Organizational designs for managing incremental and radical innovation

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Abstract

This paper explores what types of organizational design mature firms in Iceland employ to host incremental and radical innovation. As innovation is generally recognized to be important for a firm's competitive success, companies need to find the right balance between exploitation through incremental innovation and exploration through radical innovation. This paper draws on a case study by Tushman, Smith, Wood, Westerman, & O'Reilly (2004), which describes four different approaches of organizational design that organizations can employ in managing radical and incremental innovation: functional design, cross-functional teams, ambidextrous design and unsupported teams. A sample of six business units in Iceland, active in innovation and competing in a variety of industries, was explored for this research. Senior managers that were highly involved in innovation projects at their respective companies were interviewed. Each organization was mapped, based on whether it had high or low senior management integration, and high or low structural differentiation. Of the companies explored, three were found to employ a functional design, two cross-functional teams, and one employs an ambidextrous design. Despite efforts to find a case company that might employ unsupported teams, none of the case firms were found to employ that particular organizational design.

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Introduction

Although, there is general recognition by managers about the need for innovation to achieve competitive success, much confusion exists about the definition of the term innovation. Some use the term to refer to small businesses, others to new businesses. Many of the greatest innovations, however, emerge in well-established businesses. Innovation, therefore, doesn't refer to an enterprise's size or age, but to a certain kind of activity. At the heart of that activity is the effort to create purposeful, focused change in an enterprise's economic or social potential (Drucker, 1985). The importance of understanding innovation was first recognized by the Austrian economist Joseph Schumpeter in the 1930s. He considered five different aspects of innovation; 1) the introduction of a good, which is new to consumers, or one of increased quality compared with what was available in the past, 2) methods of production, which are new to a particular branch of industry, 3) the opening of new markets, 4) the use of new sources of supply, or 5) new forms of competition, which lead to the re-structuring of an industry (Schumpeter, 1934). Michael Porter defined innovation "to include both improvements in technology and better methods of doing things. It can be manifested in product changes, process changes, new approaches to marketing, new forms of distribution, and new concepts of scope. Innovation results as much from organizational learning as much as from formal R&D" (Porter, 1990).

There are four main factors that create the need for innovation; 1) technological advances, 2) changing customers, 3) intensified competition, and 4) changes in the business environment (Sheth & Ram, 1987). How firms intend to deal with these external forces depends on their strategic intent or the aim of key stakeholders, including senior management. Furthermore, there are different degrees of innovation. There can be breakthrough innovations, such as penicillin, the *walkman* or nylon, which are referred to as radical innovations. They can create new markets or change existing ones. Then, there are incremental innovations or small changes to existing products, services or processes that can also be important. However, since the degree of innovation is context dependent, the definition on what is considered radical or incremental innovation remains somewhat ambiguous. Some may perceive an innovation to be radical, while others consider the same innovation to be incremental (Goffin & Mitchell, 2010).

The roles of incremental and radical innovation can be very important for organizations. Different degrees of innovation, from incremental to radical, typically generate different revenues and organizations need to maintain a good balance between the two. A study on 100 companies showed that 86% of all new product launches were line extensions or incremental innovation, which accounted for 62% of total revenues and 39% of total profits. The remaining 14%, which were new product launches or radical innovations, generated 38% of revenues, and a 61% of total profits (Kim, 1997). Incremental innovation still remains important for established firms in cases of increased competition. Incremental innovation improves a firm's ability to stay in front of its competitors as well as being important for the people who use the firm's products (Banbaury & Mitchell, 1995). The term "kaizen" in Japanese for example, is well known to manufacturers who see the benefits of continuously improving their processes and services. Incremental improvements can lead to higher quality at lower cost and increase overall performance (Goffin & Mitchell, 2010). It has been established that a successful strategy for success is to focus on continuous incremental innovation with sessions of radical innovations, which create new markets and business opportunities (Leifer, O'Connor, & Rice, 2001). Although radical innovation remains important, large, well established organizations have found difficulties in managing the radical innovation process, as they have mastered operational efficiency but aren't prepared to handle the uncertainty that comes with new technology (Leifer, O'Connor, & Rice, 2001). Radical innovation involves managerial challenges, as it includes high technological and market uncertainty. Therefore, the organization process differs from incremental innovation, where firms often do not employ a highly structured process in the development of new radical products in order to stay "loose" (Veryzer, 1998).

An organization's dynamic capability relies on its ability to exploit through incremental innovation as well as to explore through radical innovation (March, 1991). A firm needs to find the right balance. Organizational structures can play an important part in harnessing the two forces (March, 1991). A firm's requirement for effective exploitative innovation is different from the characteristics needed for effective exploratory innovation. Where exploitative innovation requires tight controls, structures, culture and disciplined processes, exploratory innovation requires looser controls, structure and more flexible processes (Tushman, Smith, Wood, Westerman, & O'Reilly, 2004). Research by Candi, van den Ende and Gemser (2013) has shown

that flexible product specifications can have a positive impact on project performance and allow companies to adjust to changes in the environment like new developments in technology or shifts in customer preferences. Flexible project planning, however, has been found to have a negative effect on project performance. Flexible project planning can reduce the urgency for innovation teams to work efficiently and effectively which can increase costs and slow down product delivery. Innovation projects should therefore be conducted in stable organization. A case study by Tushman and O'Reilly (1996) proposed that ambidextrous organizational design would be the most effective organizational design in balancing explorative innovation with exploitative innovation.

Organizational ambidexterity is a firm's ability to pursue and synchronize explorative and exploitative innovation simultaneously. This requires organizational and management skills that enable an organization to compete in a mature market by continuously improving their existing products with incremental innovation, as well as develop new products and services with radical innovation. Therefore, managers need to be ambidextrous, meaning they need to be able to handle both at the same time.

Well established firms tend to develop structural and cultural inertia. As companies grow, they develop structures in an attempt to handle the increased complexity of their work. They become interlinked, which can make changes more difficult, especially if they are engaged in more than small, incremental modifications. Corporate culture also plays a big part, as it is important for an organization's short term and long term success. Managed correctly, it can provide competitive advantage which can be critical for innovation by creating a simultaneously tight and loose corporate culture. On one hand, it can be considered tight in that the culture is broadly shared and emphasizes norms that are ideal for innovation, such as autonomy, initiative and risk taking. On the other hand, it can be considered loose where common values are expressed according to the type of innovation required. The tight-loose concept is crucial for ambidextrous organizations (Tushman & O'Reilly III, 1996).

A case study conducted by Tushman, Smith, Wood, Westerman and O'Reilly (2004) on different organizational designs and their effects on the success on innovation streams, revealed that firms

who employ an ambidextrous organizational design were the most effective for radical innovation as well as for sustaining performance of existing products. The sample included 15 different business units operating in various industries from health care to the tire industry. The researchers followed 36 innovation episodes performed by the business units. All business units were simultaneously managing an established product (incremental innovation) as well as one radical innovation. In the study, four different approaches of organizational design were described that organizations can employ for harnessing dynamic capabilities. Along with ambidextrous design, functional design, cross-functional teams, and unsupported teams are other organizational designs that can be used.

