Rotterdam School of Management

Erasmus University

“Driving Innovation from the Bottom”

Paul de Boer

(afstudeerder)

4 December 2013

Rotterdam School of Management

Erasmus University

“Driving Innovation from the Bottom”

Afstudeerscriptie

als onderdeel van het doctoraal bedrijfskunde

major ‘Strategisch Management’

December 2013

Paul de Boer

(afstudeerder)

Afstudeercommissie:

- dr. R.L. Olie (coach)
- prof dr.ir. J. van den Ende (meelezer)

The author declares that the contents of this master thesis has been created by the author himself and that no other resources than the resources mentioned in the literature list have been used.

Master thesis

Driving Innovation from the bottom

Increasing subsidiary innovation initiatives in the MNC

December 4, 2013

Paul de Boer

352176

Erasmus Universiteit

Rotterdam School of Management

PTO MScBA/drs. Bedrijfskunde

Burgemeester Oudlaan 50

3062 PA Rotterdam

Preface

With this master thesis, I conclude my part-time study of business administration on the Erasmus University in Rotterdam. I started this study to increase my knowledge and skills in the area of business administration and thought it was a good addition to my previously gained engineering knowledge. This has proven to be true and I can truly say now that the combination of an engineering degree with a business administration degree provides an excellent basis for working in a managing director function.

It has broadened my perspective and triggered me to actively pursue more knowledge in the future.

It has been a long journey and it did not come for free. I have been supported by several people, without whom it would be impossible to complete this master thesis.

First of all I would like to thank my coach René Olie, who provided me with structured feedback along the way and always found a way to challenge me to take the next steps in the research. Secondly, I would like to thank my second coach Jan van den Ende, who provided me with valid different perspectives and good direction in the area of innovation.

I have performed my research in the GE Power & Water division and gained a lot of support from my GE colleagues in this group. I would like to thank them for all their support and making themselves available. A special thanks to my manager Derrick Reeves and the interviewees: Kennedy Oates, Christian Bleicher, Gergo Lencses and Paula Martin.

The English text of this master thesis has been checked by Harry van Lingen and I would like to thank him for that. Despite the short notice he has done a great job.

Finally, I would like to thank my girlfriend Laura van Lingen for her relentless support. This master thesis consumed the major part of my time in the last year and I thank her for her patience and motivating me to finish it.

Also thanks to my kids, Jesse and Sterre, who did see me less in the last years due to this study. For them I would like this to be an example that you are never too old to learn and develop yourself.

Paul de Boer

Den Haag

December 4, 2013

Contents

Summary

Innovation is important for companies to be able to keep their competitive advantage. A lot of research has been done in the area of innovation and its determinants. Most of this research is focused on product innovation or market innovation. These types of innovation are more radical by nature than incremental.

Also a lot of research has been done into multinational corporations (MNCs) and how they operate. The structure of MNCs has been transformed in the last 30 years from a hierarchy to a network model where the holding operates in a network of connections with the subsidiaries. The role of the subsidiaries has become increasingly important in this network and also in the area of innovation.

MNCs are more and more structured as supply chain environments where the subsidiary network forms a supply chain to manufacture the end products of the MNC. In this environment, innovation is present in the form of process innovation and improvement in efficiencies. Process innovation is more incremental by nature than radical as it should not jeopardize the specifications and quality of the end product. Variation of process innovation performance has been seen by comparing subsidiaries in the same network.

This study has tried to find the causes for the variation in process innovation between subsidiaries by testing hypotheses on the plant level of the global supply chain. It has tested the relationships between single factors and innovation performance, looked for necessary conditions for good innovation performance and tried to find the best configuration of factors to result in good innovation performance.

Conclusion of this study is that the combination of a high level of strategic and financial controls by Headquarters with a high level of internal knowledge exchange results in a high level of subsidiary innovation initiatives.

Besides that, the use of financial controls and strategic controls by Headquarters show to be necessary conditions for good innovation performance of the subsidiary. A medium level of internal knowledge exchange is found to be another necessary condition.

1 Introduction

A lot of research has been done into multinationals or multinational corporations (MNCs). The starting point of that research is normally based on the hierarchical organization structure with the parent company at the top and the subsidiaries below. This point of view, on the structure of MNCs has been transformed in the last 30 years from a hierarchy to a network model where the holding operates in a network of connections with the subsidiaries. The multi-national organization can be seen as an inter-organizational network (Ghoshal & Bartlett, 2005).

The sheer size of many MNCs and the variation of locations of the subsidiaries around the world make it more difficult to start all initiatives and actions at the parent company's head office.

The Headquarters normally is geographically also very distant from the customers and markets where the subsidiaries are. A new role for the subsidiaries has emerged to surface and a modification of the structure of the top-down management of an MNC seems appropriate.

This development could be seen as a decrease of control of the MNC on her subsidiaries and an increase in financial risks. Empowering subsidiaries to take initiatives could result in opportunistic behavior of the subsidiary managers and this is a reason for resistance by the parent company to actively pursue it. Birkinshaw (2012) has stated that it is necessary to overcome the "corporate immune system".

Subsidiaries can develop themselves in three ways (Birkinshaw, 2012): initiative from the manager of the subsidiary, investment decisions of Headquarters and the opportunities in the local market.

Initiative is defined here as the proactive and deliberate pursuit of a new business opportunity by a subsidiary company, with a view to expand the subsidiary's scope of responsibility in a manner consistent with the MNC's strategic goals.

Research has been performed to investigate the driving factors of subsidiary initiative in general (Birkinshaw, Hood, Jonsson and Fry, 1998, 1999, 2012). Support has been found for the relationship between the level of distinctive capabilities and the level of credibility of the subsidiary and the level of their initiative.

In a world where information flows are quicker by internet and other media, timing is of essential importance to find business opportunities and take action for innovation. Subsidiaries of multinational firms play an important role in the globalization of innovation (Phene & Almeida, 2008) to build and sustain competitive advantage and there is some evidence that multi-nationality itself drives the innovation propensity (Frenz and Gillies, 2005).

It is interesting to investigate what factors drive innovation initiatives starting at the subsidiaries for exploitation of new opportunities with the ultimate goal of improving overall performance of the subsidiaries and thus of the company as a whole.

Birkinshaw (2012) defines four distinct types of subsidiary initiative; one type is externally focused on new opportunities in the local market place. The second type is internally focused. The third type is focused on global market opportunities and the fourth type is a hybrid of the second and third.

The external focused initiative is linked to opportunities that are identified with customers, suppliers or governments. Typically they come from gaps between customer demands and supplier capabilities. The internally focused initiative is linked to opportunities to increase efficiencies and exploitation. Initiatives for process innovation could be placed in this category.

Research on determinants for innovation and subsidiary initiative shows that autonomy of the subsidiary is both related to subsidiary initiative (Birkinshaw, Fry, Hood and Jonsson, 1998) as market innovation (Venaik et al., 2005).

Determinants for the level of innovation are knowledge transfer (Mahler et al., 2011), knowledge assimilation (Phene and Almeida, 2008) and knowledge structure (Ong et al., 2003).

The flow of knowledge and the visibility of it seem to be a very important driving force for innovation. Phene and Almeida measure innovation performance by using patent data of multinational subsidiaries.

Research on innovation has been focusing on market innovation and product innovation and is linked to an exploration strategy. Product innovation is also related to radical innovation while process innovation relates more to incremental innovation. In a Supply Chain environment, it is expected that the strategy has a cost-focus and will be exploitative by nature. Process innovations will support that cost strategy and result in incremental

innovation. The area of process innovations in a supply chain environment has not been researched extensively and provides an interesting scope for this study.
Subsidiary initiative for process improvements can be divided in generation of improvement ideas and realization of improvement ideas. Initiative itself does not have to incorporate an actual implementation of an improvement idea. While factors driving initiative itself have been found in previous studies, it is not completely clear how these factors are influencing the generation and the realization of innovation initiatives as separate items at the subsidiary level.
Building on the research into subsidiary initiative and innovation in multinationals, it is interesting to investigate what factors drive process innovation-initiatives on the MNC subsidiary level. This is an area not yet researched in depth and could contribute to the existing knowledge of managing subsidiaries of MNCs.
This leads to the main research question:

Which factors determine the level of subsidiary innovation initiatives?

Understanding what drives subsidiary initiatives and knowing that knowledge exchange improves subsidiary performance, the relation between knowledge exchange and innovation initiative from the subsidiary is not well understood. A sub-question derived from this is:

How does knowledge exchange influence the level of subsidiary innovation initiatives?

Research on determinants for innovation and subsidiary initiative shows that autonomy of the subsidiary is both related to subsidiary initiative (Birkinshaw, 1998) as market innovation (Venaik, 2005). Other research has demonstrated that the use of controls mechanisms by Headquarters has a positive effect on the level of entrepreneurship of the subsidiary (Zahra, 2000).
This leads to the following sub-question:

How do controls mechanisms of Headquarters influence the level of subsidiary innovation initiatives?

Besides looking at single factors it can also be expected that a combination of factors is necessary to ensure a high level of subsidiary initiative. It would be interesting to see what configuration of factors is ideal.
This leads to the following sub-question:

Which combination of factors maximizes the level of subsidiary innovation initiatives?

2 Theory & Hypotheses

First step in this research was to explore the existing literature on theories concerning the concepts of subsidiary initiatives, innovation, knowledge exchange and controls systems. These concepts have been studied and described in several studies and will form the starting point for this thesis.
As the context for this study is the multinational corporation, the exploration of theory was focused to this context.
From the exploration of the theory, definitions of the concepts were established and the expected relationships between them derived. The following paragraphs describe this process.

2.1 Subsidiary Innovation Initiatives

Corporate entrepreneurship can take the form of focused corporate entrepreneurship or dispersed corporate entrepreneurship (Birkinshaw, 1997). Focused corporate entrepreneurship is centralized at the corporate Headquarters. The dispersed form is sometimes called intrapreneurship and occurs throughout the firm. This thesis focuses on intrapreneurship in the multinational corporation at the subsidiary level. This is called subsidiary initiative.
Subsidiary initiative can be externally or internally focused. Externally by focusing on external markets, suppliers and customers or internally by focusing on the internal organization and processes.
Birkinshaw (1997, 1998, 1999, and 2012) has performed and was part of a lot of research on subsidiary initiative. Subsidiary initiative is important with regards to new business opportunities as the subsidiaries are closer and tighter connected with customers and suppliers than the headquarters.
Birkinshaw defines initiative as the proactive and deliberate pursuit of a new business opportunity by a subsidiary company, with a view to expand the subsidiary's scope of responsibility in a manner consistent with the MNC's strategic goals.

Another definition comes from Kanter (1982) and Miller (1983) who define initiative as a proactive undertaking that advances a new way for the corporation to use or expand its resources.

For this study the business opportunity of the subsidiary is defined as the opportunity of changing or renewing the subsidiary's processes with the aim to increase production or efficiencies. A new way of using resources can be linked to increasing efficiencies in the subsidiary. This study is not interested in finding new market opportunities to expand the number of products manufactured by the subsidiary.

The internally focused initiative is linked to opportunities to increase efficiencies and exploitation. Initiatives for process innovation could be placed in this category.

For the research of this thesis, the internally focused initiative is relevant as the relation between independent variables and process-innovation initiatives is the area of interest. Internal innovation initiatives are focused on increasing efficiencies and normally surface in situations of diminishing returns (Birkinshaw, 2012). In highly environmental competitive situations, a higher level of exploitative innovation will also increase the firm performance (Jansen et al., 2006). Ultimately, innovation initiatives have the goal to increase the overall performance of the company.

Joseph Schumpeter was the first to recognize the importance of understanding the concept of innovation in the 1930s. In 1985, Peter Drucker defined innovation as the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or service. It is capable of being presented as a discipline, capable of being learned, capable of being practiced.

Michael Porter (1990) stated that innovation should "include both improvements in technology and better methods or ways of doing things and results as much from organizational learning as much as from formal R&D". This can be linked to the forms of corporate entrepreneurship described by Birkinshaw (1997). The focused form can take the form of a centralized R&D division/group and the dispersed form as a network process of knowledge transfer between subsidiaries.

The element of better methods or ways of doing things can be translated to process innovation. A process innovation is defined as the implementation of new or significantly

improved production or delivery method. This includes significant changes in techniques, equipment and/or software (Oslo Manual; OECD-Eurostat, 2005).
This definition will be used in this thesis.

2.2 Determinants of Subsidiary initiatives

2.2.1 Knowledge Exchange

Inter-unit learning in MNCs involves transfer of proprietary and tacit knowledge and information between the parent and subsidiaries, and among the subsidiaries of the multinational firm (Venaik et al., 2005). The transfer of tacit knowledge is here defined as sharing best-practices among globally dispersed business units.
Research has also linked tacit knowledge to skills (Nelson & Winter, 1982), know-how (Kogut and Zander, 1992) and classified it as uncodifiable (Hu, 1995) and implicit (Spender, 1994).
Best-practice sharing is also related to the term networking. Networking is here defined as the extent to which the marketing mix decisions in the MNC are taken in groups, such as teams, task forces and committees, comprising managers from the corporate and regional headquarters and country subsidiaries.
Knowledge exchange can be split into internal and external exchange. The internal knowledge exchange is sharing knowledge between the Headquarters and the subsidiaries or within the subsidiaries of the MNC.
External knowledge exchange is sharing knowledge between the subsidiary or Headquarters and external knowledge institutes. These knowledge institutes can be universities, suppliers or customers. Sharing knowledge with external parties in the host country is an important element for innovation performance as demonstrated by research from Phene and Almeida (2008). Their research shows that the level of subsidiary innovation is positively related to knowledge assimilation from other firms in the host country.

