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Cross-industry Collaborations in the Convergence Area of Functional Foods

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Abstract

Convergence processes are based on the activity of distinct industry sectors showing cross-industry collaborations. The aim of this paper is to analyze cross-industry collaborations between the food and pharmaceutical sectors in the convergence area of functional foods. Selected companies from food (Nestlé/Danone) and pharmaceutical (Martek/Bayer HealthCare) sectors are analyzed using the determinants of motivation and industrial scope. The analysis shows that food companies are more active in cross-industry collaborations than pharmaceutical companies. The latter are more active at the front-end of the value chain focusing on research and development, and delivering their ingredients to food companies that due to their higher expertise in consumer marketing launch the products. While the first cross-industry collaborations were based on an exploration motivation, those that follow focus on exploitation. Acquisitions and licensing agreements are dominant in inside-out and outside-in processes, whereas strategic alliances and joint ventures are based on a coupled process between the food and pharmaceutical sectors.

Keywords: cross-industry collaborations, convergence, food industry, pharmaceutical industry

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Introduction

The market for foods and food ingredients has changed rapidly in recent years (Siró et al. 2008). There is a growing interest among consumers in so-called functional foods, including ingredients that may alleviate the symptoms of ageing and illness (Gray, Armstrong, and Farley 2003; Siró et al. 2008). Most new product launches in the functional food sector deliver new products; this is in contrast to the established food market, where most new products are only variations of existing products (Mark-Herbert 2004). Consequently, competences from different industries (i.e. food and pharmaceuticals) are required for the innovation process. Indeed, there is evidence that firms of various industrial backgrounds are active on the functional food market (Curran, Bröring, and Leker 2010; Bröring 2005; Bornkessel, Bröring, and Omta 2014; Boehlje, Roucan-Kane, and Bröring 2011).

Recent literature focuses on innovations across industrial boundaries. The concept of cross-industry innovation is defined as the creative imitation and retranslation of existing solutions from one industry segment to another (Enkel and Gassmann 2010; Gassmann, Daiber, and Enkel 2011; Hahn 2015). Furthermore, 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 (Hacklin 2008; Bröring 2005). Both concepts are discussed as a process rather than a steady state (e.g. Curran, Bröring, and Leker 2010; Hacklin 2008; Gassmann and Sutter 2013). Extant literature addresses the front end of science and technology convergence using scientific publications and patent documents (e.g. Curran, Bröring, and Leker 2010). However, literature regarding the assessment of market and industry convergence using cross-industry collaborations is limited, especially in the emerging area at the borderline of foods and drugs leading to functional foods.

The overall aim of this paper is to analyze cross-industry collaborations in convergence leading to the functional food sector. In doing so, the determinants of cross-industry collaborations are analyzed regarding the motivation and industrial scope of each identified collaboration. Using a longitudinal case study approach, this study focuses on the emerging area at the borderline of foods and drugs, where new product-market combinations such as functional foods or dietary supplements arise. The goal is to identify differences between the companies stemming from the food and pharmaceutical sectors in the employment of cross-industry collaborations.

The remainder of this paper is structured as follows. Section 2 focuses on cross-industry collaborations in convergence. In doing so, the resource-based view is employed to derive the underlying dynamics of the cross-industry collaborations using the two determinants of motivation and industrial scope of the collaboration. Section 3 presents the sample and methods of the study. In section 4, the four case studies focusing on the emerging area of functional foods are presented; the section then concludes with a cross-case comparison. Finally, the findings of the study and their implications for academics and practitioners are discussed, before the paper concludes with an outlook on future research possibilities.

Theoretical Background

Cross-Industry Collaborations in Convergence

Numerous recent literature sources discuss the phenomenon of innovation across industry borders (Enkel and Gassmann 2010; Gassmann, Daiber, and Enkel 2011; Gassmann, Enkel, and

Chesbrough 2010). General concepts such as open innovation or the innovation value chain can be discussed either within a special industrial sector or across different sectors. The horizontal innovation across industry boundaries is still a challenge to manage, both in literature and in practice (Hahn 2015; Gassmann, Enkel, and Chesbrough 2010). Especially in the rapidly growing functional food market, active companies have to cope with technology, market and regulatory challenges (Bröring 2005; Wong, Lai, and Chan 2015). Multifaceted definitions of convergence can be found in the literature. Recent studies provide a comprehensive overview of these definitions and their different emphases (Bröring 2005; Hacklin 2008; Curran 2010; Preschitschek 2014), mainly following the common idea summarised by the Organization for Economic Co-operation and Development: “the blurring of technical and regulatory boundaries between sectors of the economy”(OECD 1992).

Regarding the process perspective on convergence, one approach is the description of the consecutive steps – science, technology, market and industry – as an idealised time series of events leading to a complete convergence of two hitherto distinct industrial sectors (Curran, Bröring, and Leker 2010; Hacklin 2008). The initial step implies that distinct scientific disciplines begin to cite each other in interaction with first collaborations of scientific disciplines. For instance, the food domain cites pharmaceutical research results in studies on functional foods. Decreasing the distance between applied sciences and the technological development of different areas is defined as the second step. The subsequent arising of new product-market combinations such as functional foods or dietary supplements is called market convergence. The final step of industry convergence¹ incorporates fusion of firms or industry segments (Curran, Bröring, and Leker 2010; Hacklin 2008). While the front end of the convergence process encompassing science and technology convergence is scrutinised in many recent studies using bibliometric data (Curran 2010; Preschitschek 2014), literature on the evaluation of the consecutive steps of market and industry convergence is scarce.

Literature on convergence defines market convergence as product-market combinations focusing on consumer products that combine functions and technologies of products from different industry sectors (Curran, Bröring, and Leker 2010; Bröring 2005; Pennings and Puranam 2001; Stieglitz 2004; Katz 1996). This definition focuses mainly on the demand side of the market, whereas first measurement approaches of market convergence primarily focus on the supply side using collaborations of companies from different industrial backgrounds (Sick et al. 2015; Preschitschek 2014). These measures of market convergence can be specified as *cross-industry collaborations*. With respect to the consecutive steps of convergence processes, the analysis of cross-industry collaborations seems to deliver the unifying element to analyze the junction between market and industry convergence. This analysis covers parts of both stages as cross-industry collaborations may provide a measure for the combination of functions and technologies of products from different industry sectors (market convergence) as well as the fusion of firms or industry segments (industry convergence). Thus, the present study focuses on the later stages of convergence, encompassing market and industry convergence.

¹ Most literature sources (e.g. Preschitschek et al. 2013; Kim et al. 2015; Bröring, Cloutier, and Leker 2006) use the term ‘industry convergence’ for the last phase as well as for the whole phenomenon as the last step is concurrently the result of the process. In this study, the term ‘convergence’ is used for the whole process and ‘industry convergence’ for the last phase of the convergence process.

