# The impact of the openness of the innovation process on the short term and the long term market performance of new products

## Evidence from new product announcements of the Dutch food and drinks industry

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Innovative companies increasingly use ideas and resources from outside the company in order to speed up the innovation process. Building and maintaining an external network has become vital to an innovative company's strategy for survival and growth. The strategic question companies have is which types of external actors and for what activities should we involve in our innovation processes? This paper takes a new approach. It does not focus on the external network of the company as a whole but on the network that is involved in the development of a new product. Also new is that we do not only investigate the impact of the external network on the product's success soon after its market launch, but also several years later. This provides insight in the role of external networks in the development of new products that are the cash cows of companies for a long period of time. We have analysed the impact of the external network for radical product innovations and incremental product innovations separately as we expert significant difference between the two when it comes to openness of the network.
Data on the product's innovativeness, the product-related network and market performance have been collected for 129 new products one-and-a-half year after product announcement. Data on long term market performance were collected seven years after product announcement. Our results show that there are significant differences in the openness of the product-related networks that affect short term versus long term market performance for the group of radical versus the group of incremental product innovations. The involvement of R&D-related (research institutes, companies that provide training), market-related (customers, marketing companies) and supply-related actors (suppliers of machinery and equipment) showed to have a significant positive impact on both short term and long term market performance of radical product innovations, but not of incremental product innovations.

*Keywords*: innovation network, innovation performance, product innovativeness

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## 1. Introduction

Innovative companies try to reach and maintain competitive advantage by developing new products that must bring them a sustainable market position in a global market which is characterized by international competition and increasing customer demands. Speed has become an increasingly important competitive weapon (Cooper 1993). In order to speed up the new product's innovation process, innovative companies increasingly use ideas and resources from outside the company. Volberda *et al.* (2006) have phrased this by stating "*Innovative companies know their weaknesses. That is one of their strengths*". As a consequence of this, networks have become vital to an innovating company's strategy for survival and growth. Therefore one of the most critical questions to be answered by the management of an innovating company is: In what role and for which activities can we successfully involve other companies and organizations in our innovation process? The main research hypothesis that is addressed in this paper is: *Food and drinks companies that use open innovation networks for idea generation and during the product development process show a better short term and long term market performance of their new products.*

Up to now most often a measure of success is used that relates to the company and thus to all the company's products and not to a specific product that is under development. Also there is hardly any research being done on the development of new products that stay on the market for an extended period of time, *ie* products which have become the cash cows of the company for the next period. The present paper aims at filling these gaps. It presents the results of a study in which we investigated the relation between the composition of the network of the firm that introduces the new product and the new product's performance, not only soon after its market launch, but also after several years. We investigate this separately for radical and for incremental product innovations.

We have built a database of 129 product innovations in the Dutch food and drinks industry. The database holds data on products which have been developed with and without using an external network. The market launch of the products was announced in the second half of 1998. Data have been collected on innovativeness and involvement of (supply chain) companies and public research organizations in the idea generation stage and in the product development stage of the innovation process. Their performance was first measured in the beginning of 2000 and again at the end of 2005, respectively one-and-a-half year and seven years after their announcement.

The study is part of a larger research project that aims at identifying determinants of successful innovations in the Dutch food and drinks

industry. Within the Netherlands the food and drinks industry is the largest manufacturing sector with a gross value added of € 11.3 billion (2004 data), representing 19% of the total of all manufacturing industries (EUKLEMS 2007). It is also the leading employer representing 15% of the Dutch manufacturing industry (*ibid*). The Dutch food and drinks industry is one of the biggest players in the EU: six Dutch companies belong to the Top-25 of European food and drinks companies (2005 data). Also in terms of R&D investments the Dutch food and drinks industry is performing very well as seven Dutch companies belong to the Top-20 of European companies by R&D-investments (CIAA 2006).
We have structured the paper as follows. Section 2 presents a short review of literature and the set of propositions to be tested. Section 3 presents the conceptual model of the study and the variables that are used in this model. In Section 4, we briefly describe the methods of data collection and data analysis. Section 5 presents the main results including descriptive information of the new products' innovation network, innovativeness and performance and the results of the analyses of the relation between the products' performance and variables that relate to the product innovativeness and its innovation network. The paper concludes by drawing conclusions in Section 6.

## 2. Literature review and hypotheses

Innovation, as Schumpeter (1939) defined it is '*any doing things differently in the realm of economic life'*. So essentially, innovation is about change: change in the products or services a company makes and change in the way the company produces them, also referred to as product innovation and process innovation (Tidd *et al.* 1997). There are degrees of chance; from only minor incremental improvements, adaptations or refinements of existing products and processes to very radical changes leading to totally new products or production processes[1].
Product and process innovations are the result of an interactive process in which actors within open organisations together with actors from other organisations transform knowledge and techniques into these new products and processes. Knowledge can be existing or new scientific and technological knowledge, knowledge of (new) markets and of organisations (McKelvey 1996).
Rothwell (1992) has described how our understanding of the innovation process has evolved from the 'First Generation innovation' model - a

[1] In addition, also organisational innovations can happen, including changes in the business structure and the development of new business models (Volberda *et al.* 2006)).

simple linear model in which innovation was basically research driven - through to increasingly complex interactive models in which the need for cross-functionality across the firm's borders was recognised. The 'Fifth Generation innovation' model considers the innovation process as an interactive, cumulative and co-operative phenomenon in which actors from inside and outside the firm participate and which requires high levels of integration at both intra- and inter-firm levels. Success and competitive advantage depend on the ability of the firm to integrate, build and reconfigure internal and external resources to address rapidly changing environments.

