network and relationships that can be built among the firm and members of the network, the network theory is presented. Network theory is a social perspective that will be regarded as a base for further research in this field. CEPHIS is acting into a network and its main issue into the network is the innovation. Then, aspects from a study conducted by Clayton M. Christensen and Michael E. Raynor will be used to discuss about the innovation process. Ideas drawn from these two perspectives are supported by the transaction cost economics theory. This theory is the foundation to understand what is more beneficial for CEPHIS, the vertical integration or disintegrated models.

The second issue concerns the choice of the network configuration in which CEPHIS finds itself. The resolution is based on a study conducted by Hans Georg Gemünden, Thomas Ritter, and Peter Heydebreck. The study is used to list the constituents of the network into which CEPHIS is located. The functions of each partner and relationships between them and the focal firm are described. Partners that can exist in a network are chosen taking in account that the goal of the network is the innovation. Previously to this section a study realized by Wenpin Tsai about knowledge transfer is presented. It gives an insight view about the importance of the position of a firm into the network and how to profit from it.

Introduction

Methodology

Network Perspective

Market Orientation

Transaction Cost Economics

Network Configuration

Innovation Process

Knowledge Transfer

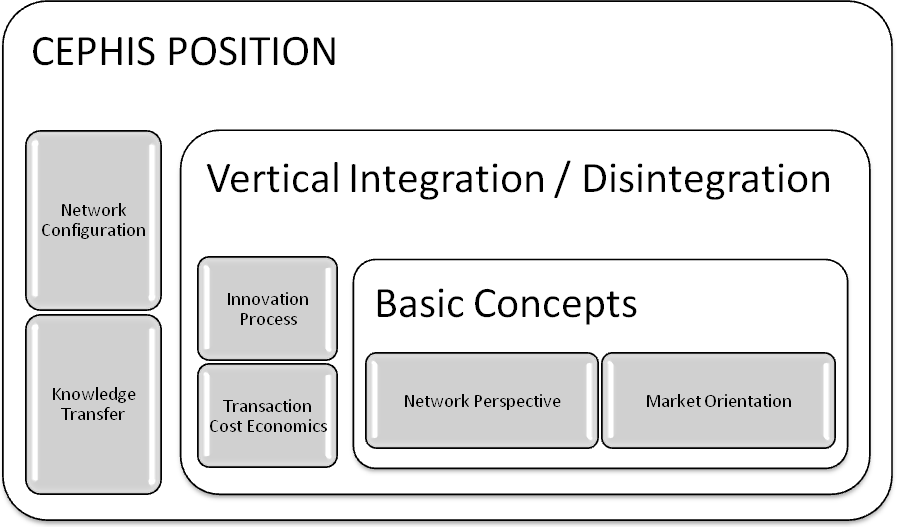
CONCLUSION / RECOMENDATIONS

Case of CEPHIS

The figure below shows the linkage procedure of the models used becoming in one framework. The connection has been built in a logical way regarding the objectives which want to be reached for the resolution of the problem formulation.

Figure 4: Framework

**CONCLUSIONS**



**Source: Own creation**

Here it is showed how the network perspective and the market orientation formed the basic concepts of the study to go further into a more accurate research. After the presentation of these models it comes the section where is discussed if it is more appropriate for CEPHIS moving into a vertical integration model or taking a disintegrated orientation. Factors delimiting the innovation process give the first insight and the transaction cost economics is used as the platform for taking the decision. At the highest level of the framework there is the network configuration as it is the goal of the project. Seven types of network configuration are presented and CEPHIS is enclosed into the relevant model. Aspects described in the other stages of the framework are positioned into the step related to the network configuration since they are essential to reach the solution. Conclusions extracted from each stage will lead to build a final conclusion combining the set of ideas reached through the development of the project.

With regards to the chapters the project design looks as follows:

Chapter 1 is the introduction to the project. It explains why the phenomenon of innovation was chosen for the purpose of the project. It also talks about network relationships and the importance of knowledge transfer among them.

Chapter 2 shows the problem formulation, which will be answered throughout the project. This chapter also points out how the answer will be achieved thanks to the Bloom’s taxonomy.

Chapter 3 forms the methodological view and approaches chosen for the project. Here fundamental perceptions, which make the foundation of the project, will be analyzed.

Chapter 4 contains the network perspective which introduces set of concepts used in network theory that will form the basis of the project.

Chapter 5, states the circumstances of CEPHIS describing the engineers team, procedures to run the business and relationships with partners.

Chapter 6 is related to the market orientation, containing basic concepts for further research along the project.

Chapter 7 encloses aspects related to the innovation process used to make a deeper study into the organizational modes.

Chapter 8 holds the platform to understand if it is more beneficial for CEPHIS to maintain all the stages of the product development, since the initial idea to its commercialization, in-house or in the market. The platform used is the transaction cost economics.

Chapter 9 is about concepts with a special importance in the knowledge transfer position. It also supports the next chapter.

Chapter 10analyses the network configuration regarding the kind of relationships established among the partners. It is made from an innovation outlook.

Chapter 11 is the conclusion. In this section the position CEPHIS finds itself into the network and the organizational model used to reach this position will be assessed.

# NETWORK PERSPECTIVE

This chapter will introduce a minimal set of concepts used in network theory. Social network theory is one of the few if perhaps the only theory in social science that is not reductionist. The theory applies to a variety of analysis levels from small groups to entire global systems.

## Definition

A network can be defined as a set of objects and a mapping of relations the objects or nodes. The simplest network is composed by two objects, 1 and 2, and one relationship that links them. It can also be found symmetrical or non-directional relationships as well: 1 and 2 like one other, or their linking is mutual.

The situations where more than one relationship can be observed are called multiplex relationships. There can be a flow between the objects or the nodes. This relationship is not as simple as sharing an attribute or being in the same place at the same time. Observing a non-directional or reciprocal three nodes relationship in which 1 and 2 like one another, and 2 and 3 like one other.

When the three of the components of the network like each other as well, the network is categorized to be “transitive” or balanced, linking directly all the nodes.

The understanding of the relationships between nodes involves a range of aspects which are explained in the following sections of this chapter.

## Sociological view of networks

This outlook considers the conditions that make more or less likely that a link between nodes would exist.

First of all are categorized three different kinds of networks: **a)** *ego-centric* are networks connected with a single node or individual. To be analyzed, the information must be available about the connection between the people forming the network; **b)** *socio-centric* are categorized by Russell Bernard as networks in a box. Those relationship drawn closed system networks such as connection between workers in an organization; **c)** *open system* networks can have boundaries not clear defined as they are not considered to be in a box. An example of this network can be connections between different firms.

### Connections

To be considered networks, connections between nodes must not only be lists of people or organizations but information must be available about these connections.

*Propinquity*

Nodes are more likely to be connected with one another, other conditions being equal, if they are geographically near to one another. This term can also be stressed if it is added the concept of time. Persons are even more likely to be connected if they are sharing information at the same place at the same time.

### Homophily

Homophily is referred to having one or more common social attributes. Two basic facts are carried out by this concept. Common norms may bring nodes with common attributes together, or the reverse[[19]](#footnote-20) and two nodes may have the same attributes because both operate in the same arena, and vice versa[[20]](#footnote-21).

The greater the homophily the more likely two nodes will be connected.

### Distance between two nodes

The distance between two nodes in a network is determined by four parameters: the size of the first order zone of nodes in the network; the extent to which nodes in the network have overlapping members in their first order zones; barriers between nodes; agency exercised by the nodes.

The region of nodes directly linked to a focal node is called the first order zone[[21]](#footnote-22). The nodes two steps removed from a focal node are called the second order zone, and so on.

The impact of each zone on an individual node declines exponentially. It has been studied that the number of effectively consequential zones is between two and three. Organizations past the third or at most fourth zone objects or nodes have relatively small effects on the focal individual or structure[[22]](#footnote-23). Loose coupling theory suggests that tight linkages between parts of an organization are not only unlikely, but also inefficient[[23]](#footnote-24).

To understand the limited effect of distant nodes it has to be understood the next. When is talked about *connected* network, if it is entirely connected it is possible to reach every other node in the network through a path or connection running from one node to another. In *dense* or *clustered* networks there may be a large proportion of mutual connections, such as friendship circles. Even when an entire network is not dense, the clusters or dense parts of the network may be confined to relatively limited *neighbourhoods* or groups. A relatively few nodes within the more dense neighbourhood have connections, called “shortcuts” with other nodes that are not part of the dense neighbourhood. This model does not depend on the number of persons or nodes known to the focal node, but only on the degree of neighbourhood clustering and the number of shortcuts.

### Dyads and Mutuality

The concept of mutuality implies the extent to which relations are reciprocal and the degree of power or asymmetry in the relationship. In contrast, dyadic system theory conceptualizes any node as a solitary individual that is to some extent isolated from the external world[[24]](#footnote-25).

Pathology in networks can be defined as either a failure of a unit adequately to identify its core self (organization’s mission); a failure of ego to understand what the other desires from ego and how this does not mesh with ego desires for itself (synchronized goals); and a failure to understand what the other wants or needs (customer orientation). Knowing these aspects from the nodes of the network leads to “mutual recognition”.

Mutual recognition plus “mutual regulation” which consist or reciprocal influence[[25]](#footnote-26) create a unique system in an interaction, a system that brings third element or factor, into the pair of dyads. The dyad creates a system that is a synthesis of ideas, feelings, cognitions, and inchoate unrecognized and unconscious material that influences the course of the interaction[[26]](#footnote-27).

### Balance and Triads

If not balanced state exists, then forces towards this state will arise, and if a change is not possible the state of imbalance will produce tension. There exist a set os possible configurations of triads and different ways of conducting a census of all these possibilities in any network[[27]](#footnote-28).

## Social attributes of Nodes and Networks

A network involves a large range of aspects that should be regarded in order to understand the kind of relationship established between two or more nodes.

### Position

If the network consists of several nodes, position o a node in the network becomes extremely important.

There are many positions about location that have been applied in describing networks configuration. The general positions are described below.

### Centrality

Hierarchy in networks is stated strictly in terms of location of a given node relative to other nodes, without assuming any content to this position. The content is given by the nature of the flow or the connection. Since node can be directional it can be use the term “degree” in order to specify the number of other nodes with which a given node is directly connected. The number of nodes flowing into a given node is called “in-degree”, which would means popularity, and the number of flowing from a given node is similarly called “out-degree”.

### Multiplexity

The term multiplexity is related to the concept of homopily presented above, taking in consideration the multiple connections that exist between nodes. Multiplexity has been used in the network literature in two related senses. One of them is the called *role multiplexity[[28]](#footnote-29),* which referrers to the possibility that two nodes occupy more than one position that ties them together. An example can be the relationship between a boss and a worker of the same company, who maintain an organizational relationship at the same time that they are friends. The second sense is related to the possibility that as a result of having a given role relationship (co-worker), there is a number of different flows between a pair of persons, for example, advice, friendship, and work on common tasks[[29]](#footnote-30). This concept is called *content multiplexity[[30]](#footnote-31).* It also can be possible that the same tie would have a number of different kind ideas flowing through it. For example, an advice can leads a solution problem, a reformulation of the problem, how to obtain information about solutions the problem, reaffirmation of an already identified solution, and the credibility of proposed solution[[31]](#footnote-32)

Multiplex relationships can be described qualitatively and discursively, but more precise characterizations of the consequences and causes of different mixes of ties requires more accurately models to be studied.