The emergent market during convergence implies a vulnerable strategic position of the involved companies due to the difficult market situation of competitors stemming from different industry sectors. In the context of the resource-based view (RBV, originated in Penrose 1959), this vulnerable strategic position triggers companies to join collaborations in order to gain critical resources and competences that enable companies to share costs and risks (Eisenhardt and Schoonhoven 1996; Das and Teng 2000; Parmigiani and Rivera-Santos 2011). As resources and competences differ between industry sectors (Penrose 1959), these are complementary (Das and Teng 2000). This might lead to competence gaps as the involved companies have to stretch their resources to serve the adjacent industry (Pennings and Puranam 2001). In order to save scarce resources, the cross-industry collaborations may show a high level of competence complementarity to take advantage of the distinct core competences (Batterink 2009; Garbade 2014; Liu et al. 2014). In analysing convergence, recent literature uses strategic alliances, joint ventures, and mergers and acquisitions to operationalise market convergence (Preschitschek 2014; Sick et al. 2015). In addition, licensing agreements are discussed in the context of convergence processes (Bornkessel, Bröring, and Omta 2014).

Licensing agreements encompass the contract between two companies about selling the rights to use resources and competences against payment of a licensing fee (Gallini and Winter 1985). The licensor possesses resources and competences, such as inventions or designs, that the licensee lacks (Parmigiani and Rivera-Santos 2011). Various definitions of *strategic alliances* can be found in the extant literature about the phenomenon of collaborations between different partners. As the broad definition leads to an overlapping of the meaning of strategic alliances with other collaboration forms, this study concentrates on a narrower perspective and defines strategic alliances as follows: formal agreements between two partners, which key attribute is to exist for a set time and task (Parmigiani and Rivera-Santos 2011). In the context of the RBV, strategic alliances are used if resources and competences for the development are owned by different companies and cannot be separated from the involved companies (Madhok 1997; Das and Teng 2000). Thus, strategic alliances deliver platforms of learning whereas the transfer of resources and competences is intricate (Parmigiani and Rivera-Santos 2011). The collaboration type of a *joint venture* is defined as the creation of a jointly-owned entity by two companies that stay separate, resulting in risks and rewards for each company (Parmigiani and Rivera-Santos 2011; Contractor and Lorange 2002). Regarding the RBV, the used resources and competences of the two companies merge in a joint venture. Based on the definition of *mergers and acquisitions* encompassing the fusion of companies (Hennart and Reddy 1997), the resources and the competences of the involved companies completely merge.

Determinants of Cross-Industry Collaborations in Convergence

Two main determinants can be used to analyze collaborations in convergence: the motivation and the industrial scope of the collaboration.²

Overall, companies join alliances to gain a competitive advantage (e.g. Lavie 2006). Beside this general aim, the exploration and exploitation model of organizational learning (based on March 1991) can be applied to analyze different collaboration forms based on the underlying motives and thus to identify the motivation of a collaboration. On the one hand, exploration

² Please refer to (Appendix) Table A1 for an overview of the used terminology.

collaborations aim to explore new opportunities while, on the other hand, exploitation collaborations aim to execute existing knowledge (March 1991; Koza and Lewin 1998; Rothaermel and Deeds 2004). Thus exploration collaborations focus on longer-term competitive advantage, whereas exploitation collaborations concentrate on short-term commercialization. The two traits *focus of collaboration* and *type of interdependency* based on the framework introduced by Parmigiani & Rivera-Santos (Parmigiani and Rivera-Santos 2011) can be used in order to analyze whether the cross-industry collaborations are of an exploration or exploitation nature. First, the *focus of collaboration* relies on the general distinction between gathering new knowledge and relying on existing knowledge. While exploration collaborations aim to create new knowledge, exploitation collaborations aim to execute existing knowledge (Rothaermel and Deeds 2004; Parmigiani and Rivera-Santos 2011; March 1991). Thus a collaboration focusing on exploration is characterised by extensive research with the aim of making new discoveries, while an exploitation collaboration utilises existing resources and competences (Rothaermel and Deeds 2004). The second trait is the *type of interdependence* in collaborations, which focuses on the intensity of cooperation. While the exploration collaboration encompasses a joint development using resources and competences from both partners (reciprocal interdependence), the exploitation collaboration shows a discrete interdependence with decisions made independently by the partners (Parmigiani and Rivera-Santos 2011).

The second determinant of industrial scope of the collaboration focuses on the involvement of different industry sectors. In the context of convergence with partners from different industrial backgrounds, the collaboration may encompass either resources and competences from one industry sector or from both involved industry sectors (Boehlje and Bröring 2011). While opening up across industrial borders, the distinction between three process forms (based on open innovation approach, ref. e.g. Enkel, Gassmann, and Chesbrough 2009) can be made: the outside-in (ref. to Ng 2011, for an application in the agricultural sector), inside-out and coupled processes. Relating the general approach to converging industries, the outside-in process encompasses the integration of resources and competences from other industry sectors (e.g. a company being a licensee) while the inside-out process focuses on the externalization of assets towards other industry sectors (e.g. a company being a licensor). The coupled process incorporates both the internalization of external assets as well as the externalization of internal assets. This leads to the following four categories to consider in analysing the industrial scope of the collaboration: (a) within the same industry or (b) following an outside-in or (c) inside-out or (d) coupled process across industrial borders.

Beyond this theoretical background, the study at hand aims to deliver a framework with which to assess convergence based on cross-industry collaborations in the emerging area of functional foods. This leads to the following research question:

RQ: *What kinds of cross-industry collaborations can be used to close competence gaps in convergence between food and drugs?*

Research Framework

Although literature about the evaluation of market and industry convergence is limited, a case study on market convergence in the biofuel sector (Preschitschek 2014) and one in the field of stationary energy storage systems (Sick et al. 2015) were recently published. There is also little literature on the emerging sector of functional foods. The convergence process is considered to

be either substitutive (leading to industry fusion) or complementary (leading to a new value chain between the old ones) (e.g. Bröring and Cloutier 2008). The convergence process of functional foods emerging between foods and drugs is already defined as complementary in the literature (Bröring and Cloutier 2008). Therefore, the study at hand concentrates on the complementary convergence process in which a new value chain arises between the food and pharmaceutical sectors, delivering borderline products such as functional foods.

To analyze the arisen inter-industry segment, the study at hand focuses on companies that originate from either the food or the pharmaceutical sectors. After identifying their general activity in licensing agreements, strategic alliances, joint ventures, and mergers and acquisitions, the study identifies and describes cross-industry collaborations focusing on the emerging inter-industry segment over the last ten years. The aim is to depict the emergence of the inter-industry segment between the food and pharmaceutical sectors (Figure 1). In addition, the relevant collaborations are analyzed using the two above-described determinants of motivation and industrial scope of collaboration.

