MASTER THESIS

THE EFFECT OF SOURCING BALANCE ON INNOVATION PERFORMANCE AND STRATEGIC FLEXIBILITY

MASTERTRACK:
BUSINESS ADMINISTRATION: INNOVATION AND ENTREPRENEURSHIP

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Title: **The Effect of Sourcing Balance on Innovation Performance and Strategic Flexibility**

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ABSTRACT

This study investigates how the process of renewing firm's competences and its inherent sourcing balance affects innovation performance and strategic flexibility. Contemporary literature on external- and internal exploration assume that these sources of exploration are complementary. However, recent advances in the field of innovation literature question this assumption. Through a study of 56 firms located in the Netherlands, this study examines the effect sourcing balance of exploration and the subsequent processes of retaining, reactivating and applying this knowledge on innovation performance and strategic flexibility. Our data suggest that the ability of the company to retain and reactivate knowledge greatly influences innovation performance and strategic flexibility. Moreover we show that the ability to exploit technological knowledge is of great importance for innovation performance. Overall we found evidence that companies which tend to have an internally focussed sourcing balance have a higher innovation performance and higher strategic flexibility, but that this relation is being complicated by the munificence of the environment.

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INTRODUCTION

Although there are many ways a firm can achieve a competitive advantage, in dynamic markets two of the most important are innovation and strategic flexibility (Zahra & George, 2002, p.195). According to contemporary theories, both innovation and strategic flexibility can be achieved through leveraging and renewing firm knowledge (e.g. Zahra & George, 2002; Lane et al, 2006; Jansen et al., 2005). Although innovation performance has often been empirically researched and confirmed to provide a competitive advantage, empirical evidence for the relation between renewing and leveraging firm knowledge and strategic flexibility remains absent. Moreover, it remains unclear what the effect is of the source of the new knowledge. The relationship between innovation performance and renewing firm competences is plagued by inconsistent results, most often caused by inconsistent operationalization of the constructs (Lane et al., 2006).

Most studies concerning renewal of firm knowledge take as dependent variables a form of innovation performance or firm performance (Lane et al., 2006). Essentially these are short term firm performance measures; long term performance measures are not often used as dependent variable. This study uses both short term measures (innovation performance) and long term performance measures (strategic flexibility). *Innovation performance* is the outcome of a firm's activities of leveraging its competences into new products and new services. A performance measure for the long term was suggested by Zahra and George (2002): strategic flexibility. *Strategic flexibility* is the ability of the firm to change its strategic plan to different contingencies (Barringer & Bluedorn, 1999). Strategic flexibility grants companies the ability to deal with changing environments. Strategic flexibility depends jointly on the inherent flexibilities of the resources available to the firm and on the firm's capabilities in applying those resources to alternative courses of action (Sanchez, 1995). This suggests a relationship between the ability to renew a firm's competences and the ability to deal with changing environments.

Competition between firms on the long term is not based on products, rather on firm's competences (Hamel and Prahalad, 1994). Products are mere manifestations of deeply rooted competences within the firm, which evolve slowly. Competences are path-dependent; past choices influence the competences of today (Danneels, 2002). However, the competence that once created a competitive advantage might become obsolete or unfit for practical applications in new products (Leonard-Barton, 1992). As companies are habituated in a tendency to give priority to short term efficiencies, they often prefer the less risky innovations

using mainly existing competences. To escape this rigidity, companies should create new competences (Ahuja & Lampert, 2001; Danneels, 2002; Ellonen et al., 2009) through knowledge exploration. This new knowledge can either be created internally or acquired externally.

While both these exploratory learning processes have been researched, mostly they have been examined separately. Internal exploration has, as of old, received considerably more attention, but has largely neglected external exploration as a modus of knowledge exploration. There are a few notable exceptions (e.g.; Cassiman and Veugelers, 2006; Cohen and Levinthal, 1989, 1990; Tsai and Wang, 2008) which empirically researched the interplay between internal and external exploration processes. Garud and Nayyar (1994) state that both internal and external creation of knowledge need to be present in order to sustain a competitive advantage. Cassiman and Veugelers (2006) find that acquiring external know-how is found to significantly increase innovative performance when the firm at the same time is engaged in internal Research and Development (R&D) activities, suggesting that internal and external exploratory learning are complementary. Tsai and Wang (2008) find that external exploration does not lead to higher firm performance per se, but is positively moderated by internal R&D efforts. Relying solely on internal exploration can lead companies into competence traps; the inability to escape from existing firm knowledge (Ahuja and Lampert, 2001). Relying solely on external exploration can lead to a diminished understanding of the possible application of technologies, because the required heuristics are missing to effectively use, integrate and improve the knowledge (Kogut and Zander, 1992).

Empirical evidence on the relationship between internal and external exploration is not conclusive. Some studies (e.g. Jones et al., 2001) find a substitution relationship between internal and external exploration. One possible reason for the inconsistent findings is the use of inappropriate measures for measuring external and internal exploration. Based on the premise that the ability to externally explore new knowledge is determined by a company's knowledge base, many scholars have used proxies for external exploration based on measuring a firm's knowledge base (Lane et al., 2006), rather than its processes. This proxy ignores the importance of the learning process required for absorbing external knowledge. Lane et al. (2006) even state that with some datasets the same measure, a firm's patents, is used for measuring both absorptive capacity and innovation (although in different studies). The proxies used in prior research do not measure the processes well since it actually measures a static resource instead of a process or a capability (Lane et al., 2006).

We build upon and extend the framework of absorptive capacity (as described by Lane et al., 2006; Lichtenthaler, 2009; Lichtenthaler and Lichtenthaler, 2009) to describe the process of renewing firm's competences. The ability to renew competences requires three subsequent processes; *exploration, transformation* and *exploitation* (Lane et al., 2006, Lichtenthaler & Lichtenthaler, 2009). *Exploration* is generating new knowledge in the firm through internal (invention) efforts and external (acquisition from external sources) acquisitions. The process of retaining knowledge and reactivating when needed is termed *transformation* (Garud and Nayyar, 1994). *Exploitation* refers to the application and examining of possible applications of knowledge that has been explored and retained in the firm (Lane et al., 2006). Although firms can have different emphasizes on the importance level of these individual processes, all these processes are complementary and thus equally important for the ability to renew firm competences (Lichtenthaler, 2009; Lane et al., 2006). For example, a company which excels in exploration cannot do much with the generated knowledge when they do not possess the skill to effectively transform and exploit this knowledge. The same holds true for companies which excel in exploitation of knowledge but lacks the ability to explore new knowledge. Without relevant (new) technological knowledge the exploitation is unlikely to result into useful new competences.

The purpose of this research is twofold; the first purpose is to answer how the subsequent abilities to renew firm's competences affect a firm's innovation performance and its strategic flexibility. The second purpose of this study is to examine the effect of sourcing balance of exploration on innovation performance and strategic flexibility. Inherent to the latter one is the question whether internal- and external exploration are complimentary or substitutes. This leads to the following two main research questions;

1. *How does the firm's ability to renew their competences affect innovation performance and strategic flexibility?*
2. *How does the firm's sourcing balance affect innovation performance and strategic flexibility?*

This paper consists of five sections. First we will review the existing literature on firm competences, and internal and external exploration. Second, we will review the existing literature on the learning processes required for renewing competences and their interdependencies. Third, the methodology will be discussed. Fourth, we will present the results and we conclude with the discussion and limitations of this study.

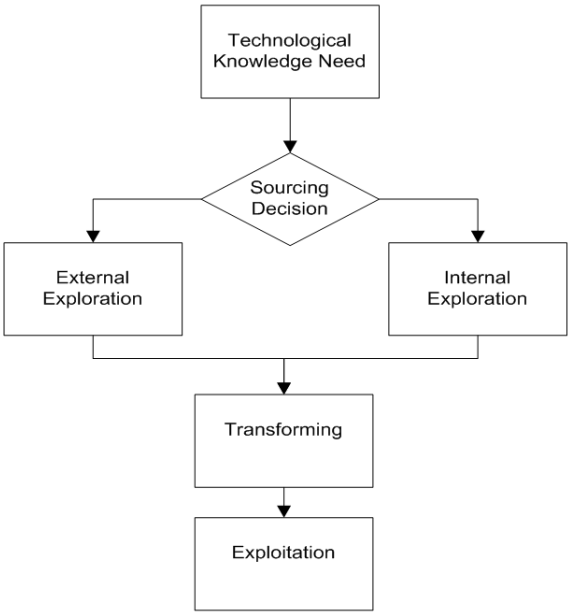
THEORETICAL BACKGROUND

Mere knowledge does not contribute anything to firm performance; it requires integration within the firm. This is the basis on what firm's competences are build. Firm's competences are integrated knowledge assets. "Competences are complex bundles of skills and collective learning, exercised through organizational processes that enable firms to coordinate activities and make use of their assets" (Day, 1994, p.38). Marketing competence for example allows a company to serve a particular group of customers. Technological competence is the ability of the firm to make certain physical products (Danneels, 2008).

