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***COLLABORATION IN  
THE INDUSTRY  
CONVERGENCE OF  
FUNCTIONAL FOODS***

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*BSc thesis*

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## Preface

The final result of my Bsc thesis on the collaboration in the industry convergence of functional foods was written within two periods. It was a process of hard work and dedication, but this has resulted in a piece of work of which I am proud of. I would like to thank my supervisor Dr. E.F.M. Wubben for his time, support and stimulation throughout my thesis. It was a pleasure to work with him, because of his great expertise and critical, but fair feedback. He helped me develop my research and writing skills to create a valuable report. Next to that, I would like to thank dr. G. van der Velde for his time on such short notice. I worked on this thesis with great delight and hope you will enjoy it too.

Kind regards,

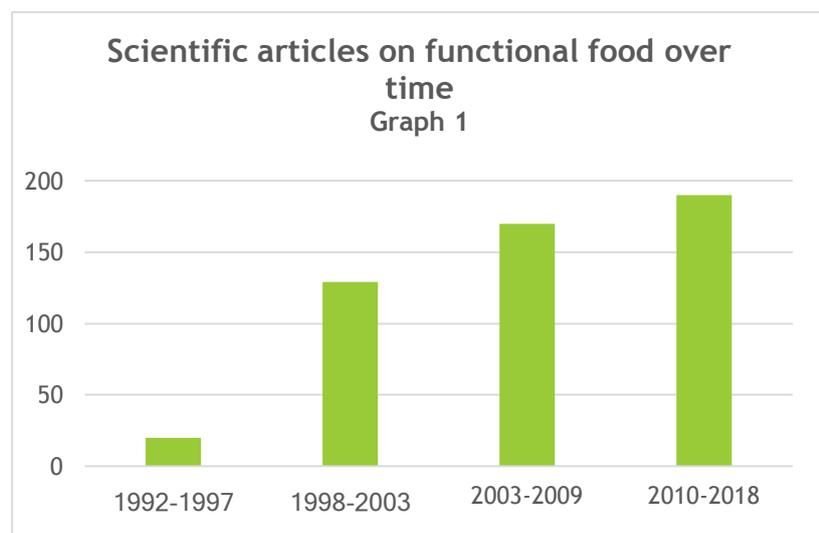
Sander Dominicus

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## 1. Introduction

During the mid-1980's the Japanese came at first with the term "functional foods" (section 4.1.). Since that moment, functional foods became increasingly popular and became more of an interest among scientists (Figure 1; Bigliardi, Galati, 2013). The definition of functional foods comes in different forms (section 4.2). A study was done on the definition of functional foods and it derived the following definition (Doyon, Labrecque, 2008): "A functional food, is, or appears similar to, a conventional food. It is part of a standard diet and is consumed on a regular basis, in normal quantities. It has proven health benefits that reduce the risk of specific chronic diseases or beneficially affect target functions beyond its basic nutritional functions".



The development of functional foods depends on high technology, which is embodied in scientific research. Its development requires different kind of specialists (Bigliardi, Galati, 2013; Richardson, 1996). In the sector of functional foods there is need for specialists from the food- and pharmaceutical sector. Therefore, we witness that the food sector and the pharmaceutical sector grows towards each other (Markt-Herbert, 2004; Richardson, 1996; Bornkessel, Bröring & Omta, 2016).

In the case of functional foods, a new sector emerged between the food sector and the pharmaceutical sector. The emerged sector consists of industries who are not active in the same sector. This creates a sector where the boundaries are blurring. One calls the blurring of industry boundaries industry convergence (Bornkessel, Bröring & Omta, 2016). In general, with an industry convergence, the collaboration between these two industries is important for the success of the emerging sector. In the case of this paper, I will focus on the collaboration in the emerging industry convergence of functional foods. During my literature study, I found out that there is no specific literature on the factors playing a role in the success factors and barriers of the collaboration in the industry convergence of functional foods.

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## **1.1 Research objective and questions**

This thesis is a descriptive research, because the characteristics of the individual subjects of functional foods, industry convergence and inter-organizational collaboration are described. In this descriptive research, the objective is to describe the success factors and barriers of collaboration in the industry convergence of functional foods (Boeije, Scheepers, Tobi, 2016). The results will contribute to the scientific literature on the industry convergence of functional foods and their collaboration. The insights found in this thesis can be of value for firms operating in the functional foods industry. The firms can use this knowledge to evaluate their collaboration and look for points of improvement within their own collaboration.

### **General research question:**

*Which success factors and barriers have an impact on the inter-organizational collaboration in the industry convergence of functional foods?*

In the general research question, the term 'have an impact' has been chosen instead of 'determine', because the available quantitative literature is not sufficient, to find out whether success factors and barriers are significant or not. Furthermore, the term barriers were chosen instead of fail factors, because during the search for relevant scientific articles the term barriers was mainly mentioned to describe the negative factors of collaboration.

The general research question has been elaborated by five different chapters. We opted for 5 chapters since there is not enough available integrated literature on the specific success factors and barriers that have an impact on the collaboration in the industry convergence of functional foods.

## **Chapters**

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### **2. Industry convergence**

*Sub-question: What are the definitions and key-characteristics of industry convergence?*

Chapter two shows how industry convergence is defined and characterized in the scientific literature. The key characteristics consist of the motivational drivers of industry convergence, the emergence process and the different types of industry convergence. In the end, there will be a description of sectors where industry convergence is visible and especially mainly in the IT sector.

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### **3. Factors influencing inter-organizational collaboration**

*Sub-question: What are the success factors and barriers that have an impact on inter-organizational collaboration?*

This chapter studies the success factors and barriers that influence inter-organizational collaboration. The factors will highlight the parts of their success and the parts that work as a barrier. The inter-organizational collaboration was specifically looked at since the main subject is about inter-organizational collaboration and not about intra-organizational collaboration.

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### **4. An overview of functional food**

*Sub-question: What is the concept of functional foods and its global market?*

This chapter gives a clear overview on functional foods. It presents the concept of functional foods by describing the multiple definitions of functional foods, the emerging demand, suppliers and types of functional foods. Furthermore, the global market of functional foods and its players will be illustrated.

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### **5. Analysis**

In this chapter, the previous chapters will be analyzed to find out which success factors and barriers of collaboration are present in the industry convergence of functional foods.

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#### **1.2 Methodology and materials**

This is a systematic literature study reviewing knowledge that is available in the current scientific literature. The first four chapters are of descriptive form, in which the aspects of industry convergence, inter-organizational collaboration and functional foods are described. In chapter five an analysis has been made of the previous chapters, to make an interpretation on the data gathered, in order to conclude on the success factors and barriers have an impact on the collaboration in case of the industry convergence of functional foods. To find all literature needed, the scientific articles are retrieved by using the following databases: Scopus, Web of sciences and ABI/inform. The various databases, search terms and amount of hits per chapter are showed in appendix A.