2.2.2 Controls Systems from Headquarters

In a global network of subsidiaries, the overall performance of the MNC is dependent on the performance of the individual subsidiaries. For this purpose, MNCs have implemented controls systems for subsidiary performance. These controls systems are a reflection of the culture and values of the parent company and can influence the behavior of the subsidiary managers and as a result the level of entrepreneurship of the subsidiary (Zahra et al., 2000). These controls systems can be split in strategic controls and financial controls. Strategic controls involve subjective assessments of the subsidiary performance against its overall objectives. They are long-term oriented and can enhance managers' support of initiatives to expand long-term value creation (Zahra et al., 2000; Hill et al., 1990). Strategic controls can be assessments against subjective criteria like customer satisfaction or against long-term performance for example.
Financial controls involve assessments of the (financial) performance of the subsidiary, based on quantifiable goals and objectives. These controls have a short-term orientation and can be seen in practice as business metrics or KPI balance scorecards.

2.3 Hypotheses

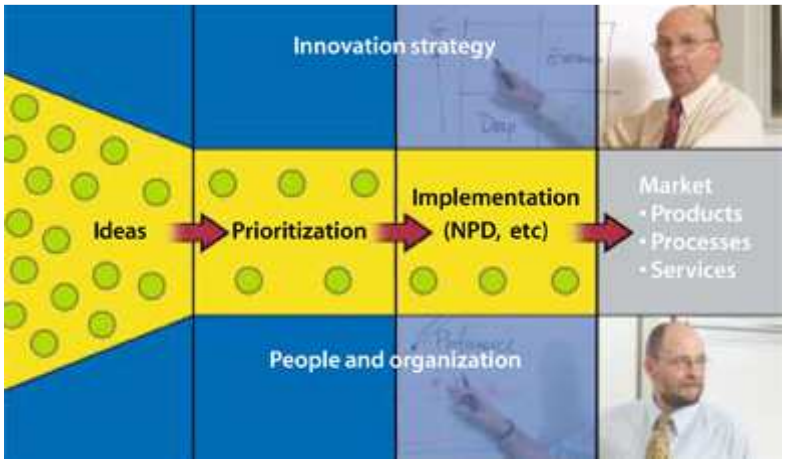
From the existing theory on subsidiary innovation initiatives, knowledge exchange in multinational corporations and controls systems from headquarters, hypotheses are made about the relationship between them in the context of the subsidiary of the MNC. The hypotheses are also created with the assumptions of necessary conditions incorporated.

2.3.1 The effect of Controls Systems

The process of innovation starts with an idea generation phase and progress through a number of phases before completion and financial benefit to the company (Goffin and Mitchell, 2010). After a funnel of ideas having been generated, the best ideas need to be selected in a prioritization phase and finally the selected ideas need to be implemented.
To reach effective innovation management, two elements need to be added to this process: Innovation Strategy and People & Organization. This results in the Innovation Pentathlon

Framework (Goffin and Mitchell, 2010). This pentathlon is built by the development funnel of ideas generation, prioritization and implementation and supported by Innovation Strategy and People and organization (figure 2.1).

Figure 2.1: Innovation Pentathlon Framework



The innovation strategy has to be set by the management and the role of innovation needs to be communicated to the employees to allocate the right resources to it. One element of the innovation strategy is implementing controls systems or metrics. The purpose of implementation of these controls systems is to monitor and evaluate the subsidiary performance against their goals & objectives. These controls systems are split in strategic controls and financial controls. Previous research has demonstrated that the use of these controls systems is positively related to the level of entrepreneurship of the organization (Barringer and Bluedorn, 1999; Zahra et al., 2000).
This leads to the following hypothesis:

H1 (a): The use of strategic controls by Headquarters is a necessary condition for subsidiary innovation initiatives

H1 (b): The use of strategic controls by Headquarters is positively related to the degree of subsidiary innovation initiatives

The element of People and Organization out of the innovation pentathlon is linked to the management of human resources. It is about creating a culture of innovation where people are motivated to take initiatives to innovate and are recognized and rewarded for that.

Research has demonstrated that the degree to which a supervisor expects the subordinate to be innovative is positively related to innovative behavior (Scott and Bruce, 1994). Expectations on innovativeness can be formalized in financial targets at the subsidiary level. These targets are part of the controls systems in the MNC.

Previous research had assumed that the use of financial controls by the Headquarters was negatively related to the subsidiary entrepreneurship (Zahra et al., 2000), but this was not supported by the data.

Using financial controls could be related to improved innovation performance as resulted from the pilot study where one manager said: “there must be a need for people to innovate, give them clear targets and a bit of pressure and they will be creative”.

This leads to the second hypothesis:

H2 (a): The use of financial controls by Headquarters is a necessary condition for subsidiary innovation initiatives

H2 (b): The use of financial controls by Headquarters is positively related to the degree of subsidiary innovation initiatives

2.3.2 The effect of Knowledge Exchange

There are different types of innovation (Goffin and Mitchell, 2010); it consists of breakthroughs or radical improvements but also of incremental improvements. Radical innovations change the existing products/processes completely by making them obsolete or abandoning those while incremental improvements are additions or changes to the existing products or processes. Both have the same importance level for manufacturing companies.

Research has shown that a high-level of distinctive subsidiary capabilities (Birkinshaw, 1999) is positively related to subsidiary initiative. Following this line of research, knowledge exchange could support the development of more distinctive capabilities in a particular subsidiary and is then expected to be positively related to (future) innovation initiatives.

Knowledge exchange is the process of sharing best-practices internally and/or externally and happens in two directions: from and to the subsidiary.

For knowledge exchange this leads to the following hypotheses:

H3 (a): Internal knowledge exchange is a necessary condition for subsidiary innovation initiatives

H3 (b): Internal knowledge exchange is positively related to the degree of subsidiary innovation initiatives

H4 (a): External knowledge exchange in the host country is a necessary condition for subsidiary innovation initiatives

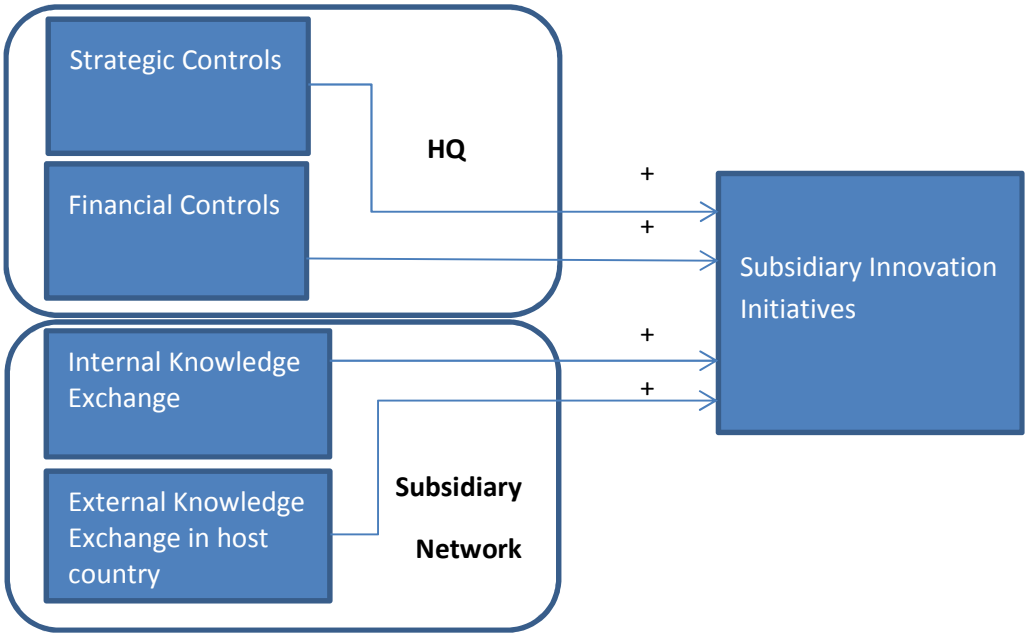
H4 (b): External knowledge exchange in the host country is positively related to the degree of subsidiary innovation initiatives

Besides assuming relations between single factors and subsidiary initiative it can be assumed that a combination of factors also relates to the level of subsidiary initiative. Based on the assumed positive single factor relations, it is assumed here that a combination of single factors at a high level lead to a higher degree of subsidiary innovation initiatives. This leads to the last hypothesis:

H5: The combination of the use of strategic controls, financial controls and internal knowledge exchange and external knowledge exchange in the host country is positively related to the degree of subsidiary Innovation initiatives

All hypotheses are visualized in the conceptual model of figure 2.2

Figure 2.2: Conceptual Model



3 Methodology

3.1 Set-up

Theory-oriented research starts with the exploration of theory for finding propositions (Dul and Hak, 2012). The first step of this theory-oriented research was performed and described in the previous chapter. The exploration of the theory showed results of research on determinants for process innovation and for subsidiary initiative. These results were relevant for different contexts and the context of a multi-national supply chain of MNC subsidiaries has not been researched to a large extent.

The unit of analysis of this research is the group of subsidiaries of the General Electric Power & Water division. General Electric (NYSE:GE) is a multi-national, American-based company founded by Thomas Edison in 1892. The company has a long history of developing new products and innovations. Each year GE files approximately 2,000 patents in the U.S., putting GE in the top 10 for innovation (source: United States Patent and Trademark Office – USPTO, 2011).

GE has businesses in more than 100 countries around the world and covers a large group of industries with products and services. The company is divided into eight segments focused on the broad markets that it serves: Power & Water, Oil & Gas, Energy Management, Aviation, Healthcare, Transportation, Home & Business Solutions and GE Capital. The total of consolidated revenues in 2012 was $147,359 million and consolidated net earnings were $13,641 million (figure 3.1). GE employs approximately 290,000 people around the world. The largest industrial segment of GE is GE Power & Water. In the GE Power & Water division there are a number of subsidiaries, the majority grouped around function and/or product. GE Power & Water consists of sixty-two plants (see attachment) and this has provided a good scope for this research. The roles and objectives of these subsidiaries and the scope of their operation are similar. This implies that the subsidiary mandate is the same (Pearce, 1999 ; Birkinshaw, 1996).

Researching subsidiaries with a similar mandate improves the internal validity of the research as variation in innovation performance is not related to variation in mandates. The observed variation in innovation performance can be expected to be the result of other factors.

Table 3.1: GE Annual Report 2012 – Financial Summary

Summary of Operating Segments

	General Electric Company and consolidated affiliates				
(In millions)	2012	2011	2010	2009	2008
REVENUES[a]					
Power & Water	**$ 28,299**	$ 25,675	$ 24,779	$ 27,389	$ 28,537
Oil & Gas	**15,241**	13,608	9,433	9,683	9,886
Energy Management	**7,412**	6,422	5,161	5,223	6,427
Aviation	**19,994**	18,859	17,619	18,728	19,239
Healthcare	**18,290**	18,083	16,897	16,015	17,392
Transportation	**5,608**	4,885	3,370	3,827	5,016
Home & Business Solutions	**7,967**	7,693	7,957	7,816	9,304
Total industrial segment revenues	**102,811**	95,225	85,216	88,681	95,801
GE Capital	**46,039**	49,068	49,856	51,776	68,541
Total segment revenues	**148,850**	144,293	135,072	140,457	164,342
Corporate items and eliminations[b]	**(1,491)**	2,995	14,495	13,939	15,427
CONSOLIDATED REVENUES	**$147,359**	$147,288	$149,567	$154,396	$179,769
SEGMENT PROFIT					
Power & Water	**$ 5,422**	$ 5,021	$ 5,804	$ 5,592	$ 4,563
Oil & Gas	**1,924**	1,660	1,406	1,440	1,555
Energy Management	**131**	78	156	144	478
Aviation	**3,747**	3,512	3,304	3,923	3,684
Healthcare	**2,920**	2,803	2,741	2,420	2,851
Transportation	**1,031**	757	315	473	962
Home & Business Solutions	**311**	237	404	360	287
Total industrial segment profit	**15,486**	14,068	14,130	14,352	14,380
GE Capital	**7,401**	6,584	3,120	1,253	7,470
Total segment profit	**22,887**	20,652	17,250	15,605	21,850
Corporate items and eliminations[b]	**(4,842)**	(287)	(1,013)	(507)	1,516
GE interest and other financial charges	**(1,353)**	(1,299)	(1,600)	(1,478)	(2,153)
GE provision for income taxes	**(2,013)**	(4,839)	(2,024)	(2,739)	(3,427)
Earnings from continuing operations attributable to the Company	**14,679**	14,227	12,613	10,881	17,786
Earnings (loss) from discontinued operations, net of taxes	**(1,038)**	(76)	(969)	144	(376)
CONSOLIDATED NET EARNINGS ATTRIBUTABLE TO THE COMPANY	**$ 13,641**	$ 14,151	$ 11,644	$ 11,025	$ 17,410

(a) Segment revenues includes both revenues and other income related to the segment.

(b) Includes the results of NBCU, our formerly consolidated subsidiary, and our current equity method investment in NBCUniversal LLC.

See accompanying notes to consolidated financial statements.

The first step in this research was a short exploration of practice by a qualitative pilot study. The purpose of this pilot study was to confirm the relevance of the propositions derived from the existing literature in the present context of the study. It was also aimed to identify "theories in-use", or the plant manager's knowledge of "what works" in practice (Dul and Hak, 2012).

The pilot study consisted of conducting interviews with one division manager and three plant managers in the GE Power & Water division. The interviews were recorded and transcripts were made.

The feedback from the managers in the interviews contained variation about the expected determinants for process innovation performance at the plant level. Their feedback was in line with the results of the theory exploration and used to set-up the next step for theory-testing research.

The theory-testing research is a quantitative study using a survey to measure the dependent variable of process innovation performance and the independent variables expected to influence them on the level of the plant.

3.2 Research Setting: GE Power & Water

GE Power & Water provides customers with a broad array of power generation, energy delivery and water process technologies to solve their challenges locally. GE Power & Water works in all areas of the energy industry including renewable resources such as wind and solar; biogas and alternative fuels; coal, oil, natural gas and nuclear energy. The business also develops advanced technologies to help solve the world's most complex challenges related to water availability and quality. The GE water business manufactures and services products for water processing and treatment.
Numerous products are qualified under the ecomagination program, GE's commitment to providing innovative solutions that maximize resources, drive efficiencies and help make the world work better. Headquartered in Schenectady, N.Y., GE Power & Water is GE's largest industrial business.