***Open innovation***

In 2003, Chesbrough introduced the concept of 'Open Innovation' to describe these changes and more specific how firms use external ideas and resources in order to speed up the innovation process. He argues that in contrast to the old model of 'Closed Innovation' in which large R&D intensive companies conduct their R&D solely in-house, these companies have become more open in their innovation processes. The concept of 'Open Innovation' describes the phenomenon that large knowledge intensive companies increasingly acquire knowledge (R&D) externally. Key drivers include the increasing availability and mobility of knowledge workers, the flourishing of the venture capital market and the increasing scope of capable external suppliers (*ibid*). But not only large and R&D intensive firms cooperate with external knowledge actors. Also smaller and less R&D-intensive firms operate in knowledge networks. They are even more dependent of the contribution and cooperation with external actors as their innovation-related infrastructure is not sufficient to innovate on their own. Overall, open innovation emphasises the need for companies to network with other actors throughout the innovation process. Open innovation combines a number of trends that scientists have recognized already for a long time, including the role of lead users (von Hippel 1977, 1978, 1988; Pavitt 1984), innovation networks (Lundvall 1993; Hakansson 1995; Edquist 1997) and the interactive, cross-disciplinary and (mostly) inter-organisational nature of the innovation process (Kline and Rosenberg 1986).

***Open innovation in the food and drinks industry***

For the food and drinks industry the interactions between food and drinks companies and their business partners in the supply chain as well as public research organisations play a crucial role in achieving successful innovations. Archibugi *et al.* (1991) found that food and drinks firms rely more on external sources of innovation than the average for all industries. These companies have developed a broad interface with innovators in

other industries and apply scientific advances that have been developed in these industries (Christensen *et al.* 1996; Rama 1996). As the food and drinks industry has to operate on a buyers market; market-orientation is considered as a key success factor for innovation in this industry (Grunert *et al.* 1996; Grunert *et al.* 1997). That is why food and drinks companies also have developed networks with actors that provide them with market intelligence through which they keep track of their end-users and explore future consumers' trends. Knox *et al.* (2001) found that a wide consultation of agencies and the involvement of expertise beyond the company had a positive impact upon the success of food and drinks products.

In the present paper we use an institutional approach to the agrofood chain which focuses on the actors, incentives and institutions that are involved in developing, producing and distributing food and drinks products (Christopher 1992; Meulenberg and Broens 1996). More specific we focus on the actors in the firms' networks that are related to the development of new products. The product-related innovation networks consist of the external actors that provide ideas for new products and those that are involved in the development of the new products. We expect that food and drinks companies that operate in networks are more successful than companies that don't. However, it should be realised that a too large network of alliances may lead to saturation and overembeddedness (Kogut *et al.* 1992; Uzzi 1997). When the company is involved in a too dense network, it can also limit a firm's openness to information and flexibility to operate (Nahapiet and Ghosdal 1998). The management of the different network links and the overall coordination of all these linkages needs a lot of attention and costs can increase considerable (Harrigan 1985). Although there will be a limit to the number of external relations that can be managed by a company successfully (Gomes-Casseres 1996), we expect that this restriction will not apply to food and drinks companies. The main reason for this is that - as Hagedoorn (2002) showed - food and drinks companies still show a relatively small numbers of network relations. Hagedoorn (2002) found that during the period 1960-1998 the share of newly established R&D-partnerships of the low tech industries such as food and drinks, metals, oil and gas is relatively small compared to high tech sectors such as aerospace, pharmaceuticals and IT industry. For that reason we formulate our first proposition as follows.

P1: *The more open the innovation network, the better the new product's short term and long term market performance.*

We expect to find differences in the level of involvement in the new product's network of specific external actors and their impact on the short term and long term market performance, depending on the innovativeness of the new product. We have elaborated this in more detail in three additional propositions, thereby opening the black box of open innovation in the food industry even further.

***Innovativeness and market performance of the new product***

We expect that the differences in the involvement of R&D-related, market-related and supply-related actors in the product's innovation network relates to the level of innovativeness of the product (see Table 1 for definitions of types of external actors).

**Table 1 Types of external actors**

| |
|---|
| R&D-related actors include universities, research institutes and institutions for higher vocational and companies that provide R&D- and engineering services. |
| Market-related actors include customers, competitors and marketing firms. Customers can be clients on the business-to-business market or consumers. |
| Supply-related actors include companies that produce machinery, equipment, raw materials or ingredients. |

Traditionally, the incremental character of innovations is considered as one of the key features of the food and drinks industry (Galizzi and Venturini 1996; Christensen *et al.* 1996). Studies on the German, Spanish, European and USA food and drinks market show that only a small portion of the product releases are truly innovative and can be considered as radical innovations (Gallo 1995; Rudolph 1995; Connor and Schiek 1996; ECR Europe 1999; Martinez and Briz 2000; Menrad 2004). However, as food and drinks companies are increasingly confronted with competition from private label products, they have to become more pro-active and take more commercial initiatives (Martinez and Brid 2000). The best strategy is to be innovative, preferable in products and processes that have proprietary elements that can be protected. This is one of the reasons why the introduction of relatively high value added products have increasingly become important for the food and drinks companies in order to raise entry barriers. The recent trend of functional foods that address specific health conditions even points to the drugs-type features of food product development and its related approval and registration regulations (Göransson and Kuiper 1997; Stein and Rodríguez-Cerezo 2008). Cox *et al.* (2002) illustrate how the introduction of ICT has dramatically changed