Before diving into the literature study, key definitions need to be pointed out, to get a common understanding about the main subject. In the overview below, the key definitions in this thesis can be found.

Industry convergence	'The emergence of a new industry segment consisting of firms formerly active in different industries, leading to a blurring of boundaries between the industries is called industry convergence". (Bornkessel, Bröring & Omta, 2016; Hacklin 2008)
Collaboration	'Collaboration is a mutually beneficial and well-defined relationship entered into by two or more organizations to achieve common goals.'" (Mattessich, Monsey, 1998)

Overview 1: Definitions

## Chapter 2. Industry Convergence

In this chapter, industry convergence will be defined and characterized in multiple key-characteristics. The key-characteristics consist of drivers that trigger the evolutionary trajectory, which explains the emergence process of industry convergence. Alternative characteristics are the various industry convergence types and examples of industries where it can be witnessed, especially in the IT sector. In this chapter, the following sub-question is answered: *What are the definitions and key-characteristics of industry convergence?*

### 2.1. Defining functional foods

Around 1998 the phenomena of industry convergence was first mentioned and described. In the years that followed more was written about it and led to a more complex and understandable definition. In the scientific literature on industry convergence various definitions have been formulated (table 1).

A trend in the evolution of technology services and industry structures. (Blackman, 1998)
Blurring boundaries between two or more industries by converging value propositions, knowledge, technologies and markets. (Choi & Valikangas, 2001; Hacklin, 2007)
“Convergence and/or collision of different industries driven by technological and regulatory forces. Consequently, interindustry competitive dynamics are becoming increasingly important.” (Burgelman & Grove, 2007)
The linking of technologies in thrilling new ways. (Kodoma, 2014)
“The emergence of a new industry segment consisting of firms formerly active in different industries, leading to a blurring of boundaries between the industries is called industry convergence.” (Bornkessel, Bröring & Omta, 2016)

Table 1. Definitions of industry convergence

Most of these definitions above are similar and complementary. I used various elements of the different definition of which I find most important and transformed it into a single definition: *The blurring of boundaries between formerly separated industries, creating one new combined industry that shares knowledge, technology and markets.* This definition has a solid foundation in which the most important elements of industry convergence come forward. None of the individual definitions in table 1 do not include the elements mentioned in the preferred definition.

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## 2.2. Motivational drivers

The motivation of companies from different industries to form an industry convergence depends on various drivers. The different drivers for companies to form an industry convergence are technology, deregulations, customer demand and business-related factors. The first driver that is widely noted in the literature is technology, because in most cases of industry convergence, it is based on combining technologies to create new ones (Borés et al. 2003; Duysters & Hagedoorn, 1999; Bröring et al. 2007). That's why 5- of the 7 articles used on the drivers of industry convergence mention the industry convergence of IT, because technology is a key aspect in that sector. According to Weaver; *'the setting and adoption of technological standards is integral in many cases of technological convergence, and thus also central as driver for industry convergence'*. The second driver that plays a role in the motivation for companies to form an industry convergence are deregulations. It concerns regulations opposed by the government that delay technological developments. For instance, in the sector of telecommunication regulations hold up the convergence process. It is only with deregulation that the convergence process can emerge (Bröring, 2010; Weaver, 2007). The third driver is customer demand, it takes place when customers treat products of different industries in the same way (Bröring, 2010; Geum et al. 2016). Finally, there are the business-related factors that drive industry convergence. The convergence between industries can be motivated by strategic mergers, acquisitions or alliances to speed up the implementation of new technologies and simultaneously attract new customers (Chan-Olmsted, 1998; Weaver, 2007).

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## 2.3. The evolutionary trajectory

It is important to know how the process of creating industrial convergence works to see how two different sectors find each other and start a new industry. The evolutionary trajectory, which explains the emergence process of industry convergence can be divided in four different stages: Initialization, knowledge diffusion, consolidation and maturation (Fig. 2). Claassen, et al 2013, based their evolutionary trajectory on industry convergence literature, the first stage of the emergence process is the continuing self-reliancy of research and development departments of the two different industries. During the second stage, the two industries share their knowledge which leads to a research collaboration in the consolidation stage. In this stage, the convergence of technology and market takes place. The final stage consists of merging sectors of the different industries, which result in an industry convergence (Claassen, et al, 2013).

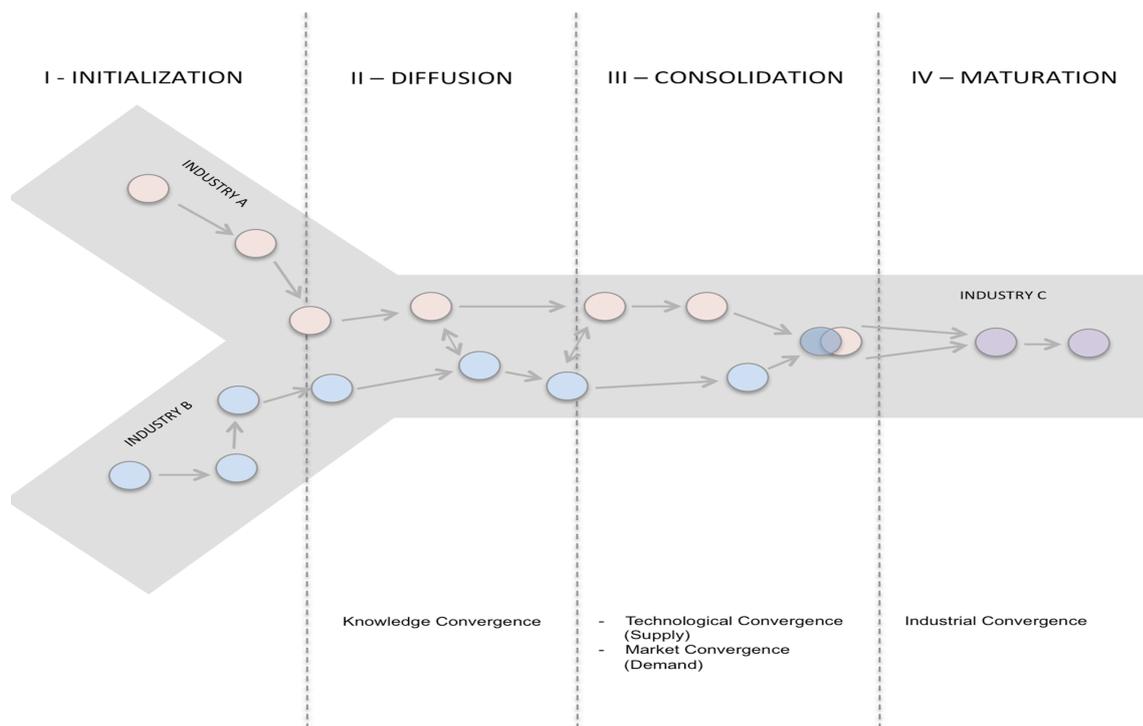


Figure 2. Evolutionary trajectory of industry convergence (Claassen et al. 2013).

