The impact of exploitative and explorative innovation on companies' financial performance: a longitudinal study

Author: Sarah Wiegard
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT

Being innovative is considered to be a fundamental cause of organizational success. Literature generated many types of innovations and previous research discovered interrelationships between different types of innovation. Conducting innovation portfolio management effectively is therefore a key factor for improving organizational performance. The main objective of this paper is to analyze whether an optimal innovation portfolio mix between exploitative and explorative innovations exists among manufacturing companies that leads to a highest possible financial performance compared to other innovation portfolio mixes. This study uses secondary data gathered over a period of eight years to examine potential portfolio mixes that achieved high financial performances over the years. Relationships between research and development hours spent on innovations and financial performance indicators are empirically tested as well as relationships between different innovation portfolio groups and financial performance indicators. The sample of 52 small- and medium-sized Dutch enterprises produces non-significant test results. Detailed limitations and suggestions for further research are given to tackle this valuable research domain, delivering guidelines of how to proceed with discovering an optimal innovation portfolio mix for manufacturing companies.

Graduation Committee members:
1st supervisor: Dr. Matthias de Visser
2nd supervisor: Dr. Michel Ehrenhard

Keywords

Innovation portfolio management, exploration, exploitation, financial performance, innovation typologies, innovation portfolio mix

11th IBA Bachelor Thesis Conference, July 10th, 2018, Enschede, The Netherlands.

1. INTRODUCTION

Innovativeness, by many referred to as the primary source of competitive success, gained over the past decades and still retains a strong focus by business scholars (Chunningham & Harney, 2012; Schilling, 2013). Especially in times of intensified competition through globalization and increased pace of change, being innovative is perceived to be an essential requirement for companies to become and stay competitive (Gunday et al., 2011; Schilling, 2013).

By adopting innovation, where innovation can be defined as the undertaking of developing and introducing new ideas, methods, materials, products or behaviors (Schilling, 2013; Draft, 1978; Walker, 2006), organizations aim to "adjust their external and internal functions so that they could respond to environmental demands, operate efficiently and effectively, and maintain or improve their performance" (Damanpour, Walker, & Avellaneda, 2009, p.655). Despite many innovation definitions, the concept is rather broad. As mentioned by Trott (1998) "clear definition of innovation is difficult as it can include just about any organisational or managerial change, whether that involves new products, processes, ventures, systems, production methods, commercial arrangements or services" (p. 13), the concept of innovation is considered as broad and comprehensive. Therefore, previous literature distinguishes between different types of innovation. These include product and process innovation or exploitative and explorative innovation, to name some. By categorizing innovations, organizations can create and monitor innovation portfolios. The management of those innovation portfolios contains the allocation of resources to current new development projects. By choosing specific new development projects and allocating resources to those projects, organizations want to implement and realize formulated corporate strategies (Meifort, 2016).

Organizations implement innovations to sustain and boost their performances. Intensifying competition, resource deficiencies or changing customer demands are examples for external environment pressure. By finding innovative solutions businesses can eliminate external pressure and sustain their performance. Proactive internal decisions to implement innovations are met to gain competitive advantage, which can lead to a boost in organizational performance (Damanpour et al., 2009). A superior business position can be gained for example by producing products more efficiently, creating the same value at a lower price than competitors, which leads to higher profit margins. Competitive advantages can also be gained by creating superior products with for example leading technology that differs from those of competitors. Reasons for companies to invest in R&D and innovations are multifaceted, however, whether external factors force companies to innovate or proactive innovation approaches are the driving force to innovate, the overall goal is to improve current performance of the company. A company's performance can be measured on various levels, for instance the product performance, market performance or financial performance. This paper will focus on the relationship between innovation and the aforementioned measure of performance, the financial accomplishments.

In research, strong focus is laid on the relationship between investments in innovation and organizational outcomes. Studies in innovation portfolio management revealed that different types of innovation are interdependent, influencing each other and organizational outcomes (Fritsch & Meschede, 2001; (Damanpour & Evan, 1984; Kotabe & Murray, 1990). Yet, according to Damanpour (2009), "most empirical studies of the innovation–performance relationship have been cross sectional, based on a single innovation type". To enrich literature by considering the interdependency of innovation types, this research will focus on two types of innovations, exploitative and explorative innovation, their relationship to each other and their combined impact on financial performance. Furthermore, this study aims to discover an optimal distribution of explorative and exploitative innovation that leads to highest financial performance. The intention of this research is to analyze the impact of explorative and exploitative innovation on the financial performance of a company. Considering the given dataset, this goal leads to the following research question: 'Does a longitudinal study over the last eight years in Dutch SME´s indicate an optimal innovation portfolio mix of exploitative and explorative innovation that promotes an increase in financial performance?' The answer to that question can be of high value for companies in general. Like mentioned before the overall aim of innovations is to improve performance. However, companies have to be aware that different types of innovation interact with each other, influencing performance outcomes. By delivering a guideline of how to allocate investments effectively, companies can profit from it, distributing their eventually scarce resources among exploitative and explorative innovations in a way that leads to highest financial performance.

This study adds to existing knowledge by empirically examining and comparing the relationship between two specific types of innovation and the influence of mixes of those types on the financial performance of companies. Additionally, this research had access to a unique dataset of secondary data including more than 5000 Dutch manufacturing SME's innovation cases with detailed R&D descriptions.

In the course of this paper previous literature is scanned to define the main concepts of innovation, innovation types, innovation portfolio and financial performance as well as to state previous findings that are connected to the research aim of this paper. Information about the used dataset, the sample and the measurement of the dependent variable "financial performance" and the independent variable "innovation performance" follow. Next, the results of the hypothesis testing and the findings of the innovation portfolio clusters are presented. Finally, this paper sums up the finding, provides a comparison with discoveries of previous literature, states limitations and gives suggestions for further research.

2. THEORY

2.1 Definition and Classification of Innovation

Before conducting an analysis of the relationship, definitions of innovation and types of innovations are necessary to provide a common understanding. According to the OECD glossary of statistical terms (2005) "an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations". This characterization delivers a general perception of innovation, however, one must determine the degree of newness of an implementation to state whether it complies as an innovation. An innovation can be significantly improved or new to an organizational subunit, an organization, an industry or to the world (Walker, 2006; Damanpour et al. 2009; Damanpour & Evan, 1984). The present study considers a novel product or process implementation as new and therefore as an innovation when the implementation was new to the organization.