Table 1 summarizes each organizational design's characteristics. The four designs are different when it comes to structural differentiation and senior management integration. Structural differentiation refers to how loosely structured the radical innovation process is. The following are factors considered in estimating the degree of structural differentiation: Whether there are separate units or employees who focus only on radical innovative projects, whether those units or employees are located in a physically separate location from those working on incremental innovation, and whether that unit has a distinct culture and/or reward system in place. Senior team integration is measured in terms of how involved senior management is in everyday operations, how much autonomy employees receive from senior management and how strong or weak the relationship is between the innovation manager and senior management (Tushman, Smith, Wood, Westerman, & O'Reilly, 2004).

Table 1. Summary of organizational designs

Functional Designs	Cross Functional Teams
• High senior team integration • Low structural differentiation • General manager takes an active part in the innovation process • Innovation executed through a functional organizational design	• Low senior team integration • Low structural differentiation • Employees from different functional areas work together on innovation projects • Employees enjoy autonomy from senior management on innovation projects
Unsupported Teams	**Ambidextrous Organizations**
• Low senior team integration • High structural differentiation • A team located in a physically separate location • Little support from senior management	• High senior team integration • High structural differentiation • Distinct units for radical and incremental innovation • Employs an ambidextrous manager

Organizational designs for innovation

Functional Design

The functional design structure is characterised by low differentiation and high senior team integration. It‘s where senior management takes an active part and responsibility in the organization’s innovation projects. Innovations are generally executed in the existing functional organization as employees from all departments are assigned to multiple projects, which can be incremental or radical. Simple functional design has been found to perform well when a radical innovation is a product substitute (Tushman, Smith, Wood, Westerman, & O'Reilly, 2004). In a functional design, members from one function can form a functional team, which is ideal for simple innovation projects. A functional team has the advantage that its members all have similar goals, which makes assembling teams easier. The limitations are narrow perspectives, which can be reduced with a moderator from another function (Goffin & Mitchell, 2010).

Unsupported Teams

The unsupported teams structure is characterised by a highly differentiated structure without strong senior management integration. This design can be described as where the innovation manager has little support from senior management or enjoys freedom to work on projects without special permission from higher authority. Furthermore, the unit working on a radical innovation may be located in a physically separate space from the main business unit, with its own unique culture and structure (Tushman, Smith, Wood, Westerman, & O'Reilly, 2004). Unsupported teams have sometimes been referred to as *skunk works*. Skunk works takes its name from Clarance L. "Kelly" Johnson at Lockheed Aerospace Corporation who assigned a team of 23 engineers to design a new jet fighter in 1943. The team was located in a separate building, free from the bureaucracy and the official R&D process. After only 43 days, the team had designed the first American fighter to fly at more than 500 miles per hour. Today, large high-tech companies frequently use skunk works to tackle specific problems as companies are concerned about the slow pace of their innovation streams. Skunk works is a strategy larger companies can use to become more nimble in their competition against small entrepreneurial companies (Gwynne, 1997).

Cross-Functional Teams

The cross-functional teams structure is characterised by low differentiated structure with low senior management integration (Tushman, Smith, Wood, Westerman, & O'Reilly, 2004). As many organizations' main operations consist of R&D, manufacturing and marketing, studies have shown that cross-functional integration improves performance of new product development. The main benefit of this design is the improvement of horizontal communication linkages. However, it presents numerous managerial challenges (Song, Thieme, & Xie, 1998): 1) Since this is sort of a matrix structure, it can complicate the relationship between functional areas with subordinates often having to answer to more than one manager. 2) Personnel from different functional areas often have different orientations, goals and values. Those different backgrounds can lead to a conflict of interests. 3) Cross-functional integration can be costly as numerous meetings are required to enable the flow of information. 4) It requires managers with special

training, who are able to coordinate the complex process of developing a product with such a diverse set of individuals.

Ambidextrous Organization

Managers need to able to foresee changes in the environment, which create the organization's need to grow and develop new products and services. With ambidextrous organizations, managers need to be able to find a good balance between incremental innovation and radical innovation (Tushman, Smith, Wood, Westerman, & O'Reilly, 2004). Ambidextrous organizational design is characterised by highly differentiated structure and high senior management integration. Ambidextrous design is the most complicated organizational form for hosting innovation streams for radical and incremental innovation. Divisions are separate and as one division would focus on radical innovation, another would focus on incremental innovation (Tushman, Smith, Wood, Westerman, & O'Reilly, 2004). It creates the managerial challenge of being able to balance these two forces equally. A metaphor for ambidexterity is a juggler who can handle multiple balls at the same time. Therefore, an ambidextrous manager is someone who is able to compete successfully by aligning the company's strategy, structure, culture and processes to make the right fit, while simultaneously focusing on radical changes forced by discontinuous environmental change (Tushman & O'Reilly III, 1996). With ambidextrous design, management of the two divisions differs. For the unit that works on incremental innovation, efficiency is key, while the radical innovation unit is encouraged to experiment and improvise. The units achieve strategic linkage through senior management. Ambidextrous organizational designs therefore don't have to sacrifice exploration for increased exploitation. Both are done simultaneously, although separately. A feature of ambidextrous design is having the units in separate physical locations.

This study explores what types of organizational design organizations in Iceland employ in hosting radical and incremental innovation. A sample of six business units in Iceland, competing in a variety of industries, was explored for this research. Senior managers from the business units were interviewed to explore manifestations of different organizations. By looking at various

organizations competing in different industries, a map could be drawn of what type of organizational design companies employ for innovation processes in practice.

Method

The research method was based mostly on Miles and Huberman's methods on qualitative data analysis (1994). Qualitative data are a source of well-grounded, rich description and explanations of processes in identifiable local contexts. Qualitative data can provide a good overview of chronological flow to understand which series of events lead to which consequences and derive fruitful explanations. They help researchers to get beyond initial conceptions and to generate or revise conceptual frameworks. Qualitative research focuses on naturally occurring, ordinary events in their natural settings. In this way, an understanding of "real life" situations becomes possible. The fact that the data are collected in close proximity to a specific situation, rather than through the phone or email gives the researcher a better understanding of underlying or non-obvious issues. Furthermore, qualitative methods can make it easier to understand complex situation through more vivid descriptions. Qualitative research has often been pointed out as the best strategy for discovery (Eisenhardt, 1989). First, it helps with exploring new areas with the purpose of the development of hypotheses. Second, it can have a strong potential for testing hypotheses and to see whether certain predictions hold up. Third, qualitative data are useful when one needs to supplement, validate, explain, illuminate or reinterpret quantitative data gathered from the same or similar settings.