## Aspects of complete networks

Complete networks are formed among the companies operating jointly on a common scenario and mapping linkages which allow them to profit from each other in a different level.

### Position and social capital

The “social capital” of a node refers to the network position of the object or node and consists of the ability to draw on the resources contained by members of the network[[32]](#footnote-33). Resources of the network can be accessible to all components at the same extent but depending on the ability of each node to manage these resources, it will make the most out of theme in a higher or lower extent.

Network positions in which the focal node is connected with other nodes themselves are not connected with other another is an important form of social capital[[33]](#footnote-34). Social capital, then, is not directly an attribute of individuals, but rather their ability to draw upon their position in a network.

After the introduction to the basis of the project CEPHIS will be presented. Understanding the concepts described in this section is necessary to be able to apply them to the particular case of CEPHIS.

# CIRCUMSTANCE OF CEPHIS

The aim of this section is to introduce the reader to the basic aspects of the company which is the central point of the project. Firstly, a brief introduction will be given to the reader about the kind of company that CEPHIS is and which are the daily tasks of the team working there. Next step is a description about the core activity of the company, how it is structured and who the players are.

## Introduction

The company that will be studied in this project is a high-technology enterprise called CEPHIS. The firm has its offices located in Bellaterra (Barcelona) and their work is on the field of microelectronic’s research.

CEPHIS was established as a Laboratory for Hardware-Software Prototypes & Solutions. They work on the research and development of new hardware and software co-design methodologies, based on the use of virtual components (IP cores) to increment the productivity of the custom-designed electronic systems.

The research laboratory is formed by professors, doctors, engineers and technicians, as well as a group of scholars from the *Universitat Autònoma de Barcelona* (henceforth UAB). Every year new scholars pass through CEPHIS and most of them become part of the staff after ending their scholarship.[[34]](#footnote-35)

The firm is owned 100% by UAB. CEPHIS depends on the issues related to the administration services; the location; internet network which includes some electrical devices; and the financial capacity. On the other hand, there is a subject controlled by CEPHIS. It is the commercial capacity. They also have own trade name and their logotype.

The services that CEPHIS offers are several:

* *Custom Solutions*. Design and development of HW/SW solutions for specific customer requirements. Embedded systems, SBC, SystemOnChip, reconfigurable systems (FPGAs).
* *Consultancy*. Support and transfer of knowledge and technology for analysis and development of technology driven projects.
* *Products*. Virtual components of Intellectual Property that can be integrated on a chip (FPGA, ASIC). Rapid prototyping platforms for specific domains (Image sensors, Ethernet, WirlessLAN).
* *Training*. Custom courses, Ph. D. courses, technical seminars and conferences.

Talking about custom solutions and products’ services, there is a room to categorize them into four different kind of projects’ development to carry out these services.

* *Consortium projects*are developed through CIDEM. CIDEM is the Innovation and Entrepreneurial Development Centre included into the Innovation, Universities and Companies Department of the *Generalitat de Catalunya* (Catalan Government). This public organization is in charge of helping to increase the resources addressed to R&D innovation as well as the relationships among the agents of the innovation system. In these cases CEPHIS presents an idea and the Innovation Department decides if it deserves to be developed. Research obtained in these projects is purely academic. It can be applied to future projects, but the sense of consortium projects is just R&D research.
* *AVANZA I+D projects*relays on the Promotion of the Technical Investigation Program. It is a tool from the Spanish Government to articulate public subventions in order to stimulate companies and other entities to carry out investigation and technical development activities. Here is the particular enterprise requiring the solution that is looking for the university to solve it and both together apply for the subsidy. The project is half subsidized by the Government and half in charge of the particular firm.
* *European projects*are developed together with partners from around Europe. Participants are universities, which lead the projects and enterprises. CEPHIS takes part acting as a university, which means that they cannot benefit from these projects. Subsidy can be only used for the aim of the project and if at the end there is some money left, it has to be returned to the Government. For the development of these projects, CEPHIS obtains financial support from the Spanish Government. Outputs from European projects are sometimes purely research for possible further applications and others can be solutions for a particular company. These projects are long-term duration, with a minimum of three years running.
* *Projects for particular enterprises*consist on a contract signed between CEPHIS and the determinate company which requires the services from CEPHIS. This kind of service provides total flexibility to spend the money gained since its justification is not required.

Projects are various and differently run, although all of them are developed together with other organizations building network relationships, which is the core issue of this study.

## Tasks

Daily work in CEPHIS evolves a variety of tasks. Each task is developed by the adequate employee who possesses the right skills to work in the specified assignment. Making a list of the roles that can be represented in the firm will help in order to relate tasks to the members of CEPHIS team. It also has to be taken in account that tasks are differentiated by in-house and outsourcing. Most of duties are carried out in-house, but a small sort of them are in charge of external people.

In-house categorization of tasks is the following:

* *Director* is the person in charge of managing the company, which translates as the CEO into United States English. The director represents the image of CEPHIS attending the important meetings arranged by the company world-wide. At the same time, he also acts as a project manager of some of the projects.
* *Promotion*. People in charge of promotion are two project managers working in the design, development and implementation of strategic plans for the organization in a cost-effective and time-efficient manner.

Project managers are the coordinators of the projects. They quantify the necessary amount of money for the development of the specific project and the way how it will be spent. When asking for the assignment of research projects proposed to be financed by the Government a report where the goals that the company will reach, the way to achieve them by tasks planning, the time the process will take and the money required to develop it are described is drawn up. This group of people makes up the visible face of CEPHIS looking for new customers and providing assistance to them before, during and after the project is ended. Projects developed by the corporation are distributed within them becoming each project manager the head of a number of assignments.

Promotion is divided into two different categories. There is the project manager in duty of *marketing* operations who periodically updates CEPHIS website including news, and the *quality assurance* manager, taking care of the fulfilment of firm’s regulations. CEPHIS created a handbook specifying the organization of the company, mission, strategy, working processes which should be done exactly in order to conform the government checking.

* *Management support* is in charge of the accounts of the company. One of the tasks this position implies is the control of any purchase. As it has been mentioned, CEPHIS is owned by the UAB, and all the actions that the company realizes are supervised by the Microelectronic Department of the University. When suitable people for buying need to acquire any product, although it would be a simple pen, they have to provide the management support with all the information required to realize the purchase. Here is when the information is transferred to the administration head of the Microelectronic Department, who has to approve the purchase in accordance with the UAB regulations and who also has the legal authority to formalize the order. Management support is also in charge of recollecting invoices of any purchase and tickets from transport and other expenses that have been paid by an employee during a business travel. This task is necessary for all the projects subsidized by the Government. CEPHIS gets funding from the Government but at the end of these projects those expenditures have to be demonstrated to be done and to be the same expenses described in the previous report.
* *Research team* is formed by a few project managers and a group of research assistants. The mission of project managers has been described below when talking about the promoters. The rest of the research team is composed by the engineers who work in the process of project development under the instruction of the project manager. Research assistants are divided into two categories; senior engineers and junior engineers. Two groups differentiate each other because of the higher grade of responsibility carried out by senior engineers. Junior engineers are in a formation phase guided by senior engineers. Seniors are the ones who assign tasks to juniors and the responsible ones in front of the client in case some of the work done would not be as expected. Within senior engineers there are two persons in charge of a specific task. One is the laboratory manager who is in charge of the laboratory maintenance and who has the authority to control the usage of the machines. CEPHIS offers the possibility of renting the use of these machines. When somebody requests using them, the laboratory manager is the one who says when it is possible to be used depending on the need of the machine for CEPHIS work and which would be the cost. The other post is the intellectual property manager even though this person also works as a server administrator. The engineer makes security copies of all the information flowing inside the company. This charge could be compared to the computing department in any other enterprise.
* *Ph.D. students* are writing their Thesis under the supervision of CEPHIS engineers. They use the information that the firm possesses to help them in their projects and take advices from senior engineers. Research developed by this group of engineers is useful for CEPHIS improvement.
* *Grants* act as research assistants but they have no responsibilities for the work they realize. Grants are there doing an internship in order to learn which provides them with practical knowledge. In the case of CEPHIS, these students give a hand in the daily work and are potential employees if during their stay in the company the director has been pleased with their work skills.

Subsequently the list of services offered by CEPHIS with the members of its work team will be related. Who acts in each job will be explained.

* *Consultancy* is realized by project managers, senior managers and even by the director of the company. Since this service requires high level of technology knowledge, engineers completely formed are in charge of assessing the customers.
* *Custom solutions* are mostly developed by senior engineers who are also in charge of after-sales services. They keep in contact with clients during the construction of the solution and after being handled the product if it is required in order to solve any related problem.
* *Products* are referred to the main core business of CEPHIS. Everybody in the company is working in the development of projects which become the production of codes and prototypes under the specific requirements. As it has been mentioned when describing the team, each engineer occupies a defined role but all of them are involved in the progress of projects.
* *Training* can be regarded from different points of view. CEPHIS is sometimes contracted by other enterprises or organizations to train other teams of engineers in some specific field realizing custom courses, seminars or conferences. The other kind of training is which junior engineer, Ph.D. students and grants gain from being working in the company. Finally there are engineers who give lessons at the UAB.

To sum up, it is relevant to say that tasks developed in CEPHIS are all carried out by engineers, with the exception of the management support. Since the firm is not in charge of industrialization and/or marketing processes, the work they realize requires expert engineers helped by students of microelectronic fields.

## Network Relationships

Carrying out European projects involves several bodies taking part of the work. Tasks are different depending on the partner and their position in the market or the fields in which they are specialized, which makes higher or lower their importance in the development of the project.

Some of the projects in which CEPHIS has been working or is still working on are the following:

* *HDTVNext* consists on the investigation and development of the new generation of high definition platforms of television. They are developing means to provide high definition at home (HD@Home) and high definition under demand (HD VoD). Partners working in this project are Spanish enterprises such as Diseño de sistemas Silico, S.A., Telefonica I+D, Robotiker-tecnalia, Europen Software Institute, I&IMS, Energy System-Sonytec and Activa Multimedia.
* *AMR global solution* for GAS on AMI standardized infrastructures is a project developed jointly with KROMSCHROEDER, Gas Natural SDG, Servicios Informáticos KIFER, MIRAKONTA, PROENGSOFT and CNM (National Center of Microelectronics).
* *ONTOMEDIA* is about ontology and web services platforms for online medicine. It is running out together with Ximetrix Network Thoughts S.L., Universitat Pompeu i Fabra, and Wolters Kluwer España S.A.
* *NFC technology* is used to purchase and validate public transport tickets. Partners in this project are WILICO, *Ferrocarril Metropolità de Barcelona* (railroad enterprise), and CNM.