## 2.4. Types of industry convergence

The types of industry convergence can be categorized in 2 basic and 3 specific types. The basic industry convergence types are the technology driven input-side convergence and the market-driven output-side convergence. Firstly, the technology driven input-side convergence consists of different technology factors across different industries on the input-side and is related with the technology drivers mentioned before. Secondly, the market-driven out-put side convergence is a market pull orientation to please various needs in one transaction which is related with the changing customer demand factor (Bröring et al. 2006;).

Not all types of industry convergence are based on technology or customer-demand, some types have other meanings. The literature provides 3 other specific types of industry convergence: policy driven environmental enhancers, service-integrated social business generators and technology driven new value generators (table 2).

Type of industry convergence	Explanation
Technology driven input-side convergence	Driven by technological determinants which leads to the emergence of new technologies. This type indicated the sharing of technology among different industries (Bröring et al. 2007). This type fits with the technology driver.
Market-driven output-side convergence	Generated by demanding structures of various industries. It arises when consumers treat products of distinct industries in an identical way (Bröring et al. 2007). This type fits with the changing customer demand driver.
The policy-driven environmental enhancers	Primarily related to environmental policies by the government. Different industries work together to create environmental sustainability. (Geum et al. 2016). This type of industry convergence fits the driver of deregulations.
The service-integrated social business generators	Focused on the need of new businesses. The firms try to merge services to their original products to create new value. (Geum et al. 2016).
Technology driven new value generators	This convergence is related with the creation of social businesses. It is driven by the need for new businesses, especially socially related business (Geum et al. 2016).

Table 2. Industry convergence types.

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## 2.5. Examples of industry convergence

Industry convergence is witnessed within all kinds of industries. The examples of the IT, chemical-, pharmaceutical- and food industries. In the scientific literature, the main focus lies on the examples of the IT sector (Bröring et al. 2007; Fahrni et al. 2009; Geum et al. 2016; Markt-Herbert, 2004). Less attention has gone to industries like the chemical-, pharmaceutical- and food industries. (Bröring et al. 2006; Fahrni et al. 2009, Geum et al. 2016; Weaver, 2007). The first example named in 10- of the 15 articles on industry convergence, mention the IT sector as a clear example. For a long time, industries like telecommunication and computers followed distinct trajectories, until the mid 1980's, because around that time these distinct sectors converged into a new industry namely the (IT) information technology sector (Borés et al. 2003; Duysters, Hagedoorn, 1998). A typical example is *'the phone line at some stage was used for getting into the Internet, the Internet can today be used for getting onto the phone'* (Fahrni et al. 2009). This example applies to the Market-driven output-side convergence that is mentioned in section 2.4. The second example is the industry convergence that is witnessed between cosmetics- and pharmaceutical industries into 'cosmeceuticals' (Weaver, 2007). The last example of industry convergence is the convergence of functional foods between the food- and pharmaceutical industries. In this sector, the convergence of technology and production processes created ingredients for functional foods (Bröring et al. 2006).

In summary, we can answer sub-question one: what are the various definitions and key-characteristics of industry convergence? Industry convergence has various definitions, but the best definition of industry convergence is the following: *The blurring of boundaries between formerly separated industries, creating one new combined industry that shares knowledge, technology and markets.* There are three key-characteristics of industry convergence. The first key-characteristic is the motivational drivers of industry convergence like technology and deregulation. The second key characteristics is the evolutionary trajectory process of four separate stages. The third key-characteristic is the types of industry convergence. The types consist of two basic types, which are technology driven input-side convergence and market driven output-side convergence, and three specific types, which are the policy-driven environmental enhancers, the service-integrated social business generators and technology driven new value generators. Examples of industry convergence are mainly witnessed in the IT industry, but also in the chemical-, pharmaceutical- and food industries.

## Chapter 3. Factors that have an impact on inter-organizational collaboration

Organizations in industry convergence will be working together to create a successful and profitable collaboration. The success or failure of inter-organizational collaboration depends on multiple factors. In this chapter, the most important factors will be described in relation to inter-organizational collaboration. On the basis of the literature, we will discuss the factors and highlight the parts of their success and the parts that work as a barrier. On the basis of the literature study it turns out that four factors that have an impact on inter-organizational collaboration: trust, power, leadership and communication. By elaborating them, an answer is given on the sub-question two: *What are the success factors and barriers that have an impact on inter-organizational collaboration?*

### 3.1. Trust

The first factor of the success of inter-organizational collaboration is trust. *“Trusting relationships are often depicted as the essence of collaboration”* (Bryson et al. 2006). Getting to know the partner and hereby develop mutual trust are critical aspects for the success of partnership (Casey, 2007). Trust is seen in the scientific literature as a necessity to develop a successful collaboration (Bititci & Van Der Meer, 2011; Bryson et al. 2006; Casey, 2008; Chao et al. 2014). Trust is developed over time, due to transparency by sharing information and knowledge (Bryson et al. 2006; Henderson et al. 2015; Fatemeh, 2014). In addition, the fair treatment and openness to one another are key elements of building trust (Henderson et al. 2015). Trust promotes ongoing interaction between partners and hereby strengthen the cooperation and performance (Henderson et al. 2015). McEvily et al. (1998) explored the effect of trust on inter-organizational performance and found a direct link between trust and performance.

Trust can also appear as a barrier in an inter-organizational collaboration. When there is a decrease in mutual trust between partners, a barrier can arise. This decrease in trust is a barrier which has a negative influence on inter-organizational collaboration. Lack of trust between partners can act as a blockade for effective collaboration (Bruneel, 2010; Casey, 2008; Chen et al. 2014; Fatemeh, 2014). The lack of trust between partners leads towards uncertainty which is not effective in an inter-organizational collaboration (Chen et al. 2014). This lack of trust results in a poorer performance of the collaboration (McEvily, 1998). This decrease in trust could eventually lead to a complete failure of the inter-organizational collaboration.