the chilled food processing value chain. Katz (1998) indicates that the use of new technologies has become a main factor that explains the differences between a line extension and a truly new food product. Trail and Meulenberg (2002) found - on the basis of a survey among European food-manufacturing firms - strong evidence that R&D expenditures were closely correlated with the development of new products. This illustrates the increasingly science and technology based character of the food innovation process (see also Enzing and van der Giessen 2003; Mark-Herbert 2003). Although several actors have provided arguments why the incrementalist character of innovations is very inherent to the food product itself[1], there is a growing body of evidence that shows that original concepts are more successful than 'copy-cat' or 'me-too' products on the food and drinks market (Knox *et al.* 2001; Van Trijp and Meulenberg 1996; Hoban 1998; Van Trijp and Steenkamp 1998; ECR Europe 1999)[2]. Joppen (2004) states that if innovative (radical) products catch on, they will almost guarantee long term commercial benefits in terms of sales and overall profitability. Line extensions and most certainly me-too products mostly deliver only short term, and relatively low-margin benefits.

The assumption we use for our propositions about the involvement of external actors is the following:

*P2. More incremental product innovations in the food and drinks industry will show a better short term market performance, while more radical product innovations will show a better long term market performance.*

***Involvement of external R&D-related, market-related and supply-related actors***

[1] Some authors argue that the incremental character of food innovations is very inherent to the food product itself as consumers reveal a specific form of risk aversion in their choices: new food products have to be rather similar to familiar products (Galizzi and Venturini 1996). Arguments for this position are not only found in the resistance against the use of specific new technologies such as gene technologies (Beckeman and Skjöldebrand 2007) or radiated foods, but also more nutritional, biopsychological and cultural constraints impose continuity on the demand side (Rama 1996). Taste and taste aversion such as the preference for sweetness and the abhorrence of bitterness, have innate biological aspects (Rozin 1987).

[2] Food consumption patterns have changed more then ever over the last period. Due to changes in life styles, new household equipment (Oldenziel 2001), new beliefs (some also scientifically proven) about the preventive health aspects of nutrition and the process of increased internationalisation leading to more contact with foreign culinary traditional food (Grigg 1995), diets have showed dramatic changes. Consumers ask for ready-to-eat meals, healthy food (not only as a prevention strategy, but also to combat obesity), snacks and more exotic food and are also very demanding when it comes to food quality and food safety (Earle 1997; Joppen 2004).

Companies invest in the development of more radical new products for which they can ask relatively higher prices and which are meant to stay on the market for a long period of time. As food and drinks companies have only limited R&D resources it is expected that they become more dependent on external R&D inputs when developing more R&D-intensive products. We also expect that companies that bring these more radical products to the market do this also on the basis of extensive market research. Through this, companies have a better view on long term consumers needs. More radical products also need more advanced and better prepared marketing efforts in order to get recognised by the public. Following our argument, the implication of this for the configuration of the external network is that it can be expected that in the case of more radical product innovations more external actors from both the science and technology domain and the market domain will be involved in the innovation process (than in the case of incremental product innovations) and that this has a positive impact on the product's performance especially the performance on the long term.

Suppliers play an important role in the innovation processes in the food and drinks industry. Through a well-developed network of inter-industry purchases and sales of machinery and equipment, as well as food ingredients developed by supplying industries, food and drinks companies benefit from new technological developments which are embedded in these supplied products (Scherer 1982, Klevorick *et al.* 1995; Christensen *et al.* 1996; Galizzi and Venturini 1996; Traill and Meulenberg 2002). As innovations in the food and drinks sector are becoming more radical and more knowledge intensive this might have an impact on the role of the supplier in the innovation process. Petroni and Panciroli (2002) found that companies assign suppliers different roles and give them varying levels of responsibility in the product development process. These roles are correlated to the suppliers' distinctive innovation capabilities. For the food and drinks industry this might imply that suppliers may not only sell machinery, equipment, raw materials or ingredients to the innovating firm, but also play a more active role, for instance as partner with whom companies collaborate in the innovation process or to whom specific tasks in the innovation process are outsourced. See for instance Joppen (2004) on the role of the supplier of ingredients which showed to be of growing importance in the innovation processes of food and drink companies as they provide important in-depth information on intrinsic aspects of ingredients (such as flavours, fragrances, antioxidants because of health benefits, fat and sugar replacers) and consumer markets.

We expect that in the case of more radical product innovations, supply-related actors are involved in the role of partners or outsourcers in the new food products innovation process and that this involvement positively affects the new product's long term market performance. We expect that in the case of more incremental innovations, supply-related actors will be mainly involved as sellers of goods and services and that their involvement will positively affect the food and drinks product's short term performance.

This brings us to a set of proposition on the involvement of external actors in incremental and radical product innovation processes and short and long term market performance of the products.