In order to make clear how the partners are acting in the development of these projects a particular project will be described. Here the players are listed and the role taken by them during the progress of the project solution is described. The project chosen is an European research named ParMa, which is currently running.

**ParMa** (Parallel Programming for Multi-core Architectures) consortium was launched in Dresden (Germany) last year by Research centres in Universities or Industries and Computing Centres, from France, Germany, the United Kingdom and Spain. Consortium is led by Stuttgart University. The total number of members jointed into the consortium rises until 17. Among them:

* Several industrial partners
* An Applied Research Lab
* A computer manufacturer
* Three renowned High Performance Computing Centers
* Three academic partners

The various partners are funded by their respective national Funding Authorities.

Here is exposed the particular case of each country, regarding at the Funding Authorities and a briefly description of the companies involved in this project.

* **France** is funded by the *Ministère de l’Économie de l’Industries et de l’Emploi.*

Enterprises taking part are:

* **Bull** designs and develops servers and software for an open environment, integrating advanced technologies and proposes services from system integration consulting to outsourcing. Its distribution network spreads to over one hundred countries world-wide.[[35]](#footnote-36)
* **UVSQ** is a university from Versailles which offers training programs based on the interaction between sciences and technology one the one hand and humanistic culture on the other.[[36]](#footnote-37)
* **CAPS Enterprise** is specialized in high performance and embedded computing.[[37]](#footnote-38)
* **Institute National des Télécommunications (INT)** is a public institution which provides graduate programs in engineering and management and carries out research in the broad field of communications and information technology. The Computer Science Department develops research in the domain of high performance computing. [[38]](#footnote-39)
* **Dassault Aviation** is expertise in the development of complex systems and flight control systems. The enterprise is operating in more than seventy countries across five continents.[[39]](#footnote-40)
* **LIST** is a software systems and technology research centre working in embedded systems, interactive systems and signal detection and processing.[[40]](#footnote-41)
* **Germany** is funded by the Federal Ministry of Education and Research

Enterprises involved are:

* **Centre for Information Services and High Performance Computing (ZIH)** is a central scientific institution of the Dresden University of Technology.[[41]](#footnote-42)
* **Forschungszentrum Jülich** is a centre for multidisciplinary research. It runs on of the most powerful scientific computer centres in Europe.[[42]](#footnote-43)
* **RECOM Services** is a spin-off from the Stuttgart University. Services apply 3D-combustion. It is working worldwide with partners in the U.S. and China.[[43]](#footnote-44)
* **GWT** conducts commissioned research for industry and the public sector, develops new products and technologies and provides a comprehensive service for all kind of innovations.[[44]](#footnote-45)
* **GNS** is a partner in many engineering analysis applications.[[45]](#footnote-46)
* **MAGMA** concerns casting design process simulations and manufacturing industry. It has employees at six locations worldwide.[[46]](#footnote-47)
* **German Federal High Performance Computing Centre (HLRS)** is a scientific institution of the Stuttgart University and hosts one of the largest European supercomputer resources.[[47]](#footnote-48)
* **United Kingdom**
* **Allinea Software** is a supplier of tools for parallel and high performance computing. It possesses a worldwide customer’s base that includes a large number of universities, government research institutes and high-profile commercial organizations.[[48]](#footnote-49)
* **Spain**. Enterprises are funding by the *Ministerio de Industria, Turismo y Comercio* (MITyC) as part of the *Planes Nacionales de Investigación Científica, Desarrollo e Innovación Tecnológica* in 2004-2007 and 2008-2011.
* **Indra** is working in the areas of Information Technologies, Simulation and Automatic Test Systems, and Avionics Electronics Equipment. They have completed projects in more than fifty countries spread over five continents.[[49]](#footnote-50)
* **Robotiker** is focused in ICTs (Information and Telecommunications Technologies) and provides R&D&I services developing new technological products. It has taken part in more than 60 international R&D projects, 8 of them as project leader.[[50]](#footnote-51)

The aim of the association is to help the HPC (High Performance Computing) community to benefit fully from the processor race while developing innovative, flexible and open technologies for taking advantage of the multi-core architectures. More specifically, the aim of the project lies on the development of advanced technologies to exploit fully the power of multi-core architectures, the delivery of substantial performance improvements for conventional HPC and for mainstream applications, and enable the advent of power-intensive innovative applications[[51]](#footnote-52).

ParMA project is a three-year ITEA 2 (Information Technology for European Advancement) project that has started in June 2007 and will last till May 2010. ITEA 2 is Europe’s premier cooperative R&D program driving pre-competitive research on embedded and distributed software-intensive systems and services. It supports co-ordinate national funding submissions and provides the link between those who provide finance, technology and software engineering.[[52]](#footnote-53)

To conclude this section it is important to remark that the aim of CEPHIS is the research and development of new hardware and software co-design methodologies, based on the use of virtual components (IP cores) to increment the productivity of the custom-designed electronic systems. Products developed by the firm are always carried out jointly by partners, since they are not in charge of industrialization and/or marketing processes. The range of acting involves several regions of Spain and some European countries.

Each project running out has an importance for CEPHIS future, but European projects can be categorized as the strategic goal to follow. European projects are signed for three years, which ensures the salary of the engineers and a worldwide recognition. CEPHIS is provided with reputation since members of the project are universities and well known enterprises.

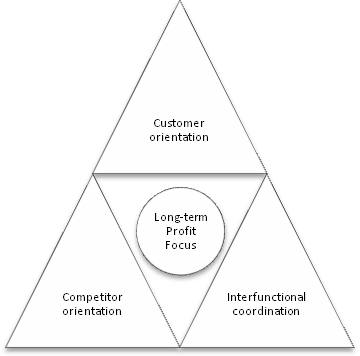
# MARKET ORIENTATION

Market orientation can be defined as the organization culture that most effectively and efficiently creates the necessary behaviours for the creation of superior value for buyers and, thus continuous superior performance for the business[[53]](#footnote-54).

Market orientation contents three behavioral components (customer orientation, competitor orientation and interfunctional coordination) and two decision criteria (long-term focus and profitability).

Figure 5: Market Orientation

Target Market



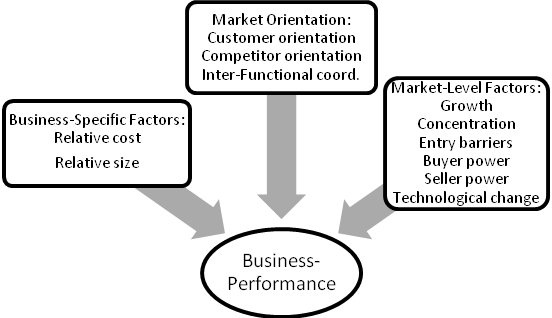
**Source: Narver, C. & Stanley F. (1990)**

The three behavioural components are, on average, of equal importance. It can be observed in the figure below where is represented the market orientation. For the aim of this study, attention will be on Customer orientation, in order to find out potential clients for CEPHIS. Customer orientation lies on the understanding of one’s target buyers to be able to create a superior value for them continuously. It requires considering a buyer’s entire value chain.

It also should be mentioned the relevance of the two decision criteria. Firstly, any enterprise cannot avoid a long-run perspective for maintaining its presence in relation to competitors. Firms should constantly look at customers’ needs implementing additional value for them. Referring to second decision criteria, profitability, it is businesses’ objective in a market orientation. Profits are perceives as a component of market orientation, thus profitability is viewed as a consequence of market orientation[[54]](#footnote-55).

There exist eight situational variables that may affect a business’s profitability[[55]](#footnote-56). These variables must be controlled in analyzing the effect of a market orientation on a business’s profitability. Figure 6 shows all the factors influencing business performance.

Figure 6: Independent effects model of relationships between market orientation, business-specific factors, market-level factors, and performance



**Source: Narver, J. & Stanley F. (1990)**

Profitability is in this model affected by business-specific- and market-level factors and the market orientation performed by the company. Relation between market orientation and business profitability is expected to be positive but in a different way depending on the kind of business. Nerver & Slater differentiate three types of business: commodity, distribution, and specialty business. And the last two business are also enclosed in a group called noncommodity business. For commodity business is more difficult to control its profitability due to the fact that price is established by the market. Since commodity businesses (e. g. apples) are not differentiating products or services, a firm is not able to fix its own price without looking at competence acting. Even though the discussion around profitability in commodity business could be a large subject, the focus of the project is on specialty business. CEPHIS business has been described as research and development of new hardware and software co-design methodologies, which leads to categorize the firm as a specialty business.

Factors influencing business profitability are named in Figure 6, but those will be studied deeply in the next chapter. A briefly view in this issue is provided here, even though for the purpose of the project more factors are relevant to achieve the solution of the problem formulation.

Market orientation is clearly related to business profitability in a positive way. From the article of Narver & Slater it is supported that market orientation is an important determinant for this issue. Business-specific factors relation with profitability is harder from relative costs, which are critical for margins the company gains from. Relative size is also critical since the bigger a firm is the more influence it can make in the market and at the same time its profits can be higher. Even so, a small company selling a low volume of its product can be enough profitable for its needs. On the other hand, market-level factors also play a role in this discussion. Growth is intrinsically linked to profitability because one aspect pushes the other to rise up. High profitability lead to better position in the market and this causes a company growth. Concentration of competitors slows down profitability owing to the difficulty for a firm to have a room in the market. Entry barriers act as a break for profitability at the side of new entrants. More efforts to get in the market are required. But from the side of already established firms, high entry barriers help to maintain profitability or even increase it if they are able to seduce new customers and cut access to new competitors. Buyer power is a detractor factor since customers are responsible to line the product price and freedom for companies to control it becoming very low. Seller power is a positive aspect giving to the firm the possibility to fix an appropriate price for selling which automatically will lead to high margins. Technological change does not help to rise up profitability because it involves investing to not become obsolete. Even so, firms that are able to manage a timing change will benefit from that taking advantage among the rest of competitors.

# INNOVATION PROCESS

This chapter is about relevant aspects coming up when founding a new business or a new product or service. The enterprise object of the study is a developed business launching innovative ideas in each of the projects they work, and here is where focus will fall on.

In order to discuss about this issue ideas drawn by Clayton M. Christensen are taken as a reference. Specifically an article named “*The Innovator’s Solution*” written by Christensen and Michael E. Raynor. The paper gives a view into the process of business creation highlighting its unpredictability.

A general idea when working on innovative products is how middle managers, named project managers in the case of CEPHIS, will act. Since the desire to preserve reputation, middle manager will be typically reticent to work with new product concepts which are not sure to be commercialized. They will prefer to make market analysis before starting a new product and this way knowing the wishes of customers. Consequences of assuring their position in the company could be losing bright ideas which could lead to a successful business. Only a few middle managers accept the risk of moving to new assignments which improve their skills and experiences.

