Institutional forces in the creation of new sustainable technologies: a case study of reusing old infrastructure from paper mills to data centers

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ABSTRACT

Reuse of old infrastructure in building new industry facilities has important practical implications to the environment. Redeploying old infrastructure would help a lot to stabilize the material balance sheet of the economy in the construction industry. Reusing old structures is often described as an adaptive process from different aspects on a macro-level. However, this often fails to explain how new sustainable technologies are created in the micro-level, when novel new technologies are formed and when not. This paper addresses this gap. I suggest that they key to understanding these processes is instead of adaptive reuse is defining the entire process as exaptation and adaptation combined, as has been done in management literature concerning other new market and technology creation. Exaptation is defined as the current use of a structure or feature that is co-opted for a different use than it was originally intended or designed for, sometimes using the term “pre-adaptation”,where as adaptation is a development a certain feature to better fit its niche. In an exploratory case study we compare how old structures in two historical Finnish paper mill sites were transformed to serving cloud computing data centers for Google, IBM and CSC. In the existing literature of sustainable reuse of old infrastructure the exaptation part is often neglected, however in the field of natural sciences it is noted as a process that adaptation might or might not follow. Our results show that besides a set of qualifications to make this kind of reusing of old structures favorable for adaptive planning, there is a different set of underlying conditions for certain type of Eco-innovations to occur, following the definitions of exaptation. To our knowledge this is the first comparative case study of why similar old infrastructure are sometimes redeployed in remarkably different ways.

The factors influencing how these sustainable practices form go beyond the organizational limits and are limited, or enabled, by the technological environment, industrial forces and organizational factors. The findings regarding these forces affecting sustainable development and innovations follow previous theories of institutional forces affecting corporations by such as DiMaggio and Powell as well as Geels, and but combine the different institutional forces and their both enabling and constraining effects in a cumulative way to prove insight of how sustainable innovations come to existence.

Keywords: sustainable reuse, new technology creation, exaptation, adaptation

INTRODUCTION

An intentional development towards sustainable innovations does not always produce ones, and sometimes sustainable innovations arise from constraints not designed to encourage them. This serendipitous way how sometimes sustainable innovations emerge is neglected in the current literature regarding sustainable development policies consistently referring to adaptational practices of structure reuse as a method to develop techniques for sustainability. In the studies regarding old infrastructure reuse, the process as entity is described as adaptive response to constraints and drivers (i.e. Bullen, 2007; Bullen and Love,2011), a term related to biology and evolutionary theory. However, it is often mistakenly combined with an entirely different concept of exaptation. Exaptation is a fairly recent term in economics, only dating back to 2004 (Dew et al, 2004), yet mentioned often in relation to evolutionary theory (Campbell and Reece, 2005; Gould,2002,), previously also known as “pre”- adaptation. The difference between exaptation and adaptation is that adaptation refers to a feature intentionally developed to better fit its purpose, whereas exaptation means a new use for a feature in the way it was not originally designed for (Gloud and Vrba, 1982). According to evolutionary scientist, adaptation should not be used so commonly without a clear knowledge of the origins of the process. Exaptation, a shift in function, or active adaptation in crisis, offers an rational explanation to when the origins of adaptational process are unclear (Gould, 2002). The factors influencing how these sustainable practices form go beyond the organizational limits and are limited, or enabled, by the technological environment, institutional forces and organizational level capabilities and choices made. The findings I present in this paper regarding these forces affecting sustainable development and innovations follow previous theories of institutional forces affecting corporations by such as DiMaggio and Powell (1983), Geels (2004), and but I present an attempt to combine the different institutional forces and their both enabling and constraining effects in a cumulative way to prove insight of how sustainable innovations come to existence with the help of differentiating adaptational practices from exaptional. The theoretical framework for understanding sustainability and innovations has been introduced to include industrial forces (i.e. Geels 2004), yet still remains a widely unstudied area with a need for recognizing the multi-level forces affecting sustainability (Patzelt and Shepherd, 2011).

This paper makes two contributions to understanding sustainable innovations. Firstly, some of the innovations occurring could be categorized as exaptation and some as adaptation offering an understanding how sustainable practices sometimes emerge unintentionally and sometimes are intentionally produced, following the current literature regarding innovations suitable for describing sustainable structure reuse. Secondly, the factors influencing the sustainable innovations are included to have a multilevel perspective of how institutions like society, market and isomorphic behavior affect the decisions on an organizational level producing opportunities for sustainable innovations while guided by the technology available. The socio-technological forces, isomorphic behavior and organizational procedures and resources all affect how innovations come to existence, however, they vary in the outcomes.

In this paper I examine two similar and simultaneous transformation processes where old infrastructure was sustained for a new use. In both of the transformations, an old paper mill site, shut down due to low profitability, was transformed into a data center for cloud computing organizations. In these processes some of the old infrastructure was reused to serve the new entrant, some was built in new and some part were left unused. This paper mainly addresses two successful exaptative sustainable innovations, and one particular lack of effective sustainable solution, and the underlying reasons for each. In addition to that, in this paper I attempt to conclude a multilevel dynamic view of how sustainable innovations emerge.

The material for the cases was selected due to two distinguishing reasons. Firstly, paper manufacturing and forest industry has been the most rapidly growing area of industry in the industrialized nations for a century (Diesen,2007). Nevertheless, in recent years the demand for paper products has not been growing such rapid paste in industrialized countries but still in still developing ones. This has been one of the several reasons why in countries like Finland, that have a long industrial history leaning on the forest industry, several paper production facilities have been shut down due to low productivity (Koskinen and Hämäläinen, 2010). Secondly, in recent years the virtual industry has been growing very rapidly in demand. Due to the fast technological development, outsourcing IT-infrastructure has become a cost-efficient way for many organizations to cut down in maintenance and additional investment for new technology (Marston et al., 2012). The constant development of technology causes a virtual race between supply and demand making it for several organizations impossible to keep up with. The virtual industry, however, faces many growing demands as well due to this. The components need to be running constantly requiring massive amounts of energy, effective cooling and cause due to that massive carbon dioxide emissions. The need for environmentally friendly data centers has risen to be a crucial question for many service producers in recent years. IT consumes 2% of global annual energy production and one data center might produce 59 kilotons of emissions (Masanet, Shehabi and Koomey,2013)

Nearly simultaneously two old paper mill sites in Finland, previously owned by Stora Enso and UPM-Kymmene, few of the largest paper industry organizations globally, were transformed to data centers for Google, IBM and CSC. These transformations reused the old infrastructure of the facilities to produce environmentally friendly, low-emission, and sustainable data centers. In both cases there were new sustainable innovations made and the old infrastructure was used effectively to host new industries. However, the motivations and the outcomes of this reuse varied widely. In both cases the initial idea was fairly similar since both data centers and paper production facilities require some similar functions, mainly large premises, the access to water and massive amounts of electricity. Yet in these cases the assets very utilized in very different ways.