Previous literature distinguishes between different types of innovation. Researchers created typologies to classify occuring innovations. Those typologies differentiate depending on the focused characteristics of an innovation or the degree of

innovativeness. One widley known typology distinguishes innovations based on their radicalness. Radical innovations were defined as innovations that are very new and different, incorporating new technologies that create new markets and are triggers for new customer demands (Colarelli O'Connor, 1998; Garcia & Calantone, 2002; Schilling, 2013). On the contrary, incremental innovations deliver comparatively minor changes to already existing technologies in existing markets (Garcia & Calantone, 2002; Schilling, 2013).

Another classification separates innovations into product, process, marketing and organizational innovations. The Oslo Manual for measuring innovation characterizes product innovation as a new or essentially improved product or service that distinguishes itself by enhanced technical specifications, improved user-friendliness, materials or other functional features. Process innovation is described as a new or essentially improved production and delivery procedure. Marketing innovation is a new marketing design including essential alterations in product design, packaging, promotion or placement. Lastly, organizational innovation is a new administrative method concerning workplace organizations, external relations or business practices (OECD, n.d.)

Furthermore, previous literature differentiates between explorative and exploitative innovations. Explorative innovation requires new knowledge to create new products or services for developing customer markets. Exploitative innovation on the other hand uses and relies on existing knowledge to amplify current products and services for existing customer markets (Benner & Tushman, 2003). According to March (1991), explorative innovation can be described by keywords such as "search, variation, risk taking, experimentation, play, flexibility, discovery, innovation" (p. 71), while exploitative innovation is marked by terms like "refinement, choice, production, efficiency, selection, implementation, execution" (p. 71). For this research paper, the typology of explorative and exploitative innovation will be used to classify the innovations of the dataset and to investigate the impact of those two types of innovation on financial performance. These two innovation types were used for two reasons. On the one hand using a typology of only two types instead of more increases the likelihood to correctly classify cases and makes the processes of labeling less problematic. On the other hand, theories of ambidexterity and punctuated equilibrium already delivered insights into the interaction between exploitation and exploration and inspected balance mechanisms of both types, which can be used as a foundation for this research. While ambidexterity design suggests to simultaneously keep two subunits occupied, one with decentralized and loose structures to construct explorative ideas and one centralized to develop exploitative ideas, punctuated equilibrium suggests long cycles of exploitative investments followed by short and intense explorative cycles to balance innovation investments effectively (Benner & Tushman, 2003; Levinthal, 1997; Levinthal & March, 1993; Siggelkow & Levinthal, 2003).

Classifying innovations and R&D projects is part of a firm's portfolio management. Managing a portfolio can be considered as an important and continuous business process in which new projects are evaluated, prioritized and selected. By allocating firm resources to specific new product developments and R&D projects, portfolio management manifests the business strategy and sets the future direction of the company (Cooper, Edgett, & Kleinschmidt, 2001). Investigating the interrelationship between explorative and exploitative innovation as well as the impact on financial performance can therefore add to the crucial knowledge domain of portfolio management.

2.2 Definition of financial performance

By implementing innovations, companies intent to increase performance. In previous literature, the concept of organizational performance can be perceived as complex and multidimensional leading to the development of various frameworks and broad definitions (Dess & Robinson, 1984). Breakdowns into financial and nonfinancial performance or financial, market and operational performance are common (Murphy, Trailer, & Hill, 1996). In general, measuring organizational performance quantifies the effectiveness and efficiency of a certain activity and compares intended outcomes with actual outcomes (Market Business News, 2018; Boddy, 2014). Financial performance measures organizational achievements in monetary terms. Frequently used measures are Return on Sales, Return on Investment, Return on Assets, growth in sales and revenues (Gunday et al. 2011; Dess & Robinson, 1984).

For the purpose of this research, changes in Return on Assests (ROA), changes in net profit and changes in operating revenues will be used to measure finanical performance. As mentioned previousley, ROA and growth in revenues are commonly used indicators of financial performance in business research, nominating those variables as reliable indicators. Furthermore, net profit will be used as a third indicator of financial performance. Operating revenue, also referred to as sales, is the inflow of economic benefits transferred into the company by its ordinary business activities (Investopia, n.d.; McLaney & Atrill, 2014). Revenue growth can demonstrate an increase or decrease of sales over time and therefore be an indicator of the financial well-being of a company. ROA indicates the profitablity of an organization in relation to its total assets. The yearly earnings are set in relation to invested capital into assets, expressing the ability of organizations to convert invested money into net income. The higher the ROA in relation to previous years, the better, since less or same amount of investment lead to same or higher amount of income (Investopia, n.d.). Lastly, net profit, also known as net income, is a frequenlty used measure of overall profitability of an organization. All occuring expenses during a period are substracted from all occuring revenues to express the profitability of an organization.

2.3 Previous research on effects of innovation on financial performance

As stated earlier, organizations invest in innovation to maintain and improve performance. Devoting scarce resources, working hours and investments into developments of innovations can be risky and costly. Still, organizations strive for innovativeness amongst others, as most innovation researchers are confident that innovation has a positive impact on firm performance.

Some studies however linked innovation negatively or neutral to firm performance. Depending on certain organizational characteristics like the degree of specialization or centralization, companies with a specific set of characteristics were showing negative or no relationship between innovation and firm performance (Subramanian & Nilakanta, 1996; Lukas & Menon, 2004). Furthermore, it was noted that highly innovative firms can face downsides like higher market risk due to general product failure rate or stress and dissatisfaction among employees decreasing the positive impact on firm performance triggered by innovation (Simpson, Siguaw, & Enz, 2006). Gunday et al. (2011) observed that "direct effects of innovations on firm performance are relatively small, and the benefits from innovations are more likely indirect" (p. 663).

Although some studies could not or merely prove a positive relationship between innovation and firm performance, a vast number of researchers did discover a positive relationship. Many

studies detected that innovation has a significant impact on organizational performance by generating a better market position leading to competitive advantages and increased performance (Damanpour & Evan, 1984; Walker, 2004; Xin, Yeung, & Cheng, 2010). It was documented that total adaption of innovation over time, regardless of the composition of innovation types, significantly improves organizational performance (Damanpour et al., 2009). A review of innovation-organizational performance literature summarized that out of 30 empirical studies, analyzing the relationship between innovation and performance, around 60 percent of the studies positively support the relationship. Only five percent generated a negative relationship; the remaining studies produced non-significant results (Walker, 2004).