## Sustaining vs. Disruptive

Sustaining technology is defined as those technologies that make much better products for the best customers that could be sold for higher margins.[[56]](#footnote-57) This technology is based on incremental improvement of previously available products or services. An example of sustaining technology lies on the photography world when the old common way of taking pictures with roll improved to digital cameras. Cameras were a product already present in the market but this change in its system made their use easier and gained high-end customers.

The other kind of technology, disruptive technology, is characterized for bringing to the market something that is worse. Products or services offered are not better in terms of performance valued by the mainstream of customers, and therefore could not be used by these customers.[[57]](#footnote-58) What characterize disruptive technology are their simplicity, convenience and less expensive prices than currently available products or services. New entrants are usually who move successfully launching business based on disruptive technology. An example to make a better understand of the concept could be the introduction of Internet telephony. When it appeared in the market the voice communication was two seconds delayed. It was not good enough for customers positioned in the higher level of telephone market but sufficient for the lower tier. A group of the last customers were foreign students who bear the delay since they could talk for a long while with their families for free.

## Scope of a business

The scope of a business lies on the core competences of a company. Regarding the innovation process, the topic should be more about needs to master today and in the future than looking to what they are doing best at present. In this way managers could be excel on the trajectory of improvements that customers will define as important.[[58]](#footnote-59) In order to achieve the right trajectory it is important to understand product’s architecture. It is formed by different components which linkages to some others creating interfaces. *Interfaces* can exist within a product or stages in the value-added chain.

Two kinds of architectures are defined; interdependent-, and modular architectures. A kind of architecture is interdependent at an interface if one part cannot be developed without the addition of other part. Products manufactured through an assembly chain that need the product from the previous stage of the chain to include a new component are an example of interdependent interfaces. When interdependences are unpredictable it is more appropriate for the company to keep those components manufacture in-house. It will allow managers to have a higher control which will permit to deal more efficiently with possible controversial variations in the product. Interdependences along the value-added chain could be seen between processes of design, manufacturing and distribution. On the other hand, modular architectures propose a complete connection within all the elements configuring a product since the initial idea until its customers’ purchase. It does not matter who makes the components or subsystems, as long as they meet the specifications.[[59]](#footnote-60) In this way, modular components can be made independently by different work groups or even different companies.

After these arguments it makes sense to say that vertical integration has no room when a product performance has a modular architecture, but it is an advisable strategy for a better run of interdependent architectures. Interdependent architectures optimize performance in terms of functionality and reliability, while modular architectures improve firm’s flexibility in some way. And it is said in some way because to reach this flexibility the specifications are required. Freedom to operate is lower under the rules that engineers have to follow to go through the specifications of the development process.

Figure 7: Overshooting the functionality that customers can utilize triggers change in the way companies must compete

**Disruptive Technology**

Compete through speed convenience and customization

Compete with superior functionality

Performance

Time

**Sustaining Technology**

**Source: Christensen, C. Verlinden, M. and Westerman, G. (2002)**

Figure 7 shows the usual formation of interdependent- and modular architectures. The blue arrow represents how sustaining technology moves in the time related to the level of performance. It is moving up disruptive technology, symbolized by the green arrow, but in the same direction. Here it is also seen that interdependent architectures usually concentrate at the beginning of sustaining technology, competing with superior functionality. On the other hand, modular architectures are present at the culminating stage of disruptive technology competing through speed convenience and customization. When sustaining technology rises up there is a room to work through the architecture that fits better with the aims of the company. The same happens at the lowest level of disruptive technologies.

## Commoditization vs. De-commoditization

Commoditization and de-commoditization are moving reciprocally through the value chain. While commoditization undermines differentiability, de-commoditization affords opportunities to create and capture value.[[60]](#footnote-61)

Commoditization and de-commoditization follow a cycle that is the foundation of the reciprocal process. It begins when a company launches a new product which, far from satisfying customers’ needs, is closer than the attributes of the competitors’ product offers. Here appears the commoditization, but when a company puts effort to not be displaced by its competitors its product sooner or later offers more functionality and reliability than customers in the lower tiers need. This fact impacts on competition in these tiers being it driven to modular architectures. Since modular architectures are characterized for disintegration in the value chain, all producers have access to the same components and assemble according to the same standards. It makes difficult to differentiate performance or costs of the product versus those of competitors.

The graphic drawn below shows when each of both phenomenon has place focused on the evolution of user needs and technological capabilities through the time and related to the level of features. Process of commoditization occurs before user needs and technological capabilities fit at the same level; when the product is not good enough. When the product features start to be higher than it is needed to satisfy customers’ necessitates it starts the de-commoditization process.

Figure 8: Commoditization & De-commoditization process

User Needs

**Level of features**

**Time**

Technological Capabilities

COMMODITIZATION

DE-COMMODITIZATION

**Source: own design**

Christensen and Raynor have developed a law of conservation of attractive profits. The law proposes that in the value chain there is a requisite juxtaposition of modular and interdependent architectures, and of reciprocal processes of commoditization and de-commoditization. Thinking that a company launching a new product where competitors are profitable will be necessarily unprofitable is not a correct reasoning. Profitability depends on the circumstances in which companies operate in a particular time and in each point in the value-added chain.[[61]](#footnote-62) When a company enters into a particular stage of the value-added chain, at the same time that technology is not good enough, profit will be captured. This is the convenient moment to state differentiable products, scale-based costs advantages, and high entry barriers.

## Appropriability

Firms are exposed to hold its position gained by the introduction of a new innovative product just for a short time. The advantage of offering a unique product will be decreased as soon as competitors will take the step of imitating the product or going for alternative solutions. The term of appropriability gives a view of innovation from another point of view. Some authors gave a view in this field, such as Schumpeter and Arrow, whose contributions where explicitly concerned with the implications of appropriabiliy for society. But the most helpful for this study is David Teece (1986), whose argument is more related to practical questions of business strategy and economic organization considering how appropriability conditions affect the ability of an industry, and the economy as a whole, to progress.[[62]](#footnote-63) He remarks three key dimensions for assessing protection of innovation: nature of technology, product, and production process. Nature of technology is seen as the most important factor as it can be protected against competitors’ intrusiveness. Technological innovations can be kept in a firm’s possession through patents and consequently maintain the firm’s position in the market. In any case, patents are not the best option because they have a limited duration since their validity expires at some time. Another manner which works more effectively is redirecting attention to knowledge. Knowledge, taking in consideration its different forms - tacit and explicit, allows a higher degree of protection. Tacit knowledge is not easily shared; it generally requires extensive personal contact. It refers to a knowledge which is only known by an individual and that is difficult to communicate to the rest of the organization or network. Tacit aspects of knowledge can only be transmitted via training or gained through personal experience.

Protection through product is related to the integrated feature that it includes. The higher is the complexity of a product, the more difficult will be to enter in the market. Even though, this is not enough due to the increasing process of internationalization that makes easier to get into the market.

The last dimension, production process, is related to the product as it will be more complex depending on the requirements of the product. And also here the knowledge plays an important role, because tasks along the production process require a specific knowledge which should be protected from competitors.

## CEPHIS innovation process

CEPHIS operations are regarded in a different way than most of businesses. The majority of companies have an idea of producing an innovative product or service and, after the corresponding market analysis, they launch it if they think it can go on and depending on the level of risk that they willing to bear. In the case of CEPHIS, clients ask for the solution they deserve from the company and engineers study if they can go through it. Here there is not the fear of producing something that customers will not accept. Even though there is the risk that the job that to be done might suffer some complications which would make it impossible to finish with the features required or at least not in the time proposed. From this argument comes the thinking that aversion of middle managers to take new projects is lower. There is still a level of aversion because the process of production cannot be ended as it was supposed to, but there is not the uncertainty of knowing if the product is in line with the customer’s needs.

The common process of innovation that CEPHIS follows fulfils the conditions to be characterized as **sustaining technology**. The company is working mostly on the research of new technologies, what means that they are offering to the market improved solutions from the ones already operating in. At the website of the firm it says explicitly that they work in “research and development of new hardware and software co-design methodologies to increment the productivity of the custom-designed electronic systems. System prototypes and solutions are developed using most modern techniques, like the use of high level design languages and new co-design methods and tools.”

The development of a prototype such the one CEPHIS works in has a clear interdependence between the previous design and the manufacture but there is no linkage between distributions since it is handled to a private firm which introduces the prototype in its product to commercialize it at a big scale. CEPHIS does not deal with final customers but it is known how the final product will look like. Process of product development departs from product specifications coming from the market. They are not in charge of mechanical jobs either industrialization- and/or marketing processes. Value chain is clearly disintegrated, fact that easily categorizes this architecture as **modular**. When the director talked about this aspect in the questionnaire, he said that specifications about the product are clearer from companies that subcontract them than the AVANZA and European projects. In these situations the firm knows how the final product will be and receives the particular specifications for the development of the component they will make. Maybe when they are working in projects such as ParMa, specifications of the whole product are not so clear for each participant, but each of them is developing the component that they are in charge of, under the conditions established. Since everybody takes delivery of their own specifications, the process can be denominated modular architecture.

The field where CEPHIS is working has passed the point where user’s needs and technological development are aligned and they jumped to the stage where sellers offer more than customers need. This is named **de-commoditization** process. It may be clearer with an example of a project realized by CEPHIS. It is the implantation of a specific prototype in the machines which scan the tickets of the train. The prototype will permit to get in the station reading the information from the mobile phone. Still nowadays people buy a ticket and pass it through the machine which checks if the user has paid the train journey. With this new invention customer will have the possibility to pay by internet facilities from his mobile phone and the machine will detect it when the individual would go through it.

**Appropriability** has been defined as the ability of maintaining or making profitable a firm. The three dimensions suggested by Tecee to obtain it through are: nature of technology, product, and process. Nature of technology can be defended by patents and taking care of tacit knowledge. CEPHIS possesses some patents, but it is not the most common way to protect its technology. As Tecee underlined, patents are not the best way to gain profitability since they expire. The most valuable information that the firm possesses is tacit knowledge. It is described as more difficult to imitate because it resides in people’s mind. Engineers working in CEPHIS owe technical knowledge from their training in the firm. Competitors have difficult access to this knowledge unless the firm would like to share it. Working with partners involves sharing knowledge, but it is the explicit knowledge which can be easily codified. Related to the achievement of profitability through the product, features of the product are the guide to measure the feasibility. The company develops high-tech solutions and it supposes the product to include elaborated attributes which are difficult to imitate. Along the process of innovation, CEPHIS works with high level design languages and new co-design methods and tools. That is why processes are also difficult to be copied by competence. There is the tacit knowledge required to go through the process.

To sum up this section CEPHIS is categorized as working in sustaining technology as the engineer team is developing new procedures from the ones already introduced in the market. The value chain of the products is clearly classifiable as modular since CEPHIS is only in charge of developing electronic components which will be integrated into the final product. The market where the firm is operating is in a de-commoditization process indentified when it is seen that technological development is ahead of customers’ needs. The last aspect of the innovation process is the appropriability of a business which is well positioned in the case of CEPHIS due to the fact that engineers possesses an important amount of tacit knowledge, features of the products and processes to develop them are difficult to imitate by competitors because they are complex.