*P3: In the case of radical product innovations, the participation of R&D-related, market-related and supply-related actors in the new product's innovation network will be positively related to especially long term market performance of the new product.*

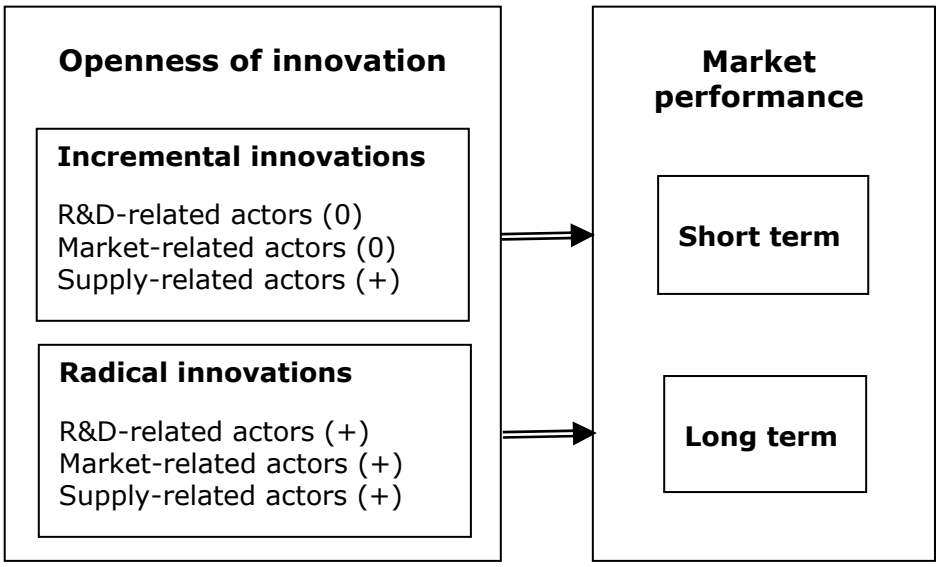
*P4: In the case of incremental product innovations, the participation of supply-related actors in the new product's innovation network will be positively related to especially short term market performance of the new product.*

## 3. Conceptual model and variables

In order to investigate the propositions we have developed a conceptual model (see Figure 1). The model is part of a larger model that includes also company internal variables (such as strategy, resources and capabilities). The variables as they appear in the model of the present study are discussed below.

*The new product's innovation network: openness*
In the present paper we focus on the product-related innovation network at the start of the new product's development process (in Coopers' terminology 'the ideation') and on the network during the new product development process. The openness of the network is operationalised using the number of external actors that are involved in the idea generation phase and in the product development phase. The more external actors are involved, the more open the network is considered to be.

**Figure 1 Conceptual model**




External actors can be involved in four different roles in the product-related network: as source of information during the idea stage of the innovation process and as partner, outsourcer or seller during the new product's development process (see Table 2 for definitions of roles of external actors).

**Table 2 Roles of external actors**

| |
|---|
| - Sources of innovation. External actors can provide ideas for new products (constituents) or their making.<br>- Partner. Partners are companies or other organizations that are directly involved in the company's innovation process.<br>- Outsourcer. Outsourcers are companies or other organisations to which specific activities in the innovation process are outsourced.<br>- Seller. Sellers are companies or other organisations from which the company buys specific goods and services that are related to the innovation process. |

*Innovativeness of the product*

In literature various classifications of innovativeness of the product have been proposed. The OECD definition (Oslo Manual) distinguishes between major product innovation (also referred to as radical product innovation) and incremental product innovation. Other classifications use a multi-steps approach indicating several stages of innovativeness (see for instance Booz and Allen 1982; ECR Europe 1999; or Hermann 1997).

Basically – as Grunert and Trail (1997) concluded – most classifications are based on an assessment of the newness of the products on two dimensions: newness to the market and newness from a technological perspective. In the present study we measured innovativeness of the new product in terms of product attributes: the more new attributes the products has the higher its level of innovativeness. Also we asked the company's assessment: is the product new or is it an improved/renewed version of an already existing product.

*Performance of the new product*
Innovation performance has been operationalised in many ways. Cooper and Kleinschmidt (1987) found three independent dimensions that characterise new product performance: financial performance, opportunity performance and market impact. Financial and market performance seem most suitable when the performance of a new product has to be measured. A variety of financial accounting-based and market-related indicators of performance can be used (see for a review Murphy *et al.* 1996). For products this includes growth of sales, growth in turnover, etc. We used two performance indicators. Short term market performance stands for the financial and market impact of the innovative product one and a half years after it was announced in the trade journals. As there are no objective financial or market data on individual food products available, subjective sources had to be used. In our case the assessment of the financial and market impact was made by the company that introduced the product on the market. Long term market performance stands for the market status of the product seven years after it was announced in the trade journals; is it on the market 'Yes' or 'No'.

## 4. Research methods: data collection and data analysis

### *4.1 Data collection*
Data on new food products introductions have been collected by a systematic review of the issues of 11 different Dutch food trade and professional journals that were published in the second half of 1998. This method of data collection on new product introductions is also referred to as the literature-based innovation output methodology (LBIO). The LBIO-method was first developed in the USA by The Futures Group (Edwards and Gordon 1984) and Acs and Audretsch (1988) and in Europe by Kleinknecht (1991). Kleinknecht (1992) and Acs and Audretsch (1993) have refined and further developed the methodology (Coombs *et al.* 1996). The basic element of the LBIO-methodology is that innovations are identified by sampling the editorially controlled 'new product

announcements' sections of technical and trade journals. The advantage of this method is that it has been the decision of the journal editors - an independent, qualified panel - to include them and not that of a stake holding actor such as the commercialising company. Coombs *et al.* (1996) found that the LBIO-based methodology which they had applied on a large sample of innovations in the UK resulted in outcomes that mirrored those found in other types of innovation research on the UK, suggesting that the LBIO-method is capturing data which have a good level of validity and reliability. Also Van der Panne (2007) found that LBIO data can be considered a fully fledged alternative to traditional innovation data. We screened the Dutch food trade and professional journals until we had identified 200 new products. For each product we gathered information about the product's name and the name of the company that had developed the product. Additional data including the data that are used for the present paper (on the product's innovation network, the innovativeness and the performance of the new product) have been collected by a survey using a structured questionnaire including 40 questions. Some questions included a number of items; for each item the question had to be answered (see the Annex to for an overview of the operationalisation of the variables in the questionnaire that are used in the present study).
After having tested the draft questionnaire through ten pilot interviews in January 2000 and the redrafting of the questionnaire, data collection took place in the period March – September of 2000. The data on the product's innovativeness, the product's network and short term market performance have been gathered through interviews by phone with executive managers of the firms that have been involved in the new product developed process. Data on long term market performance were collected in December 2005, seven years after the product's announcement, through desk research in combination with telephone interviews with the companies.