### 3.2. Power

The second factor that is described in the scientific literature on inter-organizational collaboration is power. Power in inter-organizational collaboration is specified as the capability of individual parties to influence collective decisions to their own advantage in various ways (Dewulf & Elbers, 2018). Another way to describe power in an inter-organizational relationship is *'the ability to influence the action of others and so alter how the roles and responsibilities of the partnership are designated'* (Casey, 2008). The kind of power needed in an inter-organizational collaboration is non-coercive power which indicates that the power appears without forcing but from expertise, reward and legitimacy (Huemer et al. 2015; Huo, 2018). Non-coercive power shows admiration to their partners and are proud to be associated with this (Huemer et al. 2015). Non-coercive power is positively associated with the partner's opportunism and in this way creates a good collaborative environment (Huo, 2018). An individual actor in a collaboration is successful when their power has the ability to influence and control (Essabar et al. 2016). This indicates that it is important that partners share responsibility and value the dividing of power (Casey, 2008). Balance of power between partners is needed to develop collaborative relationships, it indicates that one partner does not dominate the other partner. There must be an equality in power sharing (Kähkönen, 2014). Power that is equally divided among partners, will have a positive influence on the success of the overall collaboration.

Power can also appear as barrier for successful inter-organizational collaboration. The transformation of power into a barrier appears when power is not divided equally among partners. The imbalance of power within inter-organizational collaborations can evolve into a prime source of conflict and form a threat to successful collaboration (Bryson et al. 2006; Casey, 2008; Dewulf & Elbers, 2018). This asymmetry in power will decrease the success of managing complex problems (Dewulf & Elbers, 2018). Bryson et al. (2006) indicates that partners will reduce their commitment and involvement to the collaboration, when they notice that their interests are not being considered or taken seriously. Power can be perceived in positive- and negative ways. The negative form of power which can manifest itself is coercive power. Coercive power is defined as the agent's ability to impose on the target things that the target does not desire, or to remove or decrease desired things (Dutton & Goodman, 2005). Coercive power has a negative impact on inter-organizational collaboration (Huemer et al. 2015). The imbalance and wrong use of power will eventually stimulate the failure of inter-organizational collaboration.

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### 3.3. Leadership

The third factor in inter-organizational collaboration is leadership. Certain leadership characteristics are needed to create effective collaboration. Leadership is *'the process of influencing the activities of an organized group toward goal achievement'*. (Behling & Rauch). For the success in the inter-organizational collaboration, effective leadership is needed. Effective leadership in this sense, consist of certain properties that helps stimulate the collaboration. It is stated in the scientific literature on inter-organizational collaboration that in an effective leadership, there is need for leaders who focus on building trust and mutual understanding (Casey, 2008; Fan & Qin, 2016; Vangen & Huxham, 2000). Leaders need to support a knowledge sharing culture in which there is a willingness to share among all employees (Casey, 2008; Fan & Qin, 2016; Fatemeh, 2014; Vangen & Huxham, 2000). A view on collaborative leadership is noted by Fan and Qin 2016, who favor a rotating leadership between partners, what they define as *'a process whereby partners alternate who controls the major decisions impacting the collaboration across collaboration phases'*. This way of leadership gives each partner the opportunity to make an impact on the collaboration. It motivates partners to cooperate and increases involvement in decision making. Effective leadership can have a positive influence on the inter-organizational collaboration.

Leadership can also act as a barrier. Leadership can work negatively when it does not support activities that lead towards goal achievement. The domination of a leadership form in which there is no support on knowledge and technology sharing (Casey, 2008; Panteli & Sockalingam, 2004), will have a negative influence on the collaboration. The barrier of leadership can arise, because the leadership does not foster trust, cooperation and an inter-organizational environment in which there is common understanding and interest (Casey, 2008; Chao et al., 2014; Fan & Qin, 2016). The barrier of leadership will have a negative influence on the success of an inter-organizational collaboration.

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### 3.4. Communication

Fourth and final, we have communication as an important factor in the success of inter-organizational collaboration. The communication between organizations is a critical factor in collaboration among firms to promote and continue value-enhancing inter-organizational relationship (Chen et al. 2008). According to Casey (2008), the growth and maintaining of inter-organization relationship is fostered by repeated communication and clear understanding about the terms of the relationship. This means that it is important to grow clear and broad lines of communication. By doing, they create a sharing environment (Bititci & Van Der Meer, 2011). An essential element in communication between organizations is feedback. This ensures *'that each partner views the particular issue as important, sees the actual or potential benefit to each partner views the particular issue as important, sees the actual or potential benefit to each partner has a sense that integration with the other partner is necessary for a solution'* (Casey, 2008).

The same is said by Huemer et al. 2015, who stated that it is important to exchange feedback and keep each other frequently informed.

The factor of communication can also influence the collaboration between organizations in a negative way. This could eventually form a barrier for successful inter-organizational cooperation. Miscommunication leads to misalignment between partners about for instance the vision and goals of the collaboration. Communication is a critical factor in maintaining a good inter-organizational relationship (Chen et al, 2008). According to Casey (2008) and Chen et al. (2008) frequent communication between organizations is essential in the development of a successful relationship, this indicates that when partners don't have frequent communication, a delay in the development of a partnership takes place. A critical barrier point in the communication between partners is when there is no feedback given to one another. The consequence of no feedback is that there is no control and enlightenment towards each other (Bitici & Van Der Meer, 2011). Poor quality communication has an impact on the failure of an inter-organizational collaboration.

To give a summary and answer sub-research question two: *What are the success factors and barriers that have an impact on inter-organizational collaboration?*

Table 3 was made to give a clear understanding answer.

Factors	Success	Barrier
Trust	Trust is essential in inter-organizational collaboration and strengthens the cooperation and performance of the collaboration.	The decreasing of trust leads to ineffective inter-organizational collaboration and reduces the cooperation and performance of the collaboration.
Power	Power between organizations need to be in balance. The equal distribution of power has a positive influence on the success of inter-organization collaboration.	Asymmetry of power between organizations decreases involvement and commitment to the collaboration. This imbalance of power has an impact on the failure of inter-organizational collaboration.
Leadership	Successful inter-organizational leadership forms need to focus on trust and mutual understanding. Furthermore, do they need to promote a knowledge and technology sharing environment.	Inter-organizational leadership that do not support a knowledge and technology sharing environment.
Communication	It is important to grow clear and broad lines of communication and an important element is (to exchange) feedback and keep each other informed.	When there is no frequent communication between partners, a stagnation in the development of this partnership will take place. Poor quality communication has impact on the failure of an inter-organizational collaboration.