This paper is constructed as follows; In the first section the theoretical framework based on current literature is introduced regarding sustainable innovations, adaptation and exaptation and defining the industrial forces. In the second part the study method and research question is presented, following a brief introduction to the industries and their background as well as main distinguishing features. In the third part the results are presented, followed by a discussion where the theoretical framework presented earlier is connected to the results. The results are presented in detail in tables in the appendixes. This paper ends in conclusion with the remarks and the recommendations for future research

CONCEPTUALIZING SUSTAINABLE INNOVATIONS ON A MULTILEVEL SCALE

Innovation is a popular term in scientific literature, defined sometimes in a very simplified way as “new combinations of existing resources” (Schumpeter, 1939), and is also not a very new phenomenon. Sustainable innovations can be understood in a very broad sense as innovative technologies that are sustainable (Rennings,2000). However, in the current literature a definition for sustainable innovation is not agreed upon (Carrillo-Hermosillo, del Rio and Könnölä, 2010). Typologies regarding general innovations vary from a linear model of research leading into development and later to production and marketing to a dynamic one. In this paper I attempt to adopt a more dynamic view of innovations - along the line of Kline and Rosenberg's (1986) suggestion of seeing innovation not as homogeneous and static (Fagerberg, 2005). Henderson and Clark have a typology regarding technological innovations based on differentiating the components that make up the final product, and the product itself as an entity. They introduce the core concept of the product what consists of components. They divide innovations into four different categories, architectural, modular, incremental and radical innovation. Architectural innovations are innovations were the design of the product is essentially changed, modular innovations are ones when theres a change in the components themselves, but not in the final product. Incremental innovation refers to improving the concept of the product or refining the components without remarkably creating notable changes. Radical innovations are innovations were both the components and the final product are changed - a combination of both architectural and modular innovation. Maj Andersen had a typology regarding Eco-Innovations in 2008 creating five different types of sustainable innovations - one of them that can be defined roughly as exaptation process, others as adaptive innovations due to The paper comes to address innovations through sustainability and environmental regulations, offering a more dynamic and sociological approach to understanding innovative capabilities of an organization. The categories are defined as add-ons, integrated, alternative products, macro-organizational and general purpose Eco-innovations. Add-on Eco-innovations are products or services that improve a certain product by increasing the eco-friendliness of it, but are by themselves not environmentally friendly. Integrated Eco-innovations are ones that improve the production technique of a certain product making it more environmentally friendly to begin with by improving the manufacturing process. Alternative product Eco-innovations are understood as completely new products, or as Andersen puts it - new technological paths or radical innovations that may require a complete change in the way the product is used or create even new markets and customers. The macro-organizational Eco-innovations refers to organizational policy changes or new techniques that improve how the organization works, for example logistical solutions, making it more environmentally friendly. General purpose Eco-innovations are understood as being a core to changing an existing paradigm in a certain field of products, making also possibly way for spin-off innovations afterwards. Innovations happening as clusters around a certain organization is not a relatively new theory, it was suggested also by Schumpeter how one important innovation tends to create possibilities for other innovations (Fagerberg, 2005, Ahmed and Shepherd, 2010). Schumpeter also discussed business cycles occurring around certain innovative new technologies during a certain period in history resulting in economic change on many industry levels. According to this classification, the next wave, the fifth wave, starting from around 1990 is focused on digital networks, biotechnology, nanotechnology and softwares (Ahmed and Shepherd,2010) and this paper addresses the digital networks. The serendipitous way how sometimes sustainable innovations emerge is neglected in the current literature regarding sustainable development policies consistently referring to adaptational practices of structure reuse as a method to develop techniques for sustainability. However, these typologies lack a term that would describe exaptation as an innovation, being described in evolutionary theory as a “rational explanation to shift in function” (Gould, 2002,) - offering an explanation when the clear origins of adaptation can no be agreed upon.

> “innovation process itself is often treated as a black box” (Fagerberg, 2005,p.3).

The focal point of these theoretical frameworks is often not in how and why do innovations occur, but how can they be turned into profit and what is their effect on the market.
If innovation is understood to be a new innovative product for the customer, it can be described as an adaptive process of intentionally developing a certain feature to better fit the given function. In this paper, however, innovation is not seen as a finished product of some type. The analogy used to understand innovation in this thesis comes from natural sciences and focuses on the core process, how the idea of the innovation came to exist. The main question could be formatted instead of how a certain innovative technique comes to the shelves, as is there a need

for it beforehand or not? According to Andersen typology the different types of innovations, it is not a question of what shall the innovation itself become, after research and development it might end up as an add-on or a general purpose innovation - but the main question is: was it intentionally produced to begin with because of a desperate need for a better solution in the market? Or was it invented in a serendipitous way - and later realized to be a crucial benefit to improve some existing product? On one hand, it might be called a radical innovation, but differing from analogies of Schumpeter, Henderson and Clark and Baker and Nelson, wheres the difference between trying to build a better technique for something and unintentionally discovering a new technique. In this paper I attempt to conceptualize innovations as events that take place, without much emphasizing whether their development afterwards leads to significant new technologies or not, i.e. measuring the amount of patents produced (Wang, Jacob, Li, 2014) In this paper the emergence of innovations is understood as a separate process, not only as an intentional development to meet a certain demand on the market, but also taking into consideration the serendipitous events sometimes leading for new technological discoveries. The theory used in this paper also does not suggest that a particular product should be finished. There is no definite point when a feature is "ready", a feature keeps on developing and adapting to the environment resulting after a long period of time maybe into different species, somewhat following the analogy of clusters of Innovations by Schumpeter and ecosystem root firms. Following the notion by Patzelt and Shepherd of not treating sustainable innovations as individual regocnisions of development opportunities (2011), as well as Geels (2004) and Rennings (2010) of including socio-technological factors affecting sustainable innovations, this paper concludes that sustainable innovations are affected by institutional forces, organizational procedures and guided by the technological environment. Although recently sustainability transitions have been receiving increasing attention (Garud et al, 2013; Mackard et al, 2012), the literature and theoretical frameworks regarding old infrastructure reuse are limited. Instead of treating infrastructure reuse as adapting to the different industrial forces (i.e. Bullen, 2007; Bullen and Love, 2011) this paper includes the dynamic nature of the innovation core process using the concepts of exaptation and adaptation due to a lack of better theoretical framework.

ADAPTATIVE AND EXAPTIVE PROCESSES

The reasons for innovations to occur can be described as either a strong demand for a novel technique, or not having one. The aim of this paper is to focus on them both, the latter being often not distinguished as separate. In order to examine the forces affecting the emergence of these, somewhat accidental, innovations happening in the microlevel in an organization, however, affected by macro level factors I adopt terminology originating from natural sciences, i.e. exaptation and adaptation. Exaptation can be defined as a shift in function, or active adaptation in a crisis situation (Gloud and Vrba, 1982; Gloud, 2002), where as adaptive behavior is improving a design to better fit its function. Sometimes sizable resources can produce new technologies, sometimes the lack of resources causes the invention of a new technology.

In construction industry reusing old infrastructure is not a new phenomenon - several transformations of for example old historical buildings put to new use as residential buildings have been studied in Australia and Europe. In 2010 in the article “ Factors influencing the adaptive reuse of buildings” Bullen and Love define driving and constraining factors that drive the re-usage of buildings. However, this study is only concentrated on the initial motivation that affect the decision to choose to reuse a structure or not. The aim of this paper is to focus on the factors effecting the sustainable solutions made during the actual transformation process, in addition to clarifying the drivers and constraints for those, but not to concentrate too much on the initial motivation whether a certain building should be reused or not. In BUllen and Love article the drivers and barriers are categorized according to their effect on the decision whether to use the old structure or not - without making a clear difference in the institutions causing them. The barriers of reusing old infrastructure include factors that are either present at the facilities (in other words, technology environment), but also the institutional constraints like regulations. Also the drivers for sustainable reuse include many external factors, like rising cost of energy and saving resources.