The products provided by GE Power & Water are manufactured in 62 plants located in 21 countries around the world. Twenty-nine plants are located in the USA, five in China, four in Canada and four in France. For the remainder, there is only one plant per country.
Thirty-one of these manufacturing plants form the GE Global Supply Chain and are managed by the Global Supply Chain Management (GSCM). The Global Supply Chain employs approximately 11,500 people.
The other thirty-one plants in the GE Power & Water group belong to the GE Water business and are managed by the GE Water global management. The GE water business employs approximately 3,000 people.
All the plants belonging to the Global Supply Chain and the ones under GE Power & Water are part of the scope of this study. There are 62 plants in total.
The plants in the Global Supply Chain are grouped in Profit & Loss centers (P&L's); Thermal, Centers of Excellence (COE's), Renewables, Nuclear, Distributed Power and Water.
Maintaining and servicing the products of customers is either performed at the customer location or in Service Centers located in the region. These Service Centers are not part of the Global Supply Chain or the GE Water business and thus outside of the scope of this research.

The plants of the GE Power & Water segment all have a similar mandate, which is to manufacture products for power generation, energy delivery and water processing and treatment.
It is interesting to research their process innovation performance and possible determinants for that performance. In a supply chain, products are manufactured according specifications made by design engineering so changing processes in the plant has the apparent risk of not meeting these specifications anymore. From this viewpoint, process innovations are not expected to occur often.
On the other hand, the plants in the Global Supply Chain are monitored and evaluated as cost centers and influence the product cost and profitability. This makes looking for cost efficiencies a daily exercise in the plants.

3.3 Pilot Study

The pilot study started with collecting data on plant and organizational characteristics, the innovation processes and innovation performances by searching the GE intranet.
Through one of the plant managers access was granted to a GE Shared Folder on the intranet which contained the GE Global Supply Chain Factory Fact Book. In this book important facts and figures of the GE Global Supply Chain are documented and sorted by plant.
The documented data contains facts on the number of employees, management team, plant size, financial performance, manufactured products and plant capability. The data is documented for the year 2012 and the financial (cost) data covers the past 3 years.
Also access was granted to the GE Water Plant Fact sheets which contained facts and figures of the GE Water business and plant locations.
The information from both the GE Global Supply Chain Factory Fact Book and the GE Water Plant Fact sheets provided a good overview of the 62 plants in the GE Power & Water segment.
However, data on plant innovation processes, innovation performance and initiatives was not recorded in this information as well as detailed information about the management teams, organization and level of connectedness in the GE network.

In order to gain a greater insight in the innovation initiatives and performance of the plants and to establish the amount of variation between the plants, the second step was to conduct interviews with selected plant managers.

An initial interview with two regional managers revealed that innovation is present as process-innovation in the plants while product-innovation is normally performed centrally in the global R&D centers of GE.

Process-innovation, linked to subsidiary initiative starts with idea generation from the different locations, flows through a prioritization phase and ends with the idea realization and implementation. These typical phases of innovation are visualized in the development funnel (Goffin and Mitchell, 2010). From the interviews, it emerged that there is variation between the plants both in the number of generated ideas as in the number of implemented innovation ideas. The reasons for these variations are not well understood and thus provide a good research subject.

More detailed interviews were set-up as semi-structured interviews with open questions based on the already researched theoretical concepts of the environmental context (Zahra, 2000), subsidiary initiative (Birkinshaw, 1999), external knowledge (Phene and Almeida, 2004), problem-solving processes (Scott and Bruce, 1994) and knowledge transfer (Monteiro et al., 2008).

In addition questions were asked on the number of initiated process innovation ideas and the rate of successful implementation in the last few years. Finally the question was asked how much money was spent on process innovation in the last few years as a percentage of Sales.

The interviews were conducted with one Global Supply Chain division manager and three plant managers in the GE Power & Water group (see table 3.1).

Preferably, the interviews would have been done in a life-setting, but this was only possible once due to good timing with the travelling schedule of that particular plant manager. The other interviews have been done by telephone as a result of the global locations of these managers.

The possibility of video-conferencing was considered, but this option was not available at that time.

In the first interview it became apparent that there is a difference in manufacturing processes of the plants in the Power & Water division. All plants of the Global Supply Chain (GSC) manufacture new products while the plants of GE Water perform chemical blending, manufacturing of chemical products, filter systems or a combination of those. In the analysis this difference has to be taken into account to check for related differences in innovation performance.

In the first interview, information on innovation performance levels was given per plant. Based on this first feedback on innovation performance of the plants, interviews were scheduled with the plant managers of a high, medium and low performing plant. The purpose of this was to look for differences between a high and low performer to get some direction of possible determinants of process-innovation performance of the subsidiary in the GE Power & Water business. This resulted in two extra interviews; one with the plant manager of a high performing unit (HPU) and one with the plant manager of a medium performing unit (MPU).

Unfortunately, setting up an interview with the plant manager of the low performing unit was unsuccessful, because of the transition of this person to another job within GE and no replacement has yet been identified.

About the interviewees, it should be noted that there were different levels of familiarity with them and this could have affected the information given in the interviews by variation of trust levels.

Table 3.2: Pilot Study interview schedule and details

Interviewee	**Interview Method**	**Interview Date**	**Familiarity with interviewer**
Division Manager	Telephone	March 18, 2013	medium
Plant Manager (MPU)	Life	Feb. 15, 2013	high
Plant Manager (MPU)	Telephone	Apr. 5, 2013	medium
Plant Manager (HPU)	Telephone	Apr. 9, 2013	low

The interviews were recorded and transcripts were made. With the process of coding in grounded theory (Bryman and Bell, 2011) the transcripts have been analyzed to see

emerging concepts and themes related to process innovation at the subsidiary level of the MNC.

The information from the interviews shows that there are groups of factors related to innovation performance of the plant: organizational characteristics, leadership characteristics, strategic and financial controls, and knowledge exchange and innovation strategy.

Organizational Characteristics

In the interviews it became apparent that the organizational structure of the Thermal group in the Power & Water division has recently been changed from a regional structure to a functional structure. This means that globally, the plants are now grouped functionally and report to the same manager. This makes sharing of ideas easier between the US and non-US plants, but harder in one country/region across different plants, like the US itself.
The Thermal group has NPI (New Product Introduction) employees, who look at the products and they look at the processes. They are part of a special group called Advanced Manufacturing and are in charge of new processes. This group is located in the US near the Headquarters.
Some plants are established as a Greenfield, others through acquisitions or a joint-venture. The division manager stated that the initial thought in a non-US acquired site was: “we are in competition with the US sites so we need to survive through innovations”.

Leadership Characteristics

In the interview with the division manager one of the reasons given for the variation of innovation performance is the experience and background of the plant manager and his management team. He said “mature teams” will innovate better. There is variation in the previous experience of the plant managers and in the time in their current role. The plant managers in the US mainly have US experience. This can be linked to the strategy of having local people lead local teams. As the division manager said; “this has three reasons: 1. Career-perspectives in the country, 2. Knowledge of the local rules & regulations and 3. Knowledge of the local language”.

On experience and background, one plant manager had a previous role named “translation leader” where he was responsible for best-practice sharing between the plants in the group of GE Lighting at that time.

Strategic and Financial Controls

In all interviews the process for goals & objective setting, implementation of controls mechanisms and communication of expectations to the employees is mentioned and explained. However, there is a significant difference in how the effect of these processes is perceived. The plant manager of the high performing unit uses hard targets for innovation projects and controls these by incorporating these targets in the employee’s appraisals and performance reviews. The process of process innovation is highly formalized and named “continuous improvement process”.

One other plant manager, of a medium performing unit, does not believe in giving hard targets on an individual level, but establishes a plant level target and drives process innovation by motivation , attention and allocating resources to innovation projects. “There must be a need of why they are working on that project, need made people to be innovative”.

In the past, he said, there were hard targets as 2 innovation projects per person every year, but the result of this was: “stupid projects, where 6 out of 7 million dollars of total savings was funny money”.

Of course this perception difference could be a result of cultural differences between host-countries, but nevertheless the difference alone makes it an interesting area for further research.

The plant manager who does use formal targets also states that the rule of thumb is that people can use 2 hours of their time every 2 weeks to work on process improvement ideas. This is implemented to ensure that time is allocated to work on process innovation.

The interviewed division manager promotes a process where one plant is prototyping an idea and takes the lead so that if successful it can be shared with the other plants. This is to prevent that several plants are working on the same ideas in parallel.

Knowledge Exchange

The interviews show a variation in knowledge exchange in the network. The internal network is separated from the external network. Feedback on the connectedness with the internal, GE Power & Water network is consistent. One plant manager said: "we are doing a lot right now to benchmark between plants". The division manager of the Thermal group promotes the interaction between the units. He states: "I am pushing for best-practice sharing a lot".

On a plant manager level there is a high frequency of communication. "There is a good relationship, they call each other". On the other levels it is mostly done within the plant, but one manager said "I am trying to change this, it doesn't go naturally now".

On knowledge exchange, the proximity to GE engineering is mentioned. "It is easier to do process innovations for the US plants, because of the localization to the engineering team" one manager said.

Connections with external knowledge institutes vary a lot. The high performing unit has a lot of these connections, including managers that serve on the board of technical universities and technical associations. "Our manufacturing engineers are connected to various institutes; they are connected with professional institutes as well as colleges".

The medium performing units do not have such tight connections, but is trying to increase this. One manager says: "every senior leader must at least have one stand-up at the university every year".

Innovation Strategy

Having a formal Innovation Strategy is part of the innovation process as innovation needs to be guided in the right direction to be of benefit for the company (Bessant and Tidd, 2011). An innovation Strategy should identify and prioritize the needs for innovation (Goffin and Mitchell, 2010) and how this is done varies from plant to plant. The high performing plant is using formal individual targets and adds them in the employee appraisals. "We drive continuous improvement the way we drive everything that is important, and that is by putting a process around it", the manager says.

One of the medium performing plants uses higher level targets and combines this with management attention and employee motivation.
Some needs for innovation are the result of historical backgrounds and competition between plants to survive when volume demands dropped in the past. "It is a way of surviving", the manager said.
Also the country of origin of the plant and method of establishment could influence the innovation strategy.

Innovation Performance

Innovation performance is linked to the process of innovation. The process of innovation starts with an idea generation phase and progresses through a number of phases before completion and financial benefit to the company (Goffin and Mitchell, 2010, Bessant and Tidd, 2011). After a funnel of ideas being generated, the best ideas need to be selected in a prioritization phase and finally the selected ideas need to be implemented. Innovation performance of the plant can be measured as the ratio of generated ideas versus realized ideas.
In the interviews there is feedback on the number of generated ideas and the percentage of implementation or the success rate of the process innovation ideas. One manager said: "people can be amazingly, amazingly creative if you give them a clear goal, you give them resources and keep them under pressure".
All plant managers believe that there is always room for improvement of their processes and want to maximize the number of process innovations. As one manager stated: "Fundamentally, we believe that every single process has an infinite capability for improvement".

3.4 Conclusions from the Pilot Study

The pilot study was a qualitative study by method of interviewing a selection of plant managers and was completed in the period of March 18 to April 9 of 2013. The results of the pilot study confirmed the relevance of the conceptual model derived from the exploration of the theory for the research setting of this study. The interviewees described a variety of existing Headquarters controls and knowledge exchange levels with others in the internal and/or external network and their assumed relation to the innovation performance of the plant.

The 62 plants in the GE Power & Water (GE P&W) business are split between the GE Global Supply Chain and the GE Water business. On the GE intranet two information sources for these plants are located: the Global Supply Chain Factory Fact Book and the GE Water Plant Fact sheets. These sources show that the plants in the GE Power & Water business have different sizes, different number of employees, locations, functional costs and product range (table 3.3).

Information about innovation performance and details of the plant organization are not documented in these sources.

The role of the plants is to manufacture components and/or equipment for the global markets and the objectives are to do this with maximum of efficiency and minimum costs while maintaining high standards of quality.

The mandate of the plants is considered to be the same in this respect. The information from the interviews confirms the equality of mandates and also shows differences in process innovation performance between the plants.

Table 3.3: GE Global Supply Chain Factory Facts

Plant (Global Supply Chain)	***Location***	***GE P&W P&L***	***Number of employees***	***Product & Process***
Greenville	USA	Thermal	1441	Gas turbine manufacturing
Schenectady	USA	Thermal	1220	Steam turbine and Generator manufacturing
Bangor	USA	Thermal	289	Steam turbine and Generator manufacturing
Duluth	USA	Thermal	292	Gas turbine Blades manufacturing
Belfort, Bourogne, Chonas	France	Thermal	487	Gas turbine & Component manufacturing
GTTC Monterrey	Mexico	Thermal	299	Steam turbine and Gas turbine Blades manufacturing
Veresegyház	Hungary	Thermal	997	Gas turbine and Gas engine packaging and Gas turbine component repairs
Shenyang Liming	China	Thermal	68	Gas turbine Component manufacturing
Hangzhou	China	COE	579	Gas turbine and Steam turbine Component manufacturing
Hai Phong	Vietnam	COE	431	Generator and Converter manufacturing
Shenyang	China	COE	52	Component manufacturing
Salem	USA	COE	372	Turbine Controls manufacturing
Jenbacher	Austria	Distributed Power	643	Gas engine manufacturing
Waukesha	USA	Distributed Power	450	Gas engine manufacturing
Pensacola, Tehachapi	USA	Renewables	306	Wind turbine manufacturing
Salzbergen	Germany	Renewables	153	Wind turbine manufacturing
Shenyang	China	Renewables	101	Wind turbine manufacturing
Pune	India	Renewables	51	Wind turbine manufacturing
St Augustine	USA	Renewables	77	Component manufacturing
Wilmington	USA	Nuclear	746	Component manufacturing
Hitachi	Canada	Nuclear	178	Component manufacturing
Canonsburg	USA	Nuclear	141	Component manufacturing
GNF	Japan	Nuclear	190	Component manufacturing
Wuxi	China	Water	167	Component manufacturing
Guelph	Canada	Water	129	Chemical blending
Minnetonka	USA	Water	478	Component manufacturing
Sorocaba	Brazil	Water	61	Chemical Blending

The plant that is marked as a high-performer on process-innovation is established as a Greenfield, has experienced local leadership, uses highly formalized processes to stimulate innovation, has geographic proximity to the Advanced Engineering group and has multiple connections with professional institutes and universities.
The plants marked as medium-performers are established through acquisitions, have local experienced leadership, use a variation of formalization in their innovation processes and have fewer connections with knowledge institutes and universities.
Preliminary conclusion of the pilot study is that the method of establishment, the level of formalization of processes and the level of knowledge exchange in the network appear to be related to the level of innovation performance of the plant.