Looking at the relationship among innovation types, previous literature stated that different types of innovation influence each other and therefore need to be enforced in combination (Walker, 2004). Adding to this, it was detected that investing in only one particular innovation type over time negatively impacts the firm performance (Damanpour et al., 2009). For this research, the interactions and synergies between explorative and exploitative innovations are crucial, yet He and Wong stated in 2004 that only little effort has been put in this area of research up until then. They then observed that the simultaneously implementation of exploitative and explorative innovation has a positive impact on sales growth rate and overall organizational performance whereas a lack of balance between those two creates negative effects on sales growth rate and performance (He & Wong, 2004). Previous to the study of He and Wong, March (1991) also analyzed the interrelationship between those two types of innovation. He revealed that organizations "that engage in exploration to the exclusion of exploitation are likely to find that they suffer the costs of experimentation without gaining many of its benefits. […] Conversely, systems that engage in exploitation to the exclusion of exploration are likely to find themselves trapped in suboptimal stable equilibria. As a result, maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity" (p. 71). Exploitative innovations can increase efficiency and create predictable profits. Nevertheless, those short-term improvements can reduce variety in the long run and constantly improved products and processes can become obsolete in changing environments. Explorative innovations, despite higher risks and opportunity costs, can antagonize by increasing companies' adaptability (Lavie, Stettner, & Tushman, 2010).

2.4 Development of hypotheses

As mentioned in the previous section, a vast amount of research with mixed results, has been undertaken concerning the relationship between implemented innovations and financial performance in general. Since different accessed data, test settings and operationalizations led to mixed outcomes, this study wants to examine, again, the relationship between innovation and financial performance. As many researchers found a positive relationship between the two variables and a general assumption in organizations seems to be that innovations do positively influence performance, the first hypothesis arises:

Hypothesis 1*: Investing in R&D positively influences ROA, net profit and operating revenues of manufacturing companies.*

H1a: Investing R&D time in explorative innovations positively influences ROA, net profit and operating revenues of manufacturing companies.

H1b: Investing R&D time in exploitative innovations positively influences ROA, net profit and operating revenues of manufacturing companies.

Aside from the general investigation of the relationship between innovation and firm performance, it can be of high importance to clarify the interrelationship among different innovation types. As mentioned previously, overall less research has been conducted in exploring the relationship and interdependencies between types of innovations. However, available results, also for exploitative and explorative innovations, indicate that interrelationships among innovation types exist and that those interrelationships influence organizational performance. Therefore, it would be interesting to analyze if observed portfolios of exploitative and explorative innovations over time perform differently depending on their mixture of innovation types. To proof whether or not exploitative and explorative innovations interrelate like indicated by previous research, companies with unitary innovations in their portfolio and companies which show investments in both types of innovation should be compared. Since already conducted research implies that investments in both, exploration and exploitation, are superior compared to investing in just one type, the second hypothesis is created:

Hypothesis 2*: Companies which invest in explorative and exploitative innovation achieve greater financial increases in ROA, net profits and operating revenues than those who solely invest in one type of innovation.*

Next to the goal of supporting previous conducted research concerning the relationship between innovation and financial performance, and the interrelationship between exploitative and explorative innovations, this longitudinal study with its data gathered over eight years, can add additional insights to previous research considering the time dimension by testing hypotheses one and two.

After analyzing the interrelationship between exploitative and explorative innovation, the question of distribution of innovation resources amongst these types arises. The term organizational ambidexterity in context of exploitative and explorative innovation describes the capability of an organization to balance both types of innovation simultaneously. Exploiting existing competencies at the same time as exploring new opportunities can lead to higher performance but can also create tensions and challenges (Nieto-Rodriguez, 2014). In cases or times of scarce resources, both types of innovation compete against a company's scarce resources and management must decide how much time and money to invest in each type to accomplish the highest positive outcome. By making these resource-allocation choices, companies face trade-offs. Choosing to invest in exploitative innovations focuses on stability, short-term productivity and usage of available knowledge to satisfy current needs to the trade-off of risking to become inflexible and obsolete in the future due to a lack of new creation and development of knowledge and skills (March, 1991; Lavie, et al, 2010). Notwithstanding the trade-offs, exploitative and explorative innovations are in association. Investing in explorative ideas creates future opportunities of exploiting those later. On the other hand, investing in exploitative innovation is perceived less risky and can create income which then can be invested in future exploration ideas (Lavie et al., 2010). Although both types of innovation are conflicting in terms of resources, companies need to engage in both to reach greater performance (Lavie et al., 2010).

While He and Wong (2004) suggest an equal distribution of exploration and exploitation, other researchers are stating that the balance point of those two types is complex, depending on several influencing variables (Lavie & Rosenkopf, 2006; Levinthal & March, 1993). Overall, little research has been

undertaken in examining optimal resource distribution between innovation types. Lavie et al. (2010) sugested that future research should fnd the optimal balance level between exploitative and explorative innovation under varying conditions. Assuming that H1 is true and there are interrationships between types of innovations then that would mean that different allocations among innovations lead to different strong interrelationships and different financial performances, indicating that certain allocations of innovation investments are superior in terms of financial performance compared to others. Therefore, the last part of this paper's analysis regards this gap in literature and tries to answer the research question of whether a longitudinal study over the last eight years in Dutch SME´s indicates an optimal innovation portfolio mix of exploitative and explorative innovation that promotes an increase in financial performance. This research question can be translated into a third hypothesis:

Hypothesis 3*: An optimal innovation portfolio mix of exploitative and explorative innovation that increases financial performance most effectively exists among manufacturing companies.*

Finding patterns in the innovation portfolios of the sampled companies that are superior in terms of financial performance could give a perfunctory guideline to manufacturing SME's in terms of how to distribute their scarce resources of R&D. Discovering that specific allocations of R&D hours between exploitative and explorative lead to different results in ROA, net profit or operating revenue, where a specific range of allocation leads to a significantly higher financial performance could be very valuable. On the other side, discovering that a specific distribution of innovation types leads to low performance in those financial performance indicators could also be of high interest.

By testing all these hypotheses caution has to be taken as previous literature revealed that a time gap between the adoption of innovation and the occurrence of financial performance improvement can occasionally be observed (Tsai, 2011; Kafouros, Buckley, Sharp, & Wang, 2008).