Among these, there have been theoretical frameworks build on how to adapt to the environment and how to make best use of the resources at hand. However, often what is defined as an adaptive process, is after all a mixture of two terms, both adapted originally from evolutionary theories. The term adaptation refers to the intentional development of a feature to better fit its niche. In other words one could describe it as R&D. The second term, not mentioned in sustainable structure reuse, is called exaptation. Exaptation is a fairly new term in the literature of economics, first introduced by Dew et al in 2004 in their article “Economic implications of exaptation”. Exaptation, formerly know as “pre-adaptation”, is defined as a feature that is currently used for a different purpose than it was originally designed for. The term was introduced by Gloud and Vrba in their article in Paleobiology in 1982 as a replacement to the paradigmatic “pre-adaptation” in the field. Due to the nature of the term, sounding too much to be referring to a predictable incident, they suggested that the “pre-” should be replaced with “x-” (Gloud and Vrba,1982), since the need for the new feature might not exist strongly beforehand, regardless how important it becomes in the future. The most common example of exaptation in biology is the development of wings. Dinosaurs already had feathers, but they were mostly used for isolation purposes. Accidentally was also at some point noticed they can be used for gliding as well, what is the definition of exaptation - feathers were given a new use that differed from their original usage. After this the form of the feathers adapted to better fit its new purpose - flying - by developing into wings. In economics exaptation has been used to explain serendipity (Cattani, 2006), and innovation in an unpredictable environment. Exaptation incidents have been described several, sometimes referred as active adaptation in a crisis situation, like many solutions used in the Apollo 13 space shuttle. After technological failure the astronauts were forced to build equipment needed for landing from the available material they had at hand (Dew et al, 2004). Exaptation offers an explanation to the shift in functionality, and is often triggered by different non-firm factors than traditionally sustainable development is considered to be dependent on. One of the examples for this is the invention of the CD-ROM technology. The technology was originally intended to improve the sound quality in vinyl records, also to provide durability. However, after the technology was invented, it was realized it can be used to store different types of data as well. After further developing that feature, the CD-ROM technology became the basis for data transfer in computer revolution starting in late 1970’s (Dew et al, 2004). The following image is based on Dew et al to conceptualize exaptational and adaptational practices. The environment describes the motivational environment, combining the market and the internal - they wanted to improve the sound quality and durability of vinyl records.

- insert Figure 1 here -

INDUSTRIAL FORCES

So far, sustainability transitions lack a multilevel approach that would also take into consideration concepts on a wider scale, like networks, social surroundings and other institutional forces (Nils and Kemp,2000; Patzelt and Shepherd, 2011 ;Geels, 2004). These features affect the outcome of sustainability issues often. In an article by Bullen (2007), he describes four definitions for adaptive reuse of old infrastructure. It is said to upgrading the building to modern standards (Latham, 2000), or a modification (Douglas,2002) – both analogical to the definition of adaptation. However, adaptational practices are also said to include the renovation of a structure for a new use (Dolnick and Davidson, 1999), or use a structure no longer in use to serve a different function (DEH, 2004) – both of what are analogical to the definition of exaptation, not adaptation. organizational adoption of new practices. In sustainable innovations the adaptive quality is to be understood as adapting to the environment (all actors within the field - i.e. CD-ROM fig.1) by producing sustainable solutions that can be then described by different types of innovations as suggested by Andersen. Structure reuse is a good example of shift in function where exaptation offers an explanation to.

According to DiMaggio and Powell (1983) organizations tend to change over time so they become similar with each other. Choosing sustainable innovation practices do follow the suggested patterns as well. Coercive isomorphism is described as the pressure from other organizations and institutions (including the law, cultural expectations - society, etc) that an organization faces. These include cultural expectations and social pressure as well as regulatory rules by the region. Mimetic process describes the organizational decisions made in an unpredictable environment, where they tend to mimic the solutions other organizations made - however this applies to sustainable practices as well . in this case however, not the organizational structure. Normative pressure causing organizations to change for the similar direction arises from formal education and the similar knowledge base of personnel occupying similar professions.

According a description by Geoffrey Hodgson in Evolution and Institutions (1999), the conceptual distinctions between firms and non-firms, the institutions in question fall into several categories. Firstly, there are the capital firms, Google, IBM, Stora Enso and UPM-Kymmene. Secondly, the public owned CSC falls into the category of employment firms by being a government owned non-profit seeking organization. In addition to this, the other systems playing a role in these sustainable innovations could be categorized as non-firms, namely the market, network and, a term missing in the description, social surroundings. The capital firms each form their own separate system, as does the employment firm, CSC. In addition to this, they function in a complex network formed by the other systems, non-firms.

Social and institutional aspects that are included in the concept of sustainable innovations have been studied before as well. In 2004 article by Geels, the supply and demand side of an innovation is combined. The supply side refers to the technological innovation of the firm responsible for the invention, and the demand side to the user environment, what can be here understood analogical to market. Geels points out also that institutions are often defined as "left-over category" and often seen only as non-market organizations. However, these institutions affect the merge of sustainable innovations, but there are others besides just the user environment (or market). In this paper I conclude the macro level forces affecting sustainable innovations, as well as the micro level firm capabilities and constraints, that the technology limits when functioning in a certain environment. Including the institutional and normative components to the study of innovations have also been suggested by Jennings and Zandbergen (1995). Defining institutional factors, such as suggested by Lawrence and Suddaby (2006) in creating, maintaining and disrupting institutional work, falls beyond this particular paper. However, some positions of the actors, after the transition of the infrastructure, included in these processes resemble ones introduced by them.

An institutional force and an organization may be defined in different ways depending on the concept. In this paper the institutions affecting sustainable innovations are described as the market, referring to the customer base, the society, referring to both legal and cultural institutions, isomorphic tendencies, referring to organizational preference to follow a known solution in an unpredictable, new environment, and lastly technology, presenting the actual structures available at the premises where the data centers decided to build their servers. The market and the society affect the organizations and depending on organizational possibilities or limitations sustainable innovations emerge in the given environment. Nidumolu, Prahalad and Rangaswami (2009) suggest in their article that sustainability is both the key to competitive advantage as well due to the constant demand for it from both customers and insitutions, why it is described in this paper as one cumulative force that acquires certain things from the organizations. The results, however, suggest that a certain institutional force does not provide a similar solution in all organizations. In this paper the data centers are identified as single organizations, not taking into consideration the entire organization behind them due to the project-like qualities (Artto, Martinsuo, Kujala, 2008) building a data center and reusing old infrastructure have. The networks consisting of associate actors, i.e. component providers, fiber cable operators, including both non-firms and capital firms (Hodgson, 1999) affecting sustainable innovations are to be further expanded in another paper.