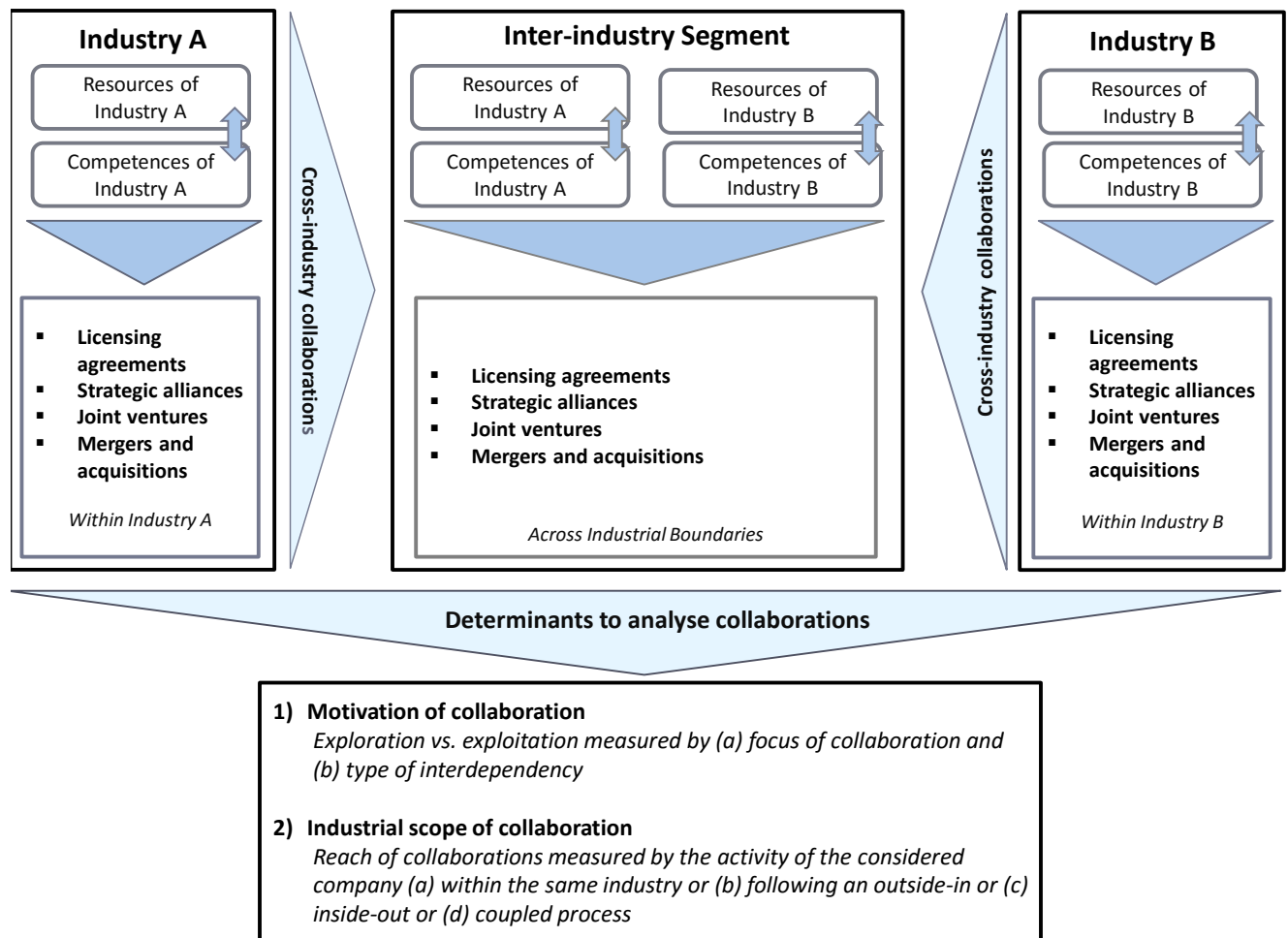


Figure 1. Emergence of inter-industry segment based on the cross-industry collaborations during convergence

Methods

Following an exploratory approach, the study at hand aims to answer the research question by employing a longitudinal case study focusing on the functional food sector. The case study approach is a research strategy that uses one or more cases, for instance to create theoretical constructs (Eisenhardt 1989; Eisenhardt and Graebner 2007). Based on different data sources, case studies contain extensive empirical descriptions of specific instances of a phenomenon (Eisenhardt and Graebner 2007; Yin 1997).

In order to analyze cross-industry collaborations in the convergence of the food and pharmaceutical sectors leading to borderline products such as functional foods and dietary supplements, two leading companies of each sector were selected based on market reports, websites focusing on this industry segment (e.g. <http://www.nutraingredients.com>), and scientific literature about functional foods (e.g. Bigliardi and Galati 2013; Siró et al. 2008), as well as further desk research. Sector leading companies are chosen as these are expected to show activities in the emerging inter-industry segment. In this way, the leading position was identified based on sales and market significance. The selected companies are Nestlé and Danone as representatives for the food sector and Martek and Bayer HealthCare for the pharmaceutical sector.

Following a quantitative approach using publicly available data, strategies to close competence gaps were analyzed from four angles: first, mergers and acquisitions; second, licensing agreements; third, strategic alliances; and fourth, joint ventures. The identified cooperating companies were scrutinised with regard to their industrial background. The industrial background of the manufacturers was categorised according to Standard Industrial Classification (SIC) codes (U.S. Securities and Exchange Commission 2011) available in the company profiles of the Nexis database. Based on SIC codes, the level of complementarity between the involved partners is discussed in the following results part. Cross-industry activities focusing on the emerging inter-industry segment are those in which the collaborating partners stem from different industrial backgrounds. Firstly, mergers and acquisitions were analyzed using the search mask '*mergers and acquisitions*' of Nexis using each company as search term. This search mask refers to the Mergerstat M&A database, which provides detailed information on over 30 years' worth of publicly announced mergers, acquisitions and divestitures (Nexis 2014).

Secondly, using the search mask '*firm*' the identified companies were analyzed considering their licensing agreements, strategic alliances and joint ventures using each company as search term. The time frame was restricted to the period from September 2005 to August 2015, covering the last 10 years as ten years show an appropriate time frame to industry developments. In addition, this time frame is characterised by an increasing importance of the functional food sector (Siró et al. 2008; Wong, Lai, and Chan 2015).

The identified cross-industry collaborations that target the emerging inter-industry segment between the food and pharmaceutical industries were analyzed according to the collaboration determinants of motivation and industrial scope based on the information given in the reports. The identified collaborations were analyzed with regard to their motivation (exploration vs. exploitation) by using the two measures of focus of collaboration (new knowledge vs. existing

knowledge) and type of interdependency (reciprocal vs. discrete). In doing so, the collaborations were analyzed with regard to their aim of either focusing on the generation of new knowledge, for example research on new functional ingredients, or focusing on the utilization of already existing knowledge, thus using already explored functional ingredients in the existing product portfolio. In addition, the relationship of the two partners was analyzed to distinguish between joint efforts to reach the aim (reciprocal), for instance a joint department to research a new functional ingredient; or the sole incorporation of resources and competences managed by one company (discrete), for instance using external research results in the context of the internal development process. The industrial scope was first identified based on the industrial background of the involved partners (SIC code). Second, if the companies stemmed from different industrial backgrounds, the direction of knowledge exchange across industrial borders (outside-in, inside-out, coupled) was determined. In the case of mergers and acquisitions, and licensing agreements, the position was considered: e.g. being a licensor shows an inside-out process and in contrast being a licensee shows an outside-in process. For joint ventures and strategic alliances, the specific agreements about knowledge exchange were considered. This categorization scheme was applied to the evaluation of the in-depth descriptions of the considered collaborations.