Hamel and Prahalad (1994) argue that competition on the long term should not be seen as competition between products; competition on products is only a manifestation of a more deeply rooted competition between firm competences. The products of companies are only a temporal expression of corporation's competences; the competences evolve much slower than products (Hamel and Prahalad, 1994). Competence usage increases the competence since it is largely a knowledge asset (Hamel and Prahalad, 1994; Gupta et al., 2006). The slowly evolving competences are path dependent, past choices influence future possibilities (Danneels, 2002). Companies often tend to invest mainly in areas in which they have already strong competences. However, companies which only pursuit in exploitative activities of their existing knowledge base might position themselves unfavourable in future markets (Christensen, 2000; Ahuja and Lampert, 2001; Chandy and Tellis, 1998; Leonard-Barton, 1992), falling victim to learning traps (Ahuja and Lampert, 2001) or core rigidities (Leonard-Barton, 1992). Core rigidities are a tendency to refer back to knowledge that served a company well in the past but is inappropriate for current appliances (Leonard-Barton, 1992). Companies which manage and renew their knowledge base perform better on the long term then companies which do not renew their knowledge base (Hamel and Prahalad, 1994). The firm's ability to combine, and effectively use its knowledge is crucial to the success of innovation (Henderson and Cockburn, 1994; Nerkar and Roberts, 2004). Competences alone do not create value for the customer; it is the combination of the competences that creates the value (Danneels, 2002; Day, 1994). A product is not a set of technologies, nor is it a set of customers, rather the combinatory nature create the value (Dougherty, 1992). Competences however are seldom based on single technologies; it is the integration of the technologies that create the knowledge set that can be used in innovations (Tsai and Wang, 2008; Brusoni and Prencipe, 2001). These sets consist of different sources of knowledge, existing technologies and new technologies, and internally created and

externally acquired technologies. As Grant (1996) noted, the more competences that need to be integrated into a higher level capability, the harder it is for the company, but also for competitors to imitate. However, the source of knowledge might influence the possible integration possibilities of different knowledge components (Grimpe and Kaiser, 2010; Tsai and Wang, 2008). On individual technology level the sourcing question can be greatly simplified. Based on the knowledge need, a firm chooses either to create or acquire. In the simplest form it looks like the process diagram as we depicted in figure 1. In this process knowledge is acquired and embedded within the organization.

Figure 1: Process model of competence renewal



As we argued earlier, the source of the new knowledge plays an important role in the application and overall usability of the knowledge (Brusoni and Prencipe, 2001). Two kinds of knowledge can be identified; explicit knowledge and tacit knowledge. Explicit knowledge can be expressed in formal and systematic language and is easily shared in the form of data, formulas and manuals. Tacit knowledge is deeply rooted in action procedures, routines, commitment, ideals, values and emotions and is thus not easily transferable (Nonaka, 2000). Where explicit knowledge is often seen as “know what” (Nonaka, 2000), tacit knowledge is often conceptualized as being “know how” (Kogut and Zander, 1992) and “know why” (Garud, 1997). Tacit knowledge consists of heuristics that identify problems and the elements consisting of the solution (Kogut and Zander, 1992, p.389). The solution itself is not likely to entail the procedural knowledge that preceded the solution (Kogut and Zander, 1992). Since explicit knowledge is easier transferable it is assumed that external knowledge consist mostly of explicit knowledge, while tacit knowledge is mostly acquired through internal exploration endeavours. The required tacit knowledge to create a (core) competence can hardly be transferred, but is mainly achieved by learning by experience in firms (Nonaka, 1991; Kogut and Zander, 1992). A problem of explicit knowledge is that anyone who acquires it can resell it without losing it (Grant, 1996). Also, the mere act of marketing knowledge makes it available to potential buyers (Grant, 1996, Kogut and Zander, 1992; Rosenberg, 1990). Therefore, mere explicit knowledge is unlikely to create a sustainable competitive

advantage.

The growing complexity of technologies increasingly forces companies to acquire more technologies externally (Tsai and Wang, 2008). Contemporary literature (e.g. Cassiman and Veugelers, 2006), Tsai and Wang (2008)) states that only few firms can solely rely on internal developed technologies as it is prone to competence traps, might be too heavy on internal resources, might miss new technological paradigms or new cutting edge technologies and might be too risky (Ahuja and Lampert, 2001; Weigelt, 2009). Supposedly companies should also externally explore knowledge as it is supposed to lead, combined with internal knowledge, to improved innovation performance and would give the company a greater strategic flexibility. At the same time, external technology cannot replace the internal processes required for innovation, since the required internal know-how cannot be acquired from an external source (Cassiman and Veugelers, 2006; Lichtenthaler, 2011; Tsai and Wang, 2008; Jones et al., 2001). To be able to assimilate external technologies an in-house capability in exploratory research should be present (Granstrand et al., 1997). Without this matching capability, an overlap between firm knowledge and the to-be acquired knowledge, the firm might miss the capacity to internalize external knowledge (Danneels, 2002). Moreover, without internal knowledge creation companies are unable to identify and value promising external technologies (Cohen and Levinthal, 1990; Tsai and Wang, 2008). Therefore, external technology acquisition can never be a substitute for internal development (Brusoni and Prencipe, 2001); it rather complements in-house research activities in building a (core) competence (Cohen and Levinthal, 1990; Kogut and Zander, 1992).

Prior research assumes that internal- and external exploration are complementary (Cassiman and Veugelers, 2006; Cohen and Levinthal, 1990; Lichtenthaler, 2009; Lichtenthaler and Lichtenthaler, 2009). The benefits of the learning process of internal exploration have largely not been empirically examined in a context with external exploration. It is possible that the same warning as with exploration/exploitation holds for internal and external exploration, overly relying on external exploration might crowd out internal exploration which decreases the firm's sensitivity to new external knowledge and thus positions the company unfavourable in future markets. External exploration tends to be somewhat reactive to current or near future market conditions (Lane et al. 2006; Kogut and Zander, 1992). Moreover internal exploration might be even more important because "many innovations based on external technology are new products that imitate others in important respects" (Mansfield, 1988, p. 1162). The required tacit knowledge to successfully exploit the

knowledge is mostly developed through internal exploration (Weigelt, 2009).

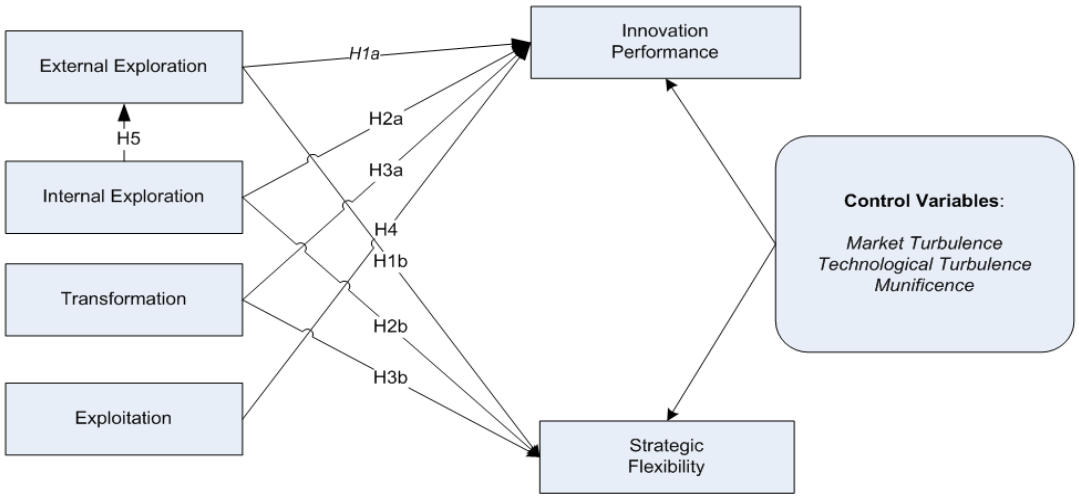
Internal knowledge creation is in the original model by Cohen and Levinthal (1989, 1990) an antecedent to absorptive capacity. A lot of scholars take this relation for granted although not much empirical evidence is present. A few notable publications are focused on the interplay between internal knowledge creation and external knowledge acquisition (e.g. Tsai and Wang, 2008; Jones et al., 2001; Cassiman and Veugelers, 2006) However the focus is mostly on how internal R&D efforts (measured in spending on R&D, or number of R&D employees) moderate acquisition of external knowledge. The most important critique on recent empirical research on absorptive capacity is that although it explicitly sees absorptive capacity as a learning process, it is often measured through the proxy *R&D spending* (Lane et al., 2006). Not only does this not reflect the construct well, it also does not allow measurements in complementarities between internal and external knowledge exploration.

The mere (external) acquisition or (internal) invention of new technologies however does not lead to innovation performance or strategic flexibility (Sanchez, 1995). The subsequent processes of transforming the knowledge and exploiting the knowledge are of equal importance for innovation performance (Lichtenthaler, 2009). Strategic flexibility requires the subsequent process of transformation (Zahra and George, 2002).

HYPOTHESES

As we stated earlier, the renewal of firm competences requires three subsequent processes; *exploration*, *transformation* and *exploitation* (see figure 1 on p5). These three processes are complementary for achieving innovation performance (Lichtenthaler, 2009). Strategic flexibility however is achieved through the processes of knowledge exploration and transformation, because this would supposedly lead to greater flexibility in reconfiguring their resource bases (Zahra and George, 2002). Our first five hypotheses deal with our first research question. These hypotheses are depicted in figure 2. All these learning processes and their relation to innovation performance and strategic flexibility are elaborated below.

Figure 2: Research Model 1



EXTERNAL EXPLORATION

External exploration is the process of acquiring new (for the firm) technological knowledge from outside the firm. It encompasses only the acquisition of knowledge; separate learning processes are required for storing the knowledge and exploiting the knowledge. External exploration requires prior knowledge to be able to understand the knowledge that is to be acquired (Cohen and Levinthal, 1990).

External exploration benefits from technology spill-overs by acquiring knowledge without internally developing it (Rosenberg, 1990; Cohen and Levinthal, 1990). Acquiring external knowledge might be beneficial for late mover advantage; the to-be acquired technology has been tested, and apparently is worth the costs. Also the company can benefit from the technology without the excessive development costs made by the original developer (Rosenberg, 1990). Perhaps the most important attribute of external exploration is the ability to acquire new knowledge that is not restrained by a company's existing knowledge base, leading to truly novel technological trajectories for the company.

Although some (large) companies are able to reinvent themselves through entrepreneurial activities (Katilla and Ahuja, 2002), most companies require some amount of external exploration to complement and leverage internal developed technologies (Tsai and Wang, 2008). Zahra and George (2002) suggest that "[…] potential absorptive capacity (the ability to value and acquire knowledge) [will lead to] higher strategic flexibility and degrees of freedom to adapt and evolve in high velocity environments" *(*p.185). Moreover, external exploration is less bound by prior knowledge and thus has the ability to prevent falling victim to

learning traps (Ahuja and Lampert, 2001; Grimpe and Kaiser, 2010). In other words, the ability to externally explore new knowledge positively influences how companies can react on changing environments. We expect therefore that external exploration will lead to higher innovation performance and strategic flexibility.