STUDY METHOD AND RESEARCH QUESTION

The study was conducted as a comparative, exploration case study (Yin,2003; Eisenhardt, 1989;). The material was collected in various places, including public archives of the forest companies and regional environmental licenses required to show the built in components demanded by the Finnish government. In depth interviews of the personnel participating in both projects were also conducted, however for the purpose of this paper they serve only as a background information source providing only few technological details to fill in the gaps. Scientific literature provided the basis for both theoretical framework and initial understanding of the industries in question, namely paper manufacturing industry in Finland and Nordic regions and the global cloud computing industry. Interviews of personnel relevant in the processes were conducted as well. However, due to the nature of the study, the interviews were not planned to reveal aspects determined in the prior section, but more to fill in the gaps left from other sources describing just how the transformation process took place. When the data was collected, the primary reason was to understand how and why did these two very similar processes vary in the scope of reused features. As the details of the different determinants influencing the actions that took place, the notion of exaptation as the key term in understanding new technology creation in sustainable solutions arose. The method of data analyze can be described more as qualitative, however instead of words (e.i., Eisenhardt, 1989) we wanted to explore the structures.

The research questions are formulated as follows:

1. How do sustainable innovations come to existence?
2. What are the industrial forces affecting the emergence of sustainable innovations?

The cases in question were selected due to both their similarities and contemporary nature. The transformation processes where old paper mills were changed to host data center happened nearly simultaneously between 2008 and 2012. However, regardless of very similar needs and initial plans, in both cases the changes made differed greatly from each other.

The two cases discussed in this paper are the data center in Summa, Hamina, owned by Google, located in the old paper machine hall previously belonging to Stora Enso. The other is a paper factory cite in Kajaani, owned by UPM-Kymmene, hosting the data centers of IBM and CSC. CSC – IT-center of science is a Finnish non-profit organization responsible for running data used educational systems, universities and hospitals. CSC is also responsible of operating the nationwide fiber optics network in Finland. Google is a widely known service provider of public cloud services and is considered to be one of the biggest players in the field, along with IBM (Marston et al,2013). However, IBM is more concentrated on private cloud computing and corporations as customer. The paper manufacturers, Stora Enso and UPM-Kymmene, are both the largest ones on a global scale. The archive material sources as well as government legal documents with their corresponding dinarynumber are listed in the references along with literature sources.

INTRODUCTION TO THE INDUSTRIES

Paper manufacturing

Forest industry has been a cornerstone of economic development for many Nordic regions, for example in Sweden and in Finland in the past century. However, nowadays the industry faces many different types of demands than it did while its golden growth period in the last century. The forest industry was growing until the very recent decades in a very rapid paste, more faster than many other, say the automobile industry. Paper demand and the growth in paper demand is usually connected to the GNP, the growth in demand is largest in developing countries, whereas the demand is facing a slight decrease in already developed industrialized countries like northern America and central Europe (Diesen,2007). Due to the shift in demand to countries far away from the Nordic regions, like Asia and Latin America, among other reasons, in past decade several paper factory sites have been closed down in the Nordic region (I. e. Diesen, 2007; Koskinen, 2009; Hämäläinen and Tapaninen, 2010). Paper mill sites are somewhat unique as industrial structures, for they demand few key features that many other industry infrastructures do not. Firstly, the paper manufacturing process demands water in the production, so the factories have been build in the immediacy of a lake, sea or a river. Secondly, the premises themselves are not very complex - the paper machines themselves require a large empty hall and when the factories close, the machine is often taken down to pieces and sold forward. Thirdly, the paper machines are costly, as is updating them to increase the product capacity. Often the machines were running at maximum capacity 24/7 and even a short interruption in power supply would cause lagging in production. When the factories were built, the electricity network was constructed in the way that minimized the possibilities for power shortage by using a network consisting of several parallel lines ensuring the power supply even if one or two of the lines would be dysfunctional. The organizations in these cases were among the largest in the forest industry globally, Stora Enso and UPM- Kymmene. The facilities were shut down due to low profitability, but at the same left behind hundreds of employers unemployed - in most cases the facilities were the largest employer in the city or region they were located. Both forest industries faced a social pressure to fill the gap left behind by the factories. The national status both forest organizations had as the cornerstones of the Finnish economy might have also affected the possibility of them to gain national positive grace trying to create new employment in the regions the factories were shut in.

Cloud computing

Cloud computing industry is a relatively new industry. Even the organizations considered to be long-line players in the industry, Amazon, Google and IBM (Marston et al, 2012) have been around merely few decades. However, the industry is facing rapid growth in the present as well as in the future. The more the technology advances, the more space and computing power is demanded constantly. For example Facebook had only a million users when it started in 2006 - but already crossed one billion users in 2013 (Facebook Timeline, 2013). Outsourcing IT-infrastructure is cost-efficient and, specially for smaller organizations, sometimes the one way to keep up with technological development without investing in the equipment and maintenance (Marston et al, 2012). Cloud computing service providers offer different types of services, depending whether their customer base is individual consumers or corporations. Google's customer base is mainly private consumers and small businesses, hence the service is operated on a public cloud. This means that the services can be accessed via Internet anywhere and often charged by usage. Some other corporations, like IBM operate mainly in a private cloud, meaning they create a service custom made for a client organization, only accessible from certain servers - other also offering supporting services like software design and advisory services.

The data centers have few distinguishing features they require in order to operate. These are mainly cooling, massive amounts of electricity and sizable premises. The servers within the facilities providing the computer power are often running on full capacity causing the equipment to overheat, possibly even leading to melting of the components. The clients often demand a relatively high rate of data accessibility, a server crashing might lead in worst cases to severe damage. In 2011 a server of the Finnish Tieto Oy crashed, but being responsible for some of the data of the pharmacies in Sweden, causing the systems keeping track of recepies to be out of order. The service provider and the client sign an agreement, named the Service Level Agreement (SLA) stating what percentage annually the information can be unavailable without the service provider having to compensate it with refunds. For example in Amazon.com's SLA the annual percentage equals roughly the annual electricity network power shortage in the United States (Washington Post, March 8th, 2013). To prevent the servers from crashing of slowing down they need to be constantly cooled, traditionally done by diesel-powered generators causing carbon dioxide emissions (Kant, 2009). In Silicon Valley in the recent years data centers are one of the main cause of air pollution and often breaking the regulations regarding carbon dioxide emissions (Bay Area Quality Air Management Control Annual Air Toxification Report, 2013).

RESULTS

Results discussed in this paper are limited to three key elements, premises, electricity and water. For the purpose of this paper I will not discuss the other structures reused or built in new, like roads, wife-networks for office purposes and the high-speed fiber optics cable required by the data centers. All the data is presented in tables in the appendixes, but the three features remain most relevant since they are ones that are the most crucial for both paper mills, and data centers.

- insert table 1 and 2 here -

Premises

Google bought the entire closed down paper mill site from Stora Enso in 2008, including the buildings and some land areas. The factory was built in 1955 and closed down due to low profitability in 2008. The water areas nearby remain still in the ownership of Stora Enso, along with damps further upstream of the nearby rivers and lakes, originally built in to ensure the water supply to the factory (ISAVI/21/04.09/2010). The factory had three paper machines while still operational, that were taken apart and sold forward, and two machine halls to host them. The facilities also included other structures, like a cold storage facility and their own waste treatment plant (Stora Enso archives). The other structures suitable to host servers are not used besides the one paper machine hall currently having all the equipment in it. The cavities in the machine hall floor were filled before the server racks were bought in. In the first stage an estimated 200 million were used in order to transform one of the paper machine halls to a data center, most of the investment was for the servers and technological equipment. A second stage was announced in 2012, where the capacity of the facility is further expanded and the final investment is estimated to be around 500 million (ESAVI/230/04.08/2012) .