For this research, a convenience sample of companies active in innovation was made in order to select the companies for the sample. The list was continuously updated during the study. New annual reports, news articles, discussion with the thesis advisor and advice from representatives of the companies used in the research helped in the selection of additional case companies. Six companies competing in various industries were used in the sample. Senior managers were contacted by telephone to confirm that they were responsible for innovation projects at their respective company and that they had sufficient knowledge of the company's structure. Following the phone call, an appointment was made with the manager contacted or whoever was responsible for managing innovation. Of the 6 companies contacted, all (100%) agreed to

participate in the survey. The questionnaire used for the research was based on the questionnaire used in the research conducted by Tushman, Smith, Wood, Westerman and O'Reilly (2004). The questionnaire was in Icelandic with 21 questions in total and is shown in the Appendix. Before the interviews, the questionnaire was tested by the researcher and reviewed by the thesis advisor in order to ensure good interview flow. The questionnaire was continuously adjusted after each interview, although only minor adjustments were made. The interviews were conducted at the location of the respective company's main headquarters, most often in a conference room where only the researcher and the respondent were present. The interviews lasted thirty minutes on average. After each interview, notes were taken in order to summarize and make a conclusion on what type of organizational design the company employed. Afterwards, each company's results were sent back to the company respondents in order for them to review the results before publication.

Participants

Qualitative researchers usually work with small samples of people, in their own context where they can be studied in-depth. Qualitative samples tend to be purposive, rather than random. Qualitative sampling is often theory-driven, meaning the sample is chosen relative to the theory. Informants can be chosen by a conceptual question, not by a concern for representativeness (Miles & Huberman, 1994). Therefore, the representatives chosen for interviews from the organizations were senior managers, which were active in innovation projects at their respective companies. The reason for this choice of informants was the fact that they were most likely innovation managers with knowledge of key events, interactions and processes concerning innovation at their organization. A convenience sample was used in the selection of companies for this research. Convenience sampling is the sample strategy which is least costly to the researcher in terms of time, effort and money, yet an approach where selection can be based on careful thought and preferences for specific research (Marshall, 1996). As this is a multiple-case sampling with multiple sources of evidence, an explicit sampling frame was made to guide the researcher in how many cases would be needed. With high complexity, too many cases can become difficult to deal with due to the large amount of data. Once fieldwork had begun, new choices for cases were allowed to come up from interviews (Miles & Huberman, 1994). The goal was to find organizations employing each of the four organizational structures anticipated based

on existing theory. That is, to find at least one which employed a functional structure, one which employed cross-functional and so on. Therefore, when one company was established to employ a cross-functional structure, an attempt was made to find an organization that employed a functional design if no company had been identified to employ such a design. The criteria for choosing firms for this research was based largely on the research by Tushman, Smith and O'Reilly (2010). In selecting companies for the sample, annual reports, news articles, and advice from the thesis advisor as well as from informants used in the research, were all used in the making of a short list of companies that could be used for the research. The companies chosen were all managing radical innovation as well as incremental innovation. In order to see if there were differences in the type of organizational designs companies employed competing in different industries, all organizations competed in separate markets.

Overview of the sample and its representatives

Marel – Senior R&D Manager

Marel is a leading provider of advanced equipment, systems and services to the poultry, fish, meat and further processing industries. It employs over 4.000 employees and has offices and subsidiaries in over 30 countries. Marel has focused on research and development and breakthrough innovation in food processing machinery since the firm was founded in 1977. Marel believes that bringing innovative products to its customers is the best way to stay ahead of the competition. In 2012, Marel introduced 56 new products and received a EuroTier Golden Innovation Award for its AeroScalder, one of Marel's innovations exhibited at EuroTier 2012 in Hannover (Marel, 2013).

Össur – New Technology Search Manager

Össur is a global leader in the non-invasive orthopaedics market. The company focuses on improving people's mobility by delivering advanced and innovative solutions within the field of bracing and supports, prosthetics and compression therapy. Innovation is a key pillar in Össur's strategy and has been an important factor in the company's organic growth. Most of Össur's technical platforms are proprietary. The focus of the company's long-term strategy is to manage the platforms' lifecycles and maintain their proprietary value. At the same time, Össur is always

on the look-out for emerging technologies, evaluating their fit into its overall strategies. Össur's main overarching aspiration in innovation is to enable people to enjoy life without limitations (Ossur, 2013).

Síminn - Senior Manager of ICT

Síminn is a market leader in the telecommunication industry in Iceland. Síminn provides telecommunication services to residential and corporate clients. The company's strategy is to open the best possible channels of communication for their customers in order to fulfil their needs. Siminn always strives to be ready with the latest telephone, mobile, TV and data transmission solutions for companies and individuals. Siminn's overall objective is to enrich the lives of its customers (About Síminn, 2013).

EFLA –Director of Business Development

EFLA is an engineering and consulting company operating in Iceland as well as having an increasing presence in international markets. EFLA operates in a wide variety of fields with the goal to provide clients with the highest possible level of services and solutions, no matter the nature or scope of the project involved. EFLA's professional expertise ranges from buildings, project management, transportation, energy, industry and environment. As an acknowledged leader in its field, EFLA places strong emphasis on innovation, cooperation and courage, regarding its employees as its most valuable resource (EFLA, 2013).

Orf –Director of Product Development

ORF Genetics Ltd. is a pioneer in the manufacturing of growth factors and other recombinant proteins in plants. The company is a biotech start-up out of Iceland and was established in 2001. ORF is an innovative company which offers unique ISOkine™ growth factors for various medical research, cell culture media and diagnostics. Its products, Bio Effect and EGF are good examples of the company's success in the medical scientific research community and the cell culture media and diagnostics market (About ORF Genetics, 2013).

Decode –VP of Genetic Research

deCODE is a global leader in analysing and understanding the human genome. deCODE's gene discovery engine is driven by a unique approach and resources, including medical information on around 370.000 individuals, which are used in the companies discovery work. Using its unique expertise and access to the well-defined population of Iceland, deCODE Genetics has discovered genetic risk factors for dozens of diseases, ranging from cardiovascular disease to cancer. Furthermore, deCODE has developed statistical algorithms, software programs, and sample handling and privacy protection systems to maximize its discovery potential. In 2012, deCODE was taken over by Amgen, an American biotechnology company that develops, manufactures and delivers human therapeutics ("Amgen to aquire", 2013).