Complete data sets have been collected through the survey for 129 of the 200 new products, in 2000. Of the 71 products that are not included 45% was non-eligible (not developed in the Netherlands, not brought to the market after all, not all data could be collected) and for the other 55% data could not be collected for several reasons (responsible person could not be identified or not be contacted, company refused to cooperate). Compared to sending questionnaires by post or email which have an average response rate of 30%, our method led to a relatively very high response rate of 76% (129 of 170). Data collection on long term market performance in 2005 could be completed for all 129 cases.

### *4.2 Method of data analysis*

The relationships in the conceptual model were tested by means of correlation analysis. Spearman rank correlation coefficient for non-parametric data was used to measure the significance of the relation between short term market performance and indicators for the level of openness of the innovation network. Missing values are deleted listwise. Chi-square statistics (including Phi and Cramer's V) were used for measuring the strength of the associations between long term market performance and the indicators for the level of openness of the innovation network. We also used single linear regression for short term and single binary logistic regression for long term market performance: this did not alter the conclusions drawn on the basis of outcomes of the correlation analyses. The Mann-Whitney test is applied to test between two groups and is suitable for non-parametric data analysis. The outcomes of Mann-Whitney tests (2-Independent samples test) with long-term performance as grouping variable did not alter the conclusions drawn on the basis of outcomes of correlation and regression analysis dealing with long-term performance.

## 5. Results

### *5.1 Baseline description*

The external network of a food and drinks company can provide important sources of ideas for innovations. Ideas are the feedstock of the new product's development process (Cooper 1993). In our sample especially market-related sources - customers and competitors - provide most often ideas for new products (see Table 3, part 1).

**Table 3 Frequencies of use of external actors as source for idea generation, as partner, as outsourcer and as seller (as percentage of the total study population, N=129)**

| | **1. Sources of innovation** | | **2. Partners** | |
|---|---|---|---|---|
| **R&D-related** | Research organisations | 2 % | Research organisations | 8 % |
| **Market related** | Customers | 37 % | Customers | 13 % |
| | Competitors | 24 % | Competitors | 4 % |
| **Supply-related** | Suppliers of raw materials/ingredients and of machinery/equipment | 20 % | Suppliers of raw materials/ingredients, machinery/equipment | 35 % |
| | **3. Outsourcers** | | **4. Sellers** | |

| | | | | |
|---|---|---|---|---|
| **R&D-related** | Research organization | 10 % | Companies/organizations providing education / training | 14 % |
| | Companies/organizations providing innovation advice | 2 % | Companies/organizations selling licenses / software | 3 % |
| **Market related** | Companies/organizations providing marketing advice | 40 % | | |
| **Supply-related** | Suppliers providing recipe advice | 5 % | Suppliers of machinery / equipment | 29 % |

Suppliers are also frequently used as sources of ideas for new products: those selling raw materials and ingredients more than those selling equipment / machinery (15% versus 5%). Research organizations are less often used as external sources of ideas for innovations.

Suppliers are the most frequently used partner in the product development phase of the innovation process (see Table 3, part 2). Also customers, research organisations and competitor operate as partner, but less frequent than suppliers. Outsourcing is most frequently done for market-related activities (Table 3, part 3). Research institutes and companies or organizations that provide innovation and recipe advice are less often used outsourcers. In more than one quarter of the cases companies have bought equipment (Table 3, part 4). Also education and training activities and licenses and software were provided by external organizations.

*Performance*

We found that nearly two-third of the new products that were introduced in the second half of 1998 were still on the market seven years later, at the end of 2005 (see Table 4). In literature overall very high failure rates (72 - 88%) are reported for new food products that are introduced to the market (Buisson 1995; Rudolph 1995; Lord 1999; Poppel 1999).The unexpected high success rate we have measured might reflect the method we have used for the identification of new products as the products were selected by the editorial board of the professional journals. It can be assumed that they have chosen for products which are worth being announced as they have a good chance to be successfully marketed.

**Table 4 Frequencies of short and long term performance for three short-term impact groups (as percentage of total study population, N=129)**

| | **Short Term Performance** | **Long Term Performance** | |
|---|---|---|---|
| | | **Still on the market** | **Not on the market** |
| Large positive impact | 38 % | 74 % (of 38%) | 26% (of 38%) |

| | | | |
|---|---|---|---|
| Small positive impact | 49 % | 67 % (of 49 %) | 33 % (of 49 %) |
| No positive impact | 13 % | 25 % (of 13 %) | 75 % (of 13%) |
| Total | 100 % | 64 % | 36 % |

More specific Table 4 show that three-quarter of the products with no positive impact on the market performance on the short term (one and a half year after product announcement) are not on the market anymore on the long term (seven years after announcement). Products with a small positive impact on market performance on the short term have much larger market sustainability on the long term (67%); while products with a large positive impact on market performance on the short term have the highest change for a long term market position (74%).Correlation analyses (Table 6) confirm this. Products that show a relatively high performance on the short term are mostly also successful on the long term. In other words: short term success breeds long term success.