Hypothesis 1a: External exploration leads to higher innovation performance

Hypothesis 1b: External exploration leads to higher strategic flexibility

INTERNAL EXPLORATION

Internal exploration refers to a firm's ability to internally explore knowledge, i.e. to generate new knowledge inside the firm. Internal exploration is determined by the effectiveness of the internal R&D processes. Internal exploration activities are path dependent (Kogut and Zander, 1992; Danneels, 2002); prior knowledge is required to explore new knowledge (Nonaka *et al.*, 2000). Internal R&D has however, also often been tested (and confirmed) as a moderating variable on absorptive capacity (Grimpe and Kaiser, 2010; Lichtenthaler, 2009; Tsai and Wang, 2008). Internal exploration is needed for a firm to renew their existing competences. Where external acquired knowledge often lacks the tacit knowledge required for deeper understanding of the technology, the tacit knowledge created through internal development facilitates further learning on the technology (Weigelt, 2009). Internal development might be more expensive but ensures greater control over its distribution (Jones et al., 2001), is less sensitive to imitation by competitors (Mansfield, 1988) and thus more likely to contributing to a competitive advantage.

Moreover, internal exploration has a positive effect on integrative capability; the ability to coordinate and synthesize various component competences effectively for forming new competences (Henderson, 1993). Internal exploration creates the glue that is needed to interpret and combine technologies. Internally developed technologies are not available to competitors, which makes the (combined) knowledge more unique, less generic and thus more valuable (Grimpe and Kaiser, 2010). Internal exploration might lead to new (combinations of) technologies that provide the firm with first mover advantage (Rosenberg, 1990). We expect that internal exploration leads to higher innovation performance. Also, internal exploration creates new strategic options for a company, thus leading to a higher strategic flexibility.

Hypothesis 2a Internal Exploration leads to higher innovation performance

Hypothesis 2b: Internal Exploration leads to higher strategic flexibility

TRANSFORMATION

The link between exploration and exploitation is the *transformation* process of the company (Garud and Nayyar, 1994). Exploitation of external technologies is not sufficient to maintain a competitive advantage (Garud and Nayyar, 1994). Retaining internal knowledge and internalizing external knowledge is vital for sustained competitive advantage. Garud and Nayyar (1994) imply that the process of knowledge retention is not different for internally or externally developed knowledge. This process is crucial since it might sometimes take years before newly acquired knowledge is applied (Lichtenthaler, 2009). This transformation process consists of choice of technology, maintenance and reactivation of existing knowledge (Garud and Nayyar, 1994). Since companies need existing knowledge to absorb new knowledge, the quality of the transformation process influences how well companies can internalize the new knowledge and consequently how well a company can exploit its knowledge into new products.

Technological products often consist of multiple integrated technologies. Some of these technologies are likely to already exist within the company while others need to be acquired through internal or external knowledge exploration. The recombination of existing and new resources is a way to overcome competence traps (Garud and Nayyar, 1994; Ahuja and Lampert, 2001). New technologies are often the result of combining or recombining existing and new knowledge, leading to new syntheses (Ahuja and Lampert, 2001). Garud and Nayyar (1994) explain how transformative capacity can lead to cross pollination of knowledge over time. They use the analogy of pollination from one flower´s stamen to another's stigma. It makes it probabilistic, path dependent and cumulative. Pollination allows the creation of hybrid varieties by crossing species. This success of crosspollination depends on many (environmental) factors, and eventually only the ones which are adapted to the environment prosper. Moreover, companies with better transformation are better capable of retaining relevant technological knowledge and are subsequently also better at reactivating the knowledge when needed. Companies with a greater and more relevant knowledge base can easier adapt to changing market conditions (Lichtenthaler, 2009), which will supposedly lead to a higher strategic flexibility.

Hypothesis 3a: Transformation leads to higher innovation performance

Hypothesis 3b: Transformation leads to higher strategic flexibility

EXPLOITATION

Exploitation is a learning process concerned with combining market knowledge with technology knowledge (Danneels, 2002; Lichtenthaler, 2009). Technology alone does not generate obvious opportunities (Lichtenthaler, 2009), rather the combination of technology with market knowledge enables value creation (Dougherty, 1992). Exploitation as a learning process refers to determining potential applications and the actual application of knowledge and does not refer solely to final knowledge application (Lichtenthaler, 2009). Through exploitation companies gain a deeper understanding of the used technologies and their possible applications (Ahuja and Lampert, 2002). According to Zahra and George (2002) exploitation can be linked to a higher innovation performance.

Recent studies have underscored the importance of having a well-developed exploitation process in order to reap the benefits of both internal and external explored knowledge (Lichtenthaler, 2009; Tsai and Wang, 2008). Exploitation is thus crucial for innovation performance since this determines how good a company is at using knowledge (Lichtenthaler, 2009). Without the ability to exploit knowledge, i.e. link technological knowledge with market knowledge, a firm is unable to gain profits from their knowledge base.

Hypothesis 4: Exploitation leads to higher innovation performance

ABSORPTIVE CAPACITY MODEL

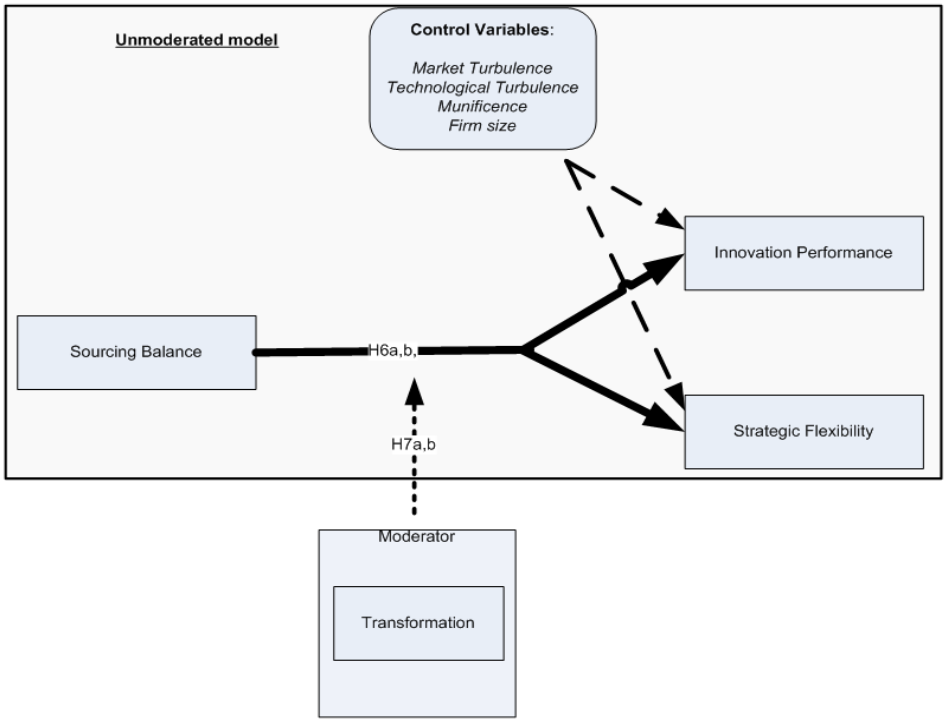
According to the original absorptive capacity model by Cohen and Levinthal (1990), absorptive capacity (external exploration) is a by-product of own internal R&D. Technologies that are acquired from outside the firm consist mostly of explicit knowledge (Nonaka et al., 2000). Some amount of tacit knowledge is however required to give meaning to the acquired knowledge (Nonaka et al., 2000). Without tacit knowledge this knowledge cannot be easily internalized by the company. When this knowledge is not internalized no further learning can take place, because it is an essential part of the learning process. Higher inventive capacity will thus lead to higher external exploration.

Hypothesis 5: Internal Exploration positively influences external exploration

SOURCING BALANCE

To answer the second research question we investigate the effect that sourcing balance has on the relationship between the learning process and innovation performance and strategic flexibility. Sourcing balance measures the propensity of the company to source exploration internally or externally. Sourcing balance ranges from purely internal exploration to purely external exploration. The research model is depicted in figure 3.

Figure 3: Research Model 2 and 3



Are companies which engage in both external and internal explorative learning processes more successful at innovation than companies which only engage in one of the two? Most research on this topic has regarded external exploration (or absorptive capacity) as a by-product of internal R&D (Cohen and Levinthal, 1990), and has consequently assumed that the two are complementary. Tsai and Wang (2008) find that external acquired knowledge only contributes to firm performance when this is matched with internal developed technology knowledge. Weigelt (2009) argues that a firm might substitute the tacit part of the external technology, which is hard to transfer, with prior experience in order to internalize the acquired knowledge easier.