Data Collection

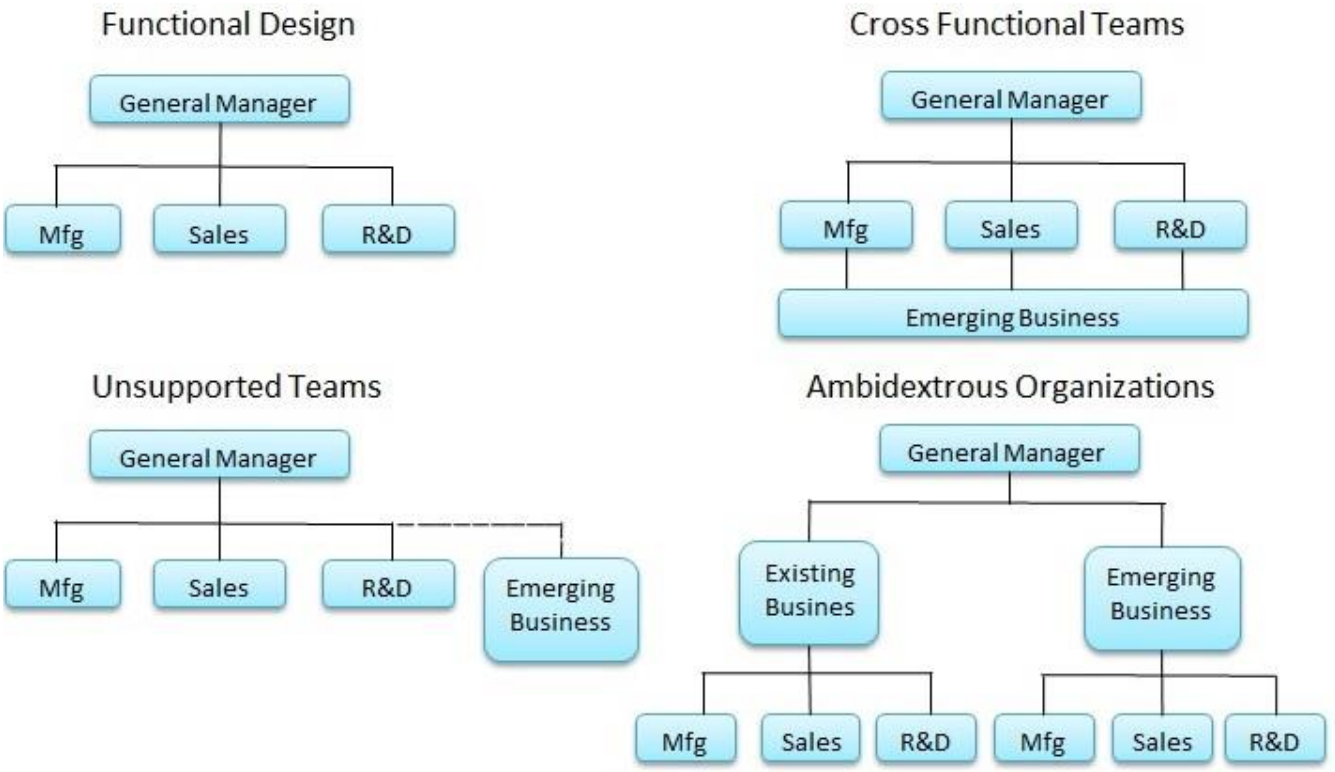
Taking notes in the field is important in the observation method. The researcher might lose sight of the process and become consumed by the content. Therefore, the researcher needs not to become lost in the interview. A qualitative interview is a goal-directed conversation. The researcher must avoid leading the study subject towards an answer. Interviews may be structured, semi-structured or unstructured. In a structured interview, questions are prepared in advance. In a semi-structured interview, the researcher may improvise questions along with prepared questions. An unstructured interview is like a conversation, although both interviewer and interviewee are aware that an interview is being conducted (Padgett, 1998). For this research, a semi-structured interview was used. The method was chosen as it is a combination of an open and structured interview which would give the researcher more flexibility to ask additional questions if needed while keeping a structure for most answers. As research data is a fragile asset, which might be accidentally erased or deleted by a computer virus (Freedland & Carney, 1992), much care was taken of the field data. To ensure the data was safe and secure, a copy of each interview was saved on the researcher's computer after each interview, as well as having it saved on his cellular phone.

For the collection of primary data, information was gathered through semi-structured interviews with open-ended questions and closed questions. The questions were aimed at getting a better

understanding of the organizational variables associated with the organizational designs that harness innovation. Theories that arose from the interviews were grounded in the data, like an emerging picture rather than a puzzle of an already known image (Morgan & Ammentorp, 1993). To make sure that the data was gathered properly, the interviews were recorded with the researcher's cellular phone. Furthermore, the researcher wrote down answers as the interview went on and took notes after each interview in order to get a better understanding of the organizational structure.

The questions were 21 in total. All the questions were in Icelandic as interviews were carried out in Icelandic. The reason was to give the interview a better flow as not all respondents are equally adept in the English language since all the interviewees were Icelandic. Five questions were on a five point Likert scale, the rest were open-ended questions. At first, the interviewee was asked what position he or she held at the company. In question 2 and 3, the interviewee was asked whether or not the company he or she represented performed radical innovation and incremental innovation. To maintain consistency in the definition of the terms radical and incremental innovation, a description was given of each term as well as examples of what type of products would qualify as incremental and radical innovations. Questions four to six were to explore whether radical innovation was located in a distinct unit inside the company, the physical location of the staff that worked on radical innovation and if that unit or staff had a specific manager. In questions seven and eight, the interviewee was asked whether the culture of the unit that hosted radical innovation differed from other units in the company. Questions nine to eleven explored whether or not there was an incentive system in the company, and if so, if the incentive system for those who worked on radical innovation projects differed from those who worked on incremental innovation projects. Question 12 explored whether or not the company hired employees specifically for radical innovation projects. Questions 13 and 16 explored the role of the lowest level manager, who had financial and strategy-making authority over both incremental and radical innovation, as well as his or her relationship with the innovation staff and the manager. Questions seventeen to nineteen explored how much the company spent on research and development in 2012, what overarching aspiration the company has for incremental and radical innovation, and what were the biggest issues the company experienced concerning innovation in 2012.

In question 20, the interviewee was presented with illustration of the four organizational designs adapted from O'Reilly and Tushman illustration (1996), which can be seen in figure 1. The interviewee was asked which of those designs described his/her company's structure best. In question 21, the interviewee was asked to draw the company's organizational structure with emphasis on the innovation part of it. The questionnaire in whole can be found in Appendix 1.



**Adapted from O'Reilly and Tushman's illustration*

Figure 1. Four organizational designs

Secondary data was used in order to gain a better understanding of each company's operations and innovation projects. Company's websites, industry media and annual reports were used as secondary data. By gaining a better knowledge about the company's operations, one could be better prepared for improvising questions in the middle of an interview. If there were any discrepancies between the informant's information and the secondary data, the researcher could ask the informant about such differences in the interview.

The researcher interviewed each respondent individually. The subjects were told the objective of the study was to gather information on the organizational structures employed by mature companies in Iceland and how innovation projects were spread out through the company. Interviewees were informed that all information given would be confidential if that was their wish. At the start of each interview, the interviewee was given a copy of the questionnaire including questions 1 to 19. If requested, the questionnaire was sent to the interviewees by e-mail before the interview took place. This happened in one case. The reason why only the first nineteen questions were sent to the interviewee was to avoid predetermined answers to questions 20 and 21. Each interview was recorded on the researcher's cellular phone, along with active note taking. After each interview, information was summarized based on the recordings and field notes including a determination of what type of organizational structure that particular organization employed. After the information gathered from the interviews had been analysed, an email was sent with the results for each company to the respective respondent for him/her to review before publication. This gave each respondent a chance to review the analysis and comment on it if they disagreed with any statement. A deadline for comments was established in the email. A follow up email was sent after the deadline had passed to confirm if the respondent had received the first email. If the representative didn't respond, it was taken as an acceptance of the analysis.