*Innovativeness of the new product*

The companies assessed 61% of the products as new products and 39% as renewed/ improved products. For our analysis we consider the group of new products as the group of radical product innovations and the group of renewed/ improved products as the group of incremental product innovations. Table 5 shows for each group the distribution across innovativeness levels.

**Table 5 Frequencies of innovativeness of the new products in terms of level of new product attributes for radical and improved/renewed products (as percentage of total study population, N=129)**

| | | **Level of new product attributes** | | | |
|---|---|---|---|---|---|
| | | **High** | **Medium** | **Low** | **Total** |
| Radical product innovations | 61% | 19% | 56% | 25% | 100% |
| Incremental product innovations | 39% | 14% | 26% | 60% | 100% |
| Total | 100% | | | | |

Radical products - as expected – are products with relatively more new product attributes at the high (three or more new product attributes) and medium (two new product attributes) level than incremental products. However, still 14% of the incremental products are highly innovative. Mann-Whitney test shows that the group of radical product innovations differs significantly from the group of incremental product innovations for the innovativeness variable. Radical new products perform better on the short and on the long term: 69% of the products with large impact on the short term are radical products and 60% of the products that are still on the market after seven years are also radical products. Correlation analyses

(see Table 7) confirm this. There is a positive significant relation between product innovativeness and long term market performance: the more new product attributes, the better the new product's long term market performance.

### *5.2 Level of openness and performance*

The results of the correlation and chi-square analyses for all cases show that openness of the innovation network is positively related to the new products' performance (see Table 6). Openness of the innovation network in terms of numbers of sources of ideas relates positive to both short and long term market performance; the most significant to the latter. Openness in terms of number of external actors involved in the new product development process relates positively to both performance indicators; most significant to short term market performance. Correlation analysis of each of the three actors groups separately – not presented in this paper - shows that only the number of different sellers relates significantly positive with short term market performance (coefficient of .213; $p < .01$).

**Table 6 Spearman rank correlations for short term market performance and Chi$^2$-statistics for long term market performance of the new products (N=129)**

| | **Short Term Performance** [a] | **Long Term Performance** [b] | |
|---|---|---|---|
| | | Phi / Cramer's V | df |
| **Performance** | | | |
| Short Term Performance | X | .27* | 3 |
| **Openness** | | | |
| External sources of ideas | .14^ | .33** | 4 |
| External actors involved in new product development | .16* | .28^ | 5 |
| **Innovativeness** | | | |
| New products attributes | .04 | .19^ | 2 |

[a] Spearman coefficient, one-tailed
[b] Chi-square: Phi for 2x2 contingency tables, Cramer's V for 2x(2+n)
Significant correlations are indicated in with ** ($p<0.01$), * ($p< 0.05$) and ^ ($p< 0.10$)

*Radical versus incremental product innovations*

The results of the correlation and chi-square analyses of the relation between variables for openness and short and long term market performance are presented for the group radical product innovations and the group incremental product innovations separately in Table 7.
For the group of radical product innovations it shows that openness of the innovation network in terms of the total number of different external sources of innovation is highly significant and positively related to the new product's long term market performance. We can conclude that the more actors are consulted as sources of innovation in the idea stage of the

**Table 7** **Spearman rank correlations for short term performance and Chi$^2$-statistics for long term performance for the group of incremental product innovations (N=50) and radical product innovations (N=79)**

| | INCREMENTAL INNOVATIONS | | | RADICAL INNOVATIONS | | |
|---|---|---|---|---|---|---|
| | Short Term Performance [a] | Long Term Performance [b] | | Short-term Performance [a] | Long Term Performance [b] | |
| | | Phi / Cramer's V | df | | Phi / Cramer's V | df |
| **Performance** | | | | | | |
| Short Term Performance | X | .34* | 2 | X | .31* | 2 |
| **Openness** | | | | | | |
| External sources of ideas | .18 | .26 | 4 | .13 | .47** | 4 |
| External actors involved in new product development | .09 | .23 | 5 | .19* | .35^ | 5 |
| **R&D-related** | | | | | | |
| Source of Innovation - Research organisations | -.05 | .10 | 2 | .07 | .13 | 2 |
| Partner – Research organisations | -.12 | .20 | 2 | .10 | .22 | 2 |
| Outsourcer – Research organisations | -.03 | .01 | 1 | .07 | .24* | 1 |
| Seller – education/training | .02 | -.07 | 1 | .27** | .16 | 1 |
| Seller - licenses/software | -.03 | .15 | 1 | .143 | .13 | 1 |
| **Market-related** | | | | | | |
| Source of Innovation – Customer | -.05 | .13 | 1 | .07 | .33** | 1 |
| Source of Innovation – Competitor | -.02 | -.03 | 1 | .11 | .28* | 1 |
| Partner – Customer | .09 | .18 | 2 | .01 | .09 | 2 |
| Outsourcer – Marketing bureau | .05 | -.01 | 1 | .20* | -.05 | 1 |
| **Supplier related** | | | | | | |
| Source of Innovation – Suppliers of mach/equip & ingr | -.13 | -.38** | 1 | .15 | .14 | 1 |
| Partner – Supplier | .08 | -.31* | 1 | .11 | -.12 | 1 |
| Outsourcer - Supplier recipe development | .12 | -.07 | 1 | .01 | -.06 | 1 |
| Seller – Supplier machinery /equipment | .09 | -.01 | 1 | .25* | .21^ | 1 |