3.5 Quantitative Study

Following the pilot study, a quantitative study was set-up to test the theoretical propositions in the broader context of the GE Power & Water division. The hypotheses derived from the conceptual model were tested by means of a survey. The survey was built up by mainly using already existing survey questions with a proven high level of internal consistency (cronbach alpha). This was done to maximize the internal reliability of the measurements. For concepts where no scales existed yet, new questions were created and tested for internal consistency with the collected data.
The survey questions measured the concepts of organizational characteristics, leadership characteristics, management diversity, strategic and financial controls, knowledge exchange and the level of generated and realized subsidiary process innovation initiatives.

3.6 Operationalization of Variables

The conceptual model has been translated into an operational model with measurable variables representing the concepts. The questions in the survey tested the level of these variables. These variables can be divided in dependent variables, independent variables and control variables.
Some variables were measured as single numerical items like the number of generated improvement ideas. Other variables were measured with a scale derived from previously performed studies or created based on existing literature on the subject.

A dependent variable is the effect or the outcome of a process that is measured. This study measured the level of process innovation performance of the subsidiary level of the MNC. This is operationalized by defining two variables: 1. Generated number of process innovation initiatives and 2. Realized number of process initiatives.

Generated process initiatives are measured as the number of process improvement ideas developed in the plant in the period of the previous year (2012). The question was phrased as:

Q24. How many process improvement ideas were developed in your plant in 2012?

Realized process initiatives are measured by the percentage of successfully implemented ideas for the same period. The question was phrased as:

Q25. What percentage of these ideas was successfully implemented?

3.6.1 Independent Variables

The independent variables are variables that are expected to influence the dependent variables. They are expected to be related to the dependent ones.

The relevance of the hypotheses was confirmed by the pilot study where feedback was received that the concepts of organizational characteristics, leadership characteristics, management diversity, strategic and financial controls and knowledge exchange are related to the level of process innovation initiatives at plant level.

Innovation Strategy was one other factor that emerged from the interviews as an influencing factor for innovation performance, but after another review I concluded that this item should be incorporated into the strategic controls. Operationalizing the various concepts into measurable variables resulted in the following definitions:

Strategic and Financial Controls from Headquarters

Multinational Corporations implement controls systems for their subsidiaries to monitor and evaluate their performances. These control systems can be split into strategic and financial controls systems (Zahra et al., 2000).

Strategic controls have a long-term orientation and involve a qualitative assessment of the performance of the subsidiary against its goals and objectives.

Strategic controls are measured by a scale of two items derived from the study of Zahra et al. (2000).
This scale for strategic controls was validated for internal reliability by taking the average of the two answers and calculating the cronbach alpha which resulted in 0.841.
Financial controls are usually based on quantifiable goals and objectives, normally with a short-term orientation. For this study they are measured on a four-item scale derived from the study of Zahra (2000). This scale for financial controls was also validated for internal reliability by taking the average of the four answers and calculating the cronbach alpha which resulted in 0.784.
For both scales a 7-point Likert scale was used, instead of the original 5-points scale from Zahra et al. (2000) with the purpose to synchronize all scales in the survey to a 7-points standard.

Knowledge Exchange in the Subsidiary network

The level of knowledge exchange can be measured by the level of knowledge transfer within and between plants internally and with knowledge institutes externally. Internal Knowledge exchange was measured by a scale derived from Gupta and Govindarajan (2000) with 8 questions on receiving knowledge and 8 questions on providing knowledge in the internal network of Headquarters and other plants. The level of receiving and providing knowledge was measured on a 7-point Likert scale in the areas of Research and Development, Purchasing, Manufacturing, Distribution, Marketing and Sales, Information Technology, Finance and Human Resources.
This scale for internal knowledge exchange was validated for internal reliability by taking the average of the answers and calculating the cronbach alpha which resulted in 0.944.
External knowledge exchange in the host country was measured by a two item scale, also derived from Gupta & Govindarajan (2000). The level of external knowledge exchange in the host country was measured by the level of external contacts located in the host country of the subsidiary.
This scale was validated for internal reliability by taking the average of the answers and calculating the cronbach alpha which resulted in 0.937.

3.6.2 Control Variables

Control variables are additional variables that may have an influence on the nature of the relationships between the dependent and independent variables of the research (Bryman and Bell, 2011). These control variables should be measured and taken into account in the analysis to ensure that their influence does not play a role in determining the relationships between the dependent and independent variables.

Organizational characteristics, leadership characteristics, management diversity, autonomy, management support and financial performance are used as control variables in this study. The scales used to measure these variables were validated for internal reliability by calculation of cronbach alphas (table 3.6).

Table 3.4: Internal reliability of scales of control variables

Control Variable	**Cronbach Alpha**
Management Diversity	0.84
Autonomy	0.74
Management Support	0.69
Financial Performance over last 3 years	0.78
Financial Performance compared to industry competitors	0.89

Organizational Characteristics

There are differences in size, number of employees, age and origin of the plants in the GE Power & Water division and those should be taken into account in the analysis of this study. Larger plants may have more resources available to engage in process innovation initiatives. The size of the plants is a variable in the survey and measured by the number of full-time employees in the plant.

The age of the plant is also measured as a variable by the number of years since its establishment. Previous research has shown that older plants may have increased cumulative experience that enhances innovation (Sørenson and Stuart, 2000). Also older plants may have built-up more distinctive capabilities which are positively related to subsidiary initiatives (Birkinshaw, 1999).

Leadership Characteristics

The leadership characteristics are about the leadership skills and experiences of the plant manager.

It can be expected that strong, experienced leaders have a positive influence on the level of innovation performance of the plant. This expectation was also mentioned in the pilot study as a plant manager said:" it is driven by the experience level of the plant manager and the level of self-confidence of him or her".

To measure the leadership characteristics of the plant manager, 6 open questions were developed to check for experience in years with the company and diversity of roles in the company. Also the level of education was asked. These questions are of the type of personal factual questions (Bryman and Bell, 2011) and were put at the start of the survey as general questions to ensure an easy start of the survey for the respondents.

Management Diversity

More diversity in the management team could enhance creativity and should also be taken into account as a control variable. Research has shown that a representation of more functional areas in a team supports considering a greater range of perspectives and facilitates creativity (Miliken and Martins, 1996; Jansen et al., 2006)

To measure the diversity of the management team, 2 open questions were developed on the size and national diversity of the team. Additionally 10 questions were derived from a survey from Jansen et al. (2006) about the expertise, backgrounds and network connectedness of the members of the management team.

The internal reliability of this 10 questions-scale was measured by calculation of the cronbach alpha of the average which resulted in 0.84. This indicates a high internal consistency as the figure of 0.70 is typically used as the rule of thumb to denote an acceptable level of internal reliability (Bryman and Bell, 2011).

Autonomy and Management Support

The autonomy of the plant to make decisions or the level of higher management support on innovation initiatives are variables that are expected to influence the level of innovation initiatives also.

Autonomy is measured on a 4-item scale derived from research from Watson O'Donnell (2000). The internal consistency of this 4-item scale was verified by calculation of the cronbach alpha for the average which resulted in 0.74.

The level of management support is measured by 4 questions in the survey on the extent to which the higher management gives financial support to pursue the innovation projects and the extent to which there is discussion and communication with them.

The internal consistency of this 4-item scale was also verified by calculation of the cronbach alpha of the average which resulted in 0.58. This indicates a low level of internal reliability as the number is well below the rule of thumb of 0.70 (Bryman and Bell, 2011).

Further analysis of the data revealed that the first item of the scale was confusing. This item is the frequency of contact with higher management about innovation projects and could be seen not as a part of management support. For example, there could be frequent contact but always initiated by the plant itself, so that does not constitute a natural supportive higher management team. Excluding this question from the scale resulted in a cronbach alpha of 0.69 which indicates an acceptable level of internal reliability.

Financial Performance

It can be expected that units with a strong track-record on financial performance will invest more money or gain more investment budget than units with less historical performance. A good track-record on financial performance will also build up credibility in the MNC. Previous study has demonstrated that a high level of subsidiary credibility is positively related to subsidiary initiative (Birkinshaw, 1999).

The (relative) financial performance is measured on a 6-item scale for both the period over the last 3 years and as compared to the industry competitors.

The internal consistency of the scale was validated by calculating the cronbach alpha for the average. For the financial performance over the last 3 years this resulted in 0.78, for the financial performance compared to the industry competitors this resulted in 0.89.

Organizational Slack

The concept of organizational slack is also measured in the survey based on the research by Nohria and Gulati (1997). The scale has two questions on organizational slack about the impact of allocating 10% of the time of all employees to work totally unconnected to tasks and responsibilities of their department.
The internal consistency of this 2-item scale was checked by calculation the cronbach alpha of the average answers which resulted in 0.43. This is an indication of a very low internal reliability for this scale.
Analyzing the data of these two items, it became clear that there is very little variation in the answers and all answers are skewed towards "serious impact". I believe that this is driven by the resource constraint situation in the GE Power & Water division and focus on functional costs and in particular headcount numbers. It should be expected that all plants are efficiently staffed with minimum slack and even when slack occurs, plant managers will not easily admit it, afraid of losing budget or resources for their operation.
Because of the low level of consistency the data on this variable was excluded in any further analysis.

3.7 Data Collection

First a survey was created on paper and checked for internal consistency and clarity.
The survey consists of 74 questions divided into the areas of general leadership, management characteristics, organizational characteristics, innovation performance, financial performance, strategic and financial controls, autonomy, management support, organizational slack and knowledge exchange.
The survey was distributed among all the plant managers of the global GE Power & Water division who are located globally also. Considering this, the survey was loaded into a company IT survey tool (SurveyCentral) and the link to the survey was sent out to all plant managers and division managers of the GE Power & Water division. This was the easiest way to reach them.

To ensure the survey questions were clear, I have forwarded the first survey to two managers as a pilot. Their feedback was used to adapt the survey slightly on textual details and it was verified that completing the survey only took around 10-15 minutes. This should have made it easier to accomplish a good response rate.
The internet link to the survey has been sent to 56 managers as mentioned in the list of the plants belonging to the GE Power & Water division.
Two weeks after sending off the survey link I had received 15 completed surveys. To increase the number of respondents, I issued the survey-link again and called a division manager to ask for his support in motivating his managers to complete the survey.
Three weeks later a total of 21 surveys were completed and I started to call individual plant managers to ask them to complete the survey too.
Some of them gave me the feedback that the survey IT-tool got stuck when they were halfway completing it. They promised to try again and alternatively they could fill out the paper one, scan and e-mail it. This alternative method proved not to be necessary.
Finally, I received a total of 25 completed surveys which corresponds with a response rate of 45%.

3.8 Descriptive Statistics

The data from the surveys was collected over the period of May 20th to June 28th of 2013. All collected data was loaded into the computer program SPSS for windows as a data-file.
This resulted in a data-file with 74 variables for 25 cases.
The first step was to check and verify the type and measure of every variable in the data file and ensure every variable was coded correctly as a nominal, ordinal or scale measure (van Dalen and de Leede, 2009). This was necessary to determine what analysis methods are applicable.
The second step was to create descriptive statistics of the collected data. Table 3.5 presents a summary of all relevant statistical data of the dependent, independent and control variables. It also shows general data which will be used later for triangulation of the findings and determining the origin (plant) of the data. The internal reliability of the used scales was already validated and recorded in the previous paragraphs of this study.

Table 3.5 supplies normal data for minimum, maximum and standard deviation of the dependent variables. This is demonstrated by the range of generated improvement ideas of 0-1000 and the percentage of successful implementation of 0-100%.
For the independent variables the data also looks normal.
The data of the control variables shows some interesting points. The minimum levels of the financial performance, management support and management diversity are around 3.0 which indicates that the collected data on these is skewed towards the agreed /high categories of the Likert scale.
The data of the control variable Autonomy does show normal minimum and maximum levels with expected variation.

3.8.1 Leadership characteristics

There is a variety of nationalities among the plant managers. Nine plant managers have the US nationality, 5 have the Chinese nationality and the rest is distributed evenly around 10 other nationalities. One respondent did not state his/her nationality. All plant managers had the local nationality of the host-country of the plant.
None of the respondents had more than 2 previous international roles within GE and their education level is all higher than or equal to a Bachelor degree.

3.8.2 Organizational Characteristics

The respondents are plant managers of 25 different plants. There is variation in plant history, like age and method of establishment. The plant age varies between 2 and 127 years. Of 25 plants, 60% was established through an acquisition.
One response to the percentage of nationalities was invalid; so on this item, 24 valid responses were recorded.