Internal developed technologies are more likely to result in higher degree of technological opportunity which can be exploited (Weigelt, 2009). However, internal development does not guarantee its success, where external technologies might be easier put to purpose. External exploration can foster innovation by gaining

access to cutting-edge technologies (Weigelt, 2009). Firms with an overreliance on external technologies might position themselves unfavorable on the long run; because they lack the capability to internally renew their knowledge base, and because they lack the required tacit knowledge to master and effectively internalize the acquired knowledge (Tsai and Wang, 2008). Although an overreliance on external technologies might be more profitable on the short term (Kogut and Zander, 1992), losing the capabilities to create technologies positions firms unfavourable for the future. Moreover, as external technologies are often also available to competitors they do not create a competitive advantage. Only when it is combined with internal knowledge the knowledge might become firm specific and consequently create a potential competitive advantage (Grimpe and Kaiser, 2010)

Engaging in both exploratory learning processes at the same time nulls out the negative effect of excessive internal exploration (most notably the competence traps) and external exploration (destruction of tacit knowledge, too little competitive advantage). This begs for the answer to the question if it matters how the current technologies of a company are generally acquired; through internal development or external acquisition. The extremes seem likely to be counterproductive; pure internal development to weighty on internal resources, while acquisition might hamper the translation from technology to innovative activity (Kogut and Zander, 1992; Tsai and Wang, 2008,; Nonaka et al., 2000). Cassiman and Veugelers (2006) found that there is a complementary effect between external acquired knowledge and internal developed knowledge if these are tightly integrated. Narula (2001) states that the 'right' mix of internal and external exploration activities help to maintain a company's long term competitive position. This leads to the following hypothesis:

Hypothesis 6a: Sourcing balance has a positive effect on innovation performance

Hypothesis 6b: Sourcing balance has a positive effect on strategic flexibility

As we argued earlier, transformation is the link between exploration and exploitation. Companies make a (conscious) economic decision on which capabilities to maintain and develop on which they expect they can gain the best future profits (Garud and Nayyar, 1994; Kogut and Zander, 1992). Earlier we stated that prior knowledge affects both internal exploration and external exploration. The better the company is at transformation, the better the company can actually put the knowledge to purpose (Zahra & George, 2002; Weigelt, 2009). As a good working transformation process retains relevant knowledge we expect that firms are better able to link external technologies with internal knowledge, thereby greatly increasing the technological

potential of external technologies for the company (Garud and Nayyar, 1994). Moreover, as companies with a well-developed transformation process do have a better maintained knowledge base the more it will be able to profit from more external knowledge. Moreover, the maintained knowledge base is likely for a large part firm specific knowledge, the combination with new external knowledge is more likely to produce a unique knowledge set and thus more likely to provide a competitive advantage (Grimpe and Kaiser, 2010). Both innovation performance and strategic flexibility profit from synthesis of existing and new knowledge. We expect that when the company is better at transforming knowledge, it is better able to utilize both internal and external explored knowledge.

Hypothesis 7a: The effect of sourcing balance on innovation performance is positively moderated by transformation.

Hypothesis 7b: The effect of sourcing balance on strategic flexibility is positively moderated by transformation.

CONTROL VARIABLES

The control variables control for industry specific variances through munificence, market turbulence and technological turbulence. Munificence measures the capacity of the environment to permit growth (Wiersema, 1993); higher munificence means that the environment allows for easier growth. We expect that companies which work in a munificent environment can easier achieve both innovation performance and strategic flexibility. Market turbulence measures the rate of change in the composition of customers and their preferences (Jaworki and Kohli, 1993). Technological turbulence measures the rate of technological change in the industry (Jaworksi and Kohli, 1993). For the second research question we also controlled for firm size. The effect of firm size has often been linked to innovation performance, although the actual relationship to innovation performance is still questioned. Firm size has been linked to increased innovation performance due to greater resource availability for research and development. On the other hand, small firms have also been linked to increased innovation performance due to greater agility. We measure firm size through the numbers of employees (in FTE).

METHODOLOGY

SURVEY DEVELOPMENT

The survey was developed based on an extensive literature review. Wherever possible we used existing scales. However, for internal exploration no scale existed and we had to create our own scale. Most items were measured on a 7 point Likert scale. The scales can be found in appendix A. The questionnaire was administered through an on-line survey. The items range from 1: "strongly disagree" to 7: "strongly agree".

INDEPENDENT VARIABLES

The scales for *external exploration, transformation* and *exploitation* are based on the work of Lichtenthaler (2009). Since no usable measures exist for measuring the process of *internal exploration* we created our own scale for internal exploration. The developed measures mainly draw on studies from Rosenberg (1990), Cohen and Levinthal (1990), Nonaka et al., (2000) and Lichtenthaler and Lichtenthaler (2009). After exploratory factor analysis we decided to retain six from the ten items.

To validate our measure for internal exploration we conducted an exploratory factor analysis. Factor analysis was appropriate since the Kaiser Meyer Olkin was .816 and the Barlett's test of sphericity tested significantly. Although we constructed the ten items for two constructs measuring internal exploration no clean loading could be found for separating the 2 constructs using Principal Component Factoring with varimax rotation and Kaiser Normalization. The loadings however allowed for constructing one measure of internal exploration consisting of 6 items which loaded cleanly on one factor. The original measure for external exploration loaded clean on the intended construct. The measures for transformation and exploitation were more problematic. Only a part of the intended measures loaded cleanly on the intended constructs. Two measures had too high cross loadings to be included in the final analysis and were therefore left out. Five measures loaded more strongly (without strong cross loading on the intended construct) on another construct than the intended construct. After subsequent analysis we chose to retain three of these five items. A note of caution with interpreting the factor analysis is that we have too many items compared to the number of respondents. To control for this possible distortion we also checked all the intended constructs pairwise with a third "trash" component, we did not find any major alterations. The output of the analysis can be found in appendix B.

The *sourcing balance* scale was adopted from Jones et al. (2001). Sourcing balance measures the tendency to acquire new technological knowledge from outside the company. A high sourcing balance means that companies relatively depend more on external sources for new technologies. It should be noted that none of the companies relied solely on external sourcing. High sourcing balance does not mean that firms only source externally; preliminary analysis showed that 90% of the companies in our dataset sourced less than 50% of their technologies externally. To simplify the initial hypothesis we assume that a higher sourcing balance in this case suggests that companies engage in both internal and external exploration activities. More information can be found in appendix E.

DEPENDENT VARIABLES

Innovation performance uses measures adopted from Song et al. (2006). This scale uses both relative and firm specific performance measures. An example of a relative performance measure of the scale is: *Compared to our major competitors, our overall new product program is far more successful.* The scale consists of five items.

The *strategic flexibility* scale was adopted from Barringer and Bluedorn (1999). It consists of nine items and measures how well a company is able to change its strategic plan to a diverse set of contingencies. An example of an item is: *How difficult is it for your firm to change its strategic plan to adjust to the emergence of a new technology*. The items can be answered from 1 "very difficult" to 7 "not at all difficult".

CONTROL VARIABLES

Technology Turbulence and *Market Turbulence* are both adopted from Hofman (2010). Both scales consists of three items. It measures the amount of uncertainty in the environment. *Munificence* was adopted form Baum and Wally (2003). This scale consists of five items and measures to what extent the environment permits growth. A higher score on the munificence scale means that the environment has a greater capacity to permit growth and is thus less threatening.

DATA COLLECTION

Our original sample consisted of 600 medium sized High Tech firms located in the Netherlands. The companies were selected through the database "company.info". We refined this sample based on short interviews on the telephone ensuring the firm met our requirements. Firms had to have a staffed in-house innovation department, have at least 100 FTE and had to be willing to participate. Of the firms which met our requirement

218 agreed to participate. The criterion to have at least 100 FTE stems from our assumption that in small companies individual efforts play a larger role in certain task performances than the actual process does.

The firms were sent a personalized paper invitation which was directly followed up by a personal invitation email. The first wave resulted in 27 usable responses. After one month a reminder was sent yielding another 19 responses. The third wave was a follow up by phone yielding 10 additional responses. Finally, 56 responses were received which is a 25% response rate, which is deemed quite high for studies directed at top managers (Gruber et al., 2010). The data was collected from November 2011 until January 2012. The firms all originate from one of the following industries; Chemicals, Pharmaceuticals, Metals, electronic devices, and computers and optical devices. Firm size varied from less than 150 (19,6%), 150 to 300 (24,8%), 300 to 500 (27%) and more than 500 employees (28,6%). The distribution of the companies over the industries of the sample and the participating companies is included in appendix C.

DATA ANALYSIS

Some issues with the data set exist. A few variables measured are not normally distributed. The KS test and Shapiro-Wilk tested for external exploration (respectively .039 and .012) significantly not normal and for exploitation the Shapiro-Wilk test was significant (.015). PLS path modelling was used for conducting the analysis of the model since the dataset has not enough respondents to conduct a 'standard' full structural equation model analysis. We used the software package SmartPLS 2.0 (Ringle, Wende, & Will, 2005). A weakness of PLS is that we could not conduct model fit tests, since no good goodness of fit measures exist for models using PLS (Hulland, 1999). A usable indication for relative model of fit in PLS is by comparing the R^2 and path coefficient, which indicates the predictive power (Hulland, 1999). All relationships were tested using a bootstrap with 5000 resamples. Bootstrapping is used to examine the significance of path estimates and consequently produce T-statistics. Since PLS path modelling does not pose requirements on the distribution assumption, significance levels for the parameter estimates which are based on normal theory are, strictly speaking, not suitable. Therefore, information about the variability of the parameter estimates and their significance has to be generated by means of resampling methods (Temme et al., 2006). Compared to other resampling techniques for generating t-values and standard errors, bootstrapping is a superior resampling technique (Temme et al., 2006).

Table 1 presents the PLS correlations, table 2 represents the Average Variance Extracted (AVE), the composite reliability (CR) and the Cronbach's Alpha. These tables are mainly used for checking on validities. Convergent Validity was checked through factor loadings (see Principal component analysis in appendix B) and Average Variance Extracted, see table 2). Discriminant Validity was checked through comparing the AVE values for any two constructs with the square root of the correlation estimate between two constructs (Hair et al., 2010; Hulland, 1999). To prove discriminant validity the diagonal elements (which show the square root of the AVE shared by a construct with its indicators) should show it shares more variance with its own items than with other constructs in the model (Hulland, 1999 (see also Fornell and Larcker, 1981)). Table1 shows us no problems concerning discriminant validity.