3. METHODLOGY

3.1 Sample and data

This research accessed an already existing dataset of 5900 innovation cases. The data was originally gathered over a period of nine years, starting in 2008 to the end of 2016. The dataset includes detailed descriptions of research and innovation projects of various Dutch small and medium sized manufacturing organizations, as well as the duration and working hours spent on those projects. Dr. Matthias de Visser made this dataset available for further research. Me and two additional students with different research goals were working together on the before mentioned dataset. We picked mostly randomly 300 innovation cases and all of those cases were classified according to common understanding of the typology concepts of the previous mentioned literature. Some cases were picked nonrandomly to create innovation portfolios of companies. After it was discovered that an automated classifier could be created to label the entire dataset, it became obvious that a not completely randomized sample was inconvenient for programming that classifier and could lead to a biased outcome which is why overrepresented companies were removed from the first sample and were replaced by new randomly picked cases. Each innovation project of the sample was classified based on its detailed project description by two students into exploration and exploitation. Keywords and indicators for explorative innovations were for example new knowledge, new product, risk taking, experimentation. Keywords and indicators for exploitative innovation were for example existing knowledge, extending existing products, broaden existing skills, improvements.

After individually classifying all projects, both classification lists of the two students were compared. In 53 percent of the cases, the students used the same classification. The remaining 141 cases showed unequal classification. Those cases with disagreeing classification were analyzed again and both students argued why they chose a certain classification and together came to an agreement on deciding which innovation type is more suitable. After this process, each innovation case of the research sample was classified into either explorative or exploitative innovation. One of the other students, Tim Roelofs, then used those classified cases to create text classification algorithms. These algorithms were used to automatically classify all cases of the dataset. This automated classifier has an accuracy of around 90 percent.

Although the classifier is able to create the classification for all 5700 cases, it was not possible to get the financial data for all 878 companies of the dataset which is why the sample used in this research is smaller. It was possible to connect 226 companies of the original dataset to their registration at the financial platforms Orbis or REACH. To be of use for this research, financial data, to be more precise, yearly net profit, yearly operating revenue and yearly return on assets of at least the last five years is needed. Therefore, those 226 registered companies were screened and only those cases of companies which at least published some of the before mentioned data between 2012 and 2017 were selected for the sample of this research. Out of those 226 companies matched and registered, only 52 published the financial data needed for this research. These 52 companies generated 405 innovation cases in the original dataset. For that reason, the sample for this research consists of 405 innovation cases created by 52 small and medium sized Dutch manufacturing companies. With those cases individual innovation portfolios for every company were created, displaying the percentage distribution of R&D hours among exploitative and explorative innovation.

3.2 Measurement of variables

Independent variable: As mentioned earlier, managing innovation portfolios requires to allocate organizational resources to new projects. Resources could for example be money invested in a new project or working hours devoted to innovations. The monetary investment indicators are not available in the given dataset, however, the original dataset provides information about the total number of working hours in R&D that were spent for each new project. Therefore, in this research these numbers are used to measure the innovation performance of each company. Thus, the independent variable innovation performance, which can be subdivided into exploitative and explorative innovation performance, is measured in working hours spent in R&D of new products and processes. For hypothesis one, the absolute hours spent on the innovation projects are used while for hypothesis two and three the percentage distribution between companies R&D hours spent on exploration and exploitation is used. Depending on the R&D hours allocated to the two types of innovation, independent categorical variables were created, which are used as the independent variable.

Dependent variable: In this research, the financial performance of a company represents the dependent variable and is measured by three indicators. Firstly, financial performance is measured by the yearly mean increase or decrease of operating revenues in percentage. Secondly, financial performance is determined by the yearly mean increase or decrease of a company's ROA in percentage. And thirdly, by the yearly mean increase or decrease

of a company's net profit. The needed financial data per year and per company were retrieved from the platforms Orbis and REACH. The stated operating revenues, ROAs and net profits in Orbis and REACH were used to calculate the yearly changes of those indicators in percentages. In order to create three dependent variables reflecting the changes in financial performance over several years, the yearly increases/decreases of the indicators between 2013 and 2017 were used to create the mean change of the indicators in that period. Thus, the used dependent variables were mean operating revenue change between 2013 and 2017 in percentage, mean ROA change between 2013 and 2017 in percentage and mean net profit change between 2013 and 2017 in percentage. For this research, three indicators of financial performance were chosen for two reasons. Firstly, because some companies in the sample did not publish all indicators for every year of the observation. Thus, by choosing three indicators, companies which for instance did not publish their operating revenues between 2012 and 2017 could still be used for the sample since information about net profits and ROA were available. Secondly, financial performance is a multifaceted concept and by using more than one indicator the concept of financial performance can be captured in more detail.

Time gap: A difficult task in this research is to consider the time line of events. The first projects of various companies in the sample were implemented in 2010 and the last projects in the sample were implemented in 2015. However, not all companies implemented their first innovation in 2010 and continued to implement innovations until 2015. For some companies, only innovations of for example one year within this period of 2010 – 2015 are observable. Considering this deviation in innovation portfolios and a possible time gap between implementation and impact on financial performance, innovation portfolios of all stated R&D projects between 2010 and 2015 of the sampled companies were created and were set into relation with the before mentioned financial data of 2013 to 2017.

3.3 Analysis

Hypothesis 1 states that innovation performance positively influences financial performance. To test this hypothesis, and the following hypotheses, SPSS, a statistical software of IBM, is used to analyze the relation between the dependent and the independent variables. Before choosing a test, which measures the correlation between innovation and financial performance the linearity between the variables has to be tested. This was done by creating and visually inspecting each scatterplots of the independent variables and the three dependent variables. In all three scatterplots significant outliers were detected, indicating a non-linearity and therefore does not allow the use of parametric testing. Therefore, to test hypothesis one, the nonparametric Spearman's rank order correlation test is used to measure the strength as well as the direction of the association between the independent variable, total hours spent on R&D between 2010 to 2015, and all three dependent variables, mean operating revenue change between 2013 and 2017, mean ROA change between 2013 and 2017 and mean net profit change between 2013 and 2017.

The same test for the same reasons is used to test hypothesis 1a and 1b, with the only difference that the independent variables used are hours spent on R&D of explorative innovations between 2010 to 2015 and hours spent on R&D of exploitative innovations between 2010 to 2015. Figure 1 gives an overview of the to be tested correlations of H1, H1a and H1b.