Table 3: Summarizing impact factors of inter-organizational collaboration

## Chapter 4. An overview of functional foods

In this chapter, an overview of the concept of functional foods will be given. The concept of functional foods will be described by its emerging demand for functional foods, different definitions, suppliers and types of functional foods. A scientific literature review was performed on the emerging demand of functional food and the various definitions of functional foods. Based on this review a new definition of functional foods was formulated. The concept of functional food is further elaborated by describing the different suppliers and main types of functional foods. At last, the global market of functional foods and its players will be illustrated. By describing the concept of functional foods and the global market the following sub-question will be answered: *What is the concept of functional foods and its global market?*

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### 4.1. Emerging demand of functional foods

As the aging population is growing and the health costs rise, the people seek for ways to live a healthy lifestyle (Bigliardi & Galati, 2013; Martirosyan & Singh, 2015; Kápolna et al. 2008; Liberatore et al. 2016). The fact of health promoting food is not something new, Hippocrates wrote many years ago "let food be thy medicine and medicine be thy food" (Martirosyan & Singh, 2015). Nowadays, consumers are becoming more and more health conscious (Basile et al. 2010, Bevilacqua et al, 2014; Bigliardi & Galati, 2013) due to health authorities and media on nutrition (Bevilacqua et al, 2014). These factors led towards an increasing worldwide demand for "healthy" food and beverages (Bevilacqua et al, 2014). The concept of food promoting health was familiar in the Asian community and in the mid-1980's the Japanese came at first with the term "functional foods" for foods containing ingredients with functions for health (Bevilacqua et al, 2014; Das & Kaur, 2011; Martirosyan & Singh, 2015; Basile et al. 2010; Weststrate et al. 2002).

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### 4.2. Definition of function foods

During the search for definitions of functional foods, it was clearly visible that some definitions are rather simple like the one from the National Institute of Nutrition (2002)(Table 4), while others are more complex like the one from Doyon & Labrecque, (2008), (Table 4). In table 4, the definitions are organized from simple to rather complex definitions.

<p>Foods or food components that may have health benefits that reduce the risk of specific diseases or health concerns (National Institute of Nutrition, 2000).</p>
<p>A food that is functional and contains a food component which affects one or more targeted functions of the body in a positive way (Oversen, 1999).</p>
<p>Foods that provide the basic attributes of traditional foods and claim to provide an additional health benefit (United States General Accounting Office (GAO), 2009).</p>
<p>Foods which are expected to have certain health benefits and have been licensed to bear a label claiming that a person using them for specified health use, may expect to obtain the health use through the consumption thereof (The Japanese Ministry of Health, Labor and Welfare (FOSHU, 1991), cited in (Bigliardi &amp; Galati, 2013).</p>
<p>A functional food, is, or appears similar to, a conventional food. It is part of a standard diet and is consumed on a regular basis, in normal quantities. It has proven health benefits that reduce the risk of specific chronic diseases or beneficially affect target functions beyond its basic nutritional functions (Doyon &amp; Labrecque, 2008).</p>
<p>Functional food is any healthy food similar in appearance to conventional foods, consumed as a part of a usual diet, and claimed to have physiological benefits like health-promoting or disease-preventing properties beyond the basic function of supplying nutrients (Das &amp; Kaur, 2011).</p>
<p>Food which could be regarded as 'functional' as being one that has been satisfactorily demonstrated to beneficially affect one or more functions in the body, beyond adequate nutritional effects, in a way which is relevant to either an improved state of health and well-being and/or a reduction of risk (The European Commission Concerted Action Group on Functional Food Science in Europe (FUSOSE) cited in (Mabel, 2000).</p>
<p>Natural or processed foods that contains known or unknown biologically-active compounds; the foods, in defined, effective, and non-toxic amounts, provide a clinically proven and documented health benefit for the prevention, management, or treatment of chronic disease (Functional Food Center cited in (Martirosyan &amp; Singh, 2015)).</p>

Table 4: Definitions of functional foods

An interesting observation is that there is no clear international consensus on the definition (Basile et al. 2010; Bultosa, G. (2016); Das & Kaur, 2011; Doyon & Labrecque, 2008; Kápolna et al. 2008; Liberatore et al. 2016; Martirosyan & Singh, 2015).

Like mentioned before, the term functional foods was first introduced in Japan and defined by the Japanese Ministry of Health, Labor and Welfare (FOSHU) in the mid-1980's. Other countries and scientist followed by creating their own definition (Basile et al. 2010; Martirosyan & Singh, 2015). This is reflected in the various definitions around the world:

- In the U.S., functional foods is defined as "foods and foods components that provide a health benefit beyond basic nutrition" (Bevilacqua et al, 2014).

- In Canada, it is defined as "food similar in appearance to, or may be, a conventional food that is consumed as part of a usual diet, and is demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions" (Bevilacqua et al, 2014).

- In China, the term functional foods is defined as "health (functional) food means that a food has special health functions or is able to supply vitamins or minerals. It is suitable for consumption by special groups of people and has the function of regulating human body functions, but it is not used for therapeutic purposes. And it will not cause any harm whether acute or subacute or chronic" (Bevilacqua et al, 2014).

- In Europe, the FuFoSE defines functional foods as "Food which could be regarded as 'functional' as being one that has been satisfactorily demonstrated to beneficially affect one or more functions in the body, beyond adequate nutritional effects, in a way which is relevant to either an improved state of health and well-being and/or a reduction of risk" (Bevilacqua et al, 2014).

After reviewing the different definitions of functional foods, some key themes were found:

A) **Promoting health.** The most important theme found is the fact that functional foods should have 'health benefit' for the consumer. This can be found back in 8- out of the 8 definitions in table 4.

B) **Disease preventing.** In 4- out of 8 definitions in table 4, it is mentioned that functional foods should reduce the risk on certain diseases.

C) **The characteristics of the food.** All definitions speak of functional food as food and not as a kind of drug. 4- out of 8 definitions in table 4 mention that functional foods should have benefits beyond its basic nutrition. Another characteristic is that 2- out of 10 definition note that the appearance of functional foods 'appear similar' to conventional food.