# TRANSACTION COST ECONOMICS

## Theory

The term “transaction cost” is frequently thought to have been coined by Ronald Coase, who used it to develop a theoretical framework for predicting when certain economics tasks would be performed by firms, and when they would be performed on the market. However, the term is actually absent from his early work up to 1970s, and Transaction cost economics (TCE) has became most associated with the work of Oliver Williamson. His focus on the costs of transactions have lead Williamson to distinguish between repeated case-by-case bargaining on the one hand and relationship-specific contracts on the other.

Transaction cost economics represents one of the firsts and most influential attempts to develop an economic theory that takes seriously the structure of firms. Previously, economic theories tended to treat the firm as a sort of “black box”, the internal workings of which were not considered to be important.

Figure 9: Market Hierarchy Model

**External transaction**

**costs**

**Source: Grochowski, A. (2008)**

Figure 9 shows institutions and market as a possible form of organization to coordinate economic transactions. When the external transaction costs are higher than the internal transaction costs, the company will grow. If the internal transaction costs are higher than the external transaction costs the company will be downsized.

This theory tries to explain the particular structure of a firm, what is more, the extent to which it will integrate vertically. It assumes that firms are profit maximizing, and that profit maximization involves costs minimization. This argument categorizes TCE as an equilibrium theory, assuming rationality on the part of owners and/or managers.

Williamson made an effort to distinguish between *transaction costs* and *production costs.* Production costs are seen as analogous to the cost of building and running a perfectly efficient market. While transactions costs are regarded as those costs incurred by departures from perfection. Transaction costs may be lower depending on the situations under which are working. If the transaction takes place in an open market, costs will be lower, which in other situations costs will be lower if managers coordinate the transaction.

In order to identify the variables that determine whether “market or hierarchy” will have the lower transaction costs in various circumstances it is necessary to cite the *assumptions* that support Williamson’s theory.

### Assumptions

Assumptions are static contextual factors. It does not vary under any circumstance. That is why assumptions cannot explain variations in organizational structure, but at the same time they are essential to make valid arguments about the effects of the variables.

*Bounded rationality* is related to the fact that people have limited memories and limited cognitive processing power. People cannot assimilate all the information they have access to, they cannot draw all the alternatives or consequences the information allows to come up with. This is also linked to the fact that in achieving a decision, managers must take in account how competitors will react.

*Opportunism* refers to the possibility that people will act in a self-interested way. People may not be totally honest and truthful about their intentions, or they might try to take advantage of unexpected situations. Williamson assumes that “people will act *oportunalistically* some of the time and that you cannot tell in advance who is an opportunist and who is not”.[[63]](#footnote-64)

### Variables

Variables are used to characterize any transaction. They will determine whether transaction costs will be lowest in a market or in a hierarchy. Considering them in respect to decisions about whether to integrate vertically is an easier way of understanding.

*Frequency*: It is less interesting than the two next variables owing to the fact that it is a clearer concept. It is so logic for every understanding that if a transaction does not happen often there is no reason to continue investing on that. Even so, the effect of frequency on transaction costs is very strong, but it is not so interesting when it is low. When a good or service is very rarely used there will be no firm which would want to integrate vertically to bring “in-house” its provisions. Related to relationships, frequency has an impact among the reputation. If a transaction occurs repetitively due to the partners’ satisfaction with the outcome, a better reputation will be rising. Reputation and frequency are moving together through the network relationships. A frequency in contracting company services is necessary in order to create a reputation which at the same time will contribute to stresses frequency form new customers who take references from network partners.

*Uncertainty*: It evaluates how hard is it to foresee the eventualities that might occur during the course of the transaction. One evident aspect here is the length of time over which the transaction will take place. When a firm is operating through transactions that finish instantly, as it occurs in “spot markets”, uncertainty is relatively little because the future does not have to be predicted. On the other hand, transactions that involve a commitment should be accurately followed as people cannot be sure about how the partner will act during the length of the contract. It is related to the assumption of bounded rationality because not all the possible eventualities can be predicted. At the same time that uncertainty is also related to the opportunism in the way that it is hard to trust somebody’s arguments.

*Asset specificity*: Williamson argues that where transactions involve assets that are only valuable in the context of a specific transaction, transaction costs will tend to be reduced by vertical integration. This concept is related to bounded rationality and opportunism which makes risky to invest in a business. Asset specificity can appears when the purchase of a precise machine to be used just for the development of a concrete project and also to relationships. Investments in relation specific assets are often correlated with superior performance.

|  |  |
| --- | --- |
|  | **Asset Specificity**  **Low for both parties High for both parties High for one party, low for one party** |
| **Uncertainty High**      **Low** | **Contract/vertical Vertical integration Vertical integration**  **integration**  **Spot contract Long-term contract Vertical integration** |

## Discussion

Transaction costs economics is a very useful analysis tool, but like in all the theories it can be found some possible weaknesses in its reasoning.

Firstly, it had been criticized the assumption that it is possible to precisely separate production and transaction costs. In practice, this is often not the case, and even more it is often very difficult to measure transaction costs even if they can be defined.

The fact that reputation and trust are not considered leads to oversight an important business asset that firms will often be willing to protect. Transactions are regarded as it occurs without any previous knowledge. In this sense, trust does not take place as it is obtained from repeating business between people.

There are some other factors that the theory do not take in account, although the assumption of bounded rationality. One of these missing factors is the power. Interests of managers and stakeholders may not be perfectly aligned, situation that leads to conflicts, which precise a hierarchy of power to be solved.

## Trust for an effective interfirm collaboration

A central premise of TCE theory is that transaction costs increase as transactions make greater asset-specific investments. The standard reasoning is that as asset specificity increases, more complex governance structures are required to eliminate or attenuate costly bargaining over profits from specialized assets. Thus, transaction costs are presumed to increase with an increase in asset specificity.[[64]](#footnote-65)

Among a population of economic actors who are engaged in repeated transactions that require investments in specialized assets, behaviours that stress cooperation, trust and forgiveness of isolated opportunism by others have an economic value. The game theory model assumes that the effects of reputation will be reasonably strong. Reputation use to be difficult to establish due to dispersion problems or a lack of communication among the population of potential participants to an exchange. An actor may have to undertake a costly search to establish the reputation of trading partner. The more dispersed the population from which the actor comes, the greater the cost of establish reputation, and the more viable opportunism because as a value-maximizing strategy.[[65]](#footnote-66)

Figure 10: A model of interfirm collaboration

Transaction Costs

Transaction Value (Joint Performance)

Investments in Relation-Specific Assets

Use of Self-Enforcing Sfeguards

* - Goodwill Trust
* - Reputation
* - Finantial Hostage

Information Sharing

Demonstrated Commiment to Future Interaction

* - High Rewin Rate
* - High Transaction Volume

( + )

( + )

( + )

( + )

( + )

( + )

( - )

( - )

**Source: Dyer, J. (1997)**

However, there are a number of mechanisms to improve the efficacy of reputation. As Granovetter (1985) noted, informal social networks are a way of communicating information concerning an actor’s reputation. This may be reinforced by more formal mechanisms such as trade associations.

The model proposed above represents an interfirm collaboration that maximizes transaction value based on the plot exposed previously. The model suggests that the credibility of a firm’s promise to behave cooperatively increases as transactors: a) demonstrate through behaviour a commitment to future interaction, b) increase the amount of information sharing, and c) employ self-enforcing safeguards to govern the relationship. This way leads to an increase in trustworthiness within the trading relationship which reduces transaction costs and increases the likelihood that transactors will invest in relation specific assets. Furthermore, lower transaction costs and greater investments in specialized asset maximize transaction value, or the joint performance of transactors.

To conclude, this outlook of TCE theory suggests that costs do not necessarily increase with an increase in relation-specific investments. Trustworthiness will often result in higher levels of performance-enhancing investment in specialized assets because trustworthy transactors:

1. Engage in greater information sharing which increases the probability that they will discover new ways to enhance performance through relation-specific investments
2. Have a longer payback period during which to earn a return of investments, thereby increasing the number of relation-specific investments that make economic sense
3. Are able to implement levels of specialized assets because the costs of safeguarding the relation-specific investments are less likely to outweigh the gains.

## Application of Transaction Cost Economics

After transaction cost economics has been exposed and the element that configures it has been described, it will be applied in the issue of study that concerns this project. A questionnaire was sent to the director of CEPHIS in order to clarify issues related to the theory. Questions were built expecting the corresponding answers being helpful to understand how the firm’s elements fit with transaction cost economics. The questionnaire is attached in the annex at the end of the project. Answers are not written exactly as the director replied because information is taken to prove if assumptions coincide with the case of CEPHIS and how the variables work.

Assumptions are accepted due to the fact that people is still assumed to be rational, in the sense that they want to maximize the profits of the firms they manage, but that there are limits on their ability to make truly rational decision to achieve this end.

Next step is the analysis of the variables suggested by Williamson in order to identify transaction costs. The answers from the director of the company will be really helpful to complete this section.

*Frequency*: customers who contract CEPHIS usually do it again in the majority of the cases. Of course, it depends on the work or the kind of company. Sometimes the company just needed CEPHIS for a specific solution but its main business would not be related to technology. An example is the department of translation and interpretation of the UAB that asked the firm to develop a program which would recognize voices and transcript them. Daily work of the department is not related to innovative programs; they will perceive the program as a tool for the development of their own core business. Even they are satisfied with the job CEPHIS realized, contracting CEPHIS again would be unlikely, or at least in a short time. This fact may happen from time to time, but a large amount of their clients are more related to technology and repeat trusting their services. It means that the job done by the company usually is satisfactory for clients. In order to determine the grade of satisfaction experienced by clients, the company sends them a questionnaire asking how pleased they are with the job done. This technique is helpful to notice weaknesses of the company and try to improve to keep their customers.

*Uncertainty*: There is a degree of intrinsic uncertainty in every process of designing new products or components, which usually come more often from clients than from CEPHIS side. Work developed by CEPHIS involves the risk of not finishing at the deadline fixed. During the course of innovative processes some unexpected difficulties can occur. The process is about making a new solution, which means that techniques that may not be applied before will come in use for the resolution. CEPHIS realizes the appropriate researches and tests before offering them to the customer, but there is always the possibility of not running as it was supposed to. At least small complications are taking into account when drawing the duration of the process since those are expected when dealing with innovation processes.

Uncertainty from the client’s side is about not having clear what they are asking for. Customers have an idea in mind but they do not really know how to solve it. That is why in some cases CEPHIS has to modify the product during its development. The company produces a component based on clients’ specifications but when it is showed to them some additions or changes can be demanded.

*Asset specificity*: Some of the projects require the purchase of specific machines which are not useful for the development of other works. In the laboratory there are machines that are useful for different proposals. Those could be categorized as basic tools for the work of the company. Since CEPHIS is running innovative projects, special machines are required. When the need to purchase some specific engine related to the projects subsidized by the Government, getting the money to buy it is not difficult. A report is written by the company before being accepted to take part in the project. This report includes a budget listing the expected expenses that would have to be afforded during the development of the project. Then, the list will contain the specific machines. Another kind of specificity detected is referred to the geography. During the development of projects the different parts have the need to be in contact in order to share their own works and understand them jointly. It is necessary for the engineers to move sometimes to the city where the central institution coordinating the project is to meet with partners and clarify aspects which need to be known by all the components of the network.