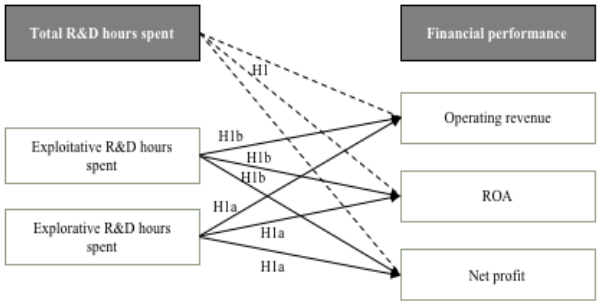

Figure 1. Overview of Hypothesis 1

The second hypothesis suggests that companies with both types of innovation achieve greater financial performance compared to those that only invested in one type of innovation. To analyze that hypothesis, the companies of the sample were grouped into those who solely invested in one type of innovation (group one-sided) and those who diversified their investments (group mixed). 18 companies in the sample showed a one-sided portfolio while 33 companies showed a mixed portfolio. Distinguishing the companies based on their allocated R&D hours creates two groups which together form a categorical variable used as the independent variable. The objective is to check if on average one group achieved higher financial increases between 2013 – 2017 compared to the other group or if both groups do not significantly differ from each other in terms of changes in financial performances. For statistical reasons $H0_2$ is that there is no difference between the changes in the financial performance indicators between the mixed and the one-sided group. Again, to decide whether a parametric or a nonparametric test can be used to analyze the hypothesis, histograms of the distributions of the three dependent variables for both groups were created. Comparing the histograms revealed that a normal distribution is not given, allowing only nonparametric testing. Therefore, a Kruskal Wallis H test, a rank-based nonparametric test, is used to determine if there is a difference between the mixed and the one-sided groups in terms of average changes in financial performance. The Kruskal Wallis H test is an omnibus test statistic and will only state whether or not there is a difference between those two groups. In case the test results indicate a difference between the groups a post hoc test is necessary to check more specifically how the groups differ regarding the changes of the financial performance indicators.

The goal of this research is to analyze whether there is an optimal portfolio mix between exploitative and explorative innovation that lead to most optimal financial performance. To hypothesis three, an innovation portfolio for each company in the sample was created. The total amount of working hours spent on R&D between 2010 and 2015 illustrates 100 percent of the innovation portfolio of each company. Based on the companies' distribution between exploitative and explorative innovation unique innovation portfolios occur. To be able to investigate the impact of different portfolios on the change of the mean financial performance indicators, those unique innovation portfolios were clustered into broader intervals of portfolio mixes. As illustrated in Figure 2, four different intervals of portfolio mixes were created. Depending on the percentage allocation of working hours between exploration and exploitation, each company of the sample was classified into one of the four intervals. These four groups represent the independent variable. Out of the 52 companies in the sample a total of nine companies were classified into the first interval, 12 in the second, 11 in the third and 19 in the fourth interval.

	Intervals			
Portfolio mix	**1**	**2**	**3**	**4**
Explorative share	0- 25%	26- 50%	51- 75%	76- 100%
Exploitative share	100- 75%	74- 50%.	49- 25%.	24- 0%

Figure 2. Breakdown of innovation portfolio intervals

The mean increases/decreases of operating revenues, net profits and ROAs in percentage from year 2013-2017 of each company are used as a measure of financial performance and state the dependent variables. The $H0_3$ is that there is no difference in changes in financial performance between the four innovation portfolio groups. Again, to decide whether a parametric or a nonparametric test can be used for this hypothesis the histograms of the distribution of the dependent variables within each group were checked. Nonlinear distributions demand the use of a nonparametric rank-based test. Once more, a Kruskal Wallis H test is adopted to examine if there is a difference between the four groups. In case the test indicates that there indeed are differences in the groups concerning financial changes, a post hoc test will be used to examine the difference between the groups.

4. RESULTS

Hypothesis 1: The Spearman's rank order correlation test was conducted between the independent variable 'total hours spent on R&D between 2010 to 2015' and the three dependent variables 'yearly mean increases or decreases of a company's ROA in percentage', 'yearly mean increases or decreases of a company's net profit in percentage' and 'yearly mean increases or decreases of a company's net profit in percentage'. So, a total of three correlation tests were run. All three test results indicate a weak and non-significant association between R&D hours and changes in financial performance, $r_{s\,profit} = .12$, $p = .40$; $r_{s\,ROA} = -.06$, $p = .66$ and $r_{s\,revenue} = .03$, $p = .87$. Therefore, it can be stated that the used data, the operationalization of the variables and the test setting in this research do not deliver enough evidence to proof an association between the dependent and independent variables, leading to a rejection of H1 that investing in R&D positively influences ROA, net profit and operating revenues of manufacturing companies.

Similar results were conducted by testing H1a and H1b. All three tests that evaluated the association between explorative R&D hours and changes in financial performances as well as all three tests between exploitative R&D hours and the dependent variables indicated a correlation coefficient close to zero and p-values indicating non-significance, with H1a $r_{s\,profit} = .11$, $p = .43$; $r_{s\,ROA} = -.09$ $p = .53$ and $r_{s\,revenue} = .01$, $p = .94$ and H1b $r_{s\,profit} = .01$, $p = .92$; $r_{s\,ROA} = -.01$, $p = .88$ and $r_{s\,revenue} = -.001$, $p = .99$

These outcomes indicate that based on the used sample, H1a and H1b, assuming a positive relationship between hours spent on innovation types and financial performance, are lacking evidence and have to be rejected. Table 1 summarizes the correlation coefficients and p-values of all tests used to reject H1, H1a and H1b.

Hypothesis 2: Three Kruskal Wallis H tests were conducted to analyze whether $H0_2$, stating that there is no difference in mean changes of financial performances between companies with a mixed portfolio and companies with portfolio consisting of only either explorative or exploitative innovations, can be rejected or not. The high p-values of all tests indicate that there is not enough evidence based on the sample to reject the $H0_2$. The test statistics for the mean net profit change between 2013- 2017 reveal $\chi 2(1) = .24$, $p = .61$ and a mean rank score of 24.56 for one-sided portfolios and 26.79 for mixed portfolios. Similarly, the statistics for the mean ROA change between 2013- 2017 report $\chi 2(1) = .14$, $p = .71$ and a mean rank score of 24.94 for one-sided portfolios and 26.58 for mixed portfolios. Lastly, the test statistics for the mean operating revenue change between 2013-2017 report $\chi 2(1) = .001$, $p = .98$ and a mean rank score of 20.07 for one-sided portfolios and 19.96 for mixed portfolios. Table 2 summarizes the aforementioned statistical outcomes. These results state that there is not enough evidence to show a significant difference between mixed and one-sided innovation portfolios in terms of changes in financial performance.