[a] Spearman coefficient, one-tailed

[b] Chi-square: Phi for 2x2 contingency tables, Cramer's V for 2x(2+n)

Significant correlations are indicated in with ** ($p<0.01$), * ($p< 0.05$) and ^ ($p< 0.10$)

innovation process the better the long term market performance of the radical new product. The other openness variable – total number of different external actors - is positively related to both performance indicators; most significant to short term performance. Correlation analysis of each actor group separately shows that the group of suppliers is the responsible actor group for this as it has a highly significant relation with short term market performance (coefficient of .32; $p < .01$). For the group of incremental product innovations openness of the innovation network neither in the idea stage nor in the product development stage plays a significant role in short term or long term market performance.

*R&D-related actors*

For the group of radical product innovations it shows that the outsourcing of R&D to research organizations relates significantly positive to long term market performance (Table 7). Additional analyses of each of the three different types of research organizations separately, shows that only the involvement of research institutes relates slightly positive to long term market performance (coefficient of .20; $p < .10$). The involvement of the companies that provide training courses has a significantly positive impact on short term market performance of radical products. Within the group of incremental product innovations no significant relation of the involvement of R&D-related actors with market performance variables was measured.

*Market-related actors*

For the group of radical product innovations customers and competitors as source of innovation contribute significantly to long term market performance (Table 7). Companies that use both sources of innovation have better long term market performance than companies that do not use them. The high significance of the role of customers as source of innovation has been found in many experimental studies, for instance Von Hippel (1988) on the important role of lead users who help in improving the product and to reduce costs and Van de Panne (2004) who found that collaboration with customers significantly reduces the risk of overestimating demand. However, the involvement of customers as partner does not show any significant relation to short or long term market performance. The outsourcing of market-related activities has a significantly positive impact on short term market performance of radical product innovations.

*Supply-related actors*

The market performance of incremental products is only significant influenced by the involvement of suppliers of machinery/equipment and ingredients/raw material as source of innovation and as partner. Both have

a significantly negative effect on long term market performance (Table 7). The suppliers of machine and equipment in their role as sellers positively affect both short and long term market performance of radical new products.

## 6. Discussion and conclusions

The results of our study support the first proposition which said that:

P1: *The more open the innovation network, the better the new product's short term and long term market performance.*

Measuring the character of openness of innovation processes in the Dutch food and drinks industry at the fuzzy front end and during the new product development process we found different modes of open innovation related to short term and long term market performance. The level and mode of openness varies per phase in the innovation process. Our study confirms that use of more external sources of innovation is an important factor for product innovations to be successful on the long term (Table 6). This can be explained by the following: companies that develop products that are meant to stay for a long term on the market need to perform more extensive scanning at the fuzzy front end of the innovation process and check all possible sources while products that are meant to stay for a shorter period of time need less extensive searching and checking of sources. They are regularly renewed. Openness in terms of involving more external actors in the new product development process is a significant affecting a better market performance, especially short term market performance (Table 6). When analyzing which actor group was most responsible for this outcome, we found that this was mostly due to the role of suppliers that sell machinery and equipment.

In order to investigate the modes of innovation networks for those involved in more radical versus those involved in more incremental product innovations, we proposed that:

*P2. More incremental product innovations in the food and drinks industry will show a better short term market performance, while more radical product innovations will show a better long term market performance.*

Although we found that our proposition proved to be right, this is not in line with what several authors found. An empirical study of Kleinschmidt and Cooper (1991) found a U-shaped relationship between success and

degree of innovation. Similar results had van der Panne (2004) who observed that radical innovations tend towards high-risk-high-return patterns, showing sales records that are above but also below expectations. However, the literature about this issue remains inconclusive as for instance Zirger (1997) – similar to our results - found a linear relation between degree of innovativeness and the products success. In our case we might explain the impact of innovativeness as we operationalised it (in terms of product attributes) on the product's long term success from the fact that these products stand out in product advantages for the customer.

The confirmed second proposition formed a solid base to analyse more in depth - for the group of incremental and radical product innovations separately - the role of R&D-related, market-related and supply-related actors, using the following propositions:

*P3: In the case of radical product innovations, the participation of R&D-related, market-related and supply-related actors in the new product's innovation network will be positively related to especially long term market performance of the new product.*

*P4: In the case of incremental product innovations, the participation of supply-related actors in the new product's innovation network will be positively related to especially short term market performance of the new product.*

Our results support proposition P3 (on radical product innovations) for the part that deals with the involvement of R&D-related and market-related actors (Table 7). Research organizations to which activities are outsourced and companies that provide training and education contribute significantly positive to long term, respectively short term market performance. We found that customers affect highly long term performance when they operate as source of innovation, not as partner. The first is in line with Maidigue and Zirger (1984) who found that the majority of successful ideas originate from the market and not from inside the firm. Our finding that involving customers as partner in the new product development is not a factor for attaining success can be explained as follows: as customers express their preferences in terms of already familiar products, customers bias innovators towards more incremental products. Involving customers as partners might diminish creativity and make the firm to disregard technology-driven ideas leading to more innovative products (Ortt and Schoormans 1993; Wind and Mahajan 1997). The part of proposition P3 on the role of suppliers as partner or outsourcer in the radical product's

innovation process could not be confirmed. The results showed that they play a significant role as sellers of machinery and equipment.
Also the proposed role of suppliers in proposition P4 (on incremental innovations) could not be confirmed. We even found that their involvement as source of innovation and as partner of the innovating company in the innovation process strongly negatively affects long-term performance. Although suppliers are the most frequently involved external actor of the innovating company, they should not interfere with the innovation process. When they get to close this negatively affects the company's performance.