Table 1: PLS Latent Variable Correlations*

	1	2	3	4	5	6	7	8
1 Tech Turb	**0,7926**							
2 Munificence	0,4542	**0,6037**						
3 Market Turb	0,3441	0,3449	**0,7552**					
4 External Explor	0,393	0,1299	0,3806	**0,841**				
5 Internal Explor	0,3434	0,0281	0,3501	0,5238	**0,7524**			
6 Transformation	0,2714	0,1597	0,2066	0,4043	0,4638	**0,8241**		
7 Exploitation	0,3072	0,1657	0,1547	0,357	0,3094	0,6243	**0,824**	
8 Sourcing Balance	0,2236	0,1333	0,1379	*NA*	*NA*	0,0657	-0,1641	**0,6441**

**Note: The bold diagonal values are the square roots of the AVE*

Reliability was checked through the composite reliability (CR) and Cronbach's alpha (α). According to Hair et al. (2010) the CR should be higher than .7 to prove reliability (see also Hulland, 1999). A often used threshold value for Cronbach's alpha is also .7. We noted that both munificence and market turbulence have a Cronbach's alpha of below .7, while the CR tested well above the threshold value. The only difference between Cronbach's alpha and composite reliability is that the alpha uses equal weighting on the construct, while composite reliability includes factor weighting. (Vinzi et al., 2010, p.695). Since the alpha score still approaches the .7 threshold and both the measures have been successfully used in prior research (munificence α=.87 in Baum and Wally (2003), market turbulence α=.70 in Hofman (2010)) we chose to retain the constructs. Our constructs scored well above the CR threshold and therefore we do not see any problems concerning reliability (see table 2).

Table 2: Reliability statistics

	AVE	CR	CronbachsAlpha
Technology Turbulence	0,6283	0,8333	0,7136
Munificence	0,4876	0,7855	0,6925
Market Turbulence	0,5704	0,7948	0,6363
External Exploration	0,7072	0,9062	0,8632
Internal Exploration	0,5662	0,8858	0,8456
Transformation	0,6795	0,9269	0,9049
Exploitation	0,6789	0,9268	0,906
Sourcing Balance	0,5248	0,8631	0,8628
Innovation Performance	0,4758	0,8147	0,711
Strategic Flexibility	0,4247	0,8677	0,8291

To check for common method bias (CMB) we performed a Harman single factor test. Harman's single factor test includes all items from all of the constructs into a factor analysis to determine whether the majority of the variance can be accounted for by one general factor (Podsakoff et al., 2003). Only 41% (using PCA) of the variance was explained through a single factor, showing no reason for concern about CMB.

RESULTS

Table 3 summarizes the correlations table, the mean and the standard deviation. We chose to use Kendall's Tau for the non-parametric correlation. Kendall's Tau is, especially in the case of a small data set, superior to Spearman's Rho (Field, 2000).

Table 3: Correlations

Kendall's Tau *(n=56)*	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Internal Exploration	3.62	1.29	1,000.									
2. External Exploration	4.08	1.4	,298**	1,000.								
3.Transformation	4.92	1.2	,241**	,220*	1,000.							
4.Exploitation	5.25	1.18	,182*	,242**	,524**	1,000.						
5.Strategic flexibility	4.05	.78	,137	,198*	,237**	,289**	1,000.					
6.Innovation Performance	4.94	.85	,161*	,113	,478**	,469**	,228**	1,000.				
7.Munificence	3.9	1.06	,025	,127	,031	,082	,222*	,214*	1,000.			
8.Technological Turbulence	3.87	1.24	,243**	,281**	,103	,168*	,151	,181*	,177*	1,000.		
9.Market Turbulence	4.06	1.3	,281**	,279**	,112	,122	,224*	,188*	,215*	,277**	1,000.	
10.Sourcing Balance	3.05	1.34	-,150	-,009	-,093	-,198*	,011	-,177	,005	0,137	,055	1,000

*'p<.1 *p<.05 **p<.01*

Table 4 and Table 5 summarize the results of the bootstrapping procedure and the hypotheses tests. The complete bootstrap results table can found in appendix D. For easier interpretability we included figures to 4 to 7 which depict the path coefficients of the different models and their significance levels. We mean-centered all interaction terms because this potentially leads to increased interpretability of the interaction (Hofman, *2010*). When controlling for environmental factors we found that munificence affected strategic flexibility (β=.258 p<.05).

The R^2 of the individual learning processes model to innovation performance is .577, which means that 57.7% of the variance in the dependent variable is explained by the independent variables. The high percentage of variance explained suggests a strong fit of the model with the data (Robins et al., 2002). The R^2 of the learning processes to strategic flexibility is .29. While the percentage of explained variance is notably

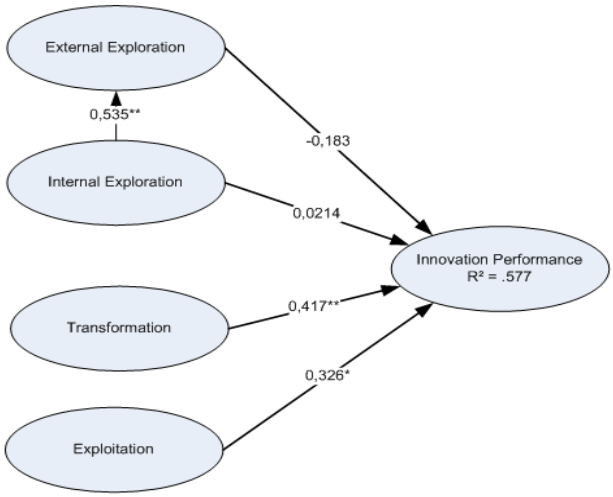
lower than for innovation performance, the amount of variance explained can still be deemed rather high. We also measured Cohen's f^2 (Cohen, 1988) to indicate the effect size of the model. The f^2 indicates the effect size of our independent variables compared to a model with only control variables inserted. An f^2 of 0.02 is interpreted as a small effect size, f^2=.15 is a medium effect size and f^2=.35 is a large effect size. This leads us to conclude that the effect size of model 1a (0.45on innovation performance) is large, and in 1b (0.07 on strategic flexibility) is small (see table 4).

HYPOTHESES TEST

INNOVATION PERFORMANCE

Hypotheses 1a and 2a propose that external exploration and internal exploration positively affect innovation performance. We could not find evidence for any direct relationship from internal or external exploration to innovation performance. Therefore we reject hypotheses 1a and 2a. In other words, a company's skill in internal and external exploration processes does not directly affect innovation performance.

Figure 4: Path analysis model 1a/c



*'p<.1 *p<.05 **p<.01*

Hypotheses 3a and 4 propose that transformation and exploitation positively affect innovation performance. Both the path coefficients are significant and therefore we find support for both hypothesis 3a (β=0,417; p<,01) and hypothesis 4 (β =0,325; p<,05).

Hypothesis 5 proposes that internal exploration has a positive relation with external exploration. Our data strongly supports this hypothesis (β=0,535; p<,001), suggesting that higher internal exploration leads to higher external exploration.

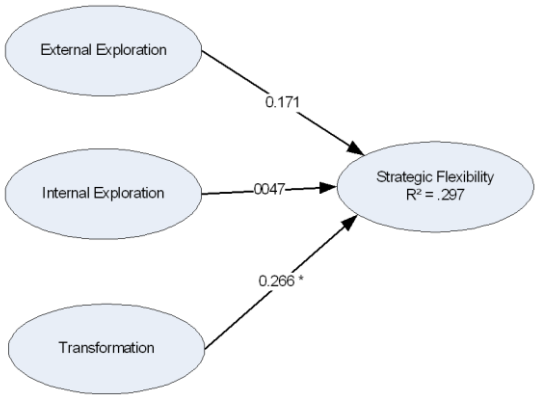
STRATEGIC FLEXIBILITY

Hypotheses 1b and 2b propose that external exploration and internal exploration would positively affect strategic flexibility. For these relations we could not find support in our data (see table 4, see appendix D for

the complete bootstrap results). This suggests that there is no direct relation between both internal and external exploration and strategic flexibility.

Hypothesis 3b proposes that transformation will positively impact strategic flexibility. Our data supports this hypothesis (β= 0,266; p<,05)). This suggests that the better a company is at retaining and reactivating knowledge, the higher its ability to adapt to changes in the environment.

Figure 5: Path analysis model 1b



*'p<.1 *p<.05 **p<.01*

Table 4: Summarized Bootstrap results model 1

Innovation Performance*(N=56)* Model 1a	**Path**	**β (sd)**	**Hypothesis Test**
H1a +	External Exploration	-0,1833 (0,1315)	**Not Supported**
H2a +	Internal Exploration	0,0214 (0,1294)	**Not Supported**
H3a +	Transformation	0,417 (0,1321) **	**Supported**
H4a +	Exploitation	0,3258 (0,1371) *	**Supported**
R^2 (F^2)[b]	**Innovation Performance**		**.577 (.45)**
Strategic Flexibility Model 1b			
H1b +	External Exploration	0,171 (0,1681)	**Not Supported**
H2b +	Internal Exploration	0,047 (0,1568)	**Not Supported**
H3b +	Transformation	0,.2667 (0,1353)*	**Supported**
R^2 (F^2)[b]	**Strategic Flexibility**		**.297 (.07)**
Inner Path Model 1c[a]	External Exploration		
H5 +	Internal Exploration -> External Exploration	0,535 (0,085)**	**Supported**
R^2	**External Exploration**		**0,276**

*[i]p<.1 *p<.05 **p<.01*

Note: The full bootstrap results can be found in appendix D

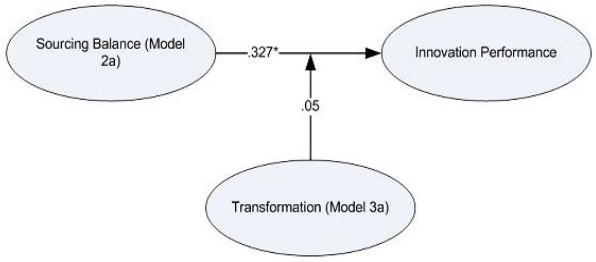
[a] This model is similar to model 1a but has the inner path from internal exploration to external exploration included

[b] The F^2 score is the relative increase in explanatory power compared to a model in which only controls are inserted.