Results

Emerging Inter-Industry Segment

The considered companies are active in cross-industry collaborations with different degrees of intensity. Most of the collaborations focusing on the emerging inter-industry segment of functional foods are across industrial borders, thus the collaborating partners stem from different industrial backgrounds. The results show that only acquisitions can be identified in the category of mergers and acquisitions focusing on the inter-industry segment of functional foods. While the two food companies (Nestlé and Danone) focus on acquisitions within and outside their native sector, the two pharmaceutical companies (Martek Biosciences Corporation and Bayer HealthCare) put the emphasis on licensing agreements (Figure B1, see Appendix B). In the following part describing the four cases, only those collaborations are considered and described in depth, focusing on the inter-industry segment of functional foods.

Cross-industry Collaborations in the Food Sector

Case 1. Nestlé

The company *Nestlé* was founded in 1866 in Switzerland and has gained a worldwide significance in the food market, operating in eighty-six countries. While the origin of the company lies in food products, in recent years Nestlé's strategy has focused on a reorientation towards health and wellbeing, which can be also shown in the SIC categorization including the food sector (codes beginning with 20) as well as the assignment of pharmaceutical preparations (SIC 2834). Nestlé's product portfolio covers a wide range of consumer food products, which are mostly marketed via brands. Key products include baby food, bottled water, cereals, chocolate, coffee, dairy products, and chilled and frozen foods. The company also shows activity in more specialised offerings, including weight management products and healthcare nutrition.

Furthermore, Nestlé’s healthcare nutrition portfolio ranges from supplements for athletic healthy persons to nutritional formulas for the recovery of patients. This product portfolio shows a high diversification in borderline products in the inter-industry segment between food and pharmaceuticals.

Chronological Development

Overall, the amount of cross-industry collaborations focusing on the inter-industry segment of functional foods increased during the last 10 years (Figure 2).

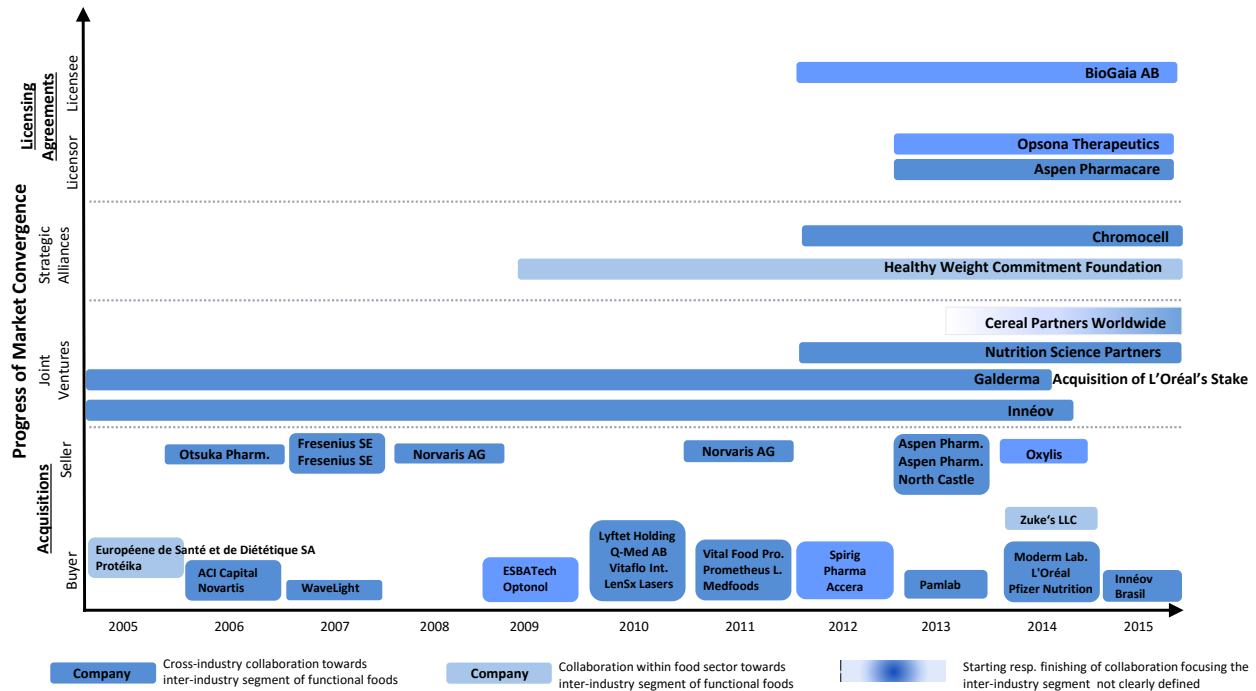


Figure 2. Chronological development of Nestlé's cross-industry collaborations focusing on the inter-industry segment of functional foods in the last ten years.

The three licensing agreements that focus on the inter-industry segment of functional foods are between partners stemming from different industrial backgrounds. In two of three licensing agreements, Nestlé is in the licensor position, thus showing an inside-out process. In 2013, Aspen Pharmacare acquired licenses for several of Nestlé’s products. In the same year, Opsona Therapeutics entered into a licensing agreement for a novel pre-clinical soluble protein. Furthermore, Nestlé uses a certain probiotic strain under the license of BioGaia for its functional food product portfolio, reflecting an outside-in process. These licenses show an exploitation collaboration, as the resources and competences are not used for research but for the integration into products, and there is no joint development.

Two strategic alliances target the inter-industry segment of functional foods. First, in 2009 Nestlé joined the Healthy Weight Commitment Foundation, the aim of which is to provide tools to help consumers achieve energy balance. Since this consortium of more than forty retailers and food and beverages manufacturers delivers a communication platform to consumers, the focus of

collaboration is existing knowledge and the type of interdependency is discrete, thus resulting in an exploitation collaboration. This alliance is within the food sector. In 2012, a collaborative agreement between Nestlé and Chromocell Corporation was established to identify compounds with potential taste-giving ingredients. This strategic alliance constitutes an exploration collaboration because its aim is to discover new knowledge, and because the relationship between the partners is reciprocal. The reciprocal interdependency implies a coupled process between the food and the pharmaceutical company.

Four joint ventures focus on the inter-industry segment between the food and pharmaceutical sectors. Although the two joint ventures between Nestlé and L'Oréal (Innéov, founded in 2002 and Galderma, founded in 1981) are between a food and personal care company, the inter-industry segment between food and pharmaceuticals is addressed. First, Innéov has launched a wide product range in the area of dietary supplements focusing on nutricosmetic health, for example targeting gastrointestinal health with probiotic products. This joint venture is an exploration collaboration that focuses on a coupled process across industrial boundaries since both companies focus on joint research (new knowledge and reciprocal interdependency). The same applies to the second joint venture, namely Galderma, which delivers products for skincare. To enter the nutraceutical market, Nestlé's subsidiary Galderma signed an agreement for the acquisitions of certain assets of the Innéov Group, since the joint venture Innéov between L'Oréal and Nestlé was terminated in 2014. The third joint venture, called Nutrition Science Partners, was established in 2012 between Nestlé and Chi-med, a pharmaceutical company focusing on traditional Chinese medicine, to develop products for gastrointestinal health, as well as for metabolic disorders and brain health in the future. Due to the joint development across industrial borders, this joint venture follows the motivation of an exploration collaboration with a coupled process. Finally, the fourth joint venture is within the food industry between General Mills and Nestlé: the Cereal Partners Worldwide. From 2014, this joint venture expanded its product portfolio to gluten-free corn flakes, thus targeting the functional food market. Due to joint research and consecutive launches, the joint venture shows an exploration collaboration form within the food sector.