The contribution of the paper lies in the focus on new products - Schumpeter's object of industrial renewal – and not on the innovation company itself. This enabled us to investigate the company network that relates to a specific product and the impact of this network to the products success on the market. A second important contribution of this paper is that the new product's success was not only measured just after market introduction, as it is usually being done, but also for a second time seven years after its introduction into the market. This enabled us to investigate what factors related to the company's network are decisive for products that provide companies with income for many years, compared to those that provide short term gains. Most important was to find significant differences in the openness of the new product-related network that affect short term versus long term success for the group of radical versus the group of incremental product innovations. The involvement of R&D-related (research institutes, companies that provide training), market-related (customers, marketing companies) and supply-related actors (suppliers of machinery and equipment) showed to have a significant positive impact on both short term and long term market performance of radical product innovations, but not of incremental product innovations.

Our findings have important managerial implications for companies that want to innovate, when it concerns the selection and role of external actors in the idea generation and product development stage. Companies that want to innovate have to select their partners carefully. The best cooperation strategy with knowledge institutions is to outsource to research institutes, more than to universities or organizations for higher vocational training. Market research and market orientation are critical activities when bringing new food and drinks products successful to the market (see for instance Traill and Grunert 1997). However, on the basis of our study we recommend companies bringing incremental product innovations to the market, not to spend too much effort in involving any market-related actor as we found that none of them showed to have a

specific impact on the product's success. Companies that plan to develop more radical products are recommended to check for a large variety of sources of ideas for innovations, especially customers. Our study shows that suppliers are important actors for the innovating companies as they are frequently involved in the new product's development process and as source of ideas for innovation. However, their role has to be chosen very carefully: as we found that in their role as source of innovation or as partner they can have a negative impact on the product's success. Cooperation with suppliers in their role as intermediates that bring new technological developments that have been develop elsewhere embedded in the provided goods and services seems to be the best supplier-related cooperation strategy for innovating firms.

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## Annex:

Operationalisation of the variables: indicators

**Product's performance**

Short term performance (two questions, ordinal indicators: decrease, no change, small increase, large increase)

- impact of the new product on the company's market share (1) and on the company's turnover (2) one and a half year after its announcement

Long-term performance (one question, dichotomous variable)

- the product 's market status seven years after its announcement: still on the market (Yes or No)

**R&D-related actor** in the role of:

Source of innovation (3 questions, dichotomous variable)

- measures the use (Yes or No) as source of innovation of research institutes (1), universities (2), higher vocational education (3). The scores for these three have been combined (sum) in one new variable 'Research organizations' (ordinal).
Partner (3 questions; dichotomous variable)
- measures the involvement as partner of research institute (1), university (2), higher vocational education (3). The scores for these three have been combined (sum) in one new variable 'Research organizations' (ordinal).
Outsourcer (4 questions; dichotomous variable)
- measures the involvement (Yes or No) as outsourcer of research institutes (1), universities (2), higher vocational education (3) and companies that provide advice on innovation (4). The scores for the three research organizations have been combined (sum) in one new variable 'Research organizations' (ordinal).
Seller (2 questions; dichotomous variable)
- measures the involvement (Yes or No) of companies or organisations selling: education / training (1), licenses / software (2) as seller.

**Market-related actor** in the role of:
Source of innovation (2 questions, dichotomous variable)
- measures the use (Yes or No) as source of innovation of customers (1), competitors (2).
Partner (2 questions; dichotomous variable)
- measures the involvement as partner of customers (1), competitors (2)
Outsourcer (1 question; dichotomous variable)
- measures the involvement (Yes or No) as outsourcer of marketing bureau's (1).

**Supply-related actor** in the role of:
Source of innovation (2 questions, dichotomous variable)
- measures the use (Yes or No) as source of innovation of supplier of raw materials and ingredients (1), suppliers of equipment /machinery (2)
Partner (1 question; dichotomous variable)
- measures the involvement as partner of suppliers
Outsourcer (1 question; dichotomous variable)
- measures the involvement (Yes or No) as outsourcer of suppliers that provide recipe advice
Sellers (1 questions; dichotomous variable)
- measures the involvement (Yes or No) as seller of companies/organisations selling machinery/equipment

**Openness of the innovation network**
As proxy for openness of the innovation network two newly created indicators were used based on data collected through variables listed under R&D-related, market-related and supply-related actors:
- 'Openness – External source of ideas': the sum of different external actors that provide sources for ideas of innovations
- Ópenness – External actors in NPDP (New Product Development Process)' the sum of different external actors involved in the network (partners, outsourcers, sellers)

**Innovativeness of the product**
Newness of product (two questions, dichotomous variables):
- the product is a new product (1), the product is an improved/renewed product (2)
Newness of product attributes (eight questions, dichotomous variables):

- measure of new product constituents (Yes or No) of new raw materials (1), new ingredients (2), new processing (3), new recipe (4), and new products' assets for the user: shelf life (5), ready to use/eat (6), packing (7), nutritional value (8)
A new indicator was created (New Product Attributes) that combines the scores on new product attributes: the more new product attributes (constituents, assets for the user), the higher its innovativeness (ordinal variable). High level is 3 or more new product attributes, Medium is 2 new attributes, Low is 1 new attribute.