Table 3.5: Descriptive Statistics

	Unit	N	Minimum	Maximum	Mean	Standard Deviation
Dependent Variables						
Generated improvement ideas	Number	25	0	1000	172.36	307.76
Successful Implemented improvement ideas	% of total	25	0	100	60.76	34.86
Independent Variables						
Strategic Controls	Ordinal	25	3.00	7.00	5.66	1.16
Financial Controls	Ordinal	25	2.00	6.50	4.99	1.18
Internal Knowledge Exchange	Ordinal	25	1.31	6.00	3.93	1.19
External Knowledge Exchange in host country	% of total	25	0	100	58.14	35.92
Control Variables						
Financial Performance (last 3 years)	Ordinal	25	2.50	6.67	5.13	0.90
Financial Performance compared to industry competitors	Ordinal	25	3.17	6.83	4.99	0.85
Management Support	Ordinal	25	3.00	5.67	4.33	0.69
Autonomy	Ordinal	25	1.00	6.00	4.58	1.28
Management Diversity	Ordinal	25	3.80	6.30	5.08	0.76
Leadership Characteristics						
Years in GE	Number	25	1.00	34.00	10.90	7.18
Years in current role	Number	25	0.20	19.00	4.17	3.87
Previous roles in GE	Number	25	0	8	2.16	1.89
International roles in GE	Number	25	0	2	0.32	0.63
Highest Education	Number	25	2	4	2.72	0.61
Organizational Characteristics						
Full-time employees	Number	25	16	1800	367.96	483.65
Employees with higher education	%	25	2.00	90.00	21.76	18.44
Other nationalities	%	24	0.00	80.00	11.02	20.41
Plant age	Number	25	2.00	127.00	21.76	26.43
Financial data of innovation						
Money spent on process innovations last 2 years	% of Revenue	24	0	15	3.30	4.27

3.8.3 Financial data of innovation

In the survey three questions were created to test for the financial data related to the innovation performance of the plants. These questions were phrased as:

1. How much money was spent on process innovations over the last 2 years in percentage of revenue?
2. What was the Variable Cost Productivity (VCP) over the last 2 years?
3. What was the R&D intensity in 2012 (R&D expenditure/Sales)?

The data in the responses of the last two questions reveals a non-normal pattern and also missing answers. After discussing with some of the plant managers about their definition of VCP and R&D intensity, it must be concluded that these concepts were not sufficiently clear and the responses are not suitable for further research.

In the responses to the first question, one of them is an outlier with a number of 100%. As none of the GE businesses spend 100% of their revenue on process innovations this response is invalid and excluded from further research.

3.9 Conclusions Methodology

Data has been collected from 25 plants in the GE Power & Water division. The response rate was 45% which is lower than targeted for this study. Despite this, the data of the surveys provide interesting material for further analysis.

The data of the dependent variables contains a large variation as expected. The innovation performance differs from plant to plant, both in generated ideas as in implemented ideas. This was also received as feedback in the interviews of the pilot study.

For the independent variables, scales were developed and tested for internal reliability by calculation of the cronbach alpha of the average responses. Both the scales for strategic and financial controls as the ones for knowledge exchange showed a high level of internal reliability and were validated.

Also scales were developed for the control variables and tested with cronbach alpha for the average answers. It was found that the scale for organizational slack had a low internal reliability. It is believed that this is because of “desirable answers” driven by plant manager

not willing to admit that they have slack resources by fear of being cut by Headquarters. All plants are viewed as cost centers by Headquarters and any opportunity to reduce costs will immediately be grasped.

Another reason could be that there is actually very few organizational slack in the plants of GE Power & Water due to effective management of resources and running a very lean operation.

In the further data analysis, the variable of organizational slack will be excluded due to the low internal reliability and missing opportunities to increase that.

The 4-item scale for the control variable of management support showed a low internal consistency and analysis showed that one item of the scale was confusing. While the other three items either contained the word “support” in the question or incorporated the accessibility of the higher management, this one item asked for the frequency of contact with the higher management. The frequency of contact with higher management can be unrelated to their supportiveness as it does not say anything on the content of this contact. This one item was excluded from the scale which resulted in an acceptable level of internal consistency. The reworked 3-item scale was used in the further analysis.

4 Data Analysis

The data from the surveys was loaded into computer program SPSS for windows and following the descriptive statistics from the previous chapter the conceptual model was used to look for relations between the independent variables and the innovation performance of the plants.

The first step was to look for correlations between the independent, control and dependent variables. Secondly, the hypotheses of the conceptual model were tested with 3 –types of analyses: regression analysis, necessary condition analysis (NCA) and fuzzy set qualitative condition analysis (fsQCA).

4.1 Correlation analysis

The result of the correlation analysis of the independent, control and dependent variables is shown in Table 4.1. Because of the ordinal type of the variables and the small sample size (N=25), the Spearman rho was calculated as the measure for correlation (van Dalen and de Leede, 2009).

The table shows that to the dependent variables of developed process improvement ideas and successfully implemented ideas, there is only one significant correlation with the 0.05 significance level. The use of financial controls by Headquarters has a significant correlation with the level of successfully implemented ideas ($r = 0.43$, $p<0.05$).

The other significant correlations are between:

1) The level of strategic controls by Headquarters and external knowledge exchange in the host country ($r = 0.40$, $p<0.05$).
2) Management diversity and the level of internal knowledge exchange. ($r = 0.49$, $p<0.05$).

Both of these have positive correlation coefficients so a higher level of the one is expected to go together with a higher level of the other.

The table also shows that there are three correlations with the 0.01 significance level:

1) Correlation between financial controls and strategic controls by Headquarters ($r = 0.56$, $p<0.01$).
2) Correlation between financial performance over the last 3 years and financial performance versus industry competitors ($r = 0.89$, $p<0.01$).

3) Correlation between management diversity and financial Controls ($r = 0.56$, $p<0.01$).

All of these three correlations have positive correlation coefficients and this finding can be explained. Financial and strategic controls are both controls systems of Headquarters and can be expected to be present together for a particular plant. If Headquarters uses controls systems, they are likely to use both instead of one to have better control on the plant. When the financial performance of a plant over the last 3 years is determined as high, that same financial performance versus industry competitors is expected to be high too. Good financial growth over three years in a stable Power & Water market is expected to reduce the competitors share also and thus their financial performance.

The correlation between management diversity and the level of financial controls by the headquarters could be explained from a risk perspective. When there is more diversity in the management team of the plant this could be perceived by headquarters as an increase in risk of opportunism and/or conflict which is mitigated by implementation of increased financial controls.

Besides the found significant correlations, the lack of some correlations is interesting too. It can be expected that there is a significant relationship between the level of developed improvement ideas and the degree of successfully implemented ideas. More generated ideas could increase the success rate of implementation. However, table 4.1 does not show a significant relation between these variables ($r = 0.31$, $p>0.05$).

It would also be expected that a high level of strategic controls by Headquarters will increase the level of internal knowledge exchange. Headquarters could act as the facilitator for knowledge exchange by making it strategically important. However, table 4.1 does not demonstrate this relation to be significant ($r = 0.29$, $p>0.05$).

Table 4.1: Correlations of variables

Spearman's Rho Correlation Coefficients	Process ideas developed	Successfully implement-ted ideas	Strategic controls	Financial controls	Internal knowledge exchange	External knowledge exchange	Financial performance last 3 years	Financial performance vs industry	Management support	Management diversity
Process ideas developed	1.00									
Successfully implemented ideas	0.31	1.00								
Strategic controls	0.06	0.28	1.00							
Financial controls	0.033	0.43*	0.56**	1.00						
Internal knowledge exchange	0.13	0.30	0.29	0.36	1.00					
External knowledge exchange	-0.26	0.08	0.40*	0.08	0.10	1.00				
Financial performance last 3 years	0.00	0.37	0.18	0.28	0.03	-0.15	1.00			
Financial performance vs industry competitors	0.02	0.30	0.28	0.27	0.23	-0.17	0.89**	1.00		
Management support	0.08	-0.02	-0.02	0.26	0.33	-0.07	0.08	0.20	1.00	
Management diversity	0.23	0.34	0.05	0.56**	0.49*	-0.03	0.03	0.03	0.26	1.00

**Correlations with significance level of 0.01 *Correlations with significance level of 0.05

4.2 Regression Analysis

A regression analysis has been performed to test the hypotheses from the conceptual model.

The relations between the independent variables and both the developed process improvement ideas as the successfully implemented ideas were tested.

The top half of table 4.2 shows the result of the linear regression analysis between the independent variables and the level of developed process improvement ideas in the plant. According to this analysis, none of the independent variables has a significant influence on the level of developed process improvement ideas in the plant when a significance level of 0.05 is taken into account.

Table 4.2: Regression analysis of independent and control variables to developed process improvement ideas

***Dependent Variable*: Developed Process Improvement Ideas**	***Standardized Beta***	***t-value***
***Independent Variable*:**		
Strategic Controls	0.25	0.96
Financial Controls	0.40	1.71
Internal Knowledge Exchange	-0.32	-1.54
External Knowledge Exchange in host country	-0.17	-0.81
***Dependent Variable*: Developed Process Improvement Ideas**	***Standardized Beta***	***t-value***
***Control Variable (Organizational Characteristics)*:**		
Plant Age	0.19	0.84
Number of full-time employees in plant	0.30	1.34
Percentage of employees with higher education	0.15	0.77
Percentage of other nationalities	-0.20	-0.96
Establishment of Plant	-0.31	-1.46
***Dependent Variable*: Developed Process Improvement Ideas**	***Standardized Beta***	***t-value***
***Control Variable (Leadership Characteristics)*:**		
Years in GE	0.01	0.05
Years in current role	-0.08	-0.37
Number of management positions within GE	0.51	2.08
Number of international management positions outside home country within GE	-0.43	-1.98
Highest completed education	0.36	1.88

In the top half of table 4.3 the result of linear regression analysis between the independent variables and the level of successfully implemented ideas is shown.

The results in the table show a significant relationship between the level of financial controls by Headquarters and the level of successfully implemented improvement ideas on the significance level of 0.05. The standardized Beta coefficient is positive and indicates that a higher level of financial controls will result in a higher level of successfully implemented improvement ideas.

This result is consistent with the correlation analysis in previous paragraph.

Table 4.3: Regression analysis of independent and control variables to successfully implemented improvement ideas

***Dependent Variable*: Successfully implemented improvement ideas**	***Standardized Beta***	***t-value***
***Independent Variable*:**		
Strategic Controls	-0.06	-0.25
Financial Controls	0.49*	2.12
Internal Knowledge Exchange	0.16	0.76
External Knowledge Exchange in host country	0.11	0.51
***Dependent Variable*: Successfully implemented improvement ideas**	***Standardized Beta***	***t-value***
***Control Variable (Organizational Characteristics)*:**		
Plant Age	0.13	0.53
Number of full-time employees in plant	0.07	0.28
Percentage of employees with higher education	-0.30	-1.46
Percentage of other nationalities	-0.19	-0.90
***Dependent Variable*: Successfully implemented Process Improvement Ideas**	***Standardized Beta***	***t-value***
***Control Variable (Leadership Characteristics)*:**		
Years in GE	0.03	0.11
Years in current role	-0.05	-0.23
Number of management positions within GE	0.42	1.57
Number of international management positions outside home country within GE	-0.42	-1.78
Highest completed education	0.04	0.21

*Correlations with significance level of 0.05

Also separate regression analysis was performed between the control variables and the developed and successfully implemented process improvement ideas. The tested control variables are organizational characteristics and leadership characteristics of the plant manager.

The mid-sections of table 4.2 and 4.3 show the results of this analysis for organizational characteristics and developed and successfully implemented improvement ideas respectively.
None of the factors of the organizational characteristics have a significant influence on the developed and successfully implemented improvement ideas on the significance level of 0.05.

The results for the regression analysis between Leadership Characteristics and the developed and successfully implemented improvement ideas are shown in the bottom sections of table 4.2 and 4.3.
The analysis shows that none of the factors of leadership characteristics have a significant influence on the developed and successfully implemented process improvement ideas on the significance level of 0.05.

Conclusions of regression analysis

The regression analysis only shows that the use of financial controls by Headquarters is positively related to the degree of successfully implemented improvement ideas. This is support for hypothesis H2 (b) from the conceptual model.
No support was found for the other hypotheses.

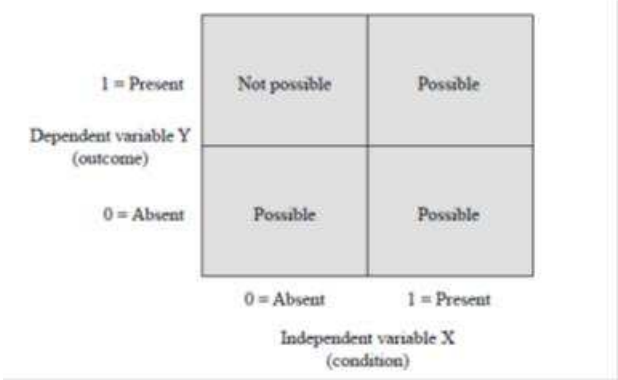
4.3 Necessary Condition Analysis (NCA)

Another type of analysis is necessary condition analysis (Dul et al., 2010). This analysis is performed to understand what X is needed to get Y. In other words, what condition does always exist when a particular outcome is present? This analysis looks for factors/variables that are necessary for the presence of a particular phenomenon.

The simplest form of the necessary condition analysis is used for dichotomous data where factors are either present or absent. This can be presented by a 2x2 matrix as in Figure 4.1. The matrix shows that the dependent variable Y can only be present when the independent variable X is present. Variable X is the necessary condition for outcome Y.

It is also possible to have variable X present when condition Y is absent and impossible to have condition Y in absence of variable X.

Figure 4.1: 2x 2 matrix representing the necessary condition (Dul et al., 2010)



To be able to perform a necessary condition analysis on the data of this study, the data are recoded to three levels: low, medium and high for both the dependent variables and the independent variables. The methodology for coding is shown in table 4.4.

As the data for generated improvement ideas is not normally distributed and can be influenced by the size of the plant this variable is recalculated to generated ideas per full-time employee by dividing the number of generated ideas through the number of full-time employees. By doing this the range of this variable changes to a range of 0 to 3.

For the data with percentages it is assumed that below 40% is low and above 60% is high. Everything in-between is considered to be at a medium level.

On the scoring on the Likert-scale questions related to the strategic and financial controls and the internal knowledge exchange, the text of the survey classifications was used as

guidance. For the controls variables, the scores 1 to 3 all contain the word “disagree” and the scores 5 to 7 contain the word “agree”. That is why these scores are recoded to low and high respectively. The scores in the middle are centered on the neutral score of 4 and recoded to medium.

The classifications of the answers on internal knowledge exchange are on a sliding scale between “not at all” to “very much”. For this reason the recoding is done more symmetrical towards the upper and lower limits.