The facilities in Kajaani, consisting of firstly paper machine halls, one of them is a historical building protected by the Finnish government and is not allowed to be altered, cold storage facility and three nearby hydro power plants (PSAVI/235/04.08/2010). The factory used electricity provided by the plants while still operational, while operational the factory was consuming estimated 2000GWh annually (UPM-Kymmene archives). The data centers of IBM and CSC are currently located to the cold storage facility that has been connected to the electricity network.

Water

The cooling systems in data centers are often a combination of a primary, closed, system that runs in the immediate proximity of the components. The primary system is then cooled with a secondary system, using free-air, forced-air, of liquid system (details of data centers technology see e.g. Novothy.2010; Kant, 2009;Masanet, Shehabi and Koomey, 2013; Malkamäki and Ovaska, 2012). Liquids capacity to transfer heat is more effective than what of airs.

In Summa, the water pipelines for pumping water used for the paper manufacturing were still in good condition. Because the water was from the sea, it could not be used for cooling the equipment with the standard cooling-systems, but due to massive resources Google had the option to specially design cooling equipment that could use seawater. They decided to use the existing pipeline to release the heated water back to the sea. In Summa, there were no hydro power plants nearby, so in using hydro power to provide electricity was not an option.

In Kajaani the initial plan was also the option to use hydro power as a source for electricity. However, the production capability of the nearby water plants was designed to provide electricity for the paper factory while still operational, and was proven to be too massive for the needs of IBM and CSC combined, offering 10MW of power when they would have only needed 2-3MW. For this reason it was not cost-efficient to use. The water pipeline delivering water to the paper machine hall were also soon noted not to be suited for the companies, due to the lack of urgent need to invest in equipment that could use the water as a coolant.

Electricity

In both, Summa and Kajaani, the electricity network around the paper factories was build in a special way. The design included many parallel lines to ensure the power supply to the premises even if one of the lines should be dysfunctional. In addition to this, the Finnish electricity network is highly reliable, the annual shortage of power is 1-7 minutes annually, since 1998 (Finnish Energy Market Authority's Annual Report, 2012). In northern America the similar figure is 90 to 200 minutes (Washington Post,2013), which is in straight correlation to the shortage of data being unavailable in for example Amazon.com's Service Level Agreement that allows the servers to be down a maximum of 260 minutes per year.

In Summa, the electricity network was similar to Kajaani. While the factories were still operational, it was crucial that the electricity was provided constantly without power shortages. The network connected to the factory had many parallel lines, in case one of the lines would be broken, the factory could still operate. Google, however, build a full-back up system to the premises. This was consisted of 21 diesel-powered generators with the capacity to provide 100% electricity to all the systems for long periods of time, in case of a power shortage (ESAVI/283/04.08/2010). However, the generators are diesel-powered, causing carbon dioxide emissions when operational and require be run on a monthly bases to check their operating condition (ESAVI/283/04.08/2010). The similar diesel generators are the main cause of carbon dioxide emissions in Silicon Valley and many data centers face fines annually due to too high emissions by the environmental agencies (Bay Area Quality Air Management District, Annual Air Toxification Report, 2013). The initial reason why this system was build cannot be determined, but it can be argued that taking in to consideration the reliability of the network and how the network was build it is over scaled. It is a standard procedure used in all the data centers by Google and the need was not in this case evaluated properly. In addition to this, the generators also need to be run on a monthly bases to ensure the functionality, causing carbon dioxide emissions while doing it. The amount of emissions is not significant, 0,4 kilotons in 2011, and clearly not comparable to the facilities in Silicon Valley by causing environmental hazard, but nevertheless does not perfectly fit the image of the most eco-efficient data center built.

In Kajaani CSC decided not build any kind of back-up system. Even thou leaving the entire system out was probably somewhat due to their client base, that differs from Google's, they did take into consideration the electricity networks benefits. .

DISCUSSION

Innovations

The environment these action took place is to be considered as a given, without questioning the initial reasons to choose it. In Kajaani the original plan was to follow in Google's footsteps and to build the servers of both IBM and CSC inside one of the paper machine halls. However, the size of the premises required by IBM and CSC was not nearly as massive as Google's. A rough estimate is that Google uses in the first stage 30% of the premises (Google About Datacenters, 2013) and IBM and CSC would have needed only few. The premises had also a cold storage facility, originally not connected to the existing networks and not intended to be used. However, due to the fact that the location was in the northern climate, the cold warehouse could be easily used to host the servers and instead of using the existing water pipelines connected to the paper machine hall, the components could be cooled with outside air. However, as the process continued it became clear that the needs of the data centers did not meet with what the factory had to offer. Firstly, they intended to use hydro power as an energy source – however the amount what the plant provided was too massive for the data centers, since they would only require roughly one fifth of what the plant was offering. Secondly, in order to use the water as a coolant, as Google did, would require specially designed equipment and a large investment that IBM and CSC did want to make due to lack of need. Both of the above systems were connected to the paper machine hall, as well as the electricity network. Due a time limit, they were forced to look for other options, when they discovered that the cold storage hall could be easily connected to the existing electricity network. Besides changing the location the environmentally friendly solutions were executed in a different way, mainly leaving back-up power to minimum and relying on the extreme liable network, and instead of water cooling taking advantage of the Nordic climate. Because of the simple structure of the cold storage facility and all year round low air temperatures they could use free-air based cooling, meaning they do not need to use generators to cool the air, they can take it directly from outside. This method is commonly used in many data centers, and backed up with generators to cool the air when outside temperatures rise,what is called forced-air cooling. However, in many places in central Europe the temperatures are low enough not to require generators (Free Air Cooling Map, 2012).

Following the earlier figure based on Dew et al (2004), the two exaptive ways sustainable innovations came to exist in these particular cases.

- insert Figure 2 and 3 here -

The underlying reasons effecting these sustainable innovations can be to some extent determined with the underlying reasons to exaptative processes providing also an insight how sustainable practices come to exist. Innovative sustainable practices fail often to explain the differences regarding different types of innovations are in the current literature more related on their effects on the market - what they become. Even thou all the sustainable innovations emerging in these particular transformation processes are not necessary “in the market” so to speak, they are fairly simply defined by for example Anderson's or Henderson's and Clark's categories When discussing what the final category of an innovation is it should be considered what in this situation is understood as the final product. If it is a environmentally friendly data center, all these innovations according Henderson and Clark fall into the category of architectural innovations, since the core design is very little affected. However, if they would be categorized as technological innovations where the final product should be the new technique used in each, they would fall following Anderson's typology into categories of add-ons, integrated and new technological path Eco-innovations, maybe later developing into general purpose innovations as a new paradigm in building data centers. In innovation literature the dynamic process of innovation developing is often seen as a static one, where the path to the finalized innovation is considered to end at a chosen point, for example stating that add-ons or new path Eco-innovations differ from general purpose innovations. I argue that, like the dynamic system of ecosystems and adaptation in nature, there is not an end to an innovation life cycle in such a simplified manner, but it is more or less a constant circle of intentional development of new sustainable practices consistent of shifts in function, modular changes and new technological paths creating general purpose innovations - after the cycle starts again.

Some innovations could be categorized as exaptation and some as adaptation offering an understanding how sustainable practices sometimes emerge unintentionally and sometimes are intentionally produced.