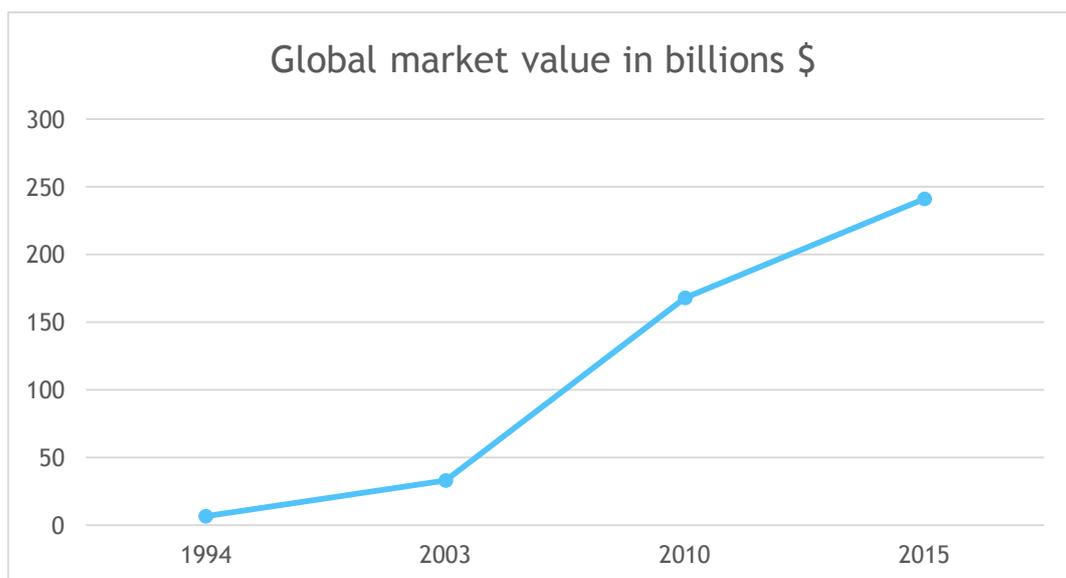
Taking all the different definitions and key themes in mind, I concluded that the best definition of functional foods is: "Food that is scientifically proven to promote the state of health and/or reduces the risk of diseases and gives benefits beyond its basic nutrition".

This definition is rather simple to understand and consist of all the key themes mentioned before. I think that it is important that the food should improve your health and that this is scientifically proven.

All these different definitions create confusion among producers and scientists on what the actual meaning and requirements for functional foods are (Martirosyan & Singh, 2015). The definition of functional foods need to be internationally standardized (Bevilacqua et al, 2014; Das & Kaur, 2011; Doyon & Labrecque, 2008; Martirosyan & Singh, 2015), to enhance international communication, create requirements for producers and increase the health of the population (Martirosyan & Singh, 2015).

### 4.3. Global market of functional foods

Due all these different definitions and the fact that there is no internationally accepted definition, it is difficult to estimate the global market value of functional foods (Bevilacqua et al, 2014; Liberatore et al.2016; Menrad, 2010; Kápolna et al. 2008). Nonetheless, gives graph 2 an estimated representation of the global market value in the last couple of years.



Graph 2: Global market value of function foods (Bevilacqua et al, 2014; Hilliam, 1998; Liberatore et al. 2016; Menrad, 2010; Kápolna et al. 2008; PR newswire, 2014)

The three regions with the most market share in the market of functional foods are the United states, Europe and Japan (Kápolna et al. 2008; Liberatore et al. 2016; Menrad, 2003). Around 1994, Japan had the largest market share of around 50% (Hilliam, 1998), but in the following years the United States of America became the largest in the market segment of functional foods with a market share of 45% in 2013, followed by the Asian Pacific with 34% and Europe with 22% (Liberatore et al. 2016).

The production of functional foods is manufactured by multiple producers. The main producers of functional food are: multinational food companies, pharmaceutical companies and small- and medium-sized niche food companies. The first group of suppliers are multinational companies that have the advantages of multiple established and well-known brands and have the financial capabilities to produce functional foods (Menrad, 2001; Kápolna et al. 2008). The second group of functional foods are pharmaceutical companies. The pharmaceutical industry has become interested in this sector due to shorter development times and lower product development costs in comparison with pharmaceutical products (Kápolna et al. 2008). This increased interest led towards an overlapping of the pharmaceutical and food industries, the so-called industry convergence of functional foods (Kápolna et al. 2008; Markt-Herbert, 2004; Richardson, 1996; Bornkessel, Bröring & Omta, 2016). The third group of suppliers are small- and medium-sized niche food companies. These companies produce functional food products for niche markets. A problem with these small- and medium-sized niche food companies is often that they lack the knowledge and resources to become a big player in the market of functional foods (Menrad, 2001; Kápolna et al. 2008).

The product of functional foods can be produced in different types. The main types of functional foods mentioned in the scientific literature are enriched products, fortified products, altered products and enhanced commodities (Table 5).

Type of functional food	Explanation
Fortified/enriched food	Food products that are enriched/fortified with new nutrients. Examples are vitamins and probiotics, which are live micro-organisms that have a health benefit for the consumer.
Altered food	Food products where components are lowered, taken out or replaced with other components. Examples are the reformulation of fatty acid profiles or inclusion of antioxidants in meat.
Enhancing properties	Food products where the components have been naturally enhanced. Mainly found back in egg products. These products are increased with omega-3 fatty acids, vitamins and antioxidants.

Table 5: Main types of functional foods (Bevilacqua, et al. 2014; Bigliardi & Galati, 2013; Das & Kaur, 2011; Kápolna et al. 2008; Spence, 2006).

To summarize, sub-question three can be answered: *What is the concept of functional foods and its global market?* The concept of functional foods is described by its emerging demand for functional foods, different definitions, suppliers and types of functional foods. The growing demand for functional foods emerged due to increasing health costs, aging population and more conscious consumers. The term functional foods was first coined during the mid-1990's in Japan. In the years following, the demand for functional foods increased around the world, but did not lead towards an internationally acknowledge definition. Nevertheless, did I conclude that the best definition of functional foods is *''Food that is scientifically proven to promote the state of health and/or reduces the risk of diseases and gives benefits beyond its basic nutrition''*. The producers of functional are multinational food companies, small- and medium-sized niche food companies and pharmaceutical companies. The main types of functional foods produced are fortified/enriched food, altered food and enhancing properties. Due to all these different definitions and the fact that there is no clear international consensus, confusion emerged among producers and scientists about the real meaning of the term functional foods, resulting in diverse statistics of the global market value and market shares. The three main regions active on the functional food market are: United States of America, Europe and Asian pacific.

## Chapter 5. Analysis

An analysis is made based on the literature found in the various chapters. All the different knowledge collected from previous chapters are analyzed to describe what the motivation and type of industry convergence the functional food sector is. The analysis will also create new knowledge on the success factors and barriers of inter-organizational collaboration in the industry convergence of functional foods. The analysis will lead a final answer of the general research question: *Which success factors and barriers have an impact on the inter-organizational collaboration in the industry convergence of functional foods?*

### **5.1 Motivation of the industry convergence of functional foods**

Industry convergence has multiple motivational drivers (section 2.2.). The industry convergence of functional foods has three motivational drivers: Technology, business-related factors and customer-demand. The first motivational driver of the industry convergence of functional food is technology. The development of functional foods depends on high technology, which is embodied in the scientific research. Its development therefore requires the technology of both industries to make it into a success. The second motivational driver is business-related factors and especially the case of strategic alliances between food- and pharmaceutical companies. To combine each other's knowledge to create new knowledge to accelerate the implementation of new technologies to attract new customers. The third motivational driver is customer-demand, because customers these days are more health conscious and look for ways to live a healthy lifestyle. The customers became more aware of their health and desire food that is not only nutritional, but also healthy (section 4.1). Therefore, the consumers generate the demand for health promoting foods.