Results

In estimating which type of organizational design the case companies employed, the information gathered from interviews was analyzed and compared to the criteria for each organizational structure based on the research by Tushman, Smith, Wood, Westerman and O'Reilly (2004). The factors taken into consideration are summarized in table 2 with an overview of the case companies. Each of the six companies explored in the sample managed incremental innovation as well as radical innovation in various degrees. More emphasis on radical innovation was found at ORF and deCODE than the other four. One company, deCODE, had distinct job separation for employees who worked on radical innovation and employees working on incremental innovation. Most of the employees at deCODE work solely on radical innovation whereas in the other companies employees mostly work on incremental as well as radically innovative projects.

Each one of the case organizations employed a person who was responsible for overseeing innovation in the company. The titles and responsibilities varied from innovation manager to department manager. Two companies had an established incentive system in place. ORF has a relatively new incentive system for their employees where they have the opportunity to be promoted and gain stock in the company whereas deCODE has had an established incentive system in place for years. At deCODE, employees are given opportunity to move up in rank and salary as well as having the opportunity to receive academic credit for their discoveries, which encourages them to explore radical ideas. deCODE is the one company that was found to have an ambidextrous manager. The CEO of deCODE is highly involved in both radical as well as incremental innovations in the company.

Each organization was mapped, based on whether it had high or low senior management integration, and high or low structural differentiation as can be seen on table 2. Two companies, Marel and Össur employ cross-functional design as they have low structural differentiation and low senior management integration. Three organizations employ a functional design, Síminn, EFLA and ORF. They have low structural differentiation and high senior management integration. One organization, deCODE employs an ambidextrous design where the company's senior team integration is high and structural differentiation is high. Despite deliberate efforts to find a case company that might employ unsupported teams, none of the case companies were found to employ unsupported teams where structural differentiation is high and senior team integration is low. Further analysis for each organizational structure is described later and in more details.

Table 2. Organizational design characteristics

Organizational design by firm	Radical Innovation	Incremental innovation	Distinct Unit For Radical Innovation	Incentive System Tied To Innovation	Employees Hired Specifically For Radical Innovation	Ambidextrous Manger	Innovation Manager	Industry	% Of Revenues Spent on R&D in 2012
Functional design									
Síminn	x	xx					Department Managers	Telecommunications	5%
EFLA	x	xx					Department Managers	Engineering and consultancy	Undisclosed
ORF	xx	x			x		Director of Product Development	Biotechnology	Undisclosed
Cross-functional design									
Össur	x	xx					New Technology Manager	Medical Devices	5,5%
Marel	x	xx					Senior R&D Manager	Food Processing	5-7%
Unsupported Teams									
Ambidextrous design									
deCODE	xx	x	x	x	xx	xx	Vice President of Research	Biotechnology	Undisclosed

xx fully in place

x partly in place

Table 3. Organization designs employed by case firms

Senior Team Integration	Structural Differentiation: LOW	Structural Differentiation: HIGH
	LOW	**HIGH**
LOW	**Cross-Functional Teams** Marel Össur	**Unsuppoted Teams**
HIGH	**Functional Design** ORF Síminn EFLA	**Ambidextrous Design** deCODE

Cross-Functional Teams

Össur

Össur is a good example of a company that has used breakthrough innovations in prosthetics to become a global leader in the non-invasive orthopedics market. Össur's strategy is to generate new products in three out of the four different growth categories in Ansoff's matrix along with developing their existing product. Ansoff's matrix is a framework that organizations use for strategic directions. Possible growth opportunities are found by combining existing and new products, and existing and new markets. The model has four distinct strategic alternatives; 1) market penetration, 2) market development, 3) product development, and 4) diversification (Ansoff, 1957). Össur mainly works on incremental innovation through product development and market development. However, radical innovation has emerged at Össur for example with, the introduction of breakthrough products, such as the POWER KNEE™, which is the world's first and only active prosthesis for above-knee amputees. Radical innovation within the company is mostly overseen by the New Technology Manager. His role is to assign employees from different departments into teams that work on new product development, as well encouraging idea creation within the company. Therefore, employees from R&D, marketing and manufacturing may work

together on new product development projects, which indicates low structural integration. Furthermore, the organizational structure is a matrix structure which is typical for an organization employing a cross-functional structure. The organization doesn't hire employees with the intention to solely work on radical innovation projects. Össur, however, tries to attract people with diverse backgrounds and encourages its employees to "think outside the box". Össur's executive management oversees the financial and strategic decisions for incremental and radical innovations. The relationship between the New Technology Manager and executive management is considered good as executive management is very enthusiastic about innovation in the company. Senior management, however, takes limited part in specific projects, it reviews multiple projects as a sort of a program where the company tries to establish innovative products in different themes and monitors the market success of various programs. Therefore, project managers are allowed autonomy as senior management doesn't oversee daily activities in innovation, which is an indication of low senior management integration.

Marel

Marel has a long history of inventing breakthrough innovations since inventing a scale for fishing boats in 1977. Since then, the organization has built upon different innovations to become a market leader in equipment for the food processing industry. Since the company has matured, it has put increased focus on incremental innovation with steady improvements rather than radical innovation projects. Marel puts a lot of emphasis on innovation and R&D. In 2012 it applied for patents for 24 new innovations along with introducing 57 new products. While most of the daily development work at Marel focuses on incremental development, rather than breakthrough innovations, Marel has introduced numerous innovative inventions to the market since being established. The Senior R&D manager at Marel oversees some of the radical innovation projects in the company, particularly in collaboration with external research and development partners. His role is to explore opportunities and ideas for innovation through the organization's employees, its environment and customers. Employees that work on radical innovation projects are spread out throughout the organization. Marel wants their employees to work in close vicinity to each other in order to improve team work and idea creation. This indicates low structural differentiation. Marel doesn't have a specific incentive system in place and it doesn't hire employees specifically for radical innovation. Marel, however, tries to attract innovative and

creative people who are able to adapt to the organization's complex environment and work on incremental innovation as well as radical innovation. The Director of Research and Development oversees the financial and strategic decisions for incremental and radical innovation at Marel. The relationship between him and the senior R&D manager is considered good. The senior R&D manager, as well as others who work on specific projects, have relatively high autonomy in the execution of their work and the Director of Research and Development mostly oversees the projects and the results on a larger scale. Therefore, Marel has low senior integration.