Table 4.4: Coding table for Necessary Condition Analysis

Variable	**Low**	**Medium**	**High**
generated improvement ideas/fte	≤ 1	1 < X < 2	≥ 2
implemented improvement ideas	≤ 40%	40% < X ≤ 60%	> 60%
Strategic Controls	≤ 3	3 < X < 5	≥ 5
Financial Controls	≤ 3	3 < X < 5	≥ 5
Internal Knowledge exchange	≤ 2	2 < X < 6	≥ 6
External Knowledge exchange	≤ 40%	40% < X ≤ 60%	> 60%

The necessary condition analysis consists of three steps (Dul et al., 2010):

1. Select successful cases
2. Formulate necessary condition hypotheses
3. Assess Trivialness

Successful cases in this study are cases with high values of the independent variable, high values of generated improvement ideas and/or high values of successfully implemented improvement ideas. These successful cases are in table 4.5 marked as high with the letter “H” and colored yellow.

Analyzing the data in table 4.5 it is found that a high level of generated improvement ideas per full-time employee (N=2) has a necessary condition of a high level of strategic controls and another necessary condition of a high level of financial controls.

It is also found that a high level of successfully implemented improvement ideas has a necessary condition of a medium level of internal knowledge exchange in the subsidiary network. A medium (not high) level of internal knowledge exchange is also necessary for a high number of generated ideas per full-time employee.

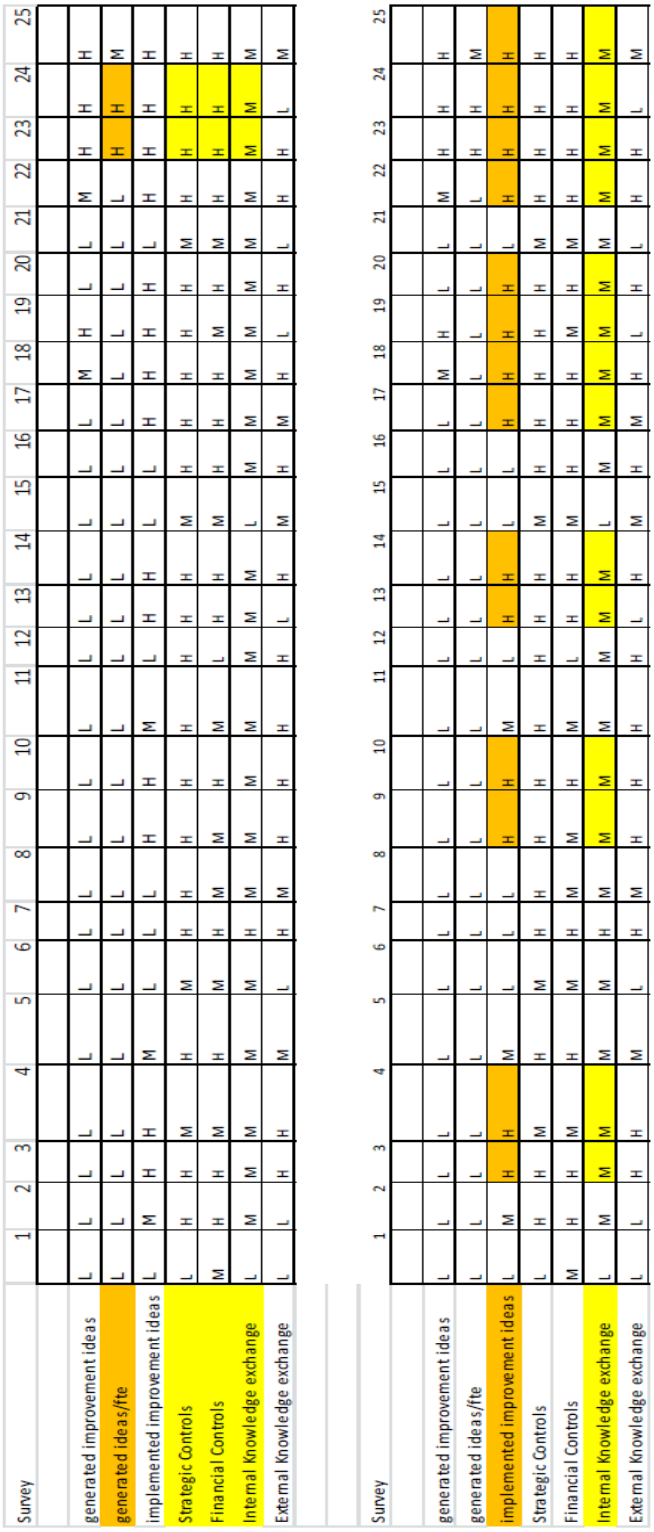
The necessary condition hypotheses were formulated at the beginning of the study and will be discussed again in the conclusion section of this thesis.

The last important step in the necessary condition analysis it to assess the trivialness (Dul et al., 2010). This assessment is performed by ensuring that a variable is not present all the time, but does show variation on all levels. It should be present in all defined levels to be able to validate the necessary condition.

Reviewing the matrix in table 4.5 it is confirmed that all independent variables are present at all levels: low, medium and high. Conclusion is that the necessary conditions are non-trivial.

Finally, a robustness check was performed by recoding the data into low, medium and high with other limits for the original data and run an analysis for these too. This check showed the same necessary conditions and verified the robustness of the analysis.

Table 4.5: Necessary conditions for developed and implemented improvement ideas



Survey	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
generated improvement ideas	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	H	L	L	M	H	H	H
generated ideas/fte	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	M
implemented improvement ideas	L	M	H	H	M	L	L	L	H	H	M	L	H	H	L	L	H	H	H	H	L	H	H	H	H
Strategic Controls	L	H	H	M	H	M	H	H	H	H	H	H	H	H	M	H	H	H	H	H	M	H	H	H	H
Financial Controls	M	H	H	M	H	M	H	M	H	H	M	L	H	H	M	H	H	H	M	H	M	H	H	H	H
Internal Knowledge exchange	L	M	M	M	M	H	H	M	M	M	M	M	M	M	L	M	M	M	M	M	M	M	M	M	M
External Knowledge exchange	L	L	H	H	M	L	H	M	H	H	H	H	L	H	M	H	M	H	L	H	L	H	H	L	M

Survey	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
generated improvement ideas	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	H	L	L	M	H	H	H
generated ideas/fte	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	M
implemented improvement ideas	L	M	H	H	M	L	L	L	H	H	M	L	H	H	L	L	H	H	H	H	L	H	H	H	H
Strategic Controls	L	H	H	M	H	M	H	H	H	H	H	H	H	H	M	H	H	H	H	H	M	H	H	H	H
Financial Controls	M	H	H	M	H	M	H	M	H	H	M	L	H	H	M	H	H	H	M	H	M	H	H	H	H
Internal Knowledge exchange	L	M	M	M	M	H	H	M	M	M	M	M	M	M	L	M	M	M	M	M	M	M	M	M	M
External Knowledge exchange	L	L	H	H	M	L	H	M	H	H	H	H	L	H	M	H	M	H	L	H	L	H	H	L	M

Another way of showing a necessary condition is to create a scatterplot of the dependent variable against the independent variable.

A necessary condition will reveal itself when the top left corner of the scatterplot is empty and holds no data points. For generated ideas per full-time employee this is shown in graphs 4.1 - 4.3. The graphs are consistent with the findings of necessary conditions out of the matrix with recoded data.

Figure 4.2: Scatterplot for generated ideas/fte vs. strategic controls

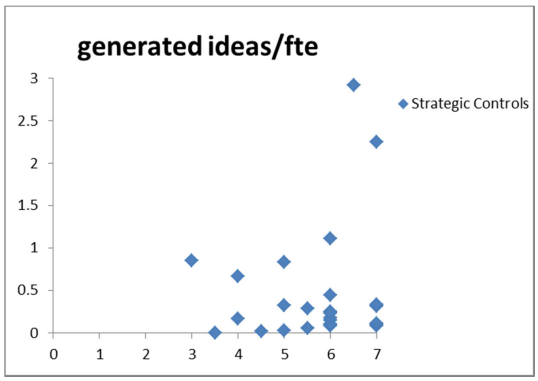


Figure 4.3: Scatterplot for generated ideas/fte vs. financial controls

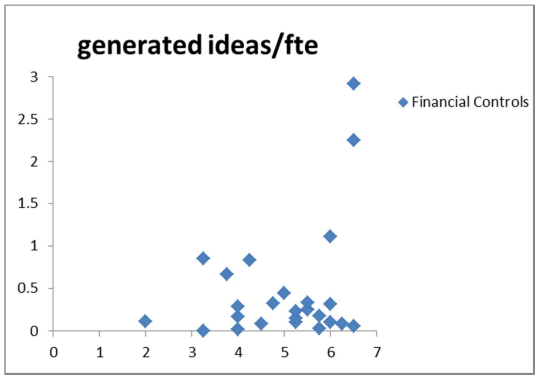
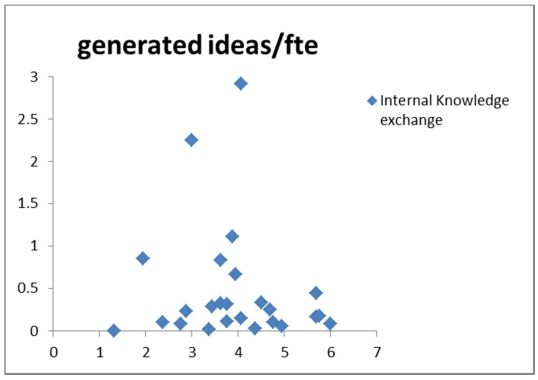
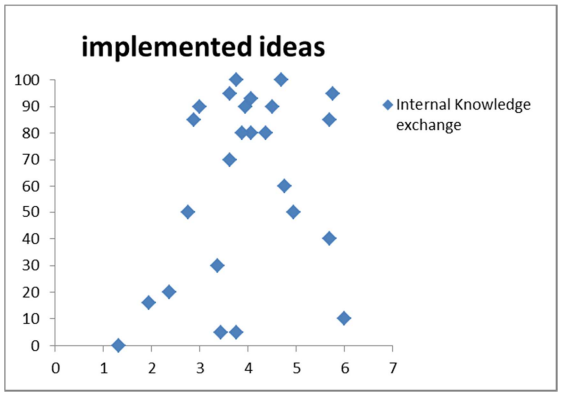


Figure 4.4: Scatterplot for generated ideas/fte vs. internal knowledge exchange



The scatterplot in graph 4.4 shows successfully implemented improvement ideas versus internal knowledge exchange and confirms the findings of the analysis of the matrix.

Figure 4.5: Scatterplot for Implemented ideas vs. Internal Knowledge Exchange



Conclusions of necessary condition analysis

The necessary condition analysis shows that a high level of financial controls and strategic controls by Headquarters are necessary conditions for a high level of generated improvement ideas. This supports hypotheses H1 (a) and H2 (a). Also the analysis shows that a medium level of internal knowledge exchange is a necessary condition for both the level of generated improvement ideas and the degree of successfully implemented ideas. This supports hypothesis H3 (a) with the note that the level of internal knowledge exchange is at the medium level and not at the high level.

4.4 Fuzzy Set Qualitative Condition Analysis (fsQCA)

Charles Ragin described a fuzzy set approach to fuzzy data (Ragin, 2000). He demonstrated that the subset relation is central to the analysis of multiple causal relations, where several different combinations of conditions are sufficient for the same outcome. This analysis determines the relation of different configurations of variables to a particular outcome. This approach can be used when the data of the research cannot be classified into discrete truth tables with dichotomous values of either present of absent. In a lot of cases independent variables vary by level or degree instead of being absent or present. Also in this study the independent variables vary in level as shown by the responses from the surveys.

A fuzzy set is created by coding data as a function of the level of "membership" to a particular group of factor. The range of this membership defines intervals between 0 (non – membership) to 1 (full membership). This allows for partial membership and classifications of being more in than out.

A discrete set of data would only have two levels, 0 or 1. Either fully in or fully out. Fuzzy sets of data can have several interval levels up to a continuous scale between 0 and 1.

To be able to use fuzzy set analysis for this study the data on the independent variables was recoded using the levels of 0.0, 0.2, 0.5, 0.8 and 1.0. The level of 0.5 is the absolute neutral point of neither fully in nor fully out. This corresponds with the score of 4 on the 7-points Likert scale used in the survey, literally called "neutral".

Using the analysis described in Ragin's: "from fuzzy sets to crisp tables" (University of Arizona, April 2005) the data of the independent variables: strategic controls (S), financial controls (F), internal knowledge exchange (I) and external knowledge exchange (E) was recoded to the levels described in table 4.6.

Table 4.6: Coding table for fuzzy set analysis

Independent Variables	**0.0**	**0.2**	**0.5**	**0.8**	**1.0**
Strategic controls (S)	≤ 2	2 < S < 4	4	4 < S < 7	7
Financial controls (F)	≤ 2	2 < F < 4	4	4 < F < 7	7
Internal knowledge exchange (I)	≤ 2	2 < I < 4	4	4 < I < 7	7
External knowledge exchange (E)	Scale:	E/100			

Also the inverse level was determined as the 1-X number and coded with the lower-case letter. Following that, 16 (2 to the power of 4) different combinations were formed and calculated using the AND function of the fuzzy set analysis (see Table 4.7).
The number of generated ideas was recalculated to generated ideas/full-time employee to stay between the 0 and 1 limit. Also the percentage of successfully implemented ideas was recalculated by dividing by 100 to stay between 0 and 1.