Industrial forces

The paper factories were shut down and the machines were sold earlier, both forest companies gaining social pressure to create new employment for the region. Data centers face a constant social pressure to create environmentally friendly ways to both cool down the equipment as well as cut down the electricity usage as much as possible. The network, consisting of associates not directly employed by the organizations caused a pressure in CSCs case since the timing constraints they were unable to change location after realizing the premises offered by UPM-Kymmene were too massive for their needs. Google on the other hand had, as far as we know, no such pressure. Being the single largest customer of technological equipment producers, as well as having the resources to manufacture their own, could demand equipment specially designed for their needs, enabling the design of sea water based cooling. The forces effecting sustainable innovations are divided into few categories, depending whether they were originating from within the company directly, or caused by another institution.

- insert Figure 4 here -

The different institutional forces can be categorized as industrial forces, firstly, social pressure, similar to coercive isomorphism. Secondly the market, describing the customer base. And thirdly, other isomorphic tendencies, similar to normative and mimetic by DiMaggio's and Powell's. The organizational capabilities or the organizational limiting factors respectively are divided into motivational, procedural and resources. Depending on the institutional force and the organizational level forces, the technology present at the site gave the framework through what sustainable innovations, adaptive and exaptive in nature, emerged.

Table 3. Multilevel approach to sustainable innovations Google

Institutional forces	**Organizational Level**		**Sustainable innovations**
Social pressure (sustainability)	Motivation (Intentional search for sustainable solutions)	**Technology**	Using water pipelines (exaptation)
Market (customer base)	Resources (ability to invest)		Water cooling system (adaptation)
Normative Isomorphism	Procedural (Lack of flexibility)		

Table 4. Multilevel approach to sustainable innovations IBM and CSC

Institutional forces	**Organizational procedures**		**Sustainable innovations**
Social pressure (sustainability)	Procedural (Flexibility)	**Technology**	No back-up power (adaptation)
Market (Customer base)	Resources (No investment)		Free-air cooling (adaptation)
Mimetic Isomorphism	Motivation (Time limit)		Reusing cold storage facilities (exaptation)

The customer base is understood here to be equivalent of user environment (Geels, 2004), i.e. the market (Hodgson, 1999). Social pressure is a loose term referring to either the national pressure as a growing demand for sustainable solutions for data centers - both from the end customers as well as regional environmental agencies and associate partners.

In the recent Academy of Management Journal Russel Funk stated that “external, geographically defined environments present opportunities and constraints - but internal factors moderate the degree to which a firm can make use of or is held back by them” (Funk, 2014). In this study regarding nanotechnology as well, he studies the R&D of nanotechnology in Silicon Valley, where the network of associates plays a key role in the emergence of innovations. His findings are in line with this study for it can be concluded that one of the reason CSC and IBM were able to adapt to the new facility of the cold storage. Being able to connect it to the electricity grid was a crucial to the enabling the decision of cutting back carbon dioxide emissions by leaving the back-up generators unbuilt. How did exactly the entrant firms be able to take advantage of local know-how and to what extent should be expanded to a different paper, here is only concluded that the flexibility and associate networks of IBM and CSC allowed them to produce a more efficient sustainable solution here. In nanotechnology the knowledge spillovers can have either no effect on the success of a corporation, but in remote and lagging areas they might be a significant resource (Wang, Jacob, Li, 2014).

The organizational procedures are divided into motivational, resources and or procedural describing their nature. Isomorphic tendencies are included in the institutional forces, rather than organizational, and the ones not having an effect on sustainable innovations in these cases are left out of the tables, although they might be different depending on the case, the relevant element is what effect they have. It is also implied that Google's isomorphic tendencies were towards company general policies, whereas IBM's and CSC's towards Google's data center in Summa. The nature of the sustainable innovations is also noted in the tables, dividing them into adaptive or exaptive. In this study is not argued whether the initial plan to choose the paper factory sites for reuse was a beneficial one, along the lines with for example Bullen and Love (2011).

CONCLUSION

This paper does not aim to build an extensive theory regarding sustainable innovations and all the industrial forces affecting it, the main reason of this paper is to produce further research ideas and an attempt to understand how infrastructure reuse could be conceptualized.

This paper concludes the following. Firstly, the sustainable innovations should be described as exaptive and adaptive offering an explanation to how innovations come to exists in different ways. Secondly, the industrial forces that affect the emergence of sustainable innovations both enable and constrain. In the case of CSC and IBM, the invention of using the cold storage facility was a result of a pressure caused by social pressure of sustainable solution and timing constraint caused by the isomorphic tendencies. In the case of Google, the social pressure of providing environmentally friendly solutions as well led to the intentional development of the cooling system technology and discovering the possibility for exaptive reuse of the water pipelines. In both cases the technology provided an environment of enabling or constraining the possibilities for innovations, these follow the previous socio-technological factors described by Geels (2004). Thirdly, the organizational factors effected how different industrial pressures would effect the emergence of innovations. In the case of CSC and IBM, the lack of resources when facing the need for a rapid solution caused the invention what would later turn out to be a successful sustainable innovation, and was enabled due to a flexibility in certain organizational processes in an technological environment that gave the options. In the case of Google, the social pressure created the need to invest and create sustainable innovations that were enabled by both the organizational resources and technology available. However, the organizational isomorphism (DiMaggio and Powell, 1983) of following a procedure used in other facilities could be described as an industrial force that was constraining the effective adaptation to the actual technological environment.

What is concluded from the results is that institutional forces affect sustainable innovation motivators in different ways. Depending on the organization, and its capabilities, resources and internal procedures, forces like the customer based- demand, society's pressure and organizational isomorphic tendencies are filtered into sustainable practices if the environment the process takes place allows or prevents them. However, not all the forces above can be predicted nor controlled, or in given circumstances defined if sustainable innovations to emerge. The organizational level procedures, capabilities (Eckhardt and Ciuhta, 2008; Marquis and Huang, 2010) and technological research (Cattani,2006) of exaptation require further study.

The network of other actors having an influence on sustainable practices emerging also requires further study. The notion that CSC was the care taker and owner of the fiber cable already close to the premises in Kajaani might or might have not affected the decision when choosing the location. In Summa, Hamina there has been a new cable connection built in connecting the premises in Summa to Russia and Europe directly. This shall be further expanded in another paper, as will the second stage changes made to Summa announced in 2012. In a recent Academy of Management Journal Raffaelli and Glynn (2014) suggest that adapting practices is effected by the network of extra-industry participants, resulting in either adopting customized or less customized practices. The theory falls in line with what is suggested in this paper as the isomorphic tendencies, as the article defines the two affecting forces as normative and mimetic in type. However, this paper also suggest that the normative isomorphism may cause a secondary effect, depending on the organization, to result in exaptive sustainable innovations. It can also be concluded that in this paper, as both of the cases were first of theirs kind and unique, there is not yet emerged a standard solution in infrastructure reuse that all cloud computing service providers might consider using as a first option. Raffaelli and Glynn also suggest that organizations respond to different institutional forces differently, that also falls in line with this paper.

The notion that sustainable infrastructure reuse should be considered as exaptation providers an concept for better understanding of shift in functionality. The factors influencing how these sustainable practices form go beyond the organizational limits and are limited, or enabled, by the technological environment, industrial forces and organizational factors. The findings regarding these forces affecting sustainable development and innovations follow previous theories of institutional forces affecting corporations by such as DiMaggio and Powell as well as Geels, and but combine the different institutional forces and their both enabling and constraining effects in a cumulative way to prove insight of how sustainable innovations come to existence. However, the results suggest that the cumulative effect is dependent on organizational factors, thus to gain a better understanding of sustainable innovation processes requires more studying.