Taking into consideration how variables play in the case of CEPHIS, it can be positioned into the matrix where uncertainty and asset specificity are combined. It is observed that the company has a high uncertainty, inherent in every innovative process, and high asset specificity, due to the specific requirements of the projects. The place where it fits in the table leads to say that the best mode of organization would be vertical integration. Even though, CEPHIS runs in a disintegrated mode. Value chain of the product is not completely into the firm. The company is in charge of designing procedures to manufacture the product and develop it, but they are not into mechanical jobs and neither industrialization and/or marketing processes. Even more, the manufacture process is in most of the project shared with more enterprises and research centres.

The convenience for CEPHIS to be working into a disintegrated value chain will be reasoned out. Since the fundamental governance question posed by Williamson is: *How can exchange relationships be structured to economize on transaction costs?*, it can disagree with the proposed positive relation within asset specificity and transaction costs. The arguments to support this position come from the ideas developed in the section about trust for an effective interfirm collaboration.

Making relation specific investment is necessary for the company. When the director was asked about the importance of gaining knowledge from their partners, this was his answer: “Nowadays access to technology and to its associated knowledge is getting more complex day after day. That is why participating in projects allows us to gain knowledge related to different scopes of application where we apply our solutions”. If CEPHIS were developing researches and manufacturing processes just on their own, relevant contributions about information which flow inside the network would not be at the firm’s access. It would block innovation process since the director expressed how important it is for their business. Furthermore, relationships among members of the value chain lead the firm to increase its reputation. Being related to renowned companies, like most of the participants in the European projects are, provides the potential CEPHIS clients with trust. In this way a disintegration model that allows CEPHIS to obtain more clients is more beneficial than a vertical integration that supposes a gap for building new relationships.

Furthermore, an incentive to be involved in a network, when talking about the risk intrinsically lying in every innovation process, is the possibility of sharing it with partners. Risk about a contradictory response of customers to the new product or about failing in the application of new procedures is so high to be suffered just by one enterprise.[[66]](#footnote-67)

Asset specificity is also distributed among the components of the network. It is referred to the requirement of specific machines for the resolution of some projects. Projects about solutions formed by different complements to be later assembled could necessitate more than one precise instrument for their development. If each partner is in charge of one complement, the purchase that each would be to afford will be just the needed for the machine that the component they are in charge requires. Other chance that partnerships can offer is the use of partners’ facilities. It does not always happen, just when both parts agree. There is the possibility of a partner needing a machine that another partner has. The partner owning the machine can propose using it for some experimentation and establish some conditions to make the deal. At least CEPHIS is doing that in some cases. They rent their instruments as long as the laboratory manager thinks it is appropriate and under the specifications set.

In order to stress the convenience of operating through a disintegrated model, some of the concepts exposed in the section of innovation process are related to the theory of transaction cost economics.

It is important to point out that CEPHIS is working with sustaining technology, what means launching innovative solutions, better than the ones running in the market. They know in advance that the product will be aligned with the needs of the buyer. Here the buyer is not referred to the final customer but to the company that will proceed with the industrialization process and possibly with the marketing process too. Also, the idea that the procedures may not end as it was expected has to be considered, but if specifications are correctly followed it will probably not occur. It reinforces the disintegrated mode.

Modular architectures are by definition disintegrated organizations having high specified and clear delimitations of each part of the value-added chain. Solutions that CEPHIS is offering would not be sold to the final customer because of their functionality. They have to be assembled into a product ready for being used at customers’ level. For example, an ID’s scanner is not useful for particular users but if it is added into a tobacco machine in order to identify if the consumer who is going to purchase a packet is into the age allowed, then it is functional for the end user. CEPHIS is specialized in the development of software devices like the ID’s scanner. Behind them, there is the company who build the tobacco machine and the tobacco manufacturers who are in charge of the marketing process. Each of them has a specific work from the initial idea until the commercialization of the product. This kind of products formed by clearly different components can be easily split along the value-added chain among different companies running into disintegrated models.

Appropriability is about keeping the knowledge of the company inside its team, but for CEPHIS is more profitable to share this information between its partners. Even so, not all the knowledge is shared. Explicit knowledge, which is easy to codify, is obviously transferred to its associates but they do not act in the same way with the tacit knowledge. Know-how possessed by engineers remains in their minds and it is not transmitted. In this sense, a disintegrated mode is more beneficial for CEPHIS than keeping working on their own.

To sum up, thoughts from this chapter lead to advise CEPHIS to operate through a vertical integration of the value chain, because of the high uncertainty and also asset specificity, if it is taken in consideration the theory developed by Williamson about transaction cost economics. Although it is more rational to take ideas from later authors who argue that not necessarily high asset specificity entails an increase in transaction costs. The fact that relation asset investments provide a more consolidate reputation enhances trust for customers to believe in the work offered by CEPHIS. This reasoning allows the company to operate in a disintegrated model.

Furthermore, in order to reinforce the opinion that a disintegrated model is optimum for CEPHIS, some of the concepts related to innovation process have been developed aligned with the transaction costs theory. Those are modular architectures that describe how the value-added chain is composed, and the term of appropriability which is related to profitability. Modular architectures are by definition disintegrated organizations having high specified and clear delimitations of each part of the value-added chain. On the other hand, appropriability is about keeping the knowledge of the company inside its team, but as said before, sharing this information is more profitable for CEPHIS.

# KNOWLEDGE TRANSFER

## Theory

One of the most important aspects related to network relationships is the knowledge transfer. Focusing on an article written by Wenpin Tsai, from the Pennsylvania State University, the principal characteristics of this field will be exposed. The article is called “*Knowledge transfer in interorganizational networks: effects of network position and absorptive capacity on business unit innovation and performance*”. The basis of Tsai’s study lies inside a multiunit organization, arguing that units can learn from each other and benefit from new knowledge developed by other units. As the core aspect of this study are the relationships between different firms, units will be understood as the enterprises that build the network where CEPHIS is operating. There will be aspects that could not be applied for the explanation of knowledge transfer in a wide range as the composition of a network relationship. Those arguments will be excluded and not mentioned in this paper. The ideas that will be taken in consideration are just the ones that fit the research purpose of this study.

This article is developed under the way of thinking that organizational units can produce more innovations and enjoy better performance if they occupy central network positions that provide access to new knowledge developed by other units. This effect depends on units’ absorptive capacity, or ability to successfully replicate new knowledge. Even though knowledge from other units is available it may not have the capacity to absorb and apply it for its own use. That’s why organizational units require external access and internal capacity to learn from their peers. Both external knowledge access and internal learning capacity are important for a unit’s innovation and performance. As Huber (1991) suggested, a learning organization is characterized by motivated units that are intimately connected to one another. By linking different units together, a network arrangement provides a flexible learning structure that replaces old hierarchical structures.

In this reasoning it has been mentioned that *network position* and *absorptive capacity* as two important concepts that determine the effectiveness of interunit learning and knowledge transfer. According to their importance, an accurately study of these two concepts will be exposed subsequently underlining some hypothesis to clarify its importance.

### Network position

Accessing to external information and knowledge is critical to develop new products or innovative ideas. The level of the capacity of a firm to access this knowledge is determined by the different network positions. If the unit is occupying a central position in the network it will be more likely to access desired strategic resources. These resources provide the external information necessary to generate new ideas, which leads the unit to innovate. At the time that innovative work will provide the firm with knowledge necessary to resolve design and manufacturing problems.

A unit’s network position is an important aspect of “social structure” that can enhance the unit’s ability to create new value and to achieve economic goals.

**Hypothesis 1a**. *The centrality of an organizational unit’s network position is positively related to its innovation.*

A central unit’s network position can leads to achieve competitive advantages in the marketplace due to the access to other units’ knowledge or practices which increases cost efficiency through dissemination of “best practices” between organizations.

**Hypothesis 1b**. *The centrality of an organizational unit’s network position is positively related to its business performance.*

### Absorptive capacity

High ability of a unit to assimilate and replicate new knowledge gained from external sources means that it possesses relevant prior knowledge. This ability is called “absorptive capacity”. Possessing relevant prior knowledge leads to better understanding of new technology that can generate new ideas and develop new products. If a unit does not own the capacity to absorb knowledge from another unit this knowledge will not be learned or transferred what in consequence will determine negatively the generation of outputs.

Absorptive capacity results from a process of investment and knowledge accumulation. That is why units’ endowment of relevant technology-based capacity is an important aspect. R&D investment is a necessary condition for the creation of absorptive capacity.

**Hypothesis 2a**. *An organizational unit’s absorptive capacity is positively related to its innovation.*

Units with high level of absorptive capacity invest more in their own R&D and have the ability to produce more innovations.

Absorptive capacity also involves the ability to apply knowledge to commercial ends and create opportunity for profits. Even more, a unit with high absorptive capacity is likely to apply new knowledge to improve its business operations. Increments to an organizational unit’s knowledge base enhance the units’ business performance in that it can profit from the new knowledge it has been absorbed.

**Hypothesis 2b**. *An organizational unit’s absorptive capacity is positively related to its business performance.*

### Interaction between network position and absorptive capacity

Absorptive capacity is likely to moderate the effect of network position on business unit innovation and performance. As it has been said before, a central network position provides access to knowledge but to use it for innovation unit should be able to absorb it through its absorptive capacity.

**Hypothesis 3a**. *The centrality of an organization unit’s network position is more positively related to innovation when the unit has high absorptive capacity than when the unit has low absorptive capacity.*

Moreover a unit’s innovation output and business performance will be higher depending on its network position which allows the unit to access new knowledge from many other units. Again, it will be still higher if the unit possesses an elevated absorptive capacity to effectively transfer the knowledge.

**Hypothesis 3b**. *The centrality of an organizational unit’s network position is more positively related to business performance when the unit has high absorptive capacity than when the unit has low absorptive capacity.*

Without a simultaneous consideration of its network position and absorptive capacity, a unit is likely to encounter a “search-transfer-problem” in which it cannot transfer the knowledge it identified through its network search. This statement shows the strength relation between absorptive capacity and network position, in the sense that a central network position requires a high absorptive capacity to transfer the knowledge to which the unit has access.

Figure 11: Business position in relation to degree of centrality

Low absorptive capacity

High absorptive capacity

**Network** **centrality**

**Performance**

**Innovation**

High absorptive capacity

**Network centrality**

Low absorptive capacity

**Source: Wenpin, T. (2001)**

The graphics below based their results on a business unit’s position measured as its in-degree centrality in its firm’s intraorganizational network. An alternative measure of network position based on the similarity of ties among business units has also been used. This evaluation was developed by Brunt in 1976, 1987. Even more, in order to identify the similarity of ties it has been followed a structural equivalence analysis using UCINET IV, from the studies of Borgatti, Everett, & Freeman in 1992. Finally, in order to be possible to come up with a result proving the hypothesis presented in this section the effects of network position and absorptive capacity on business units’ performance have been tested whether they are mediated by their effects on business units’ innovation. It has been achieved by entering business unit innovation as an additional control variable in the business unit performance analysis.