SOURCING BALANCE

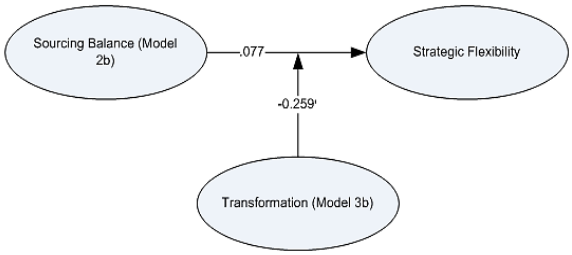
Hypothesis 6a and 6b propose a positive relation of sourcing balance to respectively innovation performance and strategic flexibility. Our results show (see table 5, see appendix D for the complete bootstrap results) a significant but negative effect of sourcing balance on innovation performance (-0,327; p<.05), which is the complete opposite of the relation we expected. It suggests that the more companies tend to get new technologies from outside the firm, the worse their innovation performance becomes. For strategic flexibility we found no significant direct effect from sourcing balance (Model 2b). If internal and external sourcing is complementary we expect to find an inverted U shaped relation of sourcing balance with both innovation performance and strategic flexibility. To test this relationship we performed a PLS path analysis on the squared term of sourcing balance. An inverted U shaped relation would show a significant negative path coefficient, while the linear term coefficient should be positive (Grimpe and Kaiser, 2010). We did not find any support for an inverted U shaped relation (β= -.331 for innovation performance; β=.196 for strategic flexibility). This leads us to reject hypothesis 6a and 6b.

Figure 7: Path analysis model 2a and 3a



*'p<.1 *p<.05 **p<.01*

Figure 6: Path analysis model 2b and 3b



*'p<.1 *p<.05 **p<.01*

Table 5: Summarized Bootstrap results model 2 and 3

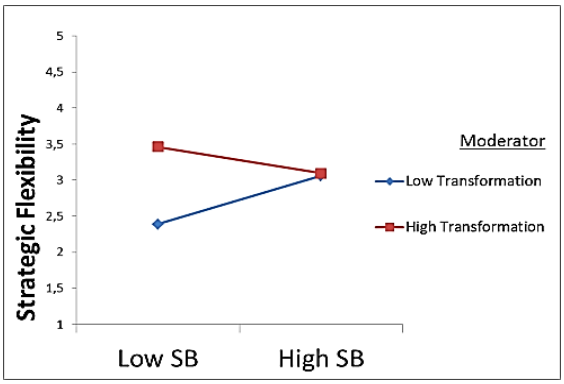
N=56		**Innovation performance**	**β (sd))**	**Hypothesis**
Model 2a	H6a+	Sourcing Balance	-0,327 (0,1765)*	**Not supported**
Model 3a	H7a+	Sourcing balance * Transformation	0,05 (0,183)	**Not supported**
		Strategic Flexibility		
Model 2b	H6b+	Sourcing Balance	0,077 (0,111)	**Not supported**
Model 3b	H7b+	Sourcing balance * Transformation	-0,259 (0,195) '	**Not supported**

*'p<.1 *p<.05 **p<.01*

Note: The full bootstrap results can be found in appendix D

Hypothesis 7a and 7b propose that transformation positively moderates the effect of sourcing balance on innovation performance and strategic flexibility. Transformation (Model 3a, see also figure 3) did not moderate the effect of sourcing balance on innovation performance. Therefore we reject hypothesis 7a. However, for strategic flexibility we find that transformation negatively moderates (β= -.259 p<.1) the relation between sourcing balance and strategic flexibility (Model 3b). This moderation effect has the opposite effect of what we expected and therefore does not support 7b. The interaction effect shows that companies which are relatively ineffective in storing and retrieving knowledge (transformation) profit less (in the sense of strategic flexibility) from a more internally focused sourcing balance than companies which are better at storing and retrieving knowledge. The interaction effect is depicted in figure 8.

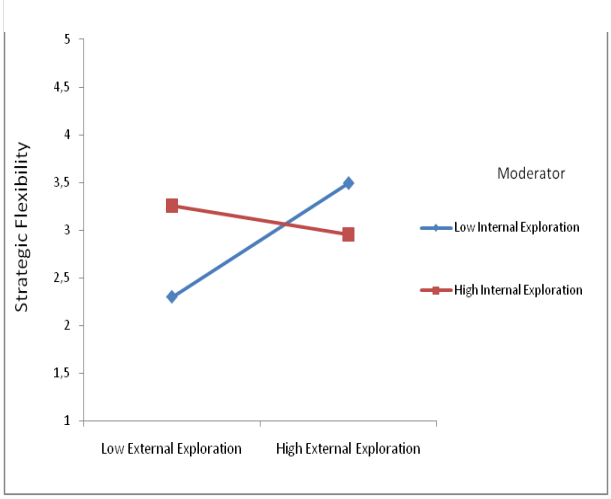
Figure 8: Moderation Effect Transformation



ADDITIONAL ANALYSES

To further examine this result we also used another operationalization to test for substitution or complementarity effect. We used the interaction of the processes internal exploration and external exploration. For innovation performance we did not find a significant interaction effect, supporting neither substitution nor complementarity. For strategic flexibility we did find a strong (β= -.375; p<.01) negative interaction, suggesting a substitution effect of internal and external exploration (see figure 9). In other words, as companies engage more in internal exploration, the effect of external exploration on strategic flexibility becomes more and more negative. The interaction also suggests that companies with low internal exploration can compensate for this by endeavouring in external exploration activities. The results of this bootstrap can be found in appendix D.

Figure 9: Moderation effect Internal Exploration



The control variable munificence tested constantly significant as a control variable. Therefore we look deeper into the relationship between munificence and both innovation performance and strategic flexibility. Munificence moderates sourcing balance significantly on innovation performance (β=.378 p<.05). Apparently the more the environment permits growth, the more positive external exploration becomes. For strategic flexibility munificence negatively moderates sourcing balance (β =-0.447 p<.05). The pictures below show how munificence influences sourcing balance for both innovation performance and strategic flexibility. Remarkable is that companies in low munificent environments have conflicting interests (see figure 10 and 11); although innovation performance requires a focus on internal exploration, strategic flexibility requires a more external oriented sourcing balance. This makes the question a trade of for companies, pursuing innovation performance or strategic flexibility. Also remarkable is that the negative relation we found for sourcing balance and innovation performance does not hold for high munificent environments.

Figure 11: Moderation effect Munificence IP

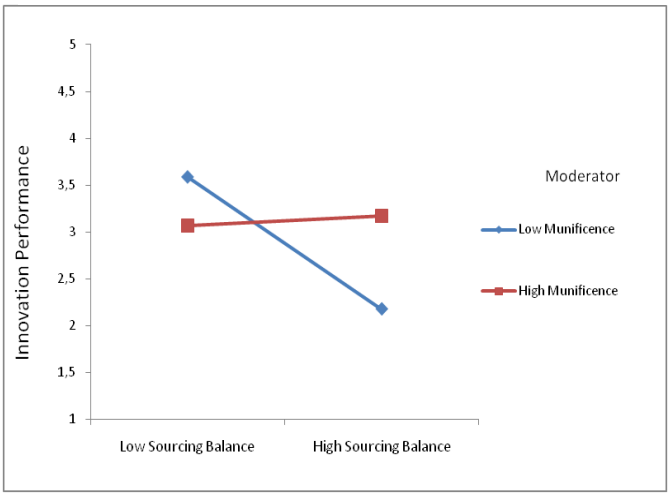
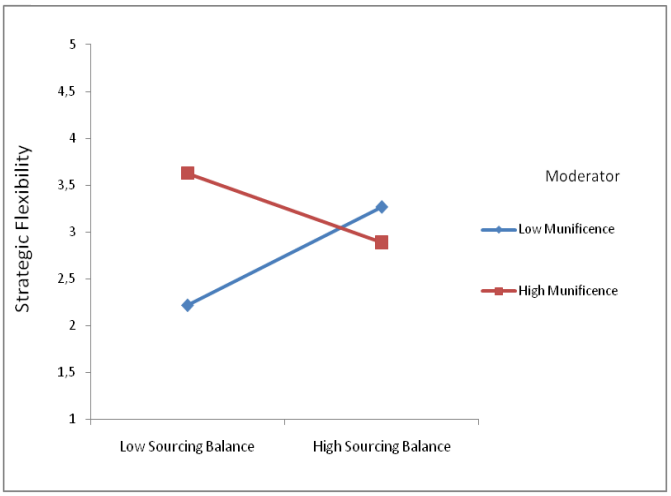


Figure 10: Moderation effect Munificence SF



DISCUSSION

This study investigated how the processes of renewing the firm's competences affect innovation performance and strategic flexibility. We started with investigating how the individual processes *internal exploration*, *external exploration*, *transformation* and *exploitation* affect innovation performance and strategic flexibility. Then we investigated if, and how, the source of technological knowledge affects both innovation performance and strategic flexibility. Our first research question was how the processes of *exploration*, *transformation* and *exploitation* affect innovation performance and strategic flexibility. The results of this study show that transformation has a positive relation on both innovation performance and strategic flexibility. The results also support our hypothesis that exploitation has a positive relation with innovation performance.

The finding that exploitation has a positive relation with innovation performance is in line with the proposition done by Zahra and George (2002) and supports the findings of Lichtenthaler (2009). It implies that although all the learning processes are of importance to achieve innovation performance, the exploitation of new knowledge is necessary to achieve commercial outputs (Lane et al., 2006). The strong direct relation of transformation to innovation performance underlines the importance of the process as was emphasized by Garud and Nayyar (1994). The strong relation can be explained that companies are continuously looking for triggers for their knowledge base and looking for synthesis with their current knowledge (Garud and Nayyar, 1994). This synthesis of newly explored and stored firm knowledge will lead to a greater technological opportunity of both existing and new knowledge, which would in turn lead to new market opportunities. The benefits do not originate only from the newly explored knowledge, but also from the reactivated stored knowledge (Kogut and Zander, 1992). Moreover, it signifies the proposition of Lichtenthaler (2009) that transformation is an important link between exploration and exploitation because new knowledge might take years before it is applied.