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TABLES AND FIGURES

Figure 1. Case: CD-ROM

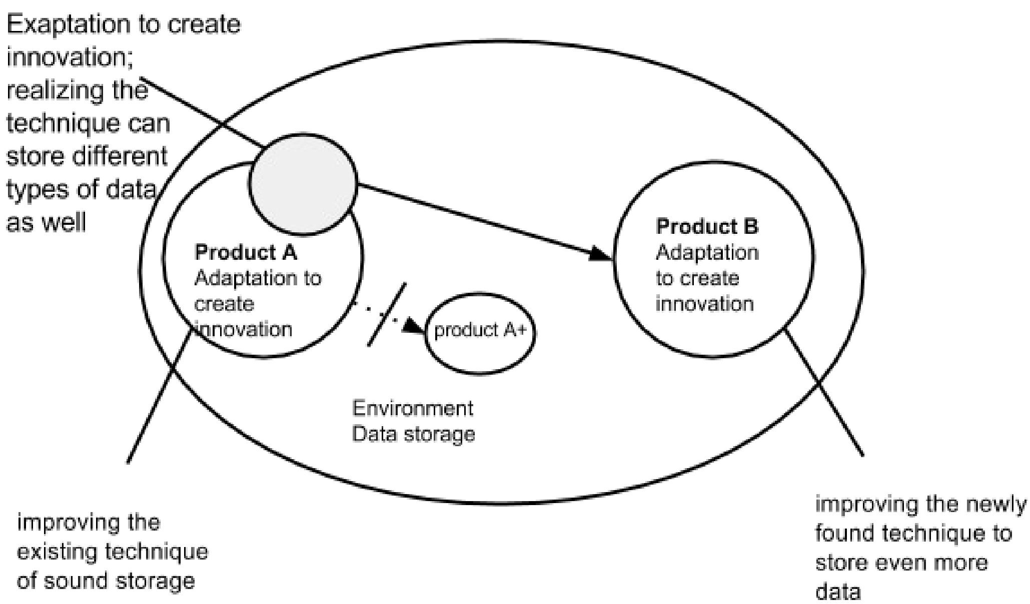


Figure 2. Case: IBM and CSC

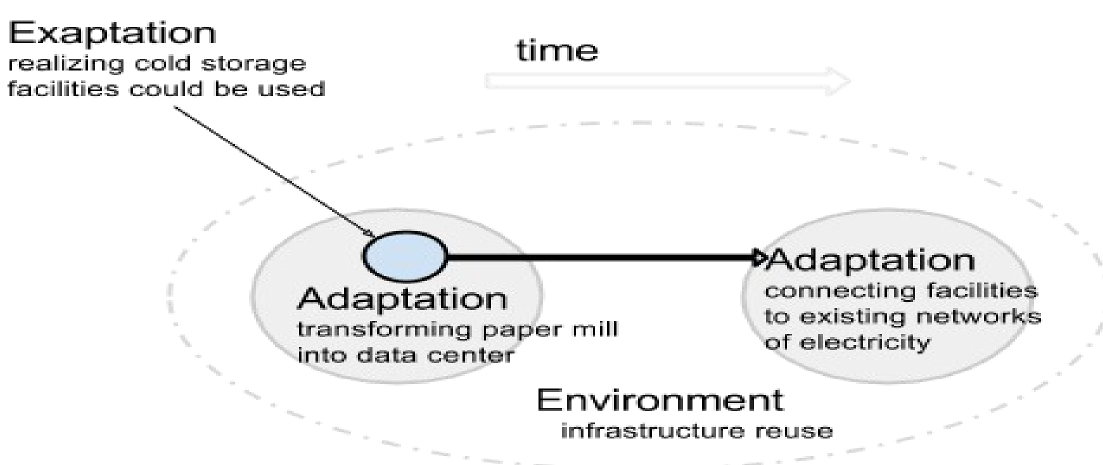


Fig. 2. IBM and CSC premises

Figure 3. Case: Google

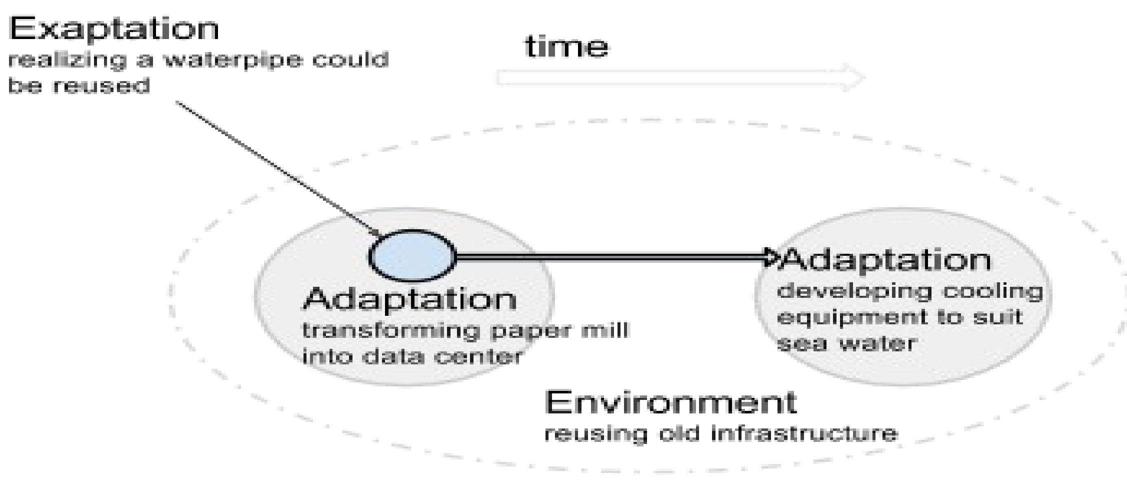
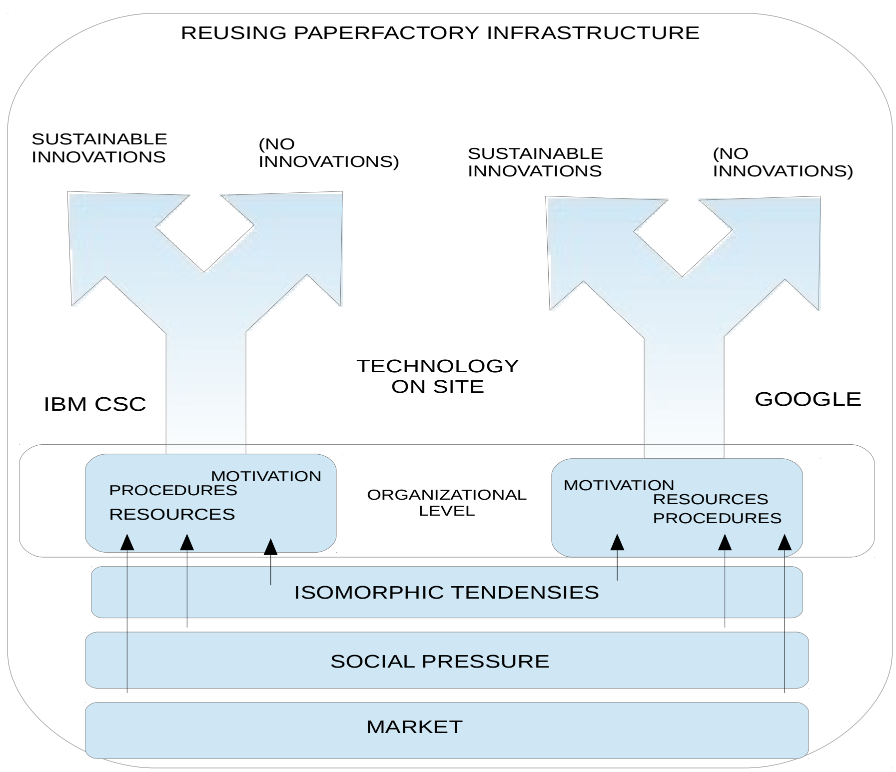


Fig. 3. Google waterpipes

Figure 4. Institutional forces affecting sustainable innovations



Tables 1 and 2. Results.