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Altogether, nineteen acquisitions of pharmaceutically based companies can be identified in the last ten years; they all show an outside-in process due to Nestlé's integration of resources and competences from the pharmaceutical sector. Especially starting in 2009, the activity in acquisitions seems to have increased. In general, these acquisitions aim to improve the research of the formerly distinct companies, thus focusing on new knowledge based on reciprocal relationships (exploration collaboration). Three acquisitions by Nestlé of food companies also focus on the arisen inter-industry segment due to the integration of resources and competences in order to develop functional foods, thus showing an exploration collaboration process. Since Nestlé also sells divisions to pharmaceutical companies (nine transactions), Nestlé shows inside-out processes that focus on the externalization of internal assets, resulting in research activities using these resources and competences (exploration collaboration).

Case 2. Danone

Danone was founded in 1919 and strengthened its position through several mergers and acquisitions leading to today's Groupe Danone S.A., which has a leading position in dairy and water products worldwide and operates in more than 140 countries. Its SIC categorization includes the food sector (codes beginning with 20) as well as the assignment of pharmaceutical preparations (SIC 2834), which shows Danone's orientation towards the health sector. Danone's product portfolio encompasses dairy products and in particular probiotic products that deliver an additional health benefit beyond their nutritional value. As market leader in the probiotic sector, Danone shows its strength in borderline products rising between food and pharmaceuticals. Their probiotic products are in the form of traditional food products, thus showing a small distance from the traditional food sector in contrast with more specialised products such as formula nutrition in the area of medical nutrition. However, concurrently Danone is also active in the medical nutrition area and delivers nutritional formulas for patients suffering from distinct diseases.

Chronological Development

Overall, Danone's activity in cross-industry collaborations focusing on the pharmaceutical sector is lower than that of Nestlé (ref. Figure 3).

Maphar Laboratories manufacture dietetic products under the licence of Danone. Thus, Danone shows an inside-out process towards the pharmaceutical sector. While the resources and competences are not integrated into the research process, the form of the collaboration is exploitation.

The strategic alliance between Danone and Eurofins encompasses on the one hand the acquisition of several of Danone's laboratories, and on the other hand an exclusive supplier

contract for all infant nutrition analyzes, thus reflecting a coupled process between the industry sectors. The focus of the collaboration is on already existing knowledge, and the relationship is discrete because for the different areas the companies stay separate. Thus, this collaboration is in the form of an exploitation.

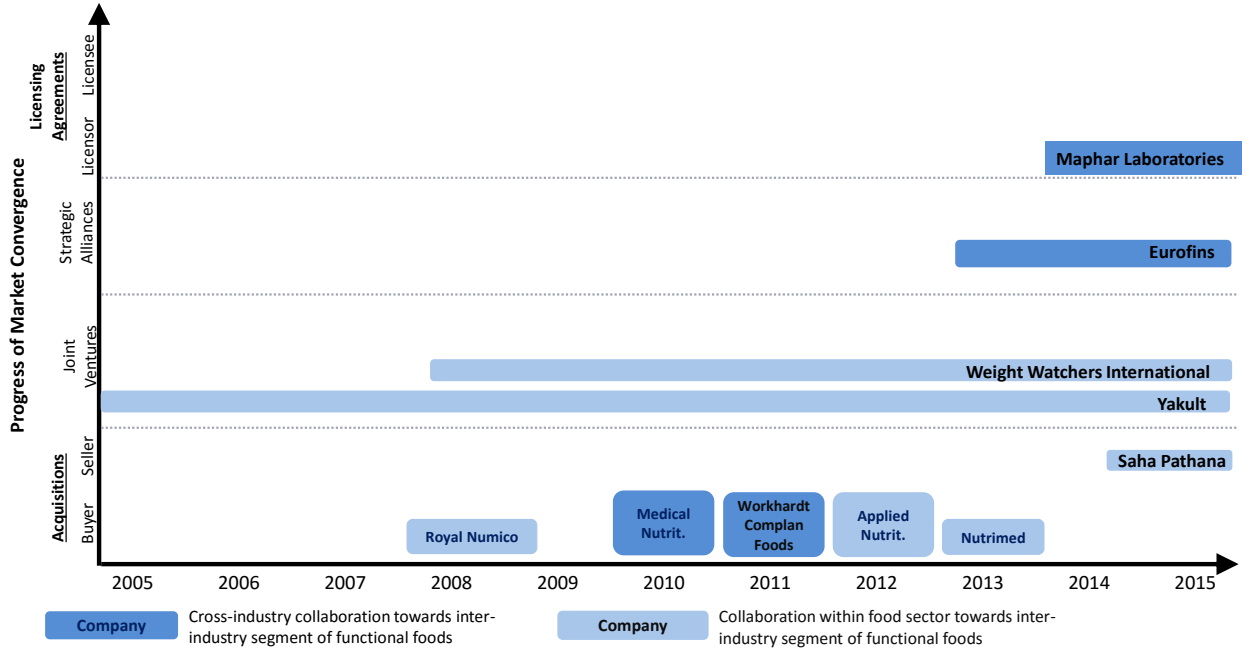


Figure 3. Chronological development of Danone's cross-industry collaborations focusing on the inter-industry segment of functional foods in the last ten years.

In 2005, a joint venture between the two food companies Danone and Yakult was formed to manufacture and launch probiotic products, thus functional foods. This joint venture shows the characteristics of an exploitation collaboration, as the aim is to use the existing knowledge to gather advantages in selling the products. In 2008, a joint venture between Danone and Weight Watchers International was formed in order to establish a weight management business in China focusing on dietary changes to improve health. The two companies stem from the food sector. Since this joint venture delivers a communication platform, the focus of the collaboration is on existing knowledge and the type of interdependency is discrete, thus resulting in an exploitation collaboration.

Three acquisitions of pharmaceutical companies in 2010 and 2011 focus on the inter-industry segment of functional foods, acquiring expertise especially in the area of nutritional supplements and showing an outside-in process by Danone. The motivation of collaboration is exploration due to the incorporation of external resources and competences. On the other hand, Danone makes use of an inside-out process focusing on the externalization of internal assets, which results in research activities using these resources and competences (exploration collaboration) while selling a division to a pharmaceutical company. In addition, three acquisitions of food companies by Danone focus on the inter-industry segment of functional foods while the

motivation of these collaborations is exploration due to their incorporation of external resources and competences.