Table 1. Statistical outcomes of testing H1, H1a and H1b

Hypothesis	Variable	Correlation. coefficient	P-Value
H1	Mean change ROA	-.06	.66
H1	Mean change profit	.12	.40
H1	Mean change revenue	.03	.87
H1a	Mean change ROA	-.09	.53
H1a	Mean change profit	.11	.43
H1a	Mean change revenue	.01	.94
H1b	Mean change ROA	-.02	.88
H1b	Mean μ change profit	.01	.92
H1b	Mean change revenue	-.001	.99

Table 2. Statistical outcomes of testing H2

Variable	Kruskal Wallis H	P-Value
Mean change ROA	.14	.71
Mean change profit	.24	.61
Mean change revenue	.001	.98

Hypothesis 3: Again, Kruskal Wallis H tests were used to examine $H0_3$. Similarly to the previous analysis, three Kruskal Wallis H tests for each dependent variable 'yearly mean changes of a company's ROA in percentage', 'yearly mean changes of a company's net profit in percentage' and 'yearly mean changes of a company's net profit in percentage' were conducted. For this part however, the independent variable consisted of four groups. $H0_3$ states that all four groups, which differ in terms of companies' allocation of R&D hours spent on exploitative and explorative innovations, do not differ in mean changes in yearly financial performances. The results of the used tests retain this hypothesis, since the observed p-values indicate that the differences between groups are not significant. The test statistics for the mean net profit change between 2013 and 2017 announce $\chi 2(3) = .87$, $p = .83$ and a mean rank score of 23.78 for group one, 23.83 for group two, 28.64 for group three and 26.89 for group four. The statistics for the mean ROA change between 2013 and 2017 expose $\chi 2(3) = .30$, $p = .96$ and a mean rank score of 24.67 for group one, 26.92 for group two, 27.55 for group three and 25.16 for group four. Lastly, the test statistics for the mean operating revenue change between 2013-2017 report $\chi 2(3) = 2.14$, $p = .57$ and a mean rank score of 25.14 for group one, 17.10 for group two, 20.71 for group three and 19.20 for group four. Table 3 summarizes these statistical outcomes.

Table 3. Statistical outcomes of testing H3

Variable	Kruskal Wallis H	P-Value
Mean change ROA	.30	.96
Mean change profit	.87	.83
Mean change revenue	2.14	.57

5. DISCUSSION AND CONCLUSION

5.1 Implications of results

Summarizing the results, one can state that the sample used in this research paper did not deliver significant evidence to proof H1, H1a, H1b H2 or H3. The research failed to produce significant evidence to proof a positive association between R&D hours spent and ROA, net profit or operating revenues. It also failed to generate a significant difference in financial performance between companies with one-sided innovation portfolios compared to companies with mixed portfolios. All efforts of investigating the concerned relationships generated high p-values, indicating non-significance of test results. One cause of those produced p-values might likely be the sample size. 52 companies are a small sample size and a bigger sample would have provided more information about the population and would have given more power in hypotheses testing. Next to the small sample size, unequal distribution of companies among the groups in H2 and H3 as well as a lack of financial data for all researched years prevented the tests from being more significant. For testing H2, 18 companies were categorized one-sided and 33 mixed. H3 used four groups with a distribution of nine, 12, 11 and 19 companies. Using strongly varying group sizes in rank-based testings makes it difficult to compare those groups with each other and creates insignificant results. These disputes make it difficult to give any kind of advice to companies, since no significant evidence was produced to reveal a relationship between innovations or innovation portfolio mixes and financial performance indicators.

As a final conclusion, the research question of this study stays unanswered. The sample drawn from a longitudinal study over the last eight years in Dutch SME's did not indicate an optimal innovation portfolio mix of exploitative and explorative innovation that promotes and increases financial performance most. However, as mentioned before and more detailed discussed in the limitation section, several restrains of this study lead to the impossibility of producing evidence of such an optimal innovation portfolio mix. A new study which respects those limitations could produce significant test results which could answer this research question.

5.2 Comparing results with previous research

Although many researches already have been conducted concerning the relationship between innovation and organizational performance and many have found a positive correlation (Damanpour & Evan, 1984; Walker, 2004; Xin, Yeung, & Cheng, 2010), some studies discovered a negative or no correlation between innovation and organizational performance (Subramanian & Nilakanta, 1996; Lukas & Menon, 2004). Due to non-significant results of hypothesis one, stating that hours investments in R&D is positively related to financial performance, this research fails to add to existing literature concerning this topic. The outcomes of the H1 tests neither agree nor disagree with the diverse established findings on the relationship between innovation and financial performance.

Previously, some research has been conducted concerning the interrelationship between innovation types and the impact of those interrelations on organizational performance. It was detected that interrelationships exist and that a focus on solely one type of innovation negatively influence performance (Walker, 2004; Damanpour et al., 2009). Furthermore, March (1991) specifically researched the relationship between exploitative and explorative innovations, revealing that a balance between those two types is highly important for organizational growth and accomplishment. H2 aspired to add to these findings by affirm that companies that balance exploitative and explorative innovations achieve higher financial performances than those who entirely invest in one type. Again, the test results for that hypothesis were non-significant. Besides the small sample size, an incomplete knowledge about all implemented exploitative and explorative innovations of all companies in the sample made it difficult to add significant findings to this area of expertise.

While some research has been conducted revealing those interrelationships and dependencies, little effort has been put into studying optimal distribution of resources for innovation types. March (1991) specified that "an appropriate balance between exploration and exploitation" (p. 71) is important to achieve organizational success; he did not specify appropriate balance in numbers or ranges. Equally, other researchers stated the importance of mixing exploitation and exploration but refused to state exact distribution advices due to many variables that can influence the optimal distribution (Lavie & Rosenkopf, 2006; Levinthal & March, 1993). He and Wong (2004) on the other hand believed that equal investment in exploitative and explorative innovation yield highest performance outcomes. The goal of this research, to add to this domain by stating intervals of exploitative and explorative innovation investments that lead to highest financal performance for manufacturing companies compared to other intervals failed. This research could not detect significant financial outcome differences between four groups of companies, which differed in the amount of R&D hours they allocated to exploitative and explorative innovations.

Overall, it is difficult to compare the findings of this research with the findings from previous ones in the same research domain, since all test results were non-significant. This setting extremly limits the explanatory power of this paper, however it can be seen as an impulse for further research in the field of optimal portfolio mixes and their financial outcomes.