Summa papermill of Stora Enso	**what was demolished**	**what was left**	**what was brought in for Google**
Land and water areas. Damps at Lake Saaramaa ja Turpaankoski to ensure the water level to be enough for the factorys needs, the factory needs estimated 8-15m3 of water per ton of paper	The Damps are no longer needed	Stora Enso still owns the water areas	
The paperfactory building, cold starage facilities	papermachines (3 machines) were disassembled	The paperfactory building, cold storage facilities.	Google bought the facilities. In the paperfactory the hole in the floor was filled. All the components used for the servers, the cooling solutions indoors and back-up systems are custom designed for the companys particular needs and self-build or self-designed
The grindery	NA	NA	NA
structures for water use included water pipelines to the Gulf of Summa, both for pumping the water and realeasing the excess water on different sides of an breakwater, damps at	NA	the other waterpipeline used to release the excess water to the Gulf of Summa on the northern side or the breakwater is used to release warm water after cooling servers,the breakwater remains	Two nes pipes were build to the depth of -5 meter on the southern side the breakwater in the Gulf of Summa. The size of the pipes in the sea 130meter in lenght and 1600mm in diameter. In the premises there is in total 250meters of pipelines. The usage of water is 0,83m3/s and maximum usage per year 40 Mm3. The water is used to chill the servers. A primary closed liquid-filled chilling system is constructed aroun the servers, and that is cooled again with the secondary open sea-water chilling system wich takes the water from the southside of the Gulf and returns it to the north side 3-15 degrees warmer than orginal.
safety structures included own fire pricade	the fire pricade no longer exists	NA	The genrators have been equiped with an automatics closing down system in case of fire as well as with fire plugs, the adaptors used are also ensured in case of fire and their temperature constantly monitored, the air ventilation has emergency stops
electricity network build in a way that ensures the power even when few lines broke. The factory got most of its energy from outside the factory (92%) and was using 857 GWh/a		the electricity networks are still funtional and can be used for electrisity needs, the estimated energy usage from the network 280 GWh/a for Google. the rest of the energy needed is coming from using the heat energy of the servers, the excess heat energy in the warm sea water provides so little anergy that there is no point trying to reuse it anymore and the water is released back to the sea	To ensure 100% back-up power for essential operating systems a total of 21 fuel generators were build with capasity to provide 110WM.
own waste treatment plant	NA	NA	The facility has been attached to the local sanitation network, also the has been some renewing of the sanitation pipelines.
internet access for office use,		internet access too slow for Googles needs	Telia Sonera Oyj's and Kymen Puhelin Oy's facilities are also on the premises, the fibre connection runs underwater to both Helsinki (where through Estonia to Europe there are several lines) and straight to Russia as well for internet connectivity for Google.
for energy needs Gasum Oy's natural gas pipeline runs throuhg the premises, also a pressure station in addition to that. Haminan Energia Oy's gaspipeline to the residental area is located on the permises, as well as their boilers (3 MW for winter use and 1 MW for summer)		The Gaspipeline is used by Google as well as the electrisity networks. The usage of natural gas is estimated to 2,1 miljm3/a.Gaspipeline is still in place as well as the boilers.	
road infrastucture	NA	NA	NA
carbon dioxide emissions measured were (1990) 43,7 kt and later (2007) 17,3. The highest sea water level at the Gulf of Summa was measured to be +1,92m above normal (2005)			carbon dioxide emissions measured in 2011 were 0,4 kt/a
2006 total turnover of the year was 228 miljon euros		the actual paperfactory facilities and parts of the land were sold for 40 milj. Euros	total of nearly 500 miljons used for the facilities, the highest invest rates are the IT-equipment used

UPM-Kymmene Kajaani papermill	**what was demolished**	**what was left**	**what new was brought for csc and ibm needs**
the old paperfactory	the paper machines were dissasembeled.	is now noted as a valuable historical sight and not to be destroyed nor altered.	
the new paperfactory one with two halls in it, cold storage facilities 100 000m2 large and the factorys grindery	the paper machines were dissasembeled from the both halls of the new paperfactory.	The new paperfactorys empty halls are named halls Rata and Kone, the large cold storage hall Varasto. The old struture for the factorys grindery is named Hiertämö	CSC is using 4000m2 and IBM 1000m2 from the Varasto building. All the premises and structures are still owned by UPM-Kymmene, they are long-term leasing the facilities for data centre use. Due to change of plans CSC and IBM ended up in the Varasto building instead or Rata or Kone. The hall in the Varasto building had to be altered for data center needs by UPM-KYmmene, this included connecting the building to UPM-Kymmene allready existing electricity network and sanitation system as well as adding security systems for the Varasto building as well. All renovation needed is done by Sweco for UPM-Kymmene, for the Rata and Kone buildings this ment only filling the holes in the floor left by the papermachines . CSC has brough in their equipment, the Taito, witch has HP ProLiant SL230s -servers, a total of 1152 prosessors and 9216 cores, connected by Mellanox Infini- Band 56 gbits/s FDR -network; and the Cray Cascade -supercomputer
a pulp factory and a saw		The pulp factorys structures are used by the saw.	
structures for water usage included a waterpipe to the river, water was used estimated 8-15m3 per a ton of paper,		the waterpipe still functional and 0,6m3/s water can be delivered to all premises, waterpipeline to the factory with 0,6 m3/s incoming water (1-22 degrees), also chemically cleaned water 0,2 m3/s.	The water is not used by CSC or IBM for the cooling equipment cannot use the water provided, the water in the rivers gets too warm in the summer for existing water-cooled chilling systems (16 degrees).
the safety structures included and a own fire pricade	fire pridace no longer exists		Specially for data center use build firesafetyequipment was build to Varasto, Rata, Kone and Hiertämö.
Specially designed electricity network to ensure power, 110KV powerlines and 10kV.		The Rata and Kone building had existing connetions to electricity network. Both 10kv and 110kV	Varasto was connected to the electricity network. Vain 110kV (?tarkista haastattelusta)
sanitation system, water sanitation systems, waste management by Kuusakoski Oy		The Rata and Kone building had existing connetions to the sanitation system. Kuusakoski Oy continues to take care of waste management.	Varasto was connected to the sanitation network.
Wi-FI for office needs		Wi-Fi connection for office demands	Fibre connection was connected to Varasto for CSC needs, Rata, Kone and Hiertämö were connected earlier.
The Road infrastructure and railways planned to transport massive amounts of wood, the usage of wood was 1,4 milj.m2 annually and was delivered from the radius of 150km.		The road is used to import equipment.	