Cross-Industry Collaborations in the Pharmaceutical Sector

Case 3. Bayer HealthCare

Bayer Healthcare is a subsidiary of Bayer AG, which was founded in 1863. While the roots of the company lie in the chemical sector, its first pharmaceutical product was launched in 1880. Bayer HealthCare became an independent legal entity in 2003. Today, Bayer HealthCare focuses on the development and manufacturing of health care products for humans and animals. Based on the SIC categorization, Bayer HealthCare belongs to the pharmaceutical sector (SIC 2834). Bayer HealthCare's product portfolio mainly focuses on over-the-counter (OTC) drugs. Nevertheless, Bayer HealthCare launches also consumer products focusing on the inter-industry segment between the food and pharmaceutical sectors; for example, in 1940 it launched the first multivitamin supplement in the US market. Today its brand 'One A Day®' in particular addresses the growing market segment of nutritional supplements.

Chronological Development

Although Bayer Healthcare has strong collaborations within its sector encompassing several research agreements with universities as well as research centres, its cross-industry joint ventures and strategic alliances are only oriented towards the technical part of the health care sector and do not focus on the food market.

Bayer HealthCare's cross-industry activities in the food sector are confined to a single acquisition in 2012. With this acquisition, Bayer HealthCare internalised the expertise of manufacturing nutritional supplements of Schiff Nutrition International, thus showing an outside-in process. The motivation of collaboration is exploration due to the incorporation of external resources and competences.

Case 4. Martek Biosciences Corporation

Founded in 1985, *Martek Biosciences Corporation* (henceforth referred to as '*Martek*') is a subsidiary of Royal DSM and has a market presence in over 49 countries through its parent company. Based on the categorization of the SIC, Martek belongs to the pharmaceutical sector because its SIC codes begin with 283, indicating '*drugs*'. Martek's development focuses on nutritional oils from microalgae and fungi, which are used in regular foods and beverages as well as in specialised nutrition such as infant formula, and pregnancy and nursing products. The products are sold directly as well as through distributors, since Martek is a main ingredient supplier. The company's product portfolio focuses on omega-3-fatty acids, since Martek is the major supplier of docosahexaenoic acid (DHA) used in infant formula in the US. From a global perspective, its products are used in about 75% of infant formulas. The ingredients are marketed as brands in the B2B sector. Regarding the level of complementarity, the described product portfolio is directly linked to the pharmaceutical sector. At first glance, Martek keeps its products in its traditional sector. Reviewing the licensed consumer products, however, the main usage of

the ingredients developed and produced by Martek lies in the fortification of food products mainly implemented by the food sector. Furthermore, dietary supplements and prescription supplements are developed through the supply and licensing agreements between Martek and pharmaceutical or food companies. With regard to the level of complementarity, the application of the ingredients in food products leading to functional (fortified) foods and dietary supplements shows a large distance.

Chronological Development

Overall, cross-industry collaborations in which the involved partners stem from different industrial backgrounds can be shown. Martek shows a strong position in licensing its developed ingredients for the food sector using the strong consumer and market competences of that sector to launch its products. Although Martek is not involved in joint ventures with the food sector, strategic alliances with companies from the food sector can be shown in their early phases.

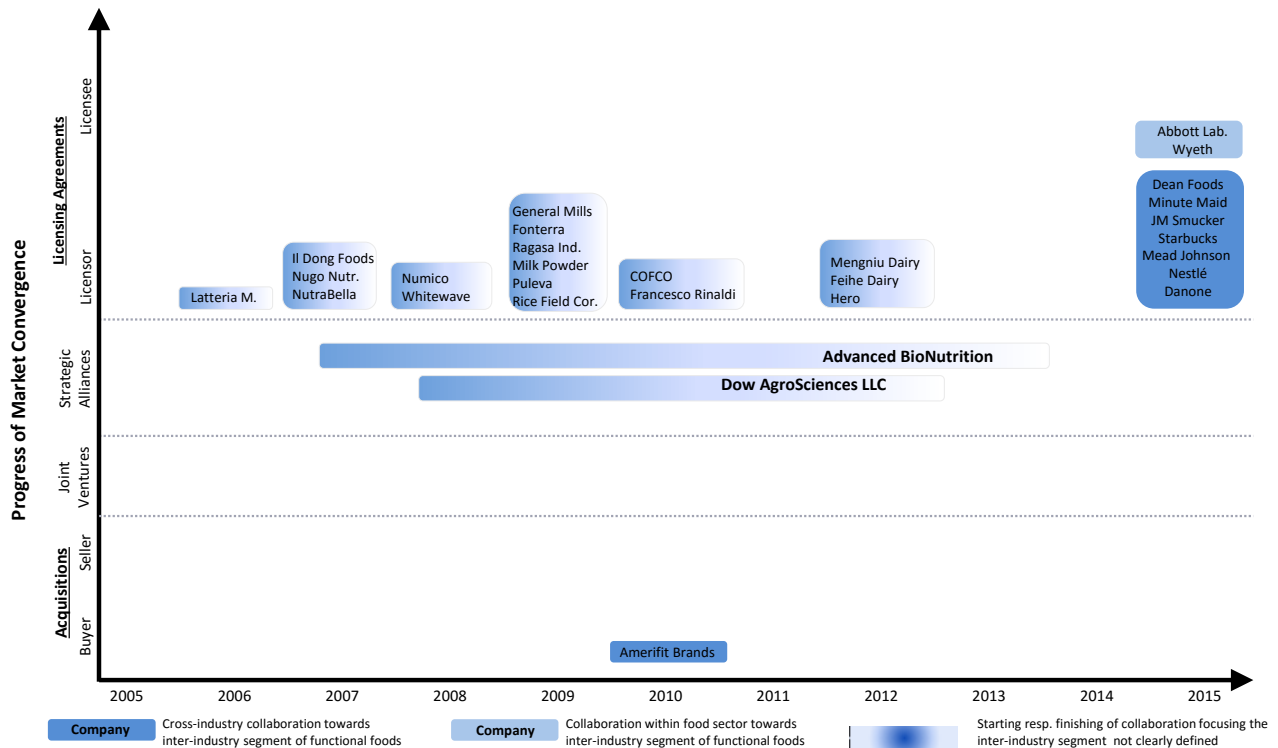


Figure 4. Chronological development of Martek's cross-industry collaborations focusing on the inter-industry segment of functional foods in the last ten years.

Overall, Martek is a strong licensor of omega-3-fatty acids, as the company is the major ingredient supplier of DHA for infant formula. In all identified licensing agreements Martek is in the licensor position. The food sector is the dominant licensee of ingredients from Martek, thus making use of an inside-out process. The motivation of these collaborations lies in the usage of existing knowledge (exploitation). Martek also licenses its ingredients to two pharmaceutical companies that focus on the functional nutrition market while delivering fortified baby nutrition. Again, the motivation of these licensing agreements is the usage of existing knowledge (exploitation).