5.3 Limitations and further research

Limitations

This study contains several limitations that should be considered for the implication of the findings. The first limitation concerns the classification of the data. Although each case was classified by two students based on common understanding and indicators and inconsistencies in classifications were discussed, classifications are to a certain degree subjective. Although a trained classifier was used to label all cases, that classifier did not reach a 100 percent accuracy and was trained based on the 300 manually labeled cases. A different classification for undistinctive cases could have led to other outcomes. During the process of classifying, it became clear that it was challenging to do so based on the information given in the dataset. Some cases mentioned several developments within one case, making it hard to judge the final type of innovation because the developments partly showed exploitative and party explorative indicators. Additionally, it was occasionally hard to classify cases based on the given description. Some descriptions were very short, for other cases it was not possible to identify whether the company already employed similar products, processes, knowledge or whether the development was very new and required the company to create new knowledge and skills. In depth knowledge about each company and personal contact to employees in charge would have improved the accuracy of the classification. Furthermore, this study solely classified into two types of innovations, but an innovation portfolio consists of many different types of innovation. Those other types are likely to also interact with each other and to impact financial performance leading to different optimal portfolio mixes.

The second limitation is connected to the dataset. One has to ask whether the companies in the used dataset are a representative sample for ordinary Dutch SME's. It might be that those companies represented in the dataset are more focused and concerned about research and development and spend more time and money in that area compared to other companies. Additionally, it is questionable whether the innovation descriptions based on which the cases were classified are reliable. Those descriptions were composed to receive funding. To get funding for implemented innovations, the companies might have exaggerated, making innovations sound more explorative than they are. Furthermore, it is not certain that every innovation made in a certain company was also reported in the given dataset. If companies did not file every exploitative or explorative R&D project in this dataset, that would lead to an incomplete innovation portfolio for this research. The expected innovation portfolio used to determine an optimal portfolio mix would deviate from the actual innovation portfolio of companies. This deviation could lead to false predictions of optimal innovation compositions. Furthermore, as mentioned previously, given the circumstances it was only possible to create a sample of 52 companies for this research. This is a very small number leading to high p-values and an impossibility to generalize any kind of outcome.

The third limitation acknowledges the time gap. Considering the construct of innovations, it is very difficult to state how long an innovation needs to be implemented in order to influence financial performance measurers. On the one hand, little research has been conducted in that area of innovation which made it difficult to estimate how many months or years after an implementation the financial data should be observed. On the other hand, this research was looking at portfolios and those portfolios implemented innovations during the observed period (2010-2015) at different points in time, making it hard to compare all portfolios with each other. Furthermore, it is very likely that some innovations have immediate effects on financial indicators while others need several years to influence the performance of organizations. This likelihood makes it difficult to associate innovation portfolios with mean changes in financial indicators. Choosing a different time gap between first innovation implementation and mean financial indicators might have led to a different test result outcome.

The fourth limitation regards the absent of content validity of the independent variable. Innovation performance is multifaceted, however this study only had access to a single measurement of innovation performance namely hours spent on R&D. Additional indicators like first mover advantage, time to market or degree of newness to the world would have created a more valid construction of innovation performance. Furthermore, one could challenge the explanatory power of hours spent on R&D. It might be that companies only estimated the hours spent on each project, not keeping accurate track of the time spent, making the measurement of innovation performance less reliable.

The fifth limitation considers the accuracy of the dependent variable. Two factors reduce the credibility of the financial data used. Firstly, the company names in the original dataset were not equal to their official firm registration name. The data mostly consisted of parts or initials only which were used by many companies in the Netherlands. This made it very hard to connect the names in the dataset to the official company names in Orbis and REACH. For some names of the dataset many options in Orbis appeared, making it an impossible task to connect the dataset companies with the true company name in Orbis and REACH. This difficulty might have led to some mistakes, wrongly connecting companies of the dataset with financial data of a different company. This presents a potential bias. Secondly, not all companies published all their financial data between 2013 and 2017. Many companies did not publish their operating revenue data leading to non-significant results. Also, many companies did not publish financial data for all years of the observed period. In those cases, the companies were still considered for the sample, but their dependent variables of mean changes consisted of one year less data, making the variable less expressive and valid.

Lastly, this research does not exclude third variables. Internal and external characteristics of the organization and the environment are likely to influence the impact of innovation on financial performance and the optimal innovation mix. Company related variables like age, size, management style, absorptive capacity, organizational culture, formalization or centralization could be the cause for this study's results or could strongly influence the optimal innovation mix for each individual company. External factors like economic crises, the industry a company is operating in, sector shocks or degree of competitiveness could also influence the outcome of this study. Operating in a dynamic environment could be a variable that constantly changes the optimal innovation portfolio mix for a company. Previous research revealed for example that smaller companies benefit financially more from innovation performance than big companies, different business sectors benefit differently from high innovation performance and organizational culture influences the innovation and financial performance of a company (Laforet, 2013; Rajapathirana & Hui, 2018). Thus, various third variables could be the actual cause of these findings or could make the findings obsolete when those variables are included in a study setting like this. Furthermore, stating that there would be an optimal innovation mix that includes all those other potential influences, external variables might trigger a decision to invest in a specific type of innovation out of a necessity, making it not possible to create an optimal innovation portfolio.

From this research and from the limitations, interesting issues for further research arise. A similar research to this with a bigger sample and more accessible data and information about the implemented innovations could help answering the research question of this study. An answer to the question of an optimal portfolio mix would be of high value for companies to further effectively improve their innovation portfolios. Furthermore, if it is possible to answer this research question under different circumstances, checking if the then observed optimal portfolio mix is consistent or depended on the, in the limitations mentioned, third variables can be of high value for the innovation research domain. Additionally, one can analyze how these third variables influence, impact, increase, decrease or destruct the interrelationship between exploitative and explorative innovation and the suggested optimal portfolio mix. Also, similar research including several types of innovations, not just exploitative and explorative innovation, for a more accurate innovation portfolio mix could be of high interest.

6. ACKNOWLEDGMENTS

I would like to thank my supervisor Dr. Matthias de Visser for his support in finding a suitable research topic and giving advice during the process whenever necessary. I would also like to thank my bachelor thesis cycle for their support and feedback and Dr. Henry van Beusichem for his help in collecting the needed financial data. Lastly, I want to express gratitude to my family and my friends, especially to Alicia Güther, who supported me during my entire bachelor's degree.