Functional Design

EFLA

EFLA is a leading innovative engineering company. In recent years its focus has shifted towards projects for international markets as EFLA operates in a wide variety of fields ranging from high tech energy projects to building simple bridges. Although EFLA places a strong emphasis on innovation, radical innovative projects have decreased since the financial crisis in 2008, the company now focuses more on steady income from safer projects as resources are scarce for "pet projects". The company is divided into divisions that are separated by the specialist fields they operate in. Each division has its own manager, who is the market director. EFLA is divided into six divisions and within each division, there are sub-departments. For instance, the industry, and buildings divisions have six sub-departments each. Therefore, the market director of, for instance, industry, has six subordinates reporting to him. These subordinates make their own budget plan and put in requests for future projects. The application process for projects at EFLA is that each department manager puts together a pitch for a project and if the project is deemed valuable, it is approved by senior management. To oversee the business development in the company, EFLA assigns the Director of Business Development to inspire ideas between different divisions. His role is to give employees and managers ideas on future projects, which can be considered radical and long term. EFLA's R&D manager's role, on the other hand, is to remind employees of project application deadlines. He oversees more incremental projects in the company. Employees that work on radical innovation projects can be considered spread throughout the company as each department can come up with a breakthrough solution to a project. EFLA views itself as an idea generating machine. However, its resources are scarce. Therefore, managers have to make

decisions based on current market conditions. It's a highly competitive market for department managers within the company to get funding for projects. Managers have to be creative and EFLA has been known for their unique solutions to problems, which has increased the company's profile in Iceland and international markets. EFLA is an example of an organization that uses functional design, as each division in the company is responsible for its innovation projects and each market director in the company takes an active part in supervising those projects.

Síminn

Síminn has gone through organizational changes in the last couple of years following the financial crisis of 2008. Its R&D department, which focused solely on new product development, was laid down and innovation in the company now comes from individual departments. Síminn is a market leader in the telecommunication industry in Iceland. It's strategy has been to be first to the market with new products and services. Síminn has been known for introducing breakthrough products to the Icelandic market, such as the company's television decoder and now recently the so-called „time travel" solution. Lack of resources in funding and staff-hours has shifted the company's focus towards more incremental innovations that provide more secure revenue streams. Síminn now aims at tailoring and shaping its products to fit customer needs. Its strategy is based on Treacy and Wiersema's three paths to market leadership which entails market leaders delivering superior value to customers through customer intimacy, operational excellence, or product leadership (1993). As previously stated, most radical innovative ideas went through the R&D department before it was laid down. Today, Síminn is divided into four separate fields, corporate market, residential market, technical department, including IT, strategy and communications. Under each field are several departments. For each field, there is a senior manager who is responsible for innovation for each department under his or her management. Radical and innovative ideas come from employees throughout the organization. Síminn, therefore is a good example of a functional design as structural differentiation is low with high senior team integration. Senior managers at Síminn, for instance the CTIO, take an active part in encouraging its employees to explore ideas and spend much time with each department.

ORF

ORF is a relatively new company. It was established in 2001 and currently employs around 40 employees. The organization is therefore small with innovation spread throughout the company. ORF has given out successful innovative products through their extensive research in the field of growth factors and recombinants proteins in plants. The Director of Product Development at ORF specializes in radical inventions in the company. All employees, however, take an active part in the innovation process. To encourage employees in performance, the company employs an incentive system where employees have the option to become shareholders in the company. This incentive system, howver, is not linked to innovation performance. One employee was hired specifically for research in radical innovation. He is also assigned to work on incremental innovation projects. ORF‘s CEO, is responsible for financial and strategic decisions for incremental as well as radical innovation within the company. He spends a lot of time with the R&D department on innovation projects. The relationship between him and the Director of Product Development is considered very strong, which facilitates communication. As the company is in its early growth stage, ORF invests heavily in R&D. ORF employs a flat structure which is typical for an organization that uses functional structure for their innovation process. Furthermore, senior management takes an active part in the daily operations of the company, which indicates high senior management integration.

Ambidextrous Organizational Design

deCODE

deCODE is a biotechnology company having access to a unique gene database with information about around 370.000 individuals. This information has given the company a strategical advantage in the global marketplace in genetic research. In 2012, deCODE was taken over by Amgen, a biotech company which develops and manufactures human therapeutics. deCODE continuously works on radical innovation through its research on the human genome. Part of the organization, then works on incremental innovation in an attempt to better refine the company‘s research processes. deCODE employs around 130 employees. Of those, 40-50 scientists work specifically on radical innovation, another 50 in support, and around 20% of the company‘s

employees work solely on incremental innovation. The Vice President of Research at deCODE oversees many of the radical innovation projects within the company. The research department is more or less the whole company as innovation stems from intense and complicated research work. The corporate culture at deCODE and its strategy, is to make breakthrough discoveries instead of simply developing products. However, the company has defined a specific part of the company to focus on value creation and how to further develop their findings. They work on improving radical innovation projects and make the process more efficient with incremental innovations. deCODE has an incentive system where employees can move up in rank and pay based on merit. The incentive system played a bigger part in the company's earlier years. The incentive system, however, is becoming a bigger factor within the company again, especially after the takeover by Amgen. In addition, as this is a research community and all results are published, researchers are motivated to innovate because of their attributions as authors of research publications. The CEO of deCODE is responsible for the financial and strategic decisions about radical and incremental innovation in the company. He spends a lot of time with the company's researchers and publishes a fair amount of work himself. His relationship with the VP of Research is very strong. The CEO of deCODE is an ambidextrous manager who oversees both the incremental and radical innovation part of the company and focuses on finding a balance between the two forces. This indicates high senior management integration. Structural differentiation is high as well, as part of the company works only on radical innovation and part of the company works solely on incremental innovation. Although, the physical location of the two units are not seperated, there is a distinction between employees who work on continuous improvements (incremental innovation), and those who work on breakthrough discoveries (radical innovation).

Unsupported Teams

An attempt was made to find an organization that employed an unsupported teams structure. Inquiries were made by phone to numerous smaller organizations known to be innovative, for example, Miracle, Sensa, Mentor and AGR. Furthermore, an interview with Gogogic's former CEO, Jónas Björgvin Antonsson, with hopes to establish whether Gogogic uses unsupported teams in their game development, concluded with the fact that the organization would be identified as an organization that employed a functional design. In addition, Jonas believed that

there were no firms in Iceland employing an unsupported team structure today. This, however, would not have been the case a couple of years ago, where for example Skyrr, an IT company, used an unsupported team structure where employees had freedom to work on projects without special supervision or approval from senior management. Jonas believed this structure would more likely be found in organizations in Silicon Valley or other gaming firms abroad, for example Valve and Google (J. Antonsson, personal communication, April 5, 2013). It should be noted that even though there wasn‘t a successful attempt made to find an organization that employed unsupported teams structure, these results should be considered tentative, as the sample was based on convenience. Therefore, not all organizations in Iceland that conduct innovation were explored and additional research would be needed to confirm these findings.

Conclusion

This research explored what types of organizational structure companies in Iceland employ for innovation in their attempt to explore through radical innovation and exploit through incremental innovation. The sample of organizations chosen was comprised of well established businesses, with the exception of ORF, as important innovations can be expected to emerge from mature organizations (Drucker, 1985). All organizations managed both incremental and radical innovation projects to different degrees. deCODE, for example, places most of its emphasis on radical innovation projects through intense research work, whereas Marel focuses more on incremental changes to their products. Pursuing incremental innovation is important to increase market share (Banbaury & Mitchell, 1995) and, indeed, Marel and Össur focus mainly on incremental innovation. However, radical innovation projects can remain even more critical as studies have shown that radical innovation can produce a much greater margin than incremental innovative products (Kim, 1997). One company, deCODE, has an incentive system in place which is tied to innovation within the company. An incentive system has been shown to promote innovation for companies working in complex environments (Agrell, Bogetoft, & Tind, 2002). Therefore, it might be a missed opportunity for companies in Iceland, not to have an incentive system in place to inspire employees to develop breakthrough products.