The results obtained through this analysis show that as higher is the network centrality followed by a higher absorptive capacity, higher are units’ level of innovation and performance.

To sum up, it can be said that the basic idea along this section is that a unit’s external knowledge access is characterized by its network position. If this position is central, a unit is likely to access useful knowledge from other units. Another idea that comes up from the research is that absorptive capacity and network position should be studied simultaneously in order to see the effects caused among units’ innovation and performance. As there is not a significant association between a unit’s network position and its business performance, the last is affected positively because of the absorption of the information about units’ organization that a central network position entails. At the same time, having a central position requires intensive coordination efforts that lead to high administrative costs. Finally, the results show that investing in absorptive capacity while expanding network links is critical to the success of organizational units in learning new knowledge that eventually leads to competitive advantage.

## Importance for the research

Theory of knowledge transfer and its implication on firm’s profitability will be developed in next sections. Since the goal of this project is the determination of CEPHIS position into the network they are in, aspects highlighted in the article of Wenpin Tsai are relevant to achieve this purpose. It is interesting to position the firm in the network to understand how they are acting with constituents but it is also important for the research to comprehend how it affects the firm and how they could gain that position. This article expresses the importance for a company to position itself as centrally as possible into the network relationships. It argues that significance of a central position lies on the possibility to gain more information from the partners. It means to have access to crucial information in a similar level to all network participants since distance from the focal company to each component of the group is as similar as central it is positioned. Although having the advantage of central position, it makes no sense if it does not go with absorptive capacity. Knowledge can be relevant for innovating but if it is not understood, it does not have any use. Absorptive capacity decodes information, what allows company to benefit from that. Absorptive capacity is strictly necessary to reach a central position because if knowledge is not timing managed it is not possible to climb up to the centre. But both concepts are reciprocally related. A company can possess absorptive capacity but to develop it is necessary to get information which comes from having a good position into the network.

This reasoning will be applied for the resolution of the problem formulation being closely related to the next section. Hypothesis presented in this chapter will be applied to the case of CEPHIS in order to prove or refute them.

# NETWORK CONFIGURATION AND INNOVATION SUCCESS

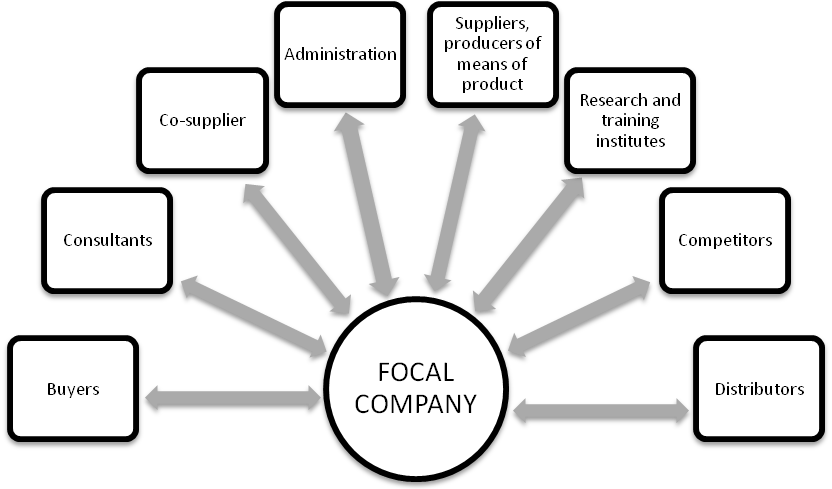
## Introduction

In this section a study realized in 1996 by Hans George Gemünden, Thomas Ritter and Peter Heydebreck from University of Karlsruhe Germany is presented. It is based on the assumption that intensity and structure are the most important dimensions of a firm’s technological network. The authors identify seven different types of technology-oriented network configurations. Results have been reached through a database of 321 high-tech companies.

## Technology-oriented relationship

Different authors pointed out the importance of technology-oriented relationships for integrating complementary resources into a firm’s innovation process, which will increase its success in the operating market.

Figure 12: Innovation partners and their contributions



**Source: Gemünden, HG. Ritten, T. Heydebrek, P. (1996)**

Figure 12 shows the different partners which can support a firm’s innovation process. Each partner offers a set of resources. ***Buyers*** are defining new requirements, solving problems of implementation and market acceptance, and reference function. **Consultants** recommend innovative concepts, structuring of process, and financial, legal and insurance services. **Co-suppliers** bid complementary know-how and solving interfaces problems. **Administration** is in charge of subsidy, political support, mediations, transfers, laws and regulations. **Suppliers** provide the focal company with new technologies of complements and systems. Through **research and training institutes** is gained qualified personnel. **Competitors** act as nexus which joint basic research, establish standards and get subsidies. Finally, **distributors** are who change and weight demands and gathers information about development of competitors.

Depending on the type of company, its specific strategic innovation aims, or the position in the market where it is operating, the relative importance of technology-oriented relationship with one type of partner in relation to the overall of networking differs significantly. Elements enclosed in Figure 12 in addition to the network pattern and the intensity of technological interweavement constitutes differences between companies. Network pattern is referred to the importance of collaboration with each specific type of partner in relation to the overall importance of networking. Networking is understood as the process of establishing a mutually beneficial relationship with other business people and potential clients and/or customers. The most important skill for effective networking is listening; focusing on how it can be helped the partner rather than what can you get from him. Intensity and pattern content a large variety of external and internal context factors which can be clustered into the banners of motivation and capability of networking. These factors draw the appearance of the network configuration, which will lead to the level of innovation success that the convenience of the factors allows to achieve. Innovation success is formed by the product innovation success and the process innovation success.

**Product innovation success** consists on improvement of products and new product development. Although it is an indicator for success, not all companies benefit itself just from innovation success. Those should also take in account commercially success, which involve customer orientation as an essential aspect to achieve product innovation success. Customers define targets for the suppliers’ product innovation success which are commercially viable. Even more, close collaboration with customers creates customer commitment which results in direct sales and increases the customers’ motivation to recommend the product to third parties.

On the other hand, **process innovation success** is based on technical support and economic relevance. It can be measured regarding the degree to which a new or improved process is superior to existent processes. Criteria in order to determine it encloses labour costs, lead time, productivity of the equipment and consumption of materials and energy. Technical process innovation success is a necessary condition to strive economic process innovation success of a company, but it is not an assurance of it.

## Types of network configuration

From the study realized by Gemünden it comes up seven different types of network configuration, such are the follows:

1. *The island* is characterized by the lowest intensity of interweavement giving the same level of importance to customers than to the other partners.
2. *The manufacturer.* Interaction with suppliers and customers is much more intensively than with universities and consultants. The overall degree of interaction with external partners is low.
3. *The toddler.* It is acting similar to the manufacturer being evidence for the low intensity of technological interaction with its environment; even so it puts more emphasis on collaboration with universities than on suppliers’ interaction.
4. *The highway* shows the same pattern of interweavement as the manufacturer but with a higher degree of interaction. There is a rapid flow of information and know-how from suppliers to the focal company to its customers and vice versa.
5. *The visionary* interacts with universities at a high level and prizes more its customers than its suppliers and consultants.
6. *The competence acquirer* regards consultancy services as the most important partners to achieve innovation success and shows the lowest collaboration with suppliers.
7. *The spider* interacts equally with all network partners being this collaboration high categorized.

It has been deduced from the analysis of the different network configuration that the highway and spider configuration are the most likely to have innovation success regarding product improvements because of its high collaboration with suppliers which help to improve existing products rapidly and efficiently. In addition to this argument, the spider, such as visionaries, is predestined to attain product innovation success led by collaboration with universities, offering them external resources and know-how.

General conclusions from the article of Gemünden turn around the idea that the network should be taken in a whole when analyzing technological networks. Customer-orientation is critical for product innovation success but interacting with suppliers is also required. Even more, universities play an important role in developing new products becoming the multi-dimensional cooperation also needed for companies’ product improvements. It also can be gained by working with consultants. The last aspect we have to refer to is the managerial implications that impact the whole focal network on innovation success.

## Network configuration of CEPHIS

In order to categorize CEPHIS into one of the seven types of network configuration described by Gemünden, Ritter, and Heydebreck; it will be first discussed the network pattern. Network pattern is referred to the importance of collaboration with each specific type of partner in relation to the overall importance of networking. Factors that affect network pattern are related to motivation and capability of networking. Looking at figure 12 where all the possible partners acting in a network are described, the kind of relationship has built CEPHIS with which one of them can be determined. Relationship with the Administration is high for the European, AVANZA I+D, and Consortium projects. Both of the first projects are funded by the Spanish Government and the last one by the *Generalitat de Catalunya*. Linkage is hard because subventions received from the Administration constitute the resources to develop the project. Without the reception of Administration’s subsidy these projects could not be run out. Connection among suppliers is relatively low as purchases that CEPHIS realizes are few. The company requires specific machines and components, but those machines are used for a long-time work. The acquisition of material for the daily work is not necessary, but for punctual necessities.

Research and training institutes shape an important source of development. In the field of high technology, science is making a fast progress and engineers have to be the same height to compete in this market. CEPHIS acts as a training institute since they teach grant students and help Ph.D.s in their writing thesis. It also has been said in the chapter about the case of CEPHIS that junior engineers are in a formation phase oriented by senior engineers. Even more, the firm funds Master studies as well as conferences and courses for its engineers.

Relationship with competitors conform a big part of the network in the projects funded by the Administration. Particular projects form their network relationships among constituents of the value-added chain. CEPHIS does not maintain relation with its competitor because it usually is the only company of their sector working on it. On the other hand, relationship with competitors developing the projects is highly relevant. Through this relation flows significant knowledge accessible for members of the network. In the projects developed for particular enterprises there is a connection with distributors because CEPHIS sells its solution to an enterprise which will develop the industrialization process of the product and in the majority of the cases also it will distribute it. In the other projects, however, distributors are usually unknown, or at least the relation is low because the aim of the network is the relationship among partners. An advantage of partnering is the possibility of redirecting clients to another partner. An example is a group of anthropologist that turn to CEPHIS asking for a program to file their database. They required building a special program with very specific fields to fulfil their discoveries during the excavation they were doing. CEPHIS was not able at that time to help them and they were redirected to a partner. The firm acted as a consultant, giving advice about cost and right features for the final solution the anthropologists expected, redirecting the production of the program to another partner.

The relationship the firm keeps up with buyers is close to the first buyer, the company that contracts them, but they are not connected to the final customer. Even though, solutions developed by CEPHIS are thought to achieve the last customer. The firm remains in the manufacturing process of the value-added chain; they are not in charge of the marketing process, but for its solutions to be sold managers in charge of the other stages will control that solutions fit into customers’ needs.