### **5.2. Type of industry convergence of functional foods**

In general, the industry convergence can be categorized. The industry convergence of functional foods is a combination of the technology-driven input-side convergence and the market-driven output-side convergence (section 2.4.). Firstly, the technology-driven input-side convergence fits the functional food convergence, because the pharmaceuticals- and food industry need each other's technology to create new technology, which leads towards a successful product of functional foods. Secondly, the market-driven output-side convergence fits the functional food convergence, because the consumers became more health conscious and demand a food product that promotes their health. The convergence of functional food is therefore also generated by the consumers' demanding structures of the food industry and the pharmaceutical industry.

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### **5.3. The success factors and barriers**

In the industry convergence of functional foods, the food companies will engage in an inter-organizational collaboration with pharmaceutical companies. The success or failure of such a collaboration depends on multiple success factors or barriers. The factors that have an impact on inter-organizational collaboration are trust, power, leadership and communication.

The first and most important success factor named in the literature on inter-organizational collaboration is trust (section 3.1.). The trust in the convergence of technology and the trust in the expertise of the pharmaceutical and food sectors is of main importance in the success of the partnership. At first, the trust in the convergence of technology is important, because the industry of functional foods is mainly based on the convergence of technology. The pharmaceutical- and food companies want to create new successful technology with each other to produce functional foods. Therefore, the trust in each other's technology is needed to make this successful. Secondly, the trust in the expertise and competencies of both parties is of importance. The pharmaceutical- and food companies take both part in the production of functional foods. The food partner takes care of the nutritional food component and the pharmaceutical partner on the health component. The pharmaceutical partner needs to trust the expertise and competencies of the food partner with the production of the nutritional food component. While the food partner needs to trust the expertise and competencies of the pharmaceutical partner in the health component of the production process. Both partners must trust that the other party meets the safety conditions of the product, because this is of extreme importance in the food sector. These high levels of trust in the convergence of technology and expertise will have a positive influence on the performance of the overall collaboration between pharmaceutical- and food companies.

Trust can also act as a barrier in the inter-organizational collaboration between food- and pharmaceutical companies. In general, the decrease in trust between companies leads towards uncertainty on - for instance - the expertise and cooperation. On the other hand, the industry convergence of functional foods is a sensitive sector, because of the health aspects of the consumers are at stake. This means that when there is no trust in the expertise of one another, it can lead to partners taking matters into their own hands and create mistakes that are dangerous to the health of the consumer. This indicates that trust in each other's expertise is of major importance, because a mistake in this sector could lead to serious reputational damage of both the pharmaceutical- and food companies. Finally, the decrease in trust can lead to the failure of performance in the inter-organizational collaboration between the food- and pharmaceutical companies. The factor trust, in my opinion, also has an impact on the upcoming three factors of power, leadership and communication.

The second factor is power (section 3.2). The factor of power can be seen as a continuum scale. More fair the distribution of power based on expertise, the more successful the collaboration. Logically, less fair distribution of power based on expertise, the less successful the collaboration. Firstly, the power between the pharmaceutical- and food companies need to have a fair distribution among the partners, the food company should not dominate the pharmaceutical company and vice versa. Secondly, the industry convergence of functional foods should be based on the convergence of technology and knowledge of the pharmaceutical and food companies. Therefore, it is important that the pharmaceuticals and food partner should have the most responsibility and power in their expertise. For instance, the pharmaceutical partner should have the most responsibility in the health aspects of the product and the food partner in the food elements of the product. It is important that both parties value each other's expertise and do not use power over the other. In this way, you create an environment with non-coercive power, in which power appears in forms of expertise and legitimacy, as standard. The fair distribution of power which is based on expertise will have a beneficial influence on the inter-organizational collaboration between the pharmaceutical- and food companies. On the other hand, when power among the partners is not fairly distributed, this indicates that the food- or pharmaceutical partners takes too much power. The less fair distribution of power can transform into a prime source of conflict, this is not beneficial for the collaboration. The less fair distribution could gradually become a barrier, which has a negative influence on the collaboration.

The third factor in the success of inter-organizational collaboration in the industry convergence of functional foods is leadership (section 3.3.). The functional food sector needs leadership that supports a sharing environment and aligns the collaboration. Firstly, in the converging industries, where two distinct industries collaborate with one another, leadership is needed to create and support a knowledge and technology sharing environment. The leaders of both food- and pharmaceutical companies should support their employees to exchange knowledge and mutual understanding with their new colleagues. Secondly, the pharmaceutical- and food partners need leadership that aligns the vision, interest and goals of the collaboration. This ensures that the interests of both companies are considered, which leads to less conflicts. I would suggest a rotating leadership between the food- and pharmaceutical partners, because this form of leadership alternates who controls the major decisions across the collaboration phases. This gives each partner the opportunity to make decisions and have an impact on the collaboration. It will increase involvement, which could be a solution for the main conflict of unequal power distribution. The rotating leadership makes sure that every partners' interest is being accounted for. The correct form of leadership will positively influence the collaboration between pharmaceutical- and food companies.

Leadership within the inter-organizational collaboration of functional foods can also function as a barrier. The negative side of leadership in the functional food sector is leadership that doesn't support a sharing environment or no leadership at all. Firstly, this barrier will have a negative influence on the collaboration when the leadership of both partners do not support an environment in which the members share their knowledge and technology on food and health. The quality of the functional food product could decrease, because there was not enough sharing of knowledge and technology between both parties. Secondly, no leadership at all leads to no alignment among the members of the collaboration. There will be no common interest and understanding about the goals of the collaboration. The barrier of leadership can eventually lead towards a negative influence on the success of an inter-organizational collaboration.