Of the organizations that were explored, three firms, Síminn, ORF and EFLA, employed functional design for innovation streams, two employed cross-functional design, Össur and Marel and deCODE employed ambidextrous organizational design.

Although this research doesn't explore the effectiveness of the use of each organizational structure, one can see that firms choose their organizational structure based on their strategy. The organizations that are somewhat most mature, Marel and Össur, use cross-functional design, as both view themselves as market leaders in their respective fields and focus on incremental innovation in order to stay ahead of the competition. Although each company is active in new product development, radical innovation is rarer and most often comes in sessions. They both employ an innovation manager who oversees radical and incremental innovation. The role of the senior R&D manager at Marel and the New Technology Manager at Össur are similar in both companies. They both actively inspire employees in their companies to generate new ideas and assemble teams from various departments to work together on innovation projects. The senior management for Össur and Marel do not get too involved in the day-to-day projects. They give their employees autonomy to work on projects and monitor the performance of the innovation process within the company as a whole.

Firms that use functional design structure like Siminn and EFLA, where structural differentiation is low and senior team integration is high, have a few things in common. Since the financial crisis of 2008, radical innovation for both companies has been in decline as the focus has shifted towards less risky projects that provide secure revenues. Innovation projects are found in both companies as EFLA is the leader in innovative solutions in the field of engineering and Siminn is a market leader in the telecommunications industry. Intensified competition in recent years, however, has made the companies reduce their spending and alter their strategy to focus more on supplying what the customer wants, not what the customer might want. Functional design, has been found to be beneficial for organizations when radical innovation focuses on developing product substitutes. In functional design, senior management takes much responsibility for innovation projects. For example, the CTIO at Siminn takes an active role in encouraging her employees to come up with innovative products and "think outside the box". Although resources are scarce for the company today, it could potentially benefit from moving into an unsupported

team structure in which employees would get more freedom for exploration. EFLA's management is similar to Siminn's; each division manager is responsible for its innovation projects. Divisions are divided into sub-departments and the senior management in the company takes an active part in the decision making, where each division has to compete for project funding. ORF is a relatively new company which makes it understandable that it uses a functional design, as each department focuses on their own operations in order to build up the company. The R&D department is managed by the Director of Product Development. They focus on radical innovation in the company as well as incremental changes to their products. Innovation, however, stems throughout the company as every employee is highly involved in new product development. Senior management integration is high, as ORF's CEO for example, takes an active part in the company's daily operations and the relationship between him and the innovation manager is considered strong. With further development, the company could benefit from moving to an ambidextrous organizational design, which would enable the company to focus on exploration and exploitation simultaneously and avoid stagnation.

The organization found to employ ambidextrous organizational design, deCODE, places much emphasis on radical innovation and breakthrough discoveries in the field of gene discoveries. deCODE displayed characteristics of an ambidextrous organization, as it uses most of its employees to work specifically on radical innovation and a certain portion of employees focuses only on incremental innovation. This gives employees working on breakthrough products more flexibility. Ambidextrous design has been shown to be the most effective organizational design in enabling firms' dynamic capabilities and attempts to explore and exploit simultaneously. Although this organizational form is complex, it has been proven to increase performance of new, and existing products (Tushman, Smith, Wood, Westerman, & O'Reilly, 2004). For an ambidextrous organization to be successful, it needs an ambidextrous manager to manage both existing products as well as breakthrough innovation. The CEO of deCODE, is a good example of an ambidextrous manager. He is very active in the company's research and development for both incremental and radical innovations. Furthermore, his relationship with deCODE's Vice President of Research which oversees radical innovation in the company, is very strong.

As there was no success in finding a company that employed an unsupported teams structure, one can speculate about the influence of market conditions. After the 2008 financial crisis struck, companies seem to have decreased their spending on radical innovation projects or "pet projects", which are deemed too uncertain and are put aside, as companies focus more on projects with secure revenue streams. In discussing the idea of unsupported teams with respondents in case companies, the general consensus was that it would have been more probable to find firms that used unsupported teams structure before the financial crisis. It appears that diminished resources have played a part. Without making any judgement about whether or not an unsupported team structure would suit better or worse than other organizational structures, it is an interesting strategy where large organizations can give their employees freedom from the structural inertia and bureaucracy that often slows the innovation process down in larger companies. Many famous innovations have been developed by some of the brightest minds from companies, who are given time and freedom to develop something exciting. For example, the Machintosh, Audi R8 and now most notably, the Google Glasses project ("17 of the most", 2013). Companies might be hesitant to employ skunk works, as there might be limited resources for innovation projects. Skunk works, however, have proved to be a strategy which some of the most successful innovative companies in the world employ with good results. Mature companies in Iceland could therefore benefit from experimenting with the strategy in an attempt to develop more radical innovations. In addition, skunk works seem ideal for Icelandic companies, as the description of unsupported teams matches the description of Iceland and its culture perfectly, an unsupported team with freedom and independence from others, located in a secluded location.

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Appendix – Questionnaire

1) Hvaða starfi gegnir þú innan fyrirtækisins?
2) Stundar **nafn fyrirtækisins** róttæka nýsköpun (radical innovation)?

- *Róttæk nýsköpun (radical innovation) felst í því að þróa alveg nýja tegund vöru eða þjónustu og byggir oft á markvissu rannsóknar- og þróunarstarfi. Dæmi um róttæka nýsköpun eru þróun nælons og getnaðarvarnarpillunnar.*

3) Stundar **nafn fyrirtækisins** smáskammtanýsköpun (incremental innovation)?

- *Smáskammtanýsköpun (incremental innovation) felst í umbótum eða endurbótum á vörum, þjónustum eða framleiðsluferlum án þess að grundvallarbreyting sé gerð á þeim. Slíkum breytingum er oft komið í verk af starfsfólki svo sem tæknifólki, stjórnendum eða þeim sem vinna við framleiðslu- eða þjónustustörf. Dæmi um smáskammtanýsköpun er ný útgáfa af Windows.*

4) Er sérstök deild eða eining innan fyrirtækisins fyrir róttæka nýsköpun?
5) Ef svo er, er deildin eða einingin með sérstakan stjórnanda?
6) Er meirihluti þeirra starfsmanna sem starfa við róttæka nýsköpun staðsettur á svæði sem er afmarkað frá því svæði þar sem starfsmenn sem starfa við skammtímanýsköpun (eða aðra starfsemi) eru staðsettir?
7) Er menning einingarinnar sem sér um róttæka nýsköpun ólík menningu annarra eininga fyrirtækisins? Ef svo er, á hvað hátt er hún frábrugðin?