Consultants have low importance, although, for some projects CEPHIS relays on them to asses about the financial specifications and to help them in proving the expenses afforded during the project.

The position that CEPHIS maintain in relation to its partners has been described, but the necessity of absorptive capacity to beneficiate through these relationships must not be forgotten. When the director of the company was asked about the importance of the interaction with its partners, he said that it is useful to get information related to the increasingly technology process. Since he said that knowledge gained through these relationships is valuable for their work, it leads to think that the team possesses absorptive capacity to be able to apply the information into their researches.

The network configuration in which CEPHIS fits in is the one named **the visionary**. This configuration is characterized by its high interaction with universities and the higher importance given to customers rather than to suppliers and consultants.

Since CEPHIS is a company owned by the UAB, linkage to the university is really close. Offices are located in the university and administration depends on the microelectronics department of the UAB. Although in the firm there is a person in charge of the administration support, the money is administered by the university. CEPHIS gives the indications of how handling the money but the university is the body that gives the approval and realizes the pertinent transactions. Relationship with the UAB provides intellectual knowledge to the engineers and reputation to the firm. UAB is a well-known university and CEPHIS is presented under its name. Interaction with universities is not just because of the connection with UAB. Most of the networks formed through jointly work for the resolution of a specific project involve other universities. It is shown in the section about the CEPHIS situation, where the partners working in ParMa project are carefully described.

As mentioned in the chapter related to market orientation, the project focuses on customer-orientation. The objective of the firm is innovating through new technology procedures. Knowledge about customers’ needs is necessary to succeed. As said before, the firm does not interact with the final customer but some partners in the value-added chain are aware of it.

Low attention paid to suppliers is because CEPHIS is not purchasing so often for its daily work. Company’s aim lays on the research and development of new hardware and software co-design methodologies, to increment the productivity of the custom-designed electronic systems. Needs to contact suppliers appear when some specific machine is required for a project and for the acquisition of some complements for those machines.

Consultants are also little regarded because CEPHIS usually work on their own. They just require some consultants to assess them about financial issues related to AVANZA I+D projects.

Figure 13: Network patterns

Suppliers

Universities

Consultants

Customers

**Source: Gemünden, HG. Ritter, T. and Heydebreck, P. (1996)**

Figure 13 interprets the form the network where CEPHIS is moving around would have. Here, the high interaction with universities and customers and the low relationship among consultants and suppliers are clear.

## Relation between network configuration, innovation process and transaction cost economics

Subsequently, concepts exposed in the section of transaction cost economics with the ones discussed in this section will be related. Concepts exposed in the article about innovation process are also taken into account since they were related to transaction cost economics.

The idea of product innovation success, which involves improvement of products and new product development, is an indicator for success. Success turns into profitability, what leads to link the product innovation with appropriability. To be profitable, an innovative product has to deal with commercially success, which implies customer orientation as an essential aspect to achieve product innovation success. Appropriability is about keeping knowledge into the firm, at least tacit knowledge, since explicit knowledge is shared with partners in a reciprocal way which also makes profitability. Keeping tacit knowledge will help to maintain commercially success protecting know-how from interference of competitors.

Process innovation success can be measured regarding the degree in which a new or improved process is superior to existent processes. It is closely related to sustaining and disruptive technology concepts and to commoditization and de-commoditization processes. Success of the process innovation is high in the case of CEPHIS as they are working with sustaining technologies, which means that the product launched is an improvement of the ones running in the market. The fact that the company is operating into de-commoditization processes is an indicator of process innovation success. De-commoditization processes are characterized by offering a technology more than good enough related to the customers’ needs. Technology is making progress and it is due to the acceptance of customers. If customers are satisfied with new products, the innovation process can be characterized successfully.

Here hypothesis presented in the chapter of knowledge are proved:

**Hypothesis 1a**. *The centrality of an organizational unit’s network position is positively related to its innovation.*

This hypothesis can be verified insofar as CEPHIS is positioned quite centrally between universities and customers but less near to consultants and suppliers. Universities and customers are the appropriate ones to create innovation. Universities offer technological knowledge and customers give the guides to create new products under their necessities.

**Hypothesis 1b**. *The centrality of an organizational unit’s network position is positively related to its business performance.*

This hypothesis is confirmed due to the fact that the company has reached the centrality position thanks to the way they develop their business. Relationship between universities exist because they run research projects jointly with other enterprises and institutional bodies and connection to customers is due to the assistance that they offer to them during and after the project resolution.

**Hypothesis 2a**. *An organizational unit’s absorptive capacity is positively related to its innovation.*

Validity of this hypothesis is established by the fact that CEPHIS is capable to acquire information from its partners, decode it and apply it for the development of innovative products.

**Hypothesis 2b**. *An organizational unit’s absorptive capacity is positively related to its business performance.*

k This hypothesis can be verified insofar as knowing how to imply information leads to increase investment in R&D. Engineers working in CEPHIS need funding to realize the researches, it entails improvements in the systems used to develop products, what means a better business performance.

**Hypothesis 3b**. *The centrality of an organizational unit’s network position is more positively related to business performance when the unit has high absorptive capacity than when the unit has low absorptive capacity.*

It has been said that centrality occupied by CEPHIS into the network relationships improve highly its business performance. On the other hand, not positioning centrality would not increase its business performance but not necessarily decrease it. This reasoning proves hypothesis 3b.

**Hypothesis 3a**. *The centrality of an organization unit’s network position is more positively related to innovation when the unit has high absorptive capacity than when the unit has low absorptive capacity.*

In the example of CEPHIS we can say that they profit from its position among partners, becoming more capable to innovate. Even so, the firm could be working on their own and also be innovative. Having contact to other enterprises increases the capacity of innovation but working alone does not imply a negative impact to innovation; it is just that innovating would be more difficult.

As it was said in the section about transaction cost economics, customers usually repeat contracting CEPHIS to work with them. The variable of frequency was valuated positively. The close relationship between UAB and CEPHIS, which provides reputation, can be regarded as a factor enhancing the frequency in which customers contract CEPHIS. Reputation is a reason for customers to contract the firm for the first time. Reputation reduces the uncertainty about trusting a firm to be able to develop a work. Then the frequency takes place, if customers liked the job done by the company. Another motive that can give reputation and lead to increases frequency is seeing the company involved in a network where there are partners that own a well-known brand. This aspect works as a guarantee assuming by customers that a recognized firm would work together with some other firm just because they transmit confidence.

To conclude, it can be said that the visionary, the network configuration where CEPHIS fits in, highly linked to universities and customers and with low interaction among suppliers and consultants, is combinable with disintegrated modes. First of all, as mentioned before, jobs whose firm is working on are developed through modular architectures. There is a complete connection within all the elements configuring a product since the initial idea until its customers’ purchase and modular components are made independently by different work groups or even different companies.

Projects developed by CEPHIS content always inherent uncertainty but it can be reduced through relationship with universities. These connections provide reputation which leads to reduce uncertainty through credibility on company’s skills.

# CONCLUSIONS

Operating into a disintegrated value chain entails the composition of a network relationship among the members taking part of the process from the origin to the commercialization of a product. Since tasks into the value-added chain are realized by different organizations, each of them takes a concrete position into the network. The grade of centrality that gives this position is the object of study of this project. A central position enriches the firm increasing easiness to access crucial knowledge from members of the network which helps to innovate if it is properly absorbed.

Previously to position CEPHIS into the network relationship and understand how it influences in its success, corroborating that a disintegrated model is the optimum model of working has been considered appropriate. Through the study of the innovation process it is understood that the company operates into modular architectures which propose a complete connection within all the elements configuring a product from the initial idea until its customers’ purchase. It does not matter who makes the components or subsystems, as long as they meet the specifications. In this way, modular components can be made independently by different work groups or even different companies. Another relevant concept for this issue is the appropriability, which is positively related to profitability. This fact would lead to operate vertically integrated because of the higher protection of knowledge, although CEPHIS is more interested in gaining knowledge from partners and using it to innovate. This willingness categorizes a disintegrated model as more beneficial if engineers are capable to keep knowledge that CEPHIS owns and only share non crucial knowledge.

In order to support a disintegrated model, transaction cost economics have given the theoretical basis. The firm is characterized by high asset specificity due to the acquisition of specific machines and the relationships strengthened for the development of some projects. Furthermore, uncertainty is also high because of the high grade of innovation which makes difficult to ensure the period of manufacturing and even the exactly construction of the proposed prototype. The matrix developed by Williamson advises a vertical integration as the most beneficial mode for CEPHIS. Even then, later authors disagree with this, arguing that not necessarily high asset specificity unleashes higher transaction costs. In the case of study, it is interesting to make relation specific investments because the firm gains reputation that entails trustworthiness and involve the possibility of expanding their customers’ portfolio. This reasoning leads to categorize disintegrated modes as the optimum way of operating.

After the explanation corroborating that disintegrated modes are beneficial for CEPHIS, the main issue of the project can be solved. It is referred to the position that the firm occupies. Among the seven different types of network configuration exposed in the article written by Gemünden, the composition that better describes the position of CEPHIS is the one called the visionary. This configuration is characterized by its high interaction with universities and the higher importance given to customers rather than to suppliers and consultants. Interaction with universities is high because of the close relation with the UAB, where its offices are located and also because it is where much knowledge comes from. Even more, for the development of projects, most of the partners are universities around the world. On the other hand, connection with customers is high because they are the ones who give the indications to make a product which will have success in the market. Low contact with suppliers is due to the fact that the firm hardly ever purchases material, since its core business is the research of innovation solutions. Finally, low interaction with consultants is given because CEPHIS rarely contracts people out of the company to assess them, but they operate under their own studies.

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# ANNEX

**Questionnaire**

1. Where do you see your core competences?

The aim of our business is the generation, acquisition and validation of knowledge in the field of TCI (specifically in the domain of hardware/software or embedded) which lately our engineers are capable to transfer to the surrounding industry. An important part of the value lies in the methodology applied for the implementation of prototypes and solutions.

1. Do you reach through to the final costumers? Do you see what the final product will be?

We do not deal with final customers but it is known how the final product will look like. Process of product development departs from product specifications coming from the market (it basically happens with subcontracted projects). We are not in charge of mechanical jobs either industrialization- and/or marketing processes.

1. Do your costumers come back on a recurring basis?

They usually do, but it depends mostly on each product. In some cases customers are asking for tasks that we are not able to offer. Then, we redirect them to other kind of solutions or to other partners.

1. Are your costumers averse to risk?

There is a degree of intrinsic uncertainty in every process of designing new products or components, which use to come more often from clients than from our side.

1. Do they require you to make very specific investments which do not serve for other purposes?

Yes, such as some machine required for the development of a specific project, but which is not usable for other works.

1. Do you obtain relevant indispensable information through your partners in the network? Or can you generate intelligence in home in a significant way?

Yes. Nowadays access to technology and to its associated knowledge is getting more complex day after day. That is why taking part in projects enables us to gain knowledge related to different scopes of application where we apply our solutions.

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