The fourth and final success factor in the inter-organizational collaboration between food- and pharmaceutical partners is communication (section 4.4.). In the functional food sector, there is a need for clear and repeated communication between the pharmaceutical- and food partners. Firstly, in the functional food sector, it is necessary that both parties create clear communication and mutual understanding on the unambiguity of definitions. There is need for mutual understanding on for instance, the definition and requirements of functional foods, because there is no clear consensus on that matter (section 4.2.). Mutual consensus will make sure that mistakes are prevented. In this way, communication can help the growth of the inter-organizational relationship. Secondly, repeated communication and feedback on the product of functional food is required. It will make sure that there is control on the final product of functional foods, which will prevent mistakes that can harm the health of the consumers. Finally, clear and repeated communication can have a positive influence on the success of the inter-organizational collaboration in the industry convergence of functional foods.

The factor of communication can also act as a barrier. In the industry convergence of functional foods miscommunication and infrequent communication can have a negative influence on the collaboration. Firstly, miscommunication occurs when the pharmaceutical- and food partners do not have mutual understanding about the definition and requirements of functional foods. Miscommunication leads towards less mutual understanding on important matters like the vision and goals of the collaboration. If both partners do not have mutual understanding on such matters, conflicts could arise or mistakes could be made which can have negative consequences for the health of the consumer. Secondly, infrequent communication between the food- and pharmaceutical companies will hold up the development of the collaboration. Infrequent communication goes hand in hand with no feedback, because little to no feedback results in less control on the functional food product, which again could have a negative influence on the health of the consumer. The barrier of communication between food- and pharmaceutical companies will have an impact on the failure of an inter-organizational collaboration.

To recap, an analysis was performed on the previous chapters of this thesis. The analysis presented that the industry convergence of functional foods has three motivational drivers. At first, we have the motivational driver of technology. The second- and third motivational driver are business-related factors and the demand of the customers. Furthermore, the type of industry convergence of functional food is based on a combination of the technology driven input-side convergence and the market-driven output-side convergence. Finally, the analysis presented that there are four success factors and barriers that have an impact on the industry convergence of functional foods. The first success factor and barrier is trust. The second success factor and barrier is power. The third success factor and barrier is leadership. The fourth and final success factor and barrier is communication.

## Conclusion

To conclude this thesis, I proposed three sub-questions in which I was able to answer the following general research question: *“Which success factors and barriers have an impact on the inter-organizational collaboration in the industry convergence of functional foods?”*.

Regarding the first sub-question: *“What are the definitions and key-characteristics of industry convergence?”* I conclude that the best definition of industry convergence reads as follows: *“The blurring of boundaries between formerly separated industries, creating one new combined industry that shares knowledge, technology and markets”*. The industry convergence consists of three key-characteristics: motivational drivers, evolutionary trajectory and types of industry convergence.

Regarding the second sub-question: *“What are the success factors and barriers that have an impact on inter-organizational collaboration?”* The factors trust, power, leadership and communication can act as a success factor or as a barrier.

Regarding the final sub-question: *“What is the concept of functional foods and its global market?”*, I conclude that the best definition of functional foods is as follows: *“Food that is scientifically proven to promote the state of health and/or reduces the risk of diseases and gives benefits beyond its basic nutrition”*. Furthermore, did the demand for functional foods increased due the increasing health costs, aging population and more health conscious consumers. The different definitions of functional foods resulted in diverse statistics of the global market value and market shares. The three main regions active on the functional food market are: The United States of America, Europe and Asian pacific.

The analysis and sub-questions lead to the answer of the general research question. I conclude that there are four success factors and barriers that have an impact on the inter-organizational collaboration in the industry convergence of functional foods. The first success factor and barrier is trust. In the functional food sector, the trust in expertise and technology is critical. The second success factor and barrier is power. This factor is a continuum scale which indicates that the more fair the distribution of power based on expertise, the more successful the collaboration and vice versa. The third success factor and barrier is leadership. The elements of collaboration alignment and sharing environment are of importance. The fourth and final success factor and barrier is communication. Clear and repeated communication have a positive influence on collaboration while miscommunication and infrequent communication have a negative influence on collaboration. Part of all these factors, it appeared that the health of the consumer plays a central role in the collaboration between the pharmaceutical- and food companies.

I suggest that the sector of functional foods should create consensus about the definition and requirements of functional foods. This will result into less conflicts and improves the communication between the pharmaceutical- and food partners. Finally, it is difficult to generalize these factors to all converging industries. The factors can act differently in other converging industries, because there are various interest at stake.

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## Reflection

During the last two periods of hard work, I learned a lot on the areas of scientific writing, developing of research questions and analytic thinking. In the first phases of the thesis process, I experience some difficulties to find a suitable thesis subject and research questions. After several meetings with my supervisor, I was able to find an appropriate topic and basis for my thesis. After this, I worked on the results in which I learned to think mathematical and make the thesis compact but valuable. In the following weeks, I noticed that I was fully integrated in the subject and was able to create a worth full report. In the end, I am satisfied with the result and enjoyed working on an interesting topic about collaboration between industries in the sector of functional foods.

## Appendix A

### Chapter 2

For chapter 2, a combination is made between on the one hand using multiple databases with several search terms and, on the other, the use of backward and forward referencing by looking at the references in scientific articles used.

Databases	Search terms	# amount of hits
Web of sciences	"industry convergence" AND boundaries AND blurring	15
Web of sciences	"industry convergence" AND types	229
Web of sciences	"industry convergence" AND "ICT industry"	71
Scopus	"industry convergence" AND "functional foods"	36
Web of sciences	"industry convergence" AND regulations	164
Web of sciences	"convergence" AND "strategic alliances" AND mergers	6

**Chapter 3**

<b>Databases</b>	<b>Search terms</b>	<b># Amount of hits</b>
Scopus	'success factors' AND inter-organization* AND collaboration AND influence	23
Web of sciences	'success factors' AND inter-organizational AND relationship	39
Web of sciences	'Leadership' AND definition	1147
Scopus	collaboration* AND factor* OR determinant* AND organizations OR "inter-organizational" AND trust	432
Scopus	collaboration* AND factor* OR determinant* AND organizations OR "inter-organizational AND trust AND "knowledge sharing"	64
Abi inform	"inter-organizational relationship" AND collaboration AND factors AND success	7036
Web of science	'Cross-sector relationship' OR 'cross-sector' AND collaboration	295
Abi inform	Power AND coercive AND "inter-organizational" AND collaboration	747

**Chapter 4**

<b>Databases</b>	<b>Search terms</b>	<b>Amount of hits</b>
Scopus	"Functional foods" AND definition	531
Scopus	"Functional foods" AND trend AND overview	94
Web of science	"Functional foods" AND definition AND overview	22
Scopus	"Functional foods" AND market AND industry AND trend	104
Web of science	"Functional foods" AND market AND global	127
Abi inform	"Functional foods" AND market AND global AND forecast	48896
Web of science	"Functional foods" AND trend AND health AND food industry	83