- *Menning er samansafn af gildum, venjum, hegðunarmynstri og sameiginlegum væntingum sem móta samskiptahætti einstaklinga og hópa. Oft er talað um „fyrirtækjamenningu“.*

8) Á skalanum 1 til 5, hversu ólík er menningin?
   **1 merkir að menning einingarinnar sé lítið ólík og 5 merkir að menning einingarinnar sé mjög ólík.*

(a) Lítið ólík 1 - 2 - 3 - 4 - 5 Mjög ólík

9) Er hvatakerfi til staðar innan fyrirtækisins?
10) Er hvatakerfið fyrir starfsmenn sem vinna við róttæka nýsköpun ólíkt hvatakerfinu fyrir starfsmenn sem starfa við skammtímanýsköpun? Ef svo er, á hvaða hátt er það ólíkt? **Dæmi: Bónusar, hlunnindi og tækifæri á stöðuhækkunum.*
11) Á skalanum 1 til 5, hversu ólíkt er hvatakerfið?
    **1 merkir lítið ólíkt og 5 merkir mjög ólíkt*

(a) Lítið ólíkt 1 - 2 - 3 - 4 - 5 Mjög ólíkt

12) Hversu margir af þeim starfsmönnum sem starfa við róttæka nýsköpun voru ráðnir inn til fyrirtækisins sérstaklega til að starfa við róttæka nýsköpun?

13) Hver er sá sem ber ábyrgð á fjármálum og ákvörðunartöku fyrir bæði almenna starfsemi fyrirtækisins og fyrir nýsköpunarstarfsemi? *(yfirleitt framkvæmdastjóri fyrirtækisins)*

14) Á skalanum 1 til 5, hversu miklum eða litlum tíma eyðir sá aðili í að sinna deildinni eða einingunni sem sér um nýsköpun?
**1 merkir að litlum tíma sé eytt og 5 merkir að miklum tíma sé eytt.*

Litlum tíma 1 - 2 - 3 - 4 - 5 Miklum tíma

15) Á skalanum 1 til 5, hversu auðveld eða erfið eru samskiptin á milli þess sem stýrir nýsköpun og þess sem stýrir fyrirtækinu í heild (framkvæmdastjórans)?
*1 merkir mjög erfið samskipti og 5 merkir mjög auðveld samskipti

Mjög erfið 1 - 2 - 3 - 4 - 5 Mjög auðveld

16) Á skalanum 1 til 5, hversu sterkt eða veikt er sambandið á milli þess sem stýrir nýsköpun og þess sem stýrir fyrirtækinu í heild (framkvæmdastjórans)?
**1 merkir mjög veikt samband og 5 merkir mjög sterkt samband*

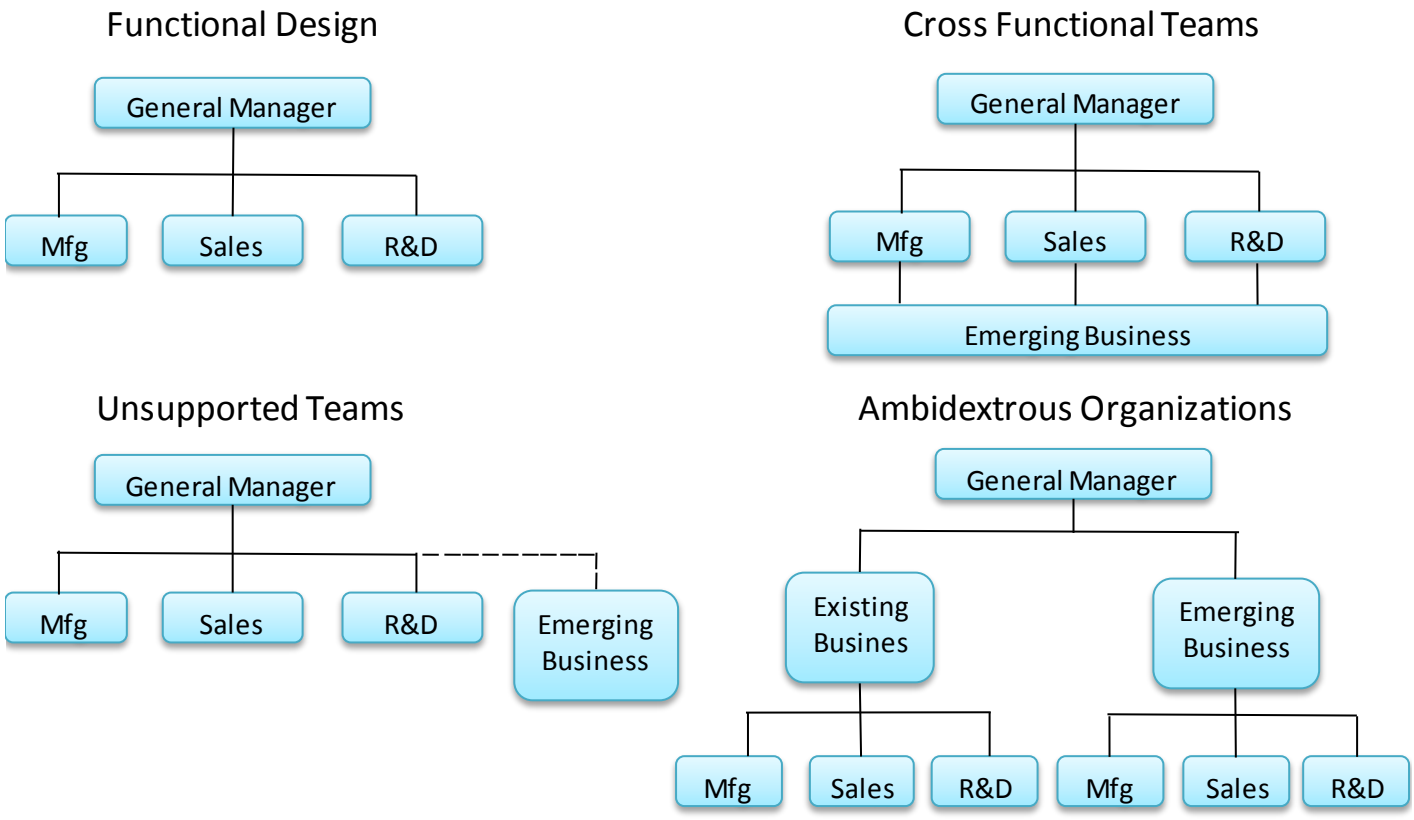
Mjög veikt 1 - 2 - 3 - 4 - 5 Mjög sterkt

17) Hversu stóru hlutfalli af veltu ársins 2012 telur þú að hafi verið eytt í nýsköpun?

18) Hvert er aðal markmið fyrirtækisins í nýsköpun, bæði róttæka og smáskammta?

19) Hver voru helstu vandamálin tengd nýsköpunarstarfi fyrirtækisins sem komu upp á síðasta ári?

- Á meðfylgjandi mynd er lýsing á fjórum gerðum skipulags/fyrirkomulags nýsköpunar.



20) Hvert af þessum fjórum gerðum skipulags/fyrirkomulags er líkast fyrirtæki þínu?

21) Vinsamlegast teiknaðu mynd af skipulagi/fyrirkomulagi fyrirtækisins fyrir nýsköpun.