In 2008, a collaborative agreement between Dow AgroSciences and Martek was formed to jointly develop and commercialise a canola seed that produces DHA. The DHA-rich canola oil is aimed at the food industry, thus showing a coupled process between the food and pharmaceutical sectors. This joint development indicates an exploration collaboration. In 2007, Martek entered into an agreement with Advanced BioNutrition Corporation showing activities in the food and the pharmaceutical sectors for the exclusive sale of DHA into the animal health market. In return, Martek became the licensee for certain technologies by Advanced BioNutrition Corporation, thus reflecting a coupled process between the food and pharmaceutical sectors. The focus of the collaboration is on already existing knowledge while the relationship is discrete since for the different areas the companies remain separate. Thus, this collaboration is in the form of an exploitation.

In 2010, Martek acquired Amerifit Brands Inc. from Charterhouse Group Inc. As Amerifit has an advanced sales and marketing infrastructure and a proven management team for selling brands' branded consumer health and wellness products, Martek may close possible competence gaps in the commercialization of consumer products, using an outside-in process. The internalization of these resources and competences to be implemented in the company's own process shows an exploration motivation.

Case Comparison

Nestlé shows the highest intensity in cross-industry collaborations, possibly due to the overall company size. As a result, the product portfolio shows a wide range of borderline products such as healthcare nutrition. The second food company considered in this study, Danone, shows a lower intensity of cross-industry collaborations than Nestlé. Nevertheless, the product portfolio including medical nutrition, for example, shows a high degree of convergence between the food and pharmaceutical sectors. The overall amount of cross-industry collaborations of the two discussed pharmaceutical companies, Bayer HealthCare and Martek, is lower than that of the food companies. Bayer HealthCare for instance focuses its research and development within the pharmaceutical sector and shows various collaborations with other pharmaceutical companies.

With regard to the different types of collaborations, the incorporation of resources and competences of the partnering companies, and thus the level of integration, differs between the collaboration forms as discussed in the following. The level of integration is low in licensing agreements because resources and competences are incorporated at most only to a limited degree, for instance in order to insert a functional ingredient into the already existing product (fortification). Strategic alliances also show a low level of integration of the partners, as only parts of the distinct resources and competences are used to complete the task, such as for instance jointly developing a specific borderline product. In joint ventures on the other hand, the used resources and competences of the involved companies merge due to the establishment of a new entity, thus resulting in a higher level of integration than in strategic alliances. Finally, in acquisitions the resources and the competences of the involved companies completely merge, thus showing the highest level of integration of the presented collaboration types.

With regard to the timely occurrence of different collaboration forms, the considered food companies first show activities in collaborations with a higher integration level (for instance

acquisitions), followed by collaborations with a lower integration level (for instance licensing agreements). This may be due to the distance of complementary competences between the different sectors. First, collaborations of higher integration are needed to overcome the distance and for joint research. Based on this movement towards each other, in later stages the distance can also be overcome by collaborations of a lower degree of integration.

Figure 6 depicts the identified collaborations focusing on the inter-industry segment of functional foods according to the two determinants *motivation of collaboration* and *industrial scope of collaboration*.

		Motivation of Collaboration	
		Exploration	Exploitation
Industrial Scope of Collaboration	Within the same industrial sector	Joint ventures: 1 Nestlé (1) Acquisitions: 6 Nestlé (3) Danone (3)	Licensing agreements: 2 Martek (2) Strategic alliances: 1 Nestlé (1) Joint ventures: 2 Danone (2)
	Inside-out process	Acquisitions: 10 Nestlé (9) Danone (1)	Out-licensing: 27 Nestlé (2) Danone (1) Martek (24)
	Outside-in process	Acquisitions: 24 Nestlé (19) Danone (3) Martek (1) Bayer HealthCare (1)	In-licensing: 1 Nestlé (1)
	Coupled process	Strategic alliances: 2 Nestlé (1) Martek (1) Joint ventures: 3 Nestlé (3)	Strategic alliances: 2 Danone (1)

Figure 5. Portfolio showing the different collaborations focusing on the inter-industry segment of functional foods according to the two determinants of motivation and industrial scope of collaboration.

The four described collaboration types occur within the same industry sector focusing on the emerging inter-industry segments of functional foods, whereas collaboration forms of lower integration are more likely to occur in case of exploitation. The exploration seems to require a higher level of integration of the involved companies.

The general characteristics of collaborations can also be shown for collaborations across industrial borders, which have to overcome a greater distance between complementary competences. If the knowledge exchange is unilateral, companies follow an inside-out or an

outside-in process. Licensing agreements are used in exploitation collaborations, thus executing the already existing knowledge. Nevertheless, these collaborations have to overcome a greater knowledge distance in comparison to licensing agreements between companies from the same sector. In other words, executing the already existing knowledge requires the competence to adapt the knowledge from outside one's own industry sector into the existing process. Acquisitions occur if the collaborations show an exploration motivation, and thus focus on the generation of new knowledge. This collaboration form shows a higher integration of resources and competences of the involved companies, or industry sectors, as a more intense cooperation is needed to generate new knowledge based on a joint development process. Strategic alliances dominate the collaboration forms and follow a coupled process to execute already existing knowledge (exploitation). The companies involved in strategic alliances seem to integrate specific assets into the development process without a higher degree of overall integration, thus remaining separate as companies. In contrast, joint ventures, which show a higher level of integration due to the establishment of a joint entity, occur in a coupled process focusing on exploration. Due to the generation of new knowledge, a more intense cooperation is required as the resources and competences of distinct industry sectors indicate a higher level of competence complementarity.

Discussion

Cross-industry collaborations arise at the interface of the food and pharmaceutical sectors, and the companies identified in the present study seem to cope differently with the upcoming challenge of competence gaps. While the selected food companies show multifaceted cross-industry activities, the selected pharmaceutical companies seem to focus on the core competence of their home sector. As a result, the pharmaceutical companies are more active at the front end of the value chain, focusing on research and delivering their products to food companies that launch the emerging borderline products due to their higher expertise in consumer marketing.

The analysis of cross-industry collaborations of the food and pharmaceutical sectors reveals a higher intensity of the companies from the food sector in cross-industry collaborations towards the emerging inter-industry segment of functional foods. While the companies of the food sector seem to try to internalise the missing research competences, for example with joint ventures focusing on collaborative research, the companies of the pharmaceutical sector on the other hand seem to overcome their competence gap in consumer marketing strategies by selling the respective ingredients to food companies strong in consumer marketing.

Convergence can be assessed using different cross-industry collaboration forms such as strategic alliances or joint ventures, especially as with a higher number of competitors—due to the involvement of different sectors—higher rates of collaborations appear (Eisenhardt and Schoonhoven 1996). The selected companies from the food and pharmaceutical sectors show differences in their intensity of using distinct collaboration types. Recent literature emphasises that multiple simultaneous collaborations between different companies is an ubiquitous phenomenon (Wassmer 2010), while different forms such as strategic alliances or joint ventures occur at the same time. Borderline products arise from companies with a high intensity of cross-industry activities as well as from those showing a lower intensity. However, the food companies dominate the launch of borderline products, such as functional foods or dietary supplements, into

the consumer market. This supports the classification of the food sector as being market oriented (Bröring 2005) in contrast to the research-intensive pharmaceutical sector (Howells, Gagliardi, and Malik 2008).