Table 4.7: Fuzzy Set analysis for 16 combinations of independent variables

sfie	sfiE	sfIe	sfIE	sFie	sFiE	sFIe	sFIE	Sfie	SfiE	SfIe	SfIE	SFie	SFiE	SFIe	SFIE	generated ideas/fte	implemented improvement ideas
0.8	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	0.2
0.2	0.0	0.2	0.0	0.2	0.2	0.2	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.8	0.0	0.1	0.5
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.8	0.2	0.9
0.0	0.5	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.2	0.0	0.2	0.3	0.9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.5	0.1	0.6
0.2	0.1	0.5	0.1	0.2	0.2	0.5	0.1	0.2	0.1	0.5	0.1	0.2	0.1	0.5	0.1	0.1	0.4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.8	0.1	0.1
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.5	0.2	0.2	0.5	0.5	0.2	0.2	0.1	0.1
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.8	0.2	0.2	0.2	0.7
0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.8	0.1	1.0
0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.8	0.1	0.2	0.1	0.5
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.1	0.8	0.1	0.2	0.1	0.2	1.0
0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.8	0.1	0.8
0.5	0.5	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.2	0.2	0.0	0.0	0	0.0
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.7	0.2	0.2	0.1	0.2
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.5	0.1	0.8
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.8	0.2	0.9
0.2	0.0	0.2	0.0	0.2	0.2	0.2	0.0	0.2	0.0	0.2	0.0	0.8	0.0	0.2	0.0	0.3	1.0
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.7	0.1	1.0
0.2	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.5	0.1	0.2	0.1	0.5	0.1	0.2	0.1	0.1	0.3
0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.8	0.1	0.2	0.1	0.9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.8	0.0	0.2	0.8	0.9
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.8	0.2	1	0.9
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.5	0.2	0.2	0.4	0.8
1	0	0	0	0	0	0	0	0	1	0	0	2	5	2	7		

Continuing the analysis of the 16 combinations versus the successfully implemented improvement ideas it is found that there are 6 combinations with one or more factors on a high level (>0.5). These 6 combinations are shown in Table 4.7 as the columns with the red cells. These six combinations contain one or more cells with a number higher than the number in the corresponding implemented ideas column (shown in red).
Further analysis shows that only 1 combination results in a higher rate of implemented ideas. This is the combination where all four independent variables: strategic controls, financial controls, internal knowledge exchange and external knowledge exchange are on a high level or in other words, more in than out.
Table 4.8 shows that only two combinations have a consistency of >0.85 which is the cut-off point. When comparing these two combinations it is clear that the level of external

knowledge exchange in the host country is an irrelevant factor as its presence or absence can both result in a high rate of successfully implemented ideas.

Table 4.8: Consistency of causal combinations with fuzzy subset relation

	Strat Control	Finan Control	Internal knowledge exchange	External knowledge exchange in host country	Consistency	outcome (implemented)
sfie	0	0	0	0	0.67	0
SfiE	1	0	0	1	0.74	0
SFie	1	1	0	0	0.78	0
SFiE	1	1	0	1	0.64	0
SFIe	1	1	1	0	0.85	1
SFIE	1	1	1	1	0.89	1
					cut-off point 0.85	

Conclusions of fuzzy set analysis

The fuzzy set analysis shows that the configuration of a high level of strategic and financial controls by Headquarters and a high level of internal knowledge exchange will lead to a high level of successfully implemented improvement ideas. This is support for hypothesis H5 from the conceptual model with the exception of the external knowledge exchange factor.

4.5 Conclusions of the analyses

Three types of analyses have been performed on the collected data out of the quantitative study. First, a regression analysis was performed and the results show that the level of financial controls by Headquarters is positively related to the level of successfully implemented improvement ideas. More financial controls will lead to more implemented ideas. The limited amount of data (N=25) means however that the results of the statistical analysis have limited validity.

Secondly, the data of the surveys was recoded into low, medium and high levels and a necessary condition analysis was performed. This analysis showed that financial and strategic controls by Headquarters are necessary conditions for a high level of generated improvement ideas.

It also shows that a medium level of internal knowledge exchange is necessary for both a high level of generated improvement ideas as well as a high level of successfully implemented ideas.

Finally, a fuzzy set analysis was performed. This analysis showed that the configuration of high level strategic controls, financial controls and internal knowledge exchange leads to a high level of successfully implemented improvement ideas.

The level of external knowledge exchange was not found to be relevant.

5 Conclusions & Recommendation

Conclusions of the study performed will be discussed in this chapter. The results of the analysis of the data of this research are reviewed against the research questions from chapter 1. From that review conclusions are drawn and an assessment is made on the validity and implications for the management of organizations in MNCs.
Also the limitations of this research are discussed as well as opportunities for further research.

5.1 Conclusions from this study

At the start of this thesis the context and historical development of the multinational corporation (MNC) was briefly explained and it was found that the model of the MNC with subsidiaries has evolved from a top-down structure to a network structure. In this new structure the subsidiaries have a changed role and need to generate initiatives for innovation and improvement to increase the performance of the business in total. Subsidiary initiative is important and should be stimulated. Research has found support for the relationship between the level of distinctive capabilities and the level of credibility of the subsidiary and the level of their initiative. When a subsidiary has more capabilities in-house and has a high trust level with Headquarters its level of initiative is expected to be high.
It is expected that other factors are also influencing the level of subsidiary initiative and that resulted in the main research question of this thesis:

1. *Which factors determine the level of subsidiary initiatives?*

To answer this question this study has focused on the subsidiary initiatives for process innovation. A lot of research has been done on product and market innovation which can be seen as radical innovations. In an MNC, and particularly a supply chain structure, a common strategy is the cost strategy. A cost strategy is driving for increased efficiencies and relates to process innovations to attain them. Process innovations are incremental by nature and not extensively researched.

The empirical data has shown that the necessary conditions for a high level of generated process improvement ideas are a high-level of strategic and financial controls by Headquarters. Also a medium level of internal knowledge exchange in the network of headquarters and subsidiaries is a necessary condition for the number of generated improvement ideas.
For a high-level of successful implementation of innovation ideas, a necessary condition is a medium level of internal knowledge exchange.

Knowledge exchange has been found in research to be positively related to the performance of a business. It has also been found that knowledge exchange is positively related to innovative behavior. The question is how it is influencing the level of subsidiary initiative and this led to the first sub-question:

1a. H*ow does knowledge exchange influence the level of subsidiary initiative?*

The analysis of the empirical data showed a difference between internal knowledge exchange and external knowledge exchange in the host country. A medium level of internal knowledge exchange in the headquarter-subsidiary network was found to be a necessary condition for both generated improvement ideas as successfully implemented ideas.
The level of external knowledge exchange was not found to be related to the subsidiary initiative in this study. This is in contrast with previous research which did find support for this relation.
The answer to the sub-question is therefor that internal knowledge exchange can bring subsidiary initiative to a high level when it is at a medium level itself.

To prevent opportunistic behavior, Headquarter can implement controls mechanisms for the subsidiary. Research has supported the positive relation between strategic controls, or long-term oriented subjective controls and the level of subsidiary entrepreneurship. It has, however, failed to link financial controls, as short-term quantifiable goals, to subsidiary entrepreneurship.

This has led to the second sub-question:

1b. *How do controls mechanisms of the Headquarter influence the level of subsidiary initiative?*

The empirical research has shown that financial controls by Headquarters are positively related to successfully implemented improvement ideas. More financial controls lead to more implemented ideas. The analysis has also shown that financial controls are a necessary condition for a high level of generated improvement ideas. Previous research has not supported this relation.
Strategic controls were also found to be a necessary condition for a high-level of generated improvement ideas but no significant correlation was found.

Besides looking at single factors influencing subsidiary initiative, it can be expected that a combination of factors can be found to be related. This has led to the last sub-question:

1c. *Which combination of factors maximizes the level of subsidiary initiative?*
Previous research has shown the relation between single factors and subsidiary initiative. It has also demonstrated the relation between single factors and the level of entrepreneurship of the subsidiary.
In this study the configuration of factors related to subsidiary innovation initiative was also reviewed and it was found that the combination of the factors financial controls, strategic controls and internal knowledge exchange at a high level will result in a high level of implemented innovation ideas.
Again it was found that the level of external knowledge exchange in the host country was irrelevant.

5.2 Implications for management

The results of this study show a variation of determinants for subsidiary innovation initiatives. When

these initiatives are divided into generated improvement ideas and successfully implemented ideas. This split can also be seen in the development funnel model or innovation pentathlon framework (Goffin and Mitchell, 2010). In this model the innovation process starts with idea generation, goes through a prioritization phase and ends with successful implementation of ideas.

For management it is important to know what drives the different stages and how these can be made more effective and efficient.

This study shows that there are some variables that influence both the starting phase as the finishing phase of the innovation process and others that are influencing only one of the phases.

Management should be aware that a necessary condition for both idea generation as idea implementation is a medium level of internal knowledge exchange in the network of Headquarter-subsidiaries. They can use this result to actively facilitate internal knowledge exchange but be cautious to which extent. It appears that there is a saturation point in this area, where the impact of knowledge sharing is not relevant anymore.

Also the results of this study show that controls systems by headquarters are necessary conditions for the idea generation phase. Whereas for strategic controls systems this relation was already shown in previous research, for financial controls systems it was not. It seems counter-intuitive to use financial quantifiable controls to stimulate idea generation but this study shows otherwise.

The results of this study also show that the level of financial controls is positively related to the level of successfully implemented improvement ideas. More financial controls lead to more implemented improvement ideas.

Management should take these results as a support for the importance of financial controls in the process of innovation initiatives and incorporate them into their management practices.

Last but not least this study shows that besides single factors, the configuration of factors is important in the implementation phase of improvement ideas. Strategic, financial controls and internal knowledge exchange go hand in hand to increase the success of implementing ideas.

As often, improving performance is a matter of balancing several variables and management should take this approach in their day-to-day work.

5.3 Limitations of the research

Every research has its own limitations as does this one. The unit of analysis of this study was the MNC subsidiary within the same MNC, namely General Electric. Performing research in one MNC holds the risk of getting results which are not very generalizable to other MNCs or companies. The culture and specifics of the researched MNC could have its own influence on the results and not be present within other MNCs.

Assuming that innovation processes in large MNCs are similar in nature, it can be assumed that the results of this study do have some validity for other MNCs as well however.

Another limitation is due to low volume of data. Eventually only data from 25 respondents was collected which is low for detailed statistical analysis. The validity of the results out of the regression analysis is therefore limited.

However, the results of the necessary condition analysis and the fuzzy set analysis have some validity because these types of analyses are specifically meant for low volumes of data.

5.4 Discussion

In this study the level of external knowledge exchange within the host country was not found as being related to subsidiary innovation initiative. This is contradictory to the feedback from the interviews of the pilot study where the plant manager of a highly innovative plant stated that there was a lot of external knowledge exchange in the host country with universities and technical institutes. Previous research has also supported the relation.

The low volume of data in this study could have affected not finding this relation and the gap between the pilot study feedback and analysis of the survey data makes the area of external knowledge exchange an interesting subject for further research.

Also a follow-up on the relation between internal knowledge exchange and subsidiary innovation initiative would be recommended. This study found that a medium level of internal knowledge exchange is necessary and a follow-up research question could be around the specifics of that medium level. For example about the frequency and different methods of exchange.

Literature

Barringer, B. R. and Bluedorn, A. C. (1999), "The relationship between corporate entrepreneurship and strategic management", *Strategic Management Journal*, 20, pp. 421-444.

Bessant, J. and Tidd, J. (2011), *Innovation and entrepreneurship*. John Wiley & Sons Ltd., Chichester, UK.

Birkinshaw, J. (1996), "How multinational subsidiary mandates are gained and lost", *Journal of International Business Studies,* 1996, Vol. 27 Issue 3, pp. 467-495.

Birkinshaw, J. (1997), "Entrepreneurship in multinational corporations: the characteristics of subsidiary initiatives", *Strategic Management Journal*, Vol. 18, No. 3 (Mar., 1997), pp. 207-229

Birkinshaw, J., Bouquet, C. and Ambos, T.C. (2007), "Managing Executive Attention in the Global Company", *MIT Sloan Management Review*, Volume 48, summer 2007, No. 4, pp. 39-45.

Birkinshaw, J. and Fry, N. (1998), "Subsidiary Initiatives to Develop New Markets", *Sloan Management Review*, spring 1998.

Birkinshaw, J. (2012), *Entrepreneurship in the global firm*, SAGE Publications, London, UK.

Birkinshaw, J., Hood, N. and Jonsson, S. (1998), "Building Firm-Specific advantages in Multinational Corporations: The role of Subsidiary Initiative", *Strategic Management Journal*, Vol. 19, pp. 221-141.

Birkinshaw, J. (1999), "The determinants and Consequences of Subsidiary Initiative in Multinational Corporations", *Entrepreneurship, Theory and Practice,* Baylor University.

Bryman, A. and Bell, E. (2011), *Business Research Methods*, Oxford University Press, New York.

De Vocht; A. (2009), *Basishandboek SPSS 16 voor windows*, Bijleveld Press, Utrecht, NL.

Dul, J. and Hak, T. (2012), *Case Study Methodology in Business Research*, Routledge, New York.

Dul, J., Hak, T., Goertz, G. and Voss, C. (2010), "Necessary condition hypotheses in operations mana-gement", *International Journal of Operations & Production Management*, Vol. 30 Iss: 11, pp. 1170 – 1190.

Drucker, P. (1985). *Innovation and Entrepreneurship*. Harper & Row, New York.

Frenz M. and Gillies G., (2005), "Does multinationality affect the propensity to innovate? An analysis of the third UK Community Innovation Survey". University of London.

Goertz, G., Hak, T. and Dul, J. (2012), "Ceilings and floors: where are there no observations", *Sociological Methods and Research*, March 8, 2012.

Goffin, K. and Mitchell, R. (2010), *Innovation Management, Strategy and implementation using the pentathlon framework*, Palgrave Macmillan, UK.

Ghoshal, S. and Bartlett, A. (2005), "*The multinational corporation as an inter-organizational network*", Prentice Hall, UK.

Gupta, A. K. and Govindarajan, V. (2000), "Knowledge Flows Within Multinational Corporations", *Strategic Management Journal*, Vol. 21, No. 4 (April 2000), pp. 473-496.

Hill, C. W. L., Hitt, M. A. and Hoskisson, R. E. (1992), "Cooperative versus competitive structures in related and unrelated diversified firms", *Organization Science*, 3, pp. 501-521.

Hu, Y. S. (1995), "The international transferability of the firm's advantages". *California Management Review,* 37, 4, 73-88.

Jansen, J.J.P.; Van Den Bosch, F.A.J. and Volberda, H.W. (2006), "Exploratory Innovation, Exploitative Innovation and Performance: Effects of Organizational Antecedents and Environmental Moderators", *Management Science,* Vol. 52, No. 11, November 2006, pp. 1661-1674.