The finding that transformation leads to strategic flexibility partially supports the proposition of Zahra and George (2002) that firms which are good at knowledge exploration and are able to integrate this knowledge in the firm's knowledge base can sustain a larger strategic flexibility. A good explanation comes from Cohen and Levinthal (1989) who state that knowledge frequently results from the search for new solutions that are based on the firm's existing knowledge base. Our findings do not support a direct relation from exploration to strategic flexibility. These findings can be quite easily explained by that exploring

knowledge is useless if it is not integrated in the company's knowledge base. As we argued earlier the synthesis of stored knowledge and new knowledge makes also the existing knowledge relevant again because of novel combinations of technologies.

We find strong evidence for the original Cohen and Levinthal (1990) absorptive capacity model; internal exploration positively influences external exploration. The ability to internally explore knowledge does have a direct relationship on the ability to externally explore knowledge. In over 20 years many scholars have accepted this relationship, while there was (to our knowledge) no sufficient empirical evidence for assuming this relationship. The strong relation we find in our data leaves no room for discussion on this relation; internal exploration positively influences external exploration.

Our second research question was how sourcing balance affects innovation performance and strategic flexibility**.** Contrary to our expectations, our data did not support our propositions on the relations between sourcing balance and innovation performance and strategic flexibility. Surprisingly, our data suggests a negative linear relation between external sourcing propensity and innovation performance. Sourcing balance did not seem to affect strategic flexibility. Subsequent analysis to look for possible inverted U shaped relations did not yield any support which contradicts the findings of Grimpe and Kaiser (2010). A first preliminary conclusion on these results would suggest that companies which are looking for both innovation performance and strategic flexibility might want to err on the internal exploration side of sourcing balance. This is in line with the finding of Jones et al. (2001) who found that external technology acquisition detracts from firm performance.

However, the relations between sourcing balance on strategic flexibility and innovation performance are being complicated by environmental influences. Additional analysis showed that the less the environment permits growth (low munificence), the stronger the effect of sourcing balance becomes. These effects are depicted in figures 10 and 11 on page 25.

For innovation performance low munificence makes the negative effect of sourcing balance stronger. In other words; in low munificent environments innovation performance is best achieved when developing new technologies internally. This can be explained by Cohen and Levinthal's (1989, 1990) argument that the propensity for knowledge spill overs affects absorptive capacity. More hostile environment (low munificence) would lead to higher intellectual property protection, which in turn would lower the appropriability of external knowledge acquisition because of the decreased knowledge spill overs in the environment (Cohen and

Levinthal, 1990). Another possible explanation might be that in low munificent environments firms might be more inclined to keep technological developments closer to the chest and thus choose to source internally since internal created knowledge is firm specific and can consequently be a source of competitive advantage (Garud and Nayyar, 1994). Moreover, external exploration is more likely to lead to new technological trajectories and often involves cannibalizing earlier technologies and thus scarce resources (Chandy and Tellis, 1998).

In contrast to the findings for innovation performance, companies in low munificent environments achieve higher strategic flexibility when looking for a more externally focused sourcing balance. This can be explained by that low munificence constitutes higher competition and does not allow much growth of resources within firms (Baum & Wally, 2003). Because of a lower slack of resources companies cannot afford to maintain a large knowledge base, and do not have the resources for a lot internal exploration activities (Castrogiovanni, 1991). Since strategic flexibility is essentially a knowledge output, strategic flexibility is actually how you can use your knowledge base. The notion that the sourcing balance tends more towards more external knowledge to create strategic flexibility makes perfect sense. Towards external sourcing the characteristic is acknowledged to create knowledge departing from existing knowledge. As a company's internal sourcing is more bound by prior firm knowledge, getting knowledge from outside the firm creates new combinations of technologies and subsequently new strategic options. Moreover, external technologies can complement and leverage internal technologies (Garud and Nayyar, 1994).

This suggests that for companies in low munificent environments the sourcing question is a trade-off; internal sourcing for better innovation performance, external sourcing for better strategic flexibility. The finding that this is a trade-off might be explained by that companies tend to invest more in technologies that they are familiar with or are in line with current technology trajectories (Ahuja and Lampert, 2001), especially when the resources are scarce and the companies cannot afford the costs of failure. That internal development leads to higher innovation performance might be explained by the path dependency of internal developed technology. It might well be the case that companies which engage in internal exploration create a rather homogenous knowledge base which they are well able to exploit, but does not provide the knowledge heterogeneity required for strategic flexibility. The depth a homogenous knowledge base takes with it helps the company making sense of technologies and is likely better able to exploit the knowledge (Prabhu et al.,

2005). However, since the environment does not provide much opportunity for growth, it is not feasible to maintain and experiment with much different sources of knowledge and sustain knowledge heterogeneity. Knowledge heterogeneity creates more knowledge breadth and allows for more creative combinations and recombination of knowledge (Rodan & Galunic, 2004). This is in line with the suggestion of Prabhu et al. (2005) who states that: "broader knowledge […] gives the firm greater flexibility and adaptability in responding to environmental change (p.116).

Contrary to our expectations we find that transformation negatively moderates the relation between sourcing balance and strategic flexibility. This moderation effect is depicted in figure 8. It implies that as companies are better in retaining and reactivating knowledge they benefit more from internal exploration. Our data suggests that companies which are not good in retaining and reactivating knowledge should endeavour in more external exploration. As we argued earlier, strategic flexibility requires a heterogeneous and broad knowledge base. Internal exploration provides new technologies which can be combined with existing knowledge and subsequently creates a greater strategic flexibility. Companies which are not that able in retaining and reactivating knowledge are not able to find new linkages in knowledge and thus cannot achieve the same amount of strategic flexibility. However, to achieve strategic flexibility, companies with low transformation need to find complementary knowledge sources. Internal exploration for acquiring this knowledge is unlikely since internal development weights heavy on the company's resources while external knowledge sources might be easier to acquire.

Our data does not provide a clear cut answer to the question how sourcing balance influences innovation performance and strategic flexibility. The ability of the environment to allow growth has an important influence on the sourcing balance question. This study underscores the importance of the process of knowledge retention and reactivation, not only does it have a direct significant relation to innovation performance and strategic flexibility, it also moderates the relation between sourcing balance and strategic flexibility. Our data does not provide evidence for a complementarity effect between internal and external exploration and innovation performance and strategic flexibility. Our data does not support the findings of Tsai and Wang (2008) and Cassiman and Veugelers (2006) who did find complementarity between internal and external exploration. A possible reason for this is that they used a completely different operationalization than we did. Tsai and Wang (2008) used R&D stock for internal exploration and patent acquisition for external

exploration. Cassiman and Veugelers (2006) used proxies as a positive internal R&D budget for internal sourcing and asking whether companies engage in external acquisition activities for external exploration.

The sourcing question clearly has no fixed configuration on where all indicators of firm performance score the highest. Strategic flexibility tends towards a more mixed sourcing, while innovation performance tends more towards internally focused sourcing; this difference is especially notable in environments which do not support growth. This places Zahra and George's (2002) notion of the relationship between exploration and strategic flexibility in a new light. Although our data did not directly fit their proposition, their premise of strategic flexibility by departing from existing firm knowledge by using external knowledge still holds. To prevent falling to competence traps firms need knowledge sources which are more remote from their existing knowledge (Ahuja and Lampert, 2001). Since knowledge in itself does not contribute anything unless it is combined and applied (Lane et al., 2006; Lichtenthaler, 2009), it is hard to find direct evidence for a relation between knowledge exploration and strategic flexibility without involving the subsequent process of transformation.

IMPLICATIONS FOR PRACTICE

One of the most important and relevant findings for practice is the important role that transformation plays in the renewing of firm competences. Companies with a well-developed ability to maintain and reactivate knowledge benefit from a higher innovation performance and a higher strategic flexibility. Synthesizing new knowledge with stored firm knowledge can revive 'old' knowledge and find novel combinations and new applications of both new and 'old' knowledge. This means that it plays an important role in both short term innovation performance as in long term strategic flexibility.

The environment plays an important role in choosing between internal or external exploration of new technologies. Especially, if the environment of the company permits little growth, the sourcing question becomes a trade-off. When companies are looking for innovation performance they can best develop new technologies mainly internally. However, as companies are looking for strategic flexibility they are better of with pursuing a more externally focussed sourcing balance. Especially in low munificent environment this is a dangerous trade-off because companies are forced to choose between short term and long term benefits. The persisting economic crisis has, and will likely continue, evaporated growth opportunities in the environment, making the sourcing balance trade-off more relevant to more and more companies.

LIMITATIONS AND FUTURE RESEARCH

This study has some limitations which need to be taken into account. First of all, our sample size was quite small (n=56). Although the response rate was quite high, it still puts limitations on the generalizability of this study. A great limitation of a sample size this small is that we could not test for group differences or industry differences since the subsamples would be too small to produce meaningful results. Despite the modest sample size, we still did find significant relations between our hypothesized effects.

Some issues with our data set forced us to use non parametric methods to test our relations. Instead of the intended 'normal' structural equation modelling we had to rely on modelling techniques which did not assume normal distribution in the data. A viable solution for this was PLS path modelling. PLS path modelling comes with a few shortcomings; we could not perform model tests since there are (currently) no tests available to prove model fit in a PLS model (Hulland, 1999). The high predictive power however, suggests that the data fit the model well (Robins et al., 2002).

The use of a single key informant can be a source of common method variance (Sharma et al., 2009; Podsakoff, 2003; Donaldson & Grant-Vallone, 2002). Also, self-report bias can be a potential threat to validity, because respondents might present performance of their firm more positive than it is in reality (Donaldson &Grant-Vallone, 2002).We used self-reports to obtain both information on the independent and the dependent variable. This might result to a common method variance (Podsakoff et al., 2003). We did check for CMV issues but could not find any reason to be concerned about common method bias. Moreover, Hofman (2010) states that objective and subjective performance measures highly correlate. We therefore do not expect that using subjective data on the dependent variable would affect our findings much.