With regard to the occurrence of cross-industry collaboration forms targeting the inter-industry segment over time, the case study indicates a series of collaborations showing at first a high level of integration towards subsequently lower levels, thus an evolution from high level of integration to lower levels. In other words, first acquisitions, second joint ventures, third strategic alliances and fourth licensing agreements emerge. Furthermore, acquisitions and ventures are more likely to be used for collaborations focusing on exploration while in contrast strategic alliances and licensing agreements are more likely to be used for collaborations focusing on exploitation. Thus, first exploration followed by exploitation collaborations occur, supporting the results from a study in the biotechnology sector (Rothaermel and Deeds 2004). The outcomes of the collaborations with different motivations (exploration vs. exploitation) build on each other. In other words, based on the exploration collaborations focusing on joint research and development, exploitation collaborations to launch products are more likely to occur.

Earlier studies on the comparison of exploitation and exploration collaborations indicate a more frequent occurrence of exploitation collaborations, for instance due to lower resource requirements (Koza and Lewin 1998; Rothaermel and Deeds 2004). In contrast, the study at hand shows a higher amount of exploration (46) than exploitation (35) collaborations. Because a large distance between the traditional fields has to be overcome in collaborations in converging industries, it seems that first a joint research background must be established based on extensive exploration collaborations before exploitation collaborations can be used to execute the knowledge generated in exploration collaborations.

Conclusion

The present paper enhances the literature on evaluating convergence to analyze the rapid market changes in emerging sectors, such as the area of functional foods. Although recent scientific publications cover approaches for measuring convergence focusing on industry segments, the study at hand complements these studies while using an approach to scrutinise convergence on a company level based on the two determinants of motivation and industrial scope of collaboration.

Practical implications arise around the possibility for companies to use this research framework with publicly available data to analyze their direct competitive environment. In doing so, based on the identified collaborations, the future market fields of competitors can be determined, such as the joint venture between Nestlé and Chi-med planning products for gastrointestinal health, for example. Furthermore, new competitors from other industry sectors can be identified. In addition, possible partners for collaborations in a certain research area as well as the appropriate type of cross-industry collaboration can be chosen.

Besides the advantage of availability of the databases used in this study, internal activities that are not published are neglected. Although the study at hand may not cover all collaborations, the data set may be of a higher objectivity due to the publicly available sources. Further studies

could concentrate on a concurrent analysis of using publicly available data and internal information, derived for example through expert interviews. Due to the small sample of cases, future studies could concentrate on a broader sample and could use examples from other industrial areas as well.

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Appendix A

Table A1. Summary of Used Terminology

Industrial scope of collaboration	
Outside-in	The outside-in process encompasses the integration of resources and competences into the development from other industry sectors.
Inside-out	The inside-out process focuses on the externalization of assets towards other industry sectors.
Coupled process	The coupled process incorporates both the internalization of external assets as well as the externalization of internal assets.
Motivation of collaboration	
Exploration	Exploration collaborations aim to explore new opportunities focussing on longer-term competitive advantage.
Exploitation	Exploitation collaborations aim to execute existing knowledge concentrating on short-term commercialization.
Type of interdependency	
Reciprocal	Reciprocal interdependency describes a joint development using resources and competences from both partners.
Discrete	Discrete interdependence describes collaborations with decisions made independently by the partners.

Appendix B

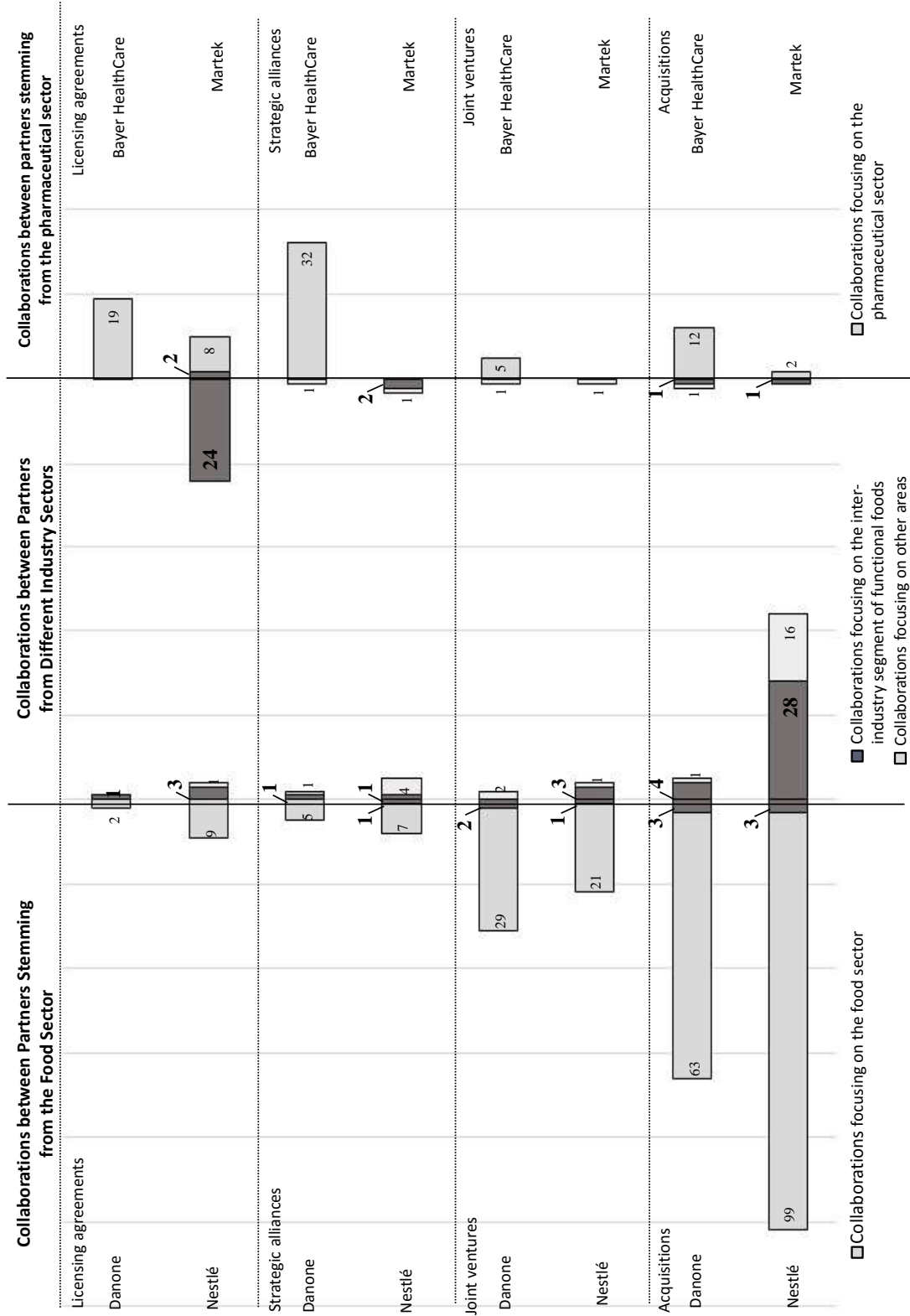


Figure B1. Emerging inter-industry segment between the food and pharmaceutical sectors.