Kanter, R. M. (July-August 1982). "The middle manager as innovator", *Harvard Business Review,* pp. 95-105.

Kogut B. and Zander U. (1992), "Knowledge of the firm, combinative capabilities, and the replication of technology". *Organizational Science,* 3, pp. 383-96.

Mahler et al. (2011), "Knowledge Transfer and Innovation in Brazilian Multinational Companies", *Journal of Technology Management & Innovation 2011,* Volume 6, Issue 4.

Miller, D. (1983). "The correlates of entrepreneurship in three types of firms", *Management Science,* 29, pp. 770-791.

Milliken, F. J. and Martins, L. L. (1996), "Searching for common threads: Understanding the multiple effects of diversity in organizational groups". *The Academy of Management Review,* Vol. 21, No. 2 (Apr., 1996), pp. 402-433.

Monteiro, L.F.; Arvidsson, N. and Birkinshaw, J. (2008), "Knowledge Flows within Multinational Corporations: Explaining Subsidiary Isolation and its Performance Implications", *Organizational Science,* Vol. 19, No. 1, January-February 2008, pp. 90-107.

Nelson, R.R. and Winter S.G. (1982), *An evolutionary theory of economic change*, The Bellknap Press, Cambridge, MA.

Nohria, N. and Gulati, R. (1997), "What is the optimum amount of organizational slack? A study of the relationship between Slack and Innovation in multinational firms". *European Management Journal,* Vol. 15, No. 6, pp. 603-611.

OECD EUROSTAT (2005), *Oslo Manual, Guidelines for collecting and interpreting innovation data,* Third edition, A joint publication of OECD and Eurostat.

Ong, C.-H., Wan, D, and Chng, S.-H. (2003)," Factors affecting individual innovation: an examination within a Japanese subsidiary in Singapore", *Technovation* 23 (2003), pp. 617–631.

Pearce, R. D. (1999). *"*The evolution of technology in multinational enterprises: the role of creative subsidiaries". *International Business Review,* 8, pp. 125-48.

Phene A. and Almeida, P. (2008*),"* Innovation in multinational subsidiaries: The role of knowledge assimilation and subsidiary capabilities", *Journal of International Business Studies (2008)* 39, pp. 901–919.

Porter, M. E. (1990), *The Competitive Advantage of Nations*. Free Press, New York.

Prahalad, C.K. and Doz, Y.L. (1987), *The Multi-National Mission, Balancing local demands and global vision*, The Free Press, USA.

Ragin, C. C. (april 2005)," From Fuzzy Sets to Crisp Truth Tables". *University of Arizona.*

Ragin, C. C. (2000), *Fuzzy set social science*, University of Chicago Press*,* Chicago, IL.

Schumpeter, J. A. (1934). *The Theory of Economic Development*. Harvard University Press, Cam-bridge, MA.

Scott, S. G.; Bruce, R. A. (1994), "Determinants of innovative behavior: a path model of individual innovation in the workplace", *Academy of Management Journal,* 1994*,* Vol. 37, No. 3, pp. 580-607.

Sørenson, J. B. and Stuart, T. E. (2000), "Aging, Obsolescence, and Organizational Innovation", *Administrative Science Quarterly March,* 2000, 45, pp. 81-112.

Spender, J.-C. (1994), "Organizational knowledge, collective practice and Penrose rents", *International Business Review,* **3-4**, 1-5.

Venaik, S.; Midgley, D.F. and Devinney, T.M. (2005), "Dual Paths to Performance: The Impact of Global Pressures on MNC Subsidiary Conduct and Performance"*, Journal of International Business Studies,* Vol. 36, No. 6 (Nov., 2005), pp. 655-675*.*

van Dalen, J. and de Leede; E. (2009)*, Statistisch onderzoek met SPSS for Windows,* Uitgeverij LEMMA, Den Haag, NL.

Watson O'Donnell, S. (2000), "Managing foreign subsidiaries: Agents of headquarters or an independent network?" **,** *Strategic Management Journal,* 21, pp. 525-548 (2000).

Zahra, S. A., Dharwadkar, R. and George. G. (2000), "Entrepreneurship in multinational subsidiaries: The effects of corporate and local environmental contexts." *Conference Proceedings, Entrepreneurship, Academy of Management*, Toronto, August 4-9. Strathclyde International Business Unit, 2000.

Websites:

United States Patent and Trademark Office (USPTO)
http://www.uspto.gov

Organization of economic co-operation and development (OECD)

http://www.oecd.org

Attachment 1: GE Power & Water Locations

GE Power & Water		Plant Manager
Thermal		
Greenville		Paula Martin
Schenectady		Ed Stefanik
Bangor		Jim Apostolides
Duluth		Trina Folk
Belfort		Francois Cavan
Bourogne		Francois Cavan
Chonas		Francois Cavan
GTTC Monterrey		Odin Haro
COE's		
Veresegyhaz		Gergo Lencses
Haiphong		Michael (Feng) Zhang
Hangzhou		George Qiu
Shenyang New Plant		Hui Xu
Shenyang Liming JV		Yongbin Sun
Salem		Stephen Roy
Aero		
Jacintoport		Kennedy Oates
Gas Engines		
Jenbacher		Martin Muehlbacher
Waukesha		Troy Groth
Renewables		
Pensacola		Bill Sawarynski
Tehachapi		Bill Sawarynski
Salzbergen		Martin Stoever
Shenyang		Yan Liu
Pune		Bharath Kumar
GEH Nuclear		
Wilmington		John Ball
Hitachi Canada		John Ball
Canonsburg		John Ball
GNF - Japan		John Ball
Water		
All locations		Istvan Zsirai

Attachment 2: Interview Questions

Pre-Research

Subsidiary innovation initiatives

GE Power & Water – Global Supply Chain Management

Paul de Boer

352176

February 15, 2013

Questions:	***Literature Reference:***
1. What are the subsidiary sizes in number of people and Sales?	Zahra et al., 2000
2. What are the subsidiary ages?	Zahra et al., 2000
3. What are the subsidiary past performances?	Zahra et al., 2000
4. What are the subsidiary technological opportunities?	Zahra et al., 2000
5. What is the country of origin of the subsidiary?	Zahra et al., 2000
6. What is the subsidiary mandate? Role, goals and scope?	Zahra et al., 2000
7. What is the level of autonomy of the subsidiary?	Zahra et al., 2000
8. What financial and strategic controls are in place?	Zahra et al., 2000
9. How is the local market characterized? Complexity, Dynamism?	Zahra et al., 2000
10. What is the level of distinctive capabilities of the subsidiary?	Birkinshaw, 1999
11. What are the details of the knowledge structure of the subsidiary?	Birkinshaw, 1999
12. What is the subsidiary credibility? idem	Birkinshaw, 1999
13. What is the technological diversity? In the host country?	Phene, Almeida, 2004
14. What is the sourcing capability of the subsidiary?	Phene, Almeida, 2004
15. What is the level of interaction with other firms in the host country?	Phene, Almeida, 2004

16. What is the level of interaction with other units in the MNC?
17. What is the combinative capability of the subsidiary? Phene, Almeida, 2004
18. What are the processes for problem-solving? Scott, Bruce, 1994
19. How are innovation expectations communicated by top management? Scott, Bruce, 1994
20. How do BU managers evaluate the innovation support they get from HQ? Scott, Bruce, 1994
21. How does knowledge transfer occur? Vertically, horizontally? Monteiro et al., 2008

(Also: to what extent are innovations developed by one SBU consequently transferred and adopted by other units?

- Additional Questions: How much did they spent on (process) innovation in the last few years (as percentage of sales)?
- How many (process) innovations did they initiate in the last few years?
- How many were eventually successful?

Attachment 3: Survey Questions

Survey to be filled in by the Plant Manager
Driving Innovation from the bottom
Increasing subsidiary innovation initiatives
http://supportcentral.ge.com/survey/sup_surveycenter_user_default.asp?prod_id=17778&doc_id=3769596

General questions

What is your nationality?	……
How long have you been working for GE?	……..years
How many years have you been manager is the current Plant?	……..years
How many previous roles did you have within GE?	……
What is the number of international roles within GE, outside your home country?	……
What is your highest completed education?	1 2 3 4

1 = secondary education
2 = bachelor degree
3 = master's degree
4 = PhD degree

Management Diversity

What is the number of members in your management team?	……
How many of these members are from another country?	……

	Strongly disagree - Strongly agree						
The members of the management team are experts in very different areas	1	2	3	4	5	6	7
The members of the management team have very different backgrounds	1	2	3	4	5	6	7
The management team consists of members with a large variety of experience	1	2	3	4	5	6	7
The members of the management team have complementary skills	1	2	3	4	5	6	7
The education level of the members of the management team varies significantly	1	2	3	4	5	6	7
Members of the management team spend a lot of time and energy to create external networks within GE	1	2	3	4	5	6	7
We are performing well in developing relationships with high-Influential people within GE	1	2	3	4	5	6	7
We are capable of using our networks to get things done	1	2	3	4	5	6	7
Members of the management team maintain good contacts with Other companies within GE	1	2	3	4	5	6	7
We have good connections with the higher management of GE	1	2	3	4	5	6	7

Organizational Characteristics

How many full-time employees are working in your plant? …….
What is the percentage of employees with higher education in your plant (bachelor degree or higher)?
……..%
What is the percentage of other nationalities in your plant? ……..%
In which year was your plant established or acquired? ……(e.g. 2001)
Your plant has been established through? 1 2 3
1 = Joint Venture
2 = Acquisition
2 = Greenfield

Innovation Performance

How many process improvement ideas were developed in your plant in 2012? …….
What percentage of these ideas was successfully implemented? ……..%
How much money was spent on process innovations over the last 2 years in percentage of revenue? ……..%

What was the Variable cost productivity (VCP) over The last 2 years? ……..USD
What was the R&D intensity in 2012 (R&D expenditure/Sales)? ……..%

Financial Performance

How do you rate the performance of your plant?	Over the last 3 years Very low – Very High							Compared to your industry competitors Very Low – Very High						
Return on Investment	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Return on Equity	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Return on Assets	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Cost Control	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Operating Margin	1	2	3	4	5	6	7	1	2	3	4	5	6	7
New product/service development	1	2	3	4	5	6	7	1	2	3	4	5	6	7

Financial Controls

Please indicate to what extent you agree with the following statements
In our plant:

	Strongly disagree						- Strongly agree
We have a formalized process improvement process	1	2	3	4	5	6	7
There are individual process innovation targets, incorporated in performance appraisals	1	2	3	4	5	6	7
There are cost productivity targets at the plant level	1	2	3	4	5	6	7
There are return on investment targets for the plant	1	2	3	4	5	6	7

Strategic Controls

Please indicate to what extent you agree with the following statements
In our plant:

	Strongly disagree						- Strongly agree
I have frequent process innovation meetings with Employees	1	2	3	4	5	6	7
The management frequently communicates the need for process improvements to the employees	1	2	3	4	5	6	7

Autonomy

For the overall business activities of the plant, please indicate the extent of Headquarters and/or Plant influence on the following decisions:

	HQ always						- Plant always
Changing to a new manufacturing process	1	2	3	4	5	6	7
Changing the plant organizational structure	1	2	3	4	5	6	7
Modifying existing manufacturing processes	1	2	3	4	5	6	7
Changing product design	1	2	3	4	5	6	7

Management Support

	Strongly disagree						- Strongly agree
We have frequent contact with higher management about our innovation projects	1	2	3	4	5	6	7
Higher management is often very supportive of our innovation projects	1	2	3	4	5	6	7
We often get additional financial support to pursue our innovation projects	1	2	3	4	5	6	7
We find it difficult to find access to higher management to discuss our innovation ideas	1	2	3	4	5	6	7

Organizational Slack

Assume that due to some sudden development, 10 per cent of the time of all people working in your department has to be spent on work totally unconnected with the tasks and responsibilities of your department. How seriously will your output be affected over the next year?'

Not at all - Very Much

1 2 3 4 5 6 7

'Assume that due to a similar development, your department's annual operating budget is reduced by I0 per cent. How significantly will your work be affected over the next year?'

Not at all - Very Much

1 2 3 4 5 6 7

Knowledge Exchange

Multinational subsidiaries often exchange knowledge, best-practices and expertise with other multinational units (Headquarters as well as other subsidiaries), and with external parties in the region. External parties could be suppliers or customers on one side or knowledge institutes like universities on the other side.

To what extent does your plant *receive* knowledge, best-practices and expertise from a) other GE plants and the corporate Headquarters; from b) external parties in the region being customers and/or suppliers and from c) external parties in the region being knowledge institutes as universities?

Knowledge, best-practices, expertise related to:

	From: HQ and Other plants Not at all – Very much
R&D	1 2 3 4 5 6 7
Purchasing	1 2 3 4 5 6 7
Manufacturing	1 2 3 4 5 6 7
Distribution	1 2 3 4 5 6 7
Marketing and Sales	1 2 3 4 5 6 7
IT	1 2 3 4 5 6 7
Finance	1 2 3 4 5 6 7
HR	1 2 3 4 5 6 7

Approximately what percentage of your external contacts from whom you receive knowledge is located in the same country? .....%

To what extent does your plant *provide* knowledge, best-practices and expertise from a) other GE plants and the corporate Headquarters; from b) external parties in the region being customers and/or suppliers and from c) external parties in the region being knowledge institutes as universities?

Knowledge, best-practices, expertise related to:

	To: HQ and Other plants Not at all – Very much						
R&D	1	2	3	4	5	6	7
Purchasing	1	2	3	4	5	6	7
Manufacturing	1	2	3	4	5	6	7
Distribution	1	2	3	4	5	6	7
Marketing and Sales	1	2	3	4	5	6	7
IT	1	2	3	4	5	6	7
Finance	1	2	3	4	5	6	7
HR	1	2	3	4	5	6	7

Approximately what percentage of your external contacts to whom you provide knowledge is located in the same country? ……%

Would you like to receive a copy of the report of our research findings? Yes/No

Thank you very much for your time and effort to complete this Survey!