Another important limitation that needs to be taken into account is that during and before the data collection a severe economic crisis was present. This might, and supposedly has, affected companies' spending to innovation endeavours. Until date the precise effects remain unclear, as this research was conducted across different industries, differences on the impact of the crisis between industries might have affected the results. This limitation also provides a great opportunity for future research. To truly measure the impact of the processes of exploration, transformation and exploitation on long term firm performance, one should just have to look at the performance of the firms a few years after the crisis has passed. Grewal and Tansuhaj (2001) show us that strategic flexibility directly affects firm performance after a crisis.

An important but until date quite unexplored field of research is the interplay between internal and external exploratory learning. We have shown that the complementarity relationship was very presumptuous. Due to the use of proxies which poorly reflect the richness and depth and the delicate balance of internal and external exploration and the neglect of the importance of the subsequent processes of transformation and exploitation empirical evidence is not consistent. Our findings need to be further validated and explored in future studies with a greater sample size.

Although previous studies in the field of innovation management have considered environmental factors and consequently have controlled for their possible influences, they are often restricted to controlling for market and technological turbulence. In this study we have uncovered that munificence is a very important, but in this field barely used, environmental factor that has a major impact on the configuration of innovative activities. A good avenue for future research is determining the impact of munificence on innovation performance and investigating the interrelations it has with other environmental factors. Especially now that the level of munificence is likely to decrease due to the economic crisis, it is important for both practice as for policy makers to know what influences munificence has.

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APPENDIX A: MEASURES

Internal Exploration (new) (α.85)
We frequently internally conduct research in areas in which our firm has no prior experience.
We invest a lot in internal research of technologies that we expect to start using in the far future.
We conduct basic research even when we have no direct application for it.
We often start own research projects with the sole objective of gaining a fuller knowledge or understanding of the subject under study
When we need technologies in where we have no prior experience we are well capable of speedily developing it internally.
We frequently develop new technologies inside the firm.
External Exploration Adapted from Lichtenthaler (2009) (α.86)
We frequently acquire technologies from external sources.
We periodically organize special meetings with external partners to acquire new technologies.
Employees regularly approach external institutions to acquire technological knowledge.
We often transfer technological knowledge to our firm in response to technology acquisition opportunities.
Transformation Adapted from Lichtenthaler (2009) (α.90)
We thoroughly maintain relevant knowledge over time.
Employees store technological knowledge for future reference.
We communicate relevant knowledge across the units of our firm.
Knowledge management is functioning well in our firm.
When recognizing a business opportunity, we can quickly rely on our existing knowledge.
It is well known who can best exploit new technologies inside our firm.
Exploitation Adapted from Lichtenthaler (2009) (α.91)
We are proficient in reactivating existing knowledge for new uses.
New opportunities to serve our customers with existing technologies are quickly understood.
We are proficient in transforming technological knowledge into new products.
Our employees are capable of sharing their expertise to develop new products.
We regularly apply technologies in new products.
Munificence Adopted from: Baum and Wally, 2003 (α.69)
There are few external threats to the survival and well-being of our firm.
Our markets are rich in investment capital.
Economic development programs offer sufficient support for our business community.
Our markets are rich in profitable opportunities.
Our firm operates in a threatening business environment.*(RC)*
Technological Turbulence Adopted from Hofman (forthcoming) (α.71)

The technologies used in our products are changing rapidly.
Future technological improvements of products and subsystems are very likely.
Specifications for products and subsystems change frequently.
Market Turbulence: Adopted from Hofman (forthcoming) (α..64)
Customers' preferences for product features have changed quite a bit over time.
We are witnessing demand for our products from customers who never bought them before.
New customers tend to have product-related needs that are different from those of our existing customers.
Technology sources (new)
In the last three year, approximately what percentage of technologies used in new developed products originated from an external source?
Relative Innovation Performance Adopted from Rundquist (2009) (α.71)
Overall, our company is one of the most successful in the industry.
Our overall performance of our new product program has met our objectives.
From an overall profitability standpoint, our new product development program has been successful.
Compared to our major competitors, our overall new product program is far more successful.
The overall quality of our new products is higher than that of our competitors.
Strategic Flexibility Adopted from Barringer & Bluedorn,(1999) (α.83)
How difficult is it for your firm to change its strategic plan to adjust to each of the following contingencies*/possibilities?*
The emergence of a new technology
Shifts in economic conditions
The market entry of new competition
Changes in government regulations
Shifts in customer needs and preferences
Modifications in supplier strategies
The emergence of an unexpected opportunity
The emergence of an unexpected threat
Political development that affect your industry
Sourcing Balance Adopted from Jones et al. (2001))(α .86)
Technologies used in products can originate from different sources. We are interested in to what extent your company's
My firm develops the product technology it requires through its own research. (RC)
My firm spends more on developing its own product technology than on purchasing it from other companies. (RC)
My firm's products are based primarily on product technology we developed in-house. (RC)
My firm acquires a majority of its product technology from related third party companies.
We are heavily dependent on other companies to supply us with new product technology.
We rely on external sources to provide us with new generations of the product technology we utilize.

APPENDIX B: EXPLORATORY FACTOR ANALYSIS

Rotated Component Matrix[a]					
	Component[b]				
	1	2	3	4	5
ICA01			0,664		
ICA02			0,766		
ICA04			0,655		
ICA05			0,672		
ICA07			0,696		
ICA10			0,662		
AC01				0,835	
AC02				0,791	
AC03				0,634	
AC04				0,583	
AC05				0,631	
AC06					0,78
AC07					0,699
AC08					0,688
AC09					0,859
TC01		0,752			
TC02		0,707			
TC03		0,779			
TC04		0,801			
TC05		0,701			
TC06	0,761				
TC07	0,592				
TC08	0,761				
INC01	0,73				
INC04	0,73				
INC05	0,79				
INC06		0,545			
INC07	0,772				
INC08		0,674			
Extraction Method: Principal Component Analysis.					
Rotation Method: Varimax with Kaiser Normalization.					
a. Rotation converged in 8 iterations.					
b. Loadings under 0,4 have been suppressed					

APPENDIX C: SAMPLE DISTRIBUTION OVER INDUSTRIES

Table 6: Distribution over industries

SBI/Industry	Complete Sample	Participating companies
20 Chemical products	30%	16%
21 Pharmaceutical industry	6%	4%
25 Metal industry	23%	29%
26 Computers and optics	16%	7%
27 Electrical devices	14%	16%
28 Transport industry	11%	7%
Blank (anonymous responses)		21%
Total number	**218**	**56**

APPENDIX D: FULL BOOTSTRAP RESULTS

Table 7: Full bootstrap results model 1

Innovation Performance	Controls β (sd))	1a β (sd))	1c β (sd))	Strategic Flexibility	Controls β (sd))	1b β (sd))
Tech Turb	0.226 (0.151)	0.135 (0.132)	0.136 (0.136)		0.138 (0.737)	0.046 (0.184)
Munificence	0,13 (0.160)	0.125 (0.132)	0.117 (0.125)		0.248* (0.138)	0.221* (0.146)
Market Turb	0.216 (0.167)	0.137 (0.13)	0.132 (0.128)		0.274* (0.143)	0.156 (0.136)
External Exploration		-0,1833 (0,131)	-0.175 (0.119)			0,171 (0,168)
Internal Exploration		0,0214 (0,129)	-0.006 (0.122)			0,047 (0,156)
Transformation		0,417** (0,132)	0.448** (0,132)			0,.2667* (0,135)
Exploitation		0,3258* (0,137)	0.307* (0.127)			
Internal exploration -> External exploration			0.534** (0.119)			
R^2	0.189	0.577	.551	**R^2**	0.246	0.297
F^2		0.45		**F^2**		0.08

[i]p<.1 *p<.05 **p<.01

Table 8: Full Bootstrap results model 2 and 3

Innovation performance	Model 2a β (sd))	Model 3a β (sd))	Strategic Flexibility	Model 2b β (sd))	Model 3b β (sd))
TechTurb	0,296 (0,1319)*	0,17 (0,135)		0,109 (0,191)	0,074 (0,174)
Munificence	0,119 (0,1393)	0,124 (0,128)		0,258 (0,143)*	0,237 (0,133)*
MarkTurb	0,192 (0,1376) [+]	0,124 (0,130)		0,269 (0,145)*	0,109 (0,132)
Firm Size	0,272 (0,092)**	0,175 (0,077)*		0,142 (0,250)	0,148 (0,182)*
Sourcing Balance	-0,327 (0,1765)*	-0,2 (0,129)		0,077 (0,111)	-0,024 (0,108)
Transformation		0,423 (0,116)**			0,2 (0,132) [+]
Sourcing balance * Transformation		0,05 (0,183)			-0,259 (0,195) [+]
R^2	**0,415**	**0,564**		**0,269**	**0,357**

[i]*p<.1 *p<.05 **p<.01*

Table 9: Bootstrap results additional analysis

	Strategic Flexibility	Strategic Flexibility	Innovation performance	Innovation Performance
External Exploration	,222 (0,142)	,064 (0,139)	-,082 (,144)	-0,137 (, 151)
Internal Exploration	,105 (0,195)	-,006 (0,163)	,139 (,162)	,085 (,163)
External Exploration * Internal Exploration		-,375 (,156) **		-,159 (275)

APPENDIX E: TECHNOLOGY SOURCES OF SAMPLE

Relative amount of technologies sourced externally

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0%	6	10,7	10,7	10,7
	1%	6	10,7	10,7	21,4
	10%	10	17,9	17,9	39,3
	15%	2	3,6	3,6	42,9
	2	1	1,8	1,8	44,6
	20%	6	10,7	10,7	55,4
	25%	6	10,7	10,7	66,1
	30%	1	1,8	1,8	67,9
	5%	10	17,9	17,9	85,7
	50%	3	5,4	5,4	91,1
	55%	1	1,8	1,8	92,9
	60%	1	1,8	1,8	94,6
	75%	2	3,6	3,6	98,2
	80%	1	1,8	1,8	100,0
	Total	56	100,0	100,0	