7. REFERENCES

Benner, M., & Tushman, M. (2003). Exploitation, Exploration, and Process Management: The Productivity Dilemma Revisited. *The Academy of Management Review,* 28(2), 238-256.

Boddy, D. (2014). *Management an Introduction* (6th ed.). United Kingdom: Pearson Education Limited.

Chunningham, J., & Harney, B. (2012). *Strategy & Strategists.* Oxford: Oxford University Press.

Colarelli O'Connor, G. (1998). Market learning and radical innovation: a cross case comparison of eight radical innovation projectsv. *Journal of Product Innovation Management,* 15(2), 151-166.

Cooper, R., Edgett, S., & Kleinschmidt, E. (2001). Portfolio management for new product development: results of an industry practices study. *R&D Management,* 31 (4), 361-380.

Damanpour, F., & Evan, W. (1984). Organizational Innovation and Performance: The Problem of "Organizational Lag". *Administrative Science Quarterly*, 29(3), 392-409.

Damanpour, F., Walker, R., & Avellaneda, C. (2009). Combinative Effects of Innovation Types and Organizational Performance: A Longitudinal Study of Service Organizations. *Journal of Management Studies*, 46(4), 650-675.

Dess, G., & Robinson, R. (1984). Measuring Organizational Performance in the Absence of Objective Measures: The Case of the Privately-Held Firm and Conglomerate Business Unit. *Strategic Management Journal*, 5(3), 265-273.

Draft, R. (1978). A dual-core model of organizational innovation. *Academy of Management Journal*, 21, 193–210.

Fritsch, M., & Meschede, M. (2001). Product innovation, process innovation, and size. *Review ofIndustrial Organization*, 19, 335-350.

Garcia, R., & Calantone, R. (2002). A critical look at technological innovation typology and innovativeness terminology: a literature review. *The Journal of Product Innovation Management*, 19, 110—132.

Gunday, G., Ulusoy, G., Kilic, K., & Alpkan, L. (2011). Effects of innovation types on firm performance. *International Journal of Production Economics*, 133(2), 662-676.

He, Z., & Wong, P. (2004). Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis. *Organization Science,* 15(4), 481-494.

Investopia. (n.d.). Retrieved 04 27, 2018, from https://www.investopedia.com/terms/r/revenue.asp

Kafouros, M., Buckley, P., Sharp, J., & Wang, C. (2008). The role of internationalization in explaining innovation performance. *Technovation,* 28(1-2), 63-74.

Kotabe, M., & Murray, J. (1990). Linking product and process innovation and modes of international sourcing in global competition: a case of foreign multinational firms. *Journal of International Business Studies,* 21, 383-408.

Laforet, S. (2013). Organizational innovation outcomes in SMEs: Effects of age, size, and sector. *Journal of World Business*, 48, 490–502.

Lavie, D., & Rosenkopf, L. (2006). Balancing exploration and exploitation in alliance formation. *Academy of Management Journal*, 49(4), 797–818.

Lavie, D., Stettner, U., & Tushman, M. (2010). Exploration and Exploitation Within and Across Organizations. *The Academy of Management Annals*, 4(1), 109-155.

Levinthal, D. (1997). Adaptation on rugged landscapes. *Management Science,* (43), 377-415.

Levinthal, D., & March, J. (1993). The myopia of learning. *Strategic Management Journal,* (14), 95–112.

Lukas, B., & Menon, A. (2004). New product quality: intended and unintended consequences of new product development speed. *Journal of Business Research*, 57, 1258 – 1264.

March, J. (1991). Exploration and Exploitation in Organizational Learning. *Organization Science*, 2(1), 71-87.

Market Business News. (2018). Retrieved 04 27, 2018, from http://marketbusinessnews.com/financial-glossary/organizational-performance-definition-meaning/

McLaney, E., & Atrill, P. (2014). *Accounting and Finance an Introductionn* (7th ed.). United Kingdom: Pearson Education Limited.

Meifort, A. (2016). Innovation Portfolio Management: A Synthesis and Research Agenda. *Creativity and Innovation Management,* 25(2), 251 - 269.

Murphy, G., Trailer, J., & Hill, R. (1996). Measuring Performance in Entrepreneurship Research. *Journal of Business Research*, 36, 15-23.

Nieto-Rodriguez , A. (2014, 10 01). *London Business School*. Retrieved 05 09, 2018, from https://www.london.edu/faculty-and-research/lbsr/organisational-ambidexterity

OECD. (n.d.). Retrieved 04 20, 2018, from Defining Innovation: https://www.oecd.org/site/innovationstrategy/defining innovation.htm

OECD. (2005, 09 09). Retrieved 04 20, 2018, from Glossary of statistical terms: https://stats.oecd.org/glossary/detail.asp?ID=6865

Rajapathirana, R., & Hui, Y. (2018). Relationship between innovation capability, innovation type, and firm performance. *Journal of Innovation & Knowledge*, 3, 44–55.

Schilling, M. A. (2013). *Strategic Management of Technological Innovation.* New York: McGraw-Hill Education.

Siggelkow, N., & Levinthal, D. (2003). Temporarily divide to conquer: Centralized, decentralized, and reintegrated organizational approaches to exploration and adaptation. *Organizational Science*, 14, 650-669.

Simpson, P., Siguaw, J., & Enz, C. (2006). Innovation orientation outcomes: the good and the bad. *Journal of Business Research*, 59(10-11), 1133-1141.

Subramanian, A., & Nilakanta, S. (1996). Organizational innovativeness: Exploring the relationship between organizational determinants of innovation, types of innovations, and measures of organizational performance. *Omega-International Journal of Management Science,* 24(6), 631-647.

Trott, P. (1998). *Innovation Management and New Product Development.* United Kingdom: Pearson Professional Limited.

Tsai, W. (2011). Knowledge Transfer in Intraorganizational Networks: Effects of Network Position and Absorptive Capacity on Business Unit Innovation and Performance. *The Academy of Management Journal*, 44(5), 996-1004.

Walker, R. (2004). Innovation and Organizational Performance: Evidence and A Research Agenda. *Advanced Institute for Management Research Working Paper,* WP No.:002-June.

Walker, R. (2006). Innovation type and diffusion: an empirical analysis of local government. *Public Administration*, 84, 311-35.

Xin, J., Yeung, C., & Cheng, T. (2010). First to market: is technological innovation in new product development profitable in health care industries? *International Journal of Production Economics*, 127(